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**EXPLORING UNIVERSAL
PRINCIPLES AND PARAMETERS
IN DESIGN.**

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Abstract.

Exploring the validity of Language based Universal Principles and Parameters in design. this research produces a series of comparative studies examining the relationship between language and design, each deploying a different methodology, working towards different goals, and dealing with different aspects of the relationship between these two seemingly distinctive abilities.

This thesis is composed from three main investigations that derive from each other in sequence, and that are based on a common Literary geometry - a relationship between different authors formed in order to serves as a conceptual framework for the intended research. In the present case the literary geometry is constructed from the work of Gibson (1986), Pinker (1994), Thwaites, Davis & Warwick (2002), Krippendorff (2006), Dong (2009) and Cross (2011). This research builds on their complimenting interests in perception, language and design thinking, on their common sources, their selection of methods, their use of complimenting case studies, and their conceptually paralleling ideas.

The main question of this research is - Can various aspects, that are at play in the universality of language, also be at play in the universality of design. In seeking to answer this question this research short term goals are:

- To inform and explore the relationship between language use and design use.
- To inquire into the structural dynamics between language and design, as competences and as activities.
- To examine the validity of Universal Structure theories from the fields of Linguistics and Structuralism in Design.

The Investigations:

Working with Pinker's *The Language Instinct: How the mind creates language (1994)*, the first investigation converges different thinkers and different strings of thought - contained in the *Literary Geometry* - into a synthesis with which the dynamic relationship between language and design is explored and the validity of concepts that are rooted in the domain of languages can be tested in the domain of design.

The research finds here that essential mechanism and structures (grammar, perception, syntax) that are at play in language activity are also at play in design activity with a consideration to a minor alignment of terminology in order to compensate for changes in modality. These findings suggest that the creation and perception of visual or material artifacts follow the same structural mechanisms and cognitive processes as the creation and perception of lingual artifacts, as well as deployed towards towards the same goals: the conceptualization of reality, of artifacts and of identities into being. In turn, this points to the reality producing nature of design and language originating from a deep and cognitive connection.

The second investigation forms a critical approach towards key aspects in the relationship between language and design. Based on the first investigation, this comparative study aims to expand further the inquiry of the relationship between language and design through a structured examination of underlying cognitive and structural mechanisms that enable language and design performance. It seeks to identify similarities and differences between brain activity, cognitive functions, structural units, and perception.

The research offers here a strong argument over the sameness of language and design capacities. It shows these abilities operate on the same set of cognitive processes with which meaning is associated and constructed from information structures that are sampled by the perceptual system. Grammar seems to be deployed by a set of cognitive processes which

associates sensory input with meaning. This set of cognitive processes seems to be at work the same way whether the act of communication is made of visual-material units or vocal ones. Different modalities, both in terms of phenomena (sound, touch, visuals) and in semiotic terms (oral, gesture, written), constitutes as the only, yet fundamental, difference between language and design domains.

The third investigation attempts to validate the conclusions above by positing a key structural model used in the domain of language into the domain of design. It aims to show a sameness of structural principles between lingual and designed artifacts, as well as an inherent structural similarity in the planning of such artifacts. This investigation introduces Jakobson's *Functions of Language Model* (1960) and examines - through case studies and qualitative investigation - how it can be used for the study of designed artifacts and design thinking, as well as how it can be used in the practice of design as a guiding universal structure of principles underlying design activity.

The research forms here a framework for thinking about design and designing. A framework that is rooted in the study of languages and the theoretical foundation of universal structures from linguistics, semiotics and structuralism. The research demonstrates how valid is Jakobson's Model after 55 years, but also demonstrates how valid it can be for the study of designed artifacts, as well as design thinking. It does so by reforming the model in accordance to Krippendorff's Ideas of User centered design (2006), circumnavigating Krippendorff's strong distantiation from the use of semiotics for the study of the domain of design.

With these three comparative investigations this research forms a theoretical foundation, accessible and applicable to design thinking and design practice, as well as a first approach towards a language based approach to design and its education – calling for systematic and synchronic approach to the study of design, design artifacts and design thinking.

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Chapter one

Goals and Direction

Published in Domus Magazine, Louise Schouwenberg's "*Why Design Doesn't Need to Perform*" (2013, p. 98-105) is a response to Timo de Rijk's article "*This Mine Sweeper is Life Threatening*" (2013, p.17), and perhaps it is more than that. While arguing against a strictly functionalist criteria in which a designed work may be judged according to its usefulness, or its ability to solve problems, Schouwenberg outlines the role of design and designers today:

"Design solves fundamental problems. Design represents how people want to live. Design possesses the power to embellish, facilitate and discipline our behavior. Design can wave a moralistic finger, design can incorporate critique, and design can represent sheer fun. Design reflects who we are in the here and now, as it represents our age and the social, cultural and technological context in which it is born and functions. Design opens new perspectives on reality."
(Schouwenberg, 2013, p. 104)

This framing of the role of design is substantially different from the practical or functionalist framing of the role of design as argued for by Timo de Rijk. However, it still sits well within Herbert Simon classical framing of design as "*aimed at changing existing situations into preferred ones*" (Simon, 1996, p.111). The role of design outlined by Schouwenberg differs than that held by de Rijk and Simon in its implication that today's design in its nature is communicative rather than practical and well-functioning.

It also implicates the involvement of language in the process and practice of design. The "*embellishing, facilitating and disciplining of behavior*" cannot take place without a shared sign system being used for the communication of values between the persons doing the disciplining

improving existing ones but ultimately with convincing and communicating to their target group and consumer segment that their solution, their design, is the better one. Working towards this outcome, those who facilitate the design and creation of cars rely not only on their ingenuity and available technological means, not only on huge marketing budgets, but also on material and visual signs and symbols, sign system structures and ultimately of the use of language.

Defining design as a factual problem solving commits designers to technical rationality that is at home largely in engineering (Simon, 1996; Krippendorff, 2006). In the past 20 years, the traditional role of design stemming out from the domains of architecture and engineering has lost its dominance in the practice of design in light of cultural and technological shifts and new methods of social interaction, that play a larger role in the success or failure of products, even practical and well-functioning ones:

“Simon’s technical rationality extended simple engineering conceptions to larger design problems in defence systems, R&D efforts, NASA projects and operation research. But it started to falter when applied to city planning, the design of corporate strategies, and even of consumer goods.” (Krippendorff, 2006, p.26)

“functional aesthetic, and market considerations that justified the products of design in the past have been replaced or overshadowed by other more social, political and cultural concerns”
(Krippendorff 2006, p. xvi)

In contemporary culture it seems not enough for a designed work to function practically, it needs also to function communicably. Ironically enough, designed works like designer Massoud

Hassani's "*Mine Kafon*" that do function communicably don't necessarily need to function practically, or function at all.

Designers in the 21st century are no longer busy with solving practical problems, they are busy solving problems revolving the communication of information, of meaning. They are busy communicating solutions and not only in terms of sales and marketing of products, but also in terms of use. For example, in human machine interfaces (Krippendorff, 2006, pp. 8-9), designers must communicate the artifact's set of affordances to users, mediating between the internal makeup of the artifact's technology and its perceived appearance. Any given designed artifact is seen no longer as a functional solution, but predominantly as an act of communication, performing as a message between the designed work and its user. The design of artifact conveys the information needed for using the artifacts, allowing meaning to find its way to the user.

This communication of information through material and visual artifacts, where meaning is extracted from objects almost intuitively, or instinctively, has been gaining momentum in past years up to a point where the relevance of language is being questioned. A few decades ago, or perhaps even a few years ago, it seemed that the future will be visual or audio visual and that people would be communicating through images and videos, that to one extent is true. These days, images are almost as abundant as words and more than often people use images to coordinate meaning and represent their ideas. But it is also true that the word is still very valid and possibly more so than ever.

This complex situation seems to blend the border between design use and language use. It also seems to reflect a "blending" between the capacities of language and design, which resonates from a relationship between language and design in terms of the competence and the performance of these abilities.

Mankind's interest in understanding design is relatively young compared with humanity's

longstanding interest in language. For more than a few centuries research in the fields of literature, medicine, philosophy, and later on in linguistics, semiotics and communication has contributed to mankind's understanding of language. These days it includes the understanding human biology and brain structure, knowledge of cognitive processes which allow for language competence and performance, knowledge of universal structures of languages - as in Joseph Greenberg's work on the *Universals of Language* (1963) - and of the lingual artifacts they enable to produce - as in structuralist theory.

Language ability seems to be universal and as widespread among human population.

"Language... is a distinct piece of the biological make up of our brains... people know how to talk in more or less the sense that spiders know how to spin webs" (Pinker, 1994, pp. 5-6). The use of *"Language is invaluable for all activities of living in a community of people: preparing food and shelter, loving, arguing, negotiating, teaching"* (Pinker, 1994, p. 19), it is also invaluable for designing. The theory of *The Language of Design* and its lingual performative operators (Dong, 2009) argues that language is essential for idea generation, concept development and evaluation of results and prototypes. In the practice of design the use of language *"is more than representational, more than standing in for design concept when no other representation yet exists, more than being pointer to places in the mind to assist in constructing memory about a design concept, more than a passive historical account. Otherwise, language is impossibly estranged from what it is deployed to do - enact design and the design work"* (Dong, 2009, p.15).

Design ability seems to be as universal and widespread among human population as language. *"Designing is something that all people do"* (Cross, 1999, p. 1), and when designing people do not depend on having had the right education or an aptitude for architecture or the construction trades. *"Everyone can - and does - design.... Design thinking is something inherent within human cognition, it is a key part of what makes us human"* (Cross, 2011, p.3). The process of

In order to validate this hypothesis this research informs and explore the relationship between language activity and design activity, in terms of ability competence and performance. It inquires into the structural dynamics with which these two seemingly distinct human abilities manifest and are applied, as well as to the validity of universal structure theories from the fields of linguistics and structuralism in design.

“The cognitive capacity for language (also referred to as linguistic competence) remains one of the most contested theories of human development. A key question is whether language is innate in the sense of a Universal Grammar (UG) shared across all humans, suggesting that UG is encoded genetically, or whether language is purely an empirically evolved (human) phenomena.”
(Dong, 2009, p.175)

“The debate on whether or whether they are learned centers around the question of how much specific information about language and design are hard wired into the brain (by genes) and how much of the knowledge we acquire, that is, learn through social and cultural transmission.”
(Dong, 2009, p. 178)

This research aims to steer away from joining the debate between linguistic nativists and empiricists on whether language competence is innate or empirically evolved. It aims to avoid a similar debate about design competence. It also aim to steer away from debating diachronic theories involving the creation and evolution of human lingual sign-systems alphabets.

Therefore, this research is not interested in the various artifacts that could produced through designing, but in the structures of design ability and activity that allow the production of designed artifacts. It intends to scrutinize the applicability of lingual principles, parameters and

structures in design. It attempts to validate theories, arguments and observations, rooted in the field of linguistics, in the field of design, and subsequently seeks to identify in what ways language and design are similar. In other words, seeking to recognize or identify patterns, which are associated with language activity, in design activity - with language use, in design use. It will do so through the following series of comparative investigations:

Part one of this research will test the applicability of lingual principles and parameters to design, drawing from ideas and concepts expressed by the thinking of Steven Pinker in *The Language Instinct* (1994). This part deals with identifying and debating possible structures, mechanism, and patterns that language shares with design.

Part two of this research broadens and expands the investigation in part one forming a critical and multidisciplinary approach towards key points in the relationship between language and design touched in part one. This will be consistent and focused comparison between underlying building blocks of language and design competences looking into 4 aspects - brain activity, cognitive functions, structural units and processing and activity of the perceptual system.

Part three will examine structural similarities between designed artifacts and lingual artifacts, investigating the applicability of structural models to design by drawing upon a structural model associated with semiotics and language, presented and discussed by Thwaites, Davis, & Warwick in *Introducing Cultural and Media Studies: a semiotic approach* (2002). The investigation here revolves around Roman Jakobson's model of communication (1960). It attempts to posit Jakobson's *functions of language* model in design through a series of case studies and interviews with design practitioners and researchers. In doing so the investigations aims to form a capacious language based framework for thinking about design, and to set up new targets and goals for further investigation in this direction, outside the scope of this research.

With these three investigations this research hopes to accomplish its final goal: to

contribute to the field of design by converging and analyzing different thinkers and different strings of thought into a synthesis that can serve as an initial framework for a language based approach to design and its education. It does so with the intention that it must be primarily accessible to both academic circles, in terms of supporting academic debate, and the work of design practitioners in terms of manageable amount of information. As such, a core *literary geometry* was formed for this research according to an intrinsic relationship that is based on inheritance, complementarity, and contrast. This core geometry is supported by further relevant case studies, articles, Dictionary.reference.com entries, and Wikipedia entries, all available and accessible for free online. This *literary geometry* will be motivated and presented in the following section of this thesis.

Finally, the analyses and the subsequent discussions forming the present research compose a very selective vision and are its intended statement. With it, this research addresses ongoing issues and establishes a scale of scrutiny that will consciously offer itself to further specific input beyond its own formulation. By laying its groundwork and saving further detailed investigation for further studies this research, as well as its process of analysis and the resulting debate, can adapt to distinct degrees of scrutiny, and can serve as a macroscopic viewpoint as well as withstand detailed contrasting.

Chapter two

Literary Geometry

As mentioned earlier, this research works with a core literary geometry of selected works. In effect, this geometry is a relationship between different authors and a selection of their works. It was formed by the researcher in order to serve as a conceptual framework for the intended research. This selection of authors and works was made according to an intrinsic geometry that is based on inheritance, complementarity, and contrast. Since a wealth of authors will be discussed through in the following thesis, this section focuses on the core authors whose presence is key to the present research, as well as on the relationship identified between them.

This core literary geometry includes the works listed below and is supported in the thesis by further relevant case studies, articles, Dictionary.reference.com and Wikipedia entries, available online with free access:

- *The Ecological Approach to Visual Perception* by James J. Gibson (1986).
- *The Language Instinct: How the mind creates language* by Steven Pinker (1994);
- *Introducing Cultural and Media Studies: A semiotic approach* by Tony Thwaites, Lloyd Davis and Warwick Mules (2002);
- *The Semantic Turn: A new foundation for design* by Klaus Krippendorff (2006);
- *The Language of Design: Theory and Computation* by Andy Dong (2009); and
- *Design Thinking: Understanding how designers think and work* by Nigel Cross, (2011).

With this selection the research aims to offer a strong and concise theoretical foundation and an initial framework for a language based approach to design and its education. It does so with the intention that it must be primarily accessible to both academic circles, in terms of supporting academic debate, and to design practitioners, in terms of manageable amount of information. The

research gave priority to influential authors and to books that offer a conclusion of their work, either as a comprehensive description and details of their theory and research, or that serve as comprehensive overview over a field of knowledge or research. The following text details this research's motivation and choice of books for the literary geometry

2.1 The Geometry

In seeking to inform itself about already existing approaches that connect language with design, the research identified Dong's *The Language of Design: Theory and computation (2009)*, Sudjic's *The Language of Things (2009)*, and Alexander, Ishikawa and Silverstein's *A Pattern Language (1977)* as key literary works. From these Andy Dong's Work seems most suitable, not only for its extensive and meticulous construction of the theory of *the language of design*, which draws upon influential authors (Cross, Simon, Schön, Austin, Butler, and Lacan are a short list of examples), but also because Dong connects his work with linguistics, structuralism and semiotics as well as with many other fields of research, using his perspective to frame the concepts which institutionalize design practice and the relationship between design and language across a multitude of fields. For an essential part, Dong's book serves as the gravitational force underlying this research. First, it pulls the geometry of authors together through its discussion; second, it formed a preliminary map of literary reviews and references which guided the researcher on his path during the early stages of the research.

Pinker's *The Language Instinct: how the mind creates language* was acquired in accordance with the contemporary nature of design, which is very much based on the serendipity and openness to contextual experience in daily life; it was picked up earlier during the research in a duty free store by the researcher, who was already then very driven by the idea of Universal Grammar and its possible application into design. Pinker's work provides a comprehensive overview on the field of linguistics and the universality of language. Pinker argues that key super-rules (Grammar) needed for learning how to use language are innate and universally shared across all humans like a biological trait. With its wealth of theoretical and empirical data, the *Language Instinct* uses a flowing narrative, and provides a clarity of information. Pinker's work had a great influence on the debate on and around language capacity as well as on what and how people think

about language.

In *Design and The Language Instinct* (Luxembourg & Alvelos, 2015) the researcher draws the following four contact points between the thinking expressed by Pinker and the thinking expressed by other key authors included in the literary geometry.

First, Dong's acknowledgment of Pinker's concept of "*mentalese*" - a language of thought - "*which proposes a strong link between the structure of language and the structure of thought*" (Dong, 2009, p. 176), and his expansion of this link to include design competence through a review of evidence and theories from the fields of biology, cognitive science, genetics, and paleontology. Dong concludes with the possibility that the origins of language and design are interconnected in terms of cognitive and evolutionary aspects.

Second, Pinker's thinking about the universality of language is in parallel position to the thinking of Nigel Cross, who argues similarly about the universality of design in *Natural intelligence in Design* (1999), *Designerly Ways of Knowing* (2006), and *Design Thinking: Understanding how designers think and work* (2011). Cross and Pinker forming conceptual parallel around the ability as competence being a part of the makeup of the human brain, together covering case studies relating to left and right hemisphere brain damage and its effects on design and language abilities.

Third, Gibson (1986), Pinker (1994), Thwaites et al. (2002), and Krippendorff (2006) form a theoretical meeting point with complementing accounts on the perceptual system and the cognitive thinking processes that facilitate the extraction of ambient information structures from the flow of radiant sensory data (Gibson, 1986).

Forth, Pinker and Krippendorff contrast each other on their position on whether language is a cultural artifact used by humans or a biological trait of the human species, but agree, like Dong, on its essential role. They also compliment each other on how meaning in perception is constructed from structural elements in sentences and in artifacts through a process of mutual

contextualization (Krippendorff, 2006, pp. 61-63) which “*embraces the entire combination and turns it into a proposition*” (Pinker, 1994, p. 110).

Another contact point, not included in that paper, between Pinker and Thwaites et al. is formed around the discussion on how language works. Both authors seem to be informed by, as well as base themselves on, the work of Ferdinand de Saussure.

While Pinker gets a little more than a footnote acknowledgment in *The Language of Design*, Dong’s uses Nigel Cross’ work as building block in his framing of design and its nature. Further on and as mentioned above, Cross’ positioning seem to be drawn in parallel to Pinker’s own thinking about language. These two authors form another complementary parallel as Cross uses case studies of damage to the right lobe and Pinker uses those relating to the left lobe in order to reveal the inner working of the brain.

Cross and Krippendorff form a contact point around the positioning of a science for design by Krippendorff (2006, pp. 34; 209-2013), who in doing so distinguishes his concepts from earlier framing of design science, and a science of design by Cross (2000, p. 96). This research motivate the choice of *Design Thinking: How designers think and work* (2011) for this geometry due it’s comprehensive yet concise overview of Cross’ work and thinking, which stretches over 50 years, as well as its coverage of earlier investigations conducted by Dong.

Anthony (tony) Thwaites, Lloyd Davis, and Warwick Mules’ *Introducing Cultural and Media Studies: a semiotic approach* has been used by the researcher for his master thesis to connect and form fashion design thinking with key principles in semiotics and structuralism. It gives a strong theoretical foundation on structuralism and semiotics and forms contact points with Pinker around Saussure’s key linguistics theory, and with Krippendorff (although more conceptually) with its unified perspective on “acts of language” and “acts of design”, texts and artifacts, respectively.

Thwaites et al. refer to the designed artifact - like a dress, or suit - as text. They treat such

artifacts not very differently from their treatment of articles in a newspaper, or written sentences:

“Obvious types of texts are a sentence someone writes or a fashion outfit someone wears. Each of these texts has paradigmatic and syntagmatic features. The words and clothes can be thought of as signs, and they join together to form a verbal text and a fashion text” (Thwaites et al., 2002, pp.77-78).

In paralleling comparison Krippendorff refers to texts, sentences and most specifically words as artifacts, here are two examples:

“It is important to respect etymology with acknowledges that words, or artifacts for that matter - after all, words are artifacts as well - can change their meaning as they travel through different uses, different situations, different times and different people’s lives.” (Krippendorff, 2006, p. xv)

“Like scientific theories, designer’s narratives are linguistic artifact.” (Krippendorff, 2006, p. 30)

An important contribution, then and now, was Thwaites’ introduction of the Saussurean framing of language - a division of the human phenomena into a sign system and the acts of speech enabled by it - and the subsequent structuralist framing of these acts as acts which can be described according to structuralist models of communication developed initially by Jakobson (1960) (whose ideas on structuralism influenced the work of F. S. von Thun, D. Hymes, J. Lacan and others). This research’s framing of the act of design as a “message” conveying information, or

meaning, between a sender and a user builds upon that, and the initial search for its validation in design practice led to the acquisition of Krippendorff's *The Semantic Turn: a new foundation for design* (2006).

The Semantic Turn gives an extremely comprehensive overview on design for the 21st century and touches on a multitude of subjects (universal language and semiotics, among others) and authors (Alexander, Chomsky, Cross, Gibson, Saussure, Schön, and Simon are only a short list of examples). It forms contact points with Dong and Pinker around the framing of language, its essential role in human culture, and its performativity; and with Cross and Thwaites as mentioned above. It offers a strong theory on how artifacts are used in communication between designers and users (referred to above as design use), complementing this research's structuralist framing of the relationship between the designed artifact and its user with a constructive framing of how users extract information from artifacts.

Further on, Krippendorff's concepts of *User Conceptual Models* ((2006, pp. 105-108) and *character attributions* (2006, pp. 155-162) seem to form a complementary contact point with Jakobson's functions of language and their factors. Krippendorff's concept of *Ideal types* (2006, pp. 92-93) seems to parallel Thwaites et al. description of the "*signified*" as pure abstract sound impression (2002, pp. 34-35) as well as echo in Pinker's thoughts on visual thinking and his concept of *mentalese* (1994, pp. 44-73). Krippendorff's discussion on semiotics and his distanciation from it (2006, pp. 273-278) seem to fall in line with this research's choice to focus exclusively on elementary structural principles in lingual semiotics rather than get entangled with the entirety and complexity of semiotics' field of research.

The final author to join this geometry is Gibson and his *Ecological Approach to Visual Perception*, whose description both of the ecology and of the faculty of human perception and its processes is comprehensive, detailed and concise. It is one of the key building blocks used by

Krippendorff for his constructive framing of the meaningful relationship between the designed artifact and its user. As mentioned above, this book forms a contact point with Pinker, Krippendorff and Thwaites in a convergence of thinking related to the perceptual system and the cognitive processes facilitating the extraction of information (Gibson’s *ambient light*) from flow of sensory input (Gibson’s *radiant light*).

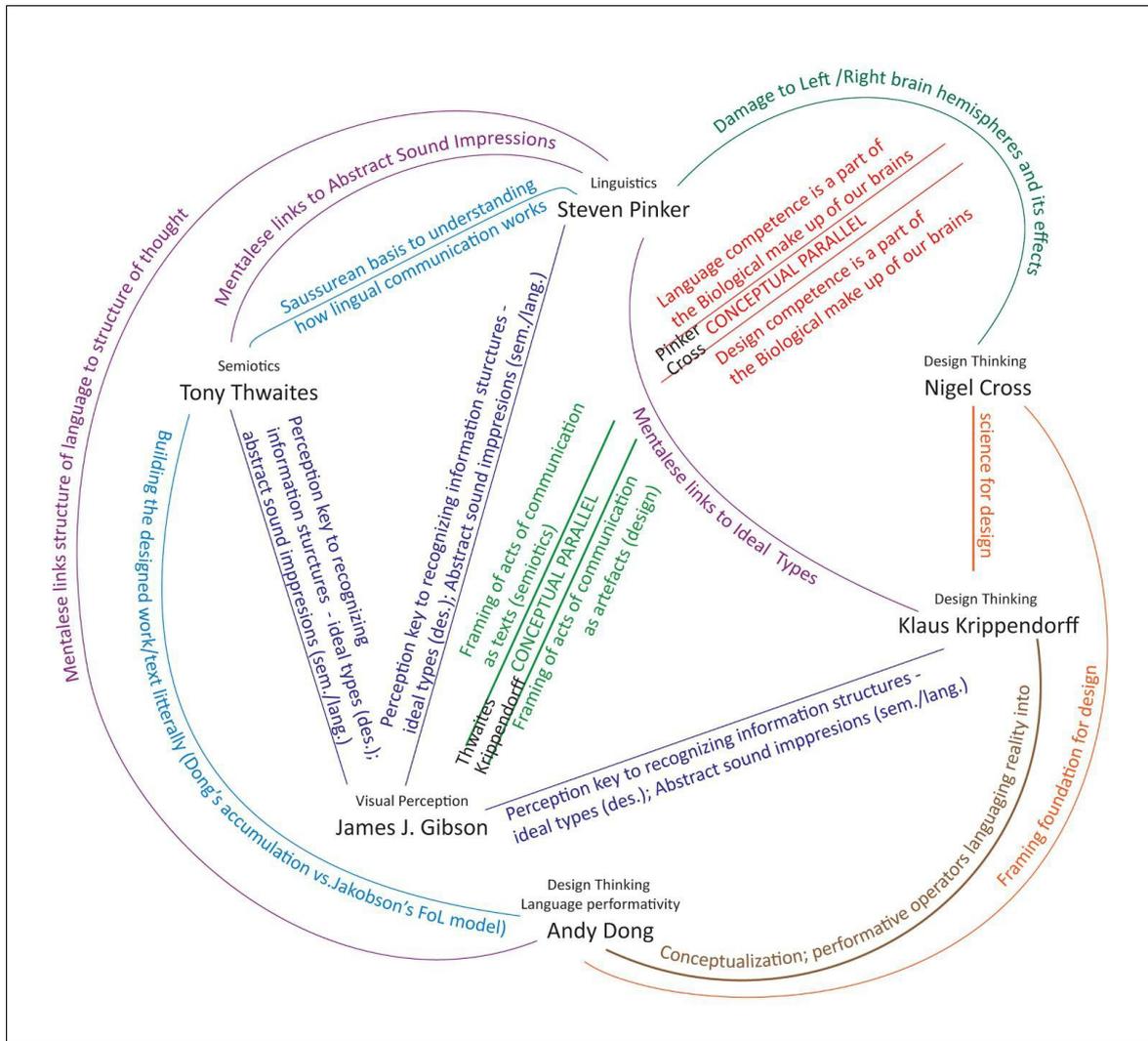


Fig. 2.1: Mapping the key connections between the different selected authors in the geometry.

Finally these six works were formed into a literal geometry according to a criteria conditioning comfort of access, comprehensive knowledge base, synchronic approach to research field, shared literary foundation, and tangibility of information. The research looked for publications facilitating an understanding of how language works in tangible terms, thus, opting for

Pinker and not for Kallir (1961), or Chomsky (1975). It looked for authors making clear connection between language and design in tangible terms and not in qualitative attributions or through philosophy, thus, opting for Dong and Krippendorf and not for Sudjic (2009) and Foucault (1994). It sought key publications which could inform about a field of knowledge in its entirety - hence choosing *Introducing Cultural and Media Studies* (Thwaites et. al., 2002), *The Ecological Approach to Visual Perception* (Gibson, 1986) and *Design Thinking* (Cross, 2011). And finally it focused on authors touching on universal structures theories and looked for literary connectivity between the different authors - opting for authors using each other's work to advance their arguments, and/or building together on a shared "literary database" of sources in the construction of their ideas.

2.2 Conclusion

First, with the relationship described above and its connections between the different authors this research shows the relevance of linguistic information to design thinking, highlighting in particular the importance of Steven Pinker's work. In drawing this geometry this research outlines only a tangible selection of possible connections that could be formed between these authors. This research also acknowledges that beyond its own limitations many more connections between this literary geometry and other authors, as well as more recent works, could be made and may have already taken place.

Second, the formed geometry helps to further this research aims of informing and exploring the relationship between language activity and design activity, in terms of ability competence and performance, and its aims of inquiring into the structural dynamics with which these two seemingly distinct human abilities manifest and are applied in practice as well as into the validity of universal structure theories in design.

Finally, This geometry provides the research with a strong foundation of theoretical knowledge with which a vision of language as the structuring structure for design - enacting the performance of design and forming the enacted designed artifacts according to its own inherent functions and structures (Dong, 2009; Jakobson, 1960) - could be tested and explored. It will start doing so in the following chapters with establishing its framing of design and examining, in more detail, the work of Steven Pinker. The latter will be done by comparing statements from *The Language Instinct* (1994) against statements from other works included in this geometry, converging Pinker's thinking with the thinking of the other authors while mapping and debating the applicability of principles and parameters associated with language use, competence and performance to the field of design.

Chapter Three

Framing and First Steps Towards a Comparative Research.

In positioning itself and its direction of investigation this research builds on one of Andy Dong's key arguments in *The Language of Design* (2009), the similarity between language and design capacities:

"It is the productive forces of language that form the logic of this book. Let us use the classic rule of transitivity to explain the logic. The rule of transitivity states that if you agree with me that A is equal to B, and that B is equal to C, then you must agree with me that A is equal to C. Thus, we must start with the agreement that language (A) is performative, that is, reality-producing (B). Certainly language 'is' lots of other 'things' but its reality-producing effects could not be argued away contemptuously. I doubt few would disagree that reality-producing (B) is the nature of design (C). Then language and design should be considered, perhaps at least conceptually, the same." (Dong, 2009, p.170)

In discussing how this similarity can be considered as more than just a conceptual aspect, Dong reviews the case of linguistic competence and its debate.

*"A key question is whether language is innate in the sense of Universal Grammar (UG) shared across all humans, suggesting that UG is encoded genetically, or whether language is purely an empirically evolved (human) phenomenon. In one camp are the so called linguistic nativists, starting with Noam Chomsky and more recently Stephen Pinker with his book *The Language**

*Instinct. In the other camp are the empiricists, most forcefully argued by Geoffrey Sampson and his response to Pinker's book specifically, and nativism broadly, in his book *The "language" instinct debate*". (Dong, 2009, pp. 175- 176)*

Dong expands this key question, and Pinker's concept of *Mentalese* - which proposes "*a strong link between the structure of language of the structure of thought*" - to the field of design by reviewing key investigations and theories highlighting the cognitive, biological, evolutionary and genetic aspects in which the capacities for language and design seem to be similar. He notes that "*The consequence of these capacities is humans' ability to represent objects (design) and abstract concepts (language) with arbitrary visual or material (design) and vocal (language) symbols and to act with reference to concepts not limited in time and space*", pointing, first, that "*where vocal language realization requires dexterous manipulation of orofacial muscles and the larynx to articulate sounds, material design realization requires dexterous proprioceptive manipulation of muscles to handle the position or movement of a part of the body*", and second, to the likelihood that this "*set of cognitive capabilities evolved simultaneously*" in humans (Dong, 2009, pp. 175-176).

Dong concludes with the possibility "*that the genetic origins of language and design are interconnected. The debate over whether language and design are innate or whether they are learned centers around the question of how much specific information about language and design are hard-wired in to the brain (by genes) and how much of the knowledge we acquire, that is learn through social and cultural transmission.*" (Dong, 2009, p. 178)

This similarity between language and design and their possibly joint genetically and evolutionary origins form the starting point for this research in its exploration of the relationship between language and design, in terms of competence and performance. This research's primary

argument is that if indeed language and design are the same, then it will be possible to form a systematic approach to the study design, designed artifacts and thinking and the education of design practice. An approach grounded in the framing and the theoretical foundation used for the study of language in the fields of linguistics, semiotics and structuralism.

This research will therefore scrutinizes the applicability in design of language based theories, ideas, and concepts, in the field of design, subsequently aiming to identify in what ways language and design are the same in terms of functionality (the way they work cognitively) and use by humans. As a part of this attempt, this research will seek to recognize patterns, which are associated with language activity, in design activity - with language use, in design use, that is, the creation and use of designed artifacts in the communication and coordination of meaning.

3.1 A Linguistic Framing for Design.

As the research's core intended statement, its comparative studies and subsequent discussion compose a selective vision which removes the conceptual and modal division between designed artifacts (design) and lingual artifacts (language). The research sees these artifacts types as two categories of man made artifacts, "*Produced by art rather than by nature*" (as cited by Simon, 1996, p. 4), that is, conceived and enacted by men and his involvement. This research's fundamental premise frames all man made artifacts as acts of communication, where communication between members of the human species is enabled by an all-round human ability to represent and refer to concepts not limited in space and time - the consequence of humans cognitive capacities to language and do design as stated above by Dong.

As such this analysis conceptualize design and the designed artifact in the same way that Linguists have conceptualized Language and the lingual artifact for over a century, beginning with the framing used by linguist Ferdinand de Saussure. According to Thwaites et al. (2002), Saussure divides the domain of language into two conceptually distinct areas:

"parole (or utterance, or speech)

A given act or artifact of language, such as a spoken utterance, a conversation, a postcard, a novel or a course handout; and

langue (or code, or system, or the language)

The system which enables acts of parole to be produced.

Saussure also uses the term Language to refer indiscriminately to either of these, so in

effect:

Language = langue + parole

Parole is made up of real, actual and concrete sign uses, and is potentially infinite. Langue is finite, but also abstract, something that is inferred behind the examples of parole that we can observe “. (Thwaites et al., 2002, p. 39)

Like Saussure's division, this analysis divides the domain of design into two distinct areas:

design parole (or speech, or utterance)

A given act of design, or a designed artifact, usually made up of arbitrary visual, or material signs and symbols; and

design langue (or code, or system)

The system which enables acts of design parole to be produced.

The term design can be used to refer indiscriminately to either of these term bringing into effect the equation:

Design = design langue + design parole

Design parole is made up of real, actual and concrete uses of material and visual elements, and is potentially infinite. Design langue is finite, but also abstract, it is something that is inferred behind the examples of designed artifacts that can be observed.

In the following investigation - in an attempt to infer *design langue* - the research will inquire into the structural dynamics with which Language and design abilities manifest and are applied as well as to the possibilities of universal structures in design. It will do so not through examining every individual or mass produced example of *design parole*, but by identifying patterns, principles and parameters associated with *langue langue* in key sources of design thinking, and by re-purposing or positing the descriptions of such lingual concepts into design by adjusting and transition key terminology in their description, as done above with the framing used by Saussure. The research will motivate each of the transitions made with a discussion or a series of notes examining the logical validity of the new design thinking statement and the terminology used for its creation.

Chapter Four

The Design Instinct: A comparative extrapolation of Steven Pinker's 1994 manifest.

This part of the research is a comparative analysis. It is aimed at contributing to the field of design through the convergence and analysis of different thinkers and different strings of thought. Doing so, it forms a synthesis that can serve as an initial framework for a language based approach to design practice and design education.

Its primary goal is to inform and to explore the relationship between language and design activities, by inquiring into the structural dynamics with which these two seemingly distinct human abilities manifest and are applied, as well as to the possibility of universal structures in design.

For that purpose, as motivated in *Literary Geometry* chapter, this research have chosen Pinker's *The Language Instinct: How the mind creates language (1994)* as source for linguistic information used for this analysis, and the following works as source for information relevant to the study of design, covering the fields of design thinking, cognitive studies, visual perception and semiotics:

- *The Ecological Approach to Visual Perception*, by James J. Gibson (1986).
- *Introducing Cultural and Media Studies: a semiotic approach*, by Tony Thwaites, Lloyd Davis and Warwick Mules (2002);
- *The Semantic Turn: A new foundation for design*, by Klaus Krippendorff (2006);
- *The Language of Design: Theory and Computation*, by Andy Dong (2009); and
- *Design Thinking: Understanding how designers think and work*, by Nigel Cross, (2011);

This comparative analysis attempts to infer *design langue*, not through examining every individual or mass produced examples of design parole, but by identifying lingual patterns,

principles and parameters presented by Pinker in key sources of design thinking, and by re-purposing or positing selected statements and descriptions of linguistic concepts and ideas (expressed by Pinker) into design, through a change of key terminology - a process of extrapolation which will be further referred to as *transitioning*.

Although using Pinker's *The Language Instinct: How the mind creates language (1994)* places this research closer to linguistic nativism and touches on key questions involving cognitive capacity for language, this analysis will steer away from joining the debate between linguistic nativists and empiricists on language competence - "one of the most contested theories of human development" (Dong, 2009, p. 175). This analysis will also steer away from diachronic approaches to the study of language and from debating subjects and theories involving the creation and evolution of specific languages and human alphabet systems, like Alfred Kallir's *Sign and Design (1961)*, for one example.

Geared towards developing an understanding of the relationship between language and design, and focusing on creating a clear and coherent vision through dynamically comparing between these abilities, the scale of this analysis consist of selected statements from the first four chapter of *The Language instinct*. These were selected according to their relevance and contribution towards constructing a concept of design ability as language or communication based - building on the frame established in the previous chapter of this thesis. The research converges these statements into logical equations consisting of the original linguistic statement and its transitioned design oriented equivalent, forming an axis of synchronized meaning between the fields of language and design.

The transition of each statement is followed by discussion and series of notes motivating the terms used in the transitioning. These examine the logical validity of the transitioned statements by contrasting against or converging the selected statements (made by Pinker) with

statements from authors included in the core literary geometry that was formed by this research and supported by further relevant case studies, articles and wikipedia entries available online.

This analysis will therefore consist from four sections, one for each of the first four chapters. Each section begins with a manifest composed of the different transitioned statements formed from its equations, which then follow up individually. Each equation is followed with a discussion motivating the axis of meaning formed, and the choice of terms and concepts used in the transitioning of the original statement. Doing so, each discussion will also examine under which conditions the altered statement would mean the same about design as meant by Pinker about language. This discussion will aim to build upon the similarity between the fields, shedding further light on the relationship between the abilities and capacities of language and design. Each section will end with a summary of key points discussed in the chapter during the transitioning of Pinker's arguments on language (from that respective chapter) to design.

At the end of this analysis a short summary will list the main conclusions reached during this part of the research. A subsequent discussion of this analysis and its conclusions forms the rest of this research and therefore is not included with this part of the research.

4.1 An Instinct to Acquire an Art.

Abstract:

(1) Design is so tightly woven into human experience that it is scarcely possible to imagine life without it. When there is no one to design for, people design for themselves, for their pets, even for their plants. (2) This manifest will not address exclusively the English *type of* design or any other type of design, but something much more basic: the instinct to learn, produce and understand design.

(3) Design is not a cultural artifact that we learn the way we learn to tell time or how the federal government works. Instead, it is a distinct piece of the biological makeup of our brains. Design is a complex, specialized skill, which develops in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic, is qualitatively the same in every individual, and is distinct from more general abilities to process information or behave intelligently. For these reasons some cognitive scientists have described design as psychological faculty, a mental organ, a neural system and a computational model. But I prefer the quaint term “instinct”. It conveys the idea that people know how to design in more or less the sense that spiders know how to spin webs. Web spinning was not invented by some unsung spider genius and does not depend on having had the right education or an aptitude for architecture or the construction trades. Rather, spiders spin webs because they have spider brains, *spider body*, and “*spider hands*” which give them the urge to spin and the competence to succeed. Although there are differences between webs and artifacts, this manifest encourages the reader to see design this way, for it helps to make sense of the phenomena it will explore.

(4) Design is no more a cultural invention than is the upright posture. It is not a manifestation of a general capacity to use symbols. (5) Instead, design is a product of well engineered biological instinct. (6) Two fundamental facts about design are: first, virtually every

***original* act of design that a person makes or understands is a brand new combination of elements, appearing for the first time in history of the universe. Therefore design cannot be a repertoire of responses; the brain must contain a recipe or program that can build unlimited set of acts of design out of a finite list of elements. That program may be called a mental grammar. The second fundamental fact is that children develop these complex grammars rapidly and without formal instruction and grow to give consistent interpretations to novel design constructions that they have never before encountered. Therefore, children must innately be equipped with a plan common to the grammars of all design types, a universal grammar that tells them how to distill the syntactic patterns out of pre-existing acts of design. (7)**

Consequently, it is fruitful to consider design as an evolutionary adaptation, like the eye, its major parts designed to carry out important functions.

1.

Original statement:

“Language is so tightly woven into human experience that it is scarcely possible to imagine life without it.... When there is no one to talk with people talk with themselves, to their pets, even to their plants.” (Pinker, 1994, p.3)

=

Altered statement:

¹Design is so tightly woven into human experience that it is scarcely possible to imagine life without it. When there is no one to design to people ²design for themselves, for their pets, even for their plants.

Researcher’s notes:

1 Language = design.

2 Talk = design. As in actions of “doing talking” and “doing designing”.

Not everyone is a professional designer working for a client, but still people design solutions from folding a paper to stop a rocking table to selecting and arranging the interior of their homes, their gardens, their office spaces, not for others benefit, but for their own benefit.

“Everyone can - and does - design. We all design when we plan for something new to happen, whether it might be a new version of recipe, a new arrangement of the living room, or a new layout of a personal web page.” (Cross, 2011, p. 3)

Krippendorff’s preliminary framing of language in *The Semantic Turn* demonstrates the scale in which language is woven into human experience:

“Language is a cultural artifact that enables humans to coordinate their conceptions, engage in joint action, and construct and reconstruct the reality they see. In the use of language, languaging, acting, and perceiving are inseparable tied to a constructive understanding. It is a truism that one cannot know what exists without conceptualizing it as such. Languaging is the primary source of conceptions. It also presupposes the bodily participation of human beings. Language is spoken, written, and communicated. Entering humans into this conception of reality entails this self reference: Humans are beings who language each other into being. This self-reference is remarkable by implicating language as a condition for understanding oneself as a human being...”(Krippendorff, 2006, p. 20).

Design seems to be as much the cultural artifact as language. Like proverbs and words, the significance of artifacts, as well as the elements they are composed from, is dependent (and vice versa) on human culture - *“the ensemble of social practices through which meaning is produced, circulated and exchange”* (Thwaites et al., 2002, p. 1).

“Words, or artifacts for that matter - after all, words are artifacts as well - can change their meaning as they travel through different uses, different situations, different times and different people’s lives”(Krippendorff, 2006, p. xv).

Design also seem to enable humans to coordinate their conceptions (or at least to align them), to engage in joint action, and to construct and reconstruct their reality. In the use of design, it seems that designing, acting and perceiving are inseparably tied to a constructive understanding. Humans seem to design themselves into being, *“All identity is active statement. It communicates its being to the surrounding world through a set of more or less clear, impressive and complicated*

signals...". Human's use of signals is not limited to lingual statements only, through the use of fashion and other man made artifacts, humans design their identity - what they wish to mean to themselves and to others. "We are so far as we can declare ourselves to be, and have full assurance of our asserted existence only when other identities register and reciprocate our life signals" (Steiner, 1969, p. 7).

Based on the etymology of design Krippendorff suggests that *"design is making sense of things"*, which can be read as *"design is a sense making activity"*. This phrase, as Krippendorff states, concerns man made artifacts or human creations, yet Krippendorff notes that *"making sense is the result of human activity as well"* (Krippendorff, 2006, p. xv). An activity to which designing, perceiving, and languaging seem to be essential.

It is possible to argue that design is tightly woven into human experience by showing how it is tightly woven into language - as done in the previous part of this thesis. In the course of *The Semantic Turn* Krippendorff demonstrates that humans do not only conceptualize themselves and each other into being, but also conceptualize their creations - man made artifacts - into being (as evident from Krippendorff discussion of User Conceptual Models and Characters). In *The Language of Design* Dong validates this idea further with his theory of lingual performative operators of aggregation, accumulation and appraisal with which humans language their creations into being (Dong, 2009; Krippendorff, 2006).

But the link between language and design ability seems to be deeper, cognitively and historically, than the causality of having the parole enabled by first cognitive ability produce the parole enabled by the latter.

"Instead it is more likely that a set of cognitive capabilities evolved simultaneously. Based on the evidence of tool forms which were not limited by mechanical constraints of the technique of

manufacture, language is believed to have evolved about the same time when tool making was unfolding (Davidson & Noble, 1993). Arbib's Mirror Language Hypothesis (2005) theorizes that the evolution of the brain proceeded at pace with the development of motor skills. For example, the ability to point to an object and to refer to the object is likely to have evolved at the same time that the brain developed the capacity to refer to objects symbolically, which Arbib argued was essential for the formation of protolanguage." (Dong, 2009, p. 176)

2.

Original statement:

“I will not be writing about the English language or any other language, but about something much more basic: the instinct to learn, speak and understand language” (Pinker, 1994, p.3)

=

Altered statement:

I will not be writing about the English ¹type of design or any other type of ²design, but about something much more basic: the instinct to learn, ³produce and understand design⁴.

Researcher’s Notes:

1 The English language is a type of language, enabling of a type of English parole made from iconic words and phrases associated with the English culture. Hence, the transition is to **English type of design** being a type of design langue enabling its own type of parole with specific and iconic elements and artifacts associated with English culture. The type of design practiced in car design or systems design would fit this sentence just as much as the term “English (type of) design”, since the meaning of the statement would not differ greatly.

Still, in this transition the researcher chose to build upon a framing of design as cultural artifact, much like an identity communicated through design parole produced by cultures. This research notes how cultural identity has changes in past centuries. Up until the industrial revolution the identity of a specific culture (as seen from its designed artifacts) was directly linked

to the territory it holds, the resources there and the culture's technological abilities for processing these into goods - designed artifacts. The coming of the industrial revolution also meant an increase in trade and with it access to resources that lay far beyond the culture's territory. With resources and raw materials available now at almost every corner of the world contemporary design rarely shows a cultural identity. Designed artifacts seem to be abstract, functional and minimalist - associated only their human users body and/or territory of destination.

2 Here there is a need to break away from the equation of "language = design" in order to maintain an equal logic to that of the original sentence. Other options for transition were "sign system" and "culture". The choice for "type of design" and "design type" is motivated in the point above.

3 "To speak" usually refers to the creation or production of vocal acts of speech using language, hence the transition from speaking acts of language to producing acts of design.

Common empirical experience shows that humans seem eager to learn how tools work, or to know what their environment with all its perceived components and the information it constitutes can afford. This eagerness seem to be biologically motivated, instinctive just as Pinker suggest about language.

"Our ancestors were always looking around. They surveyed the environment, for they needed to know where they were and what there was in all directions. Children pay attention to their surroundings when allowed to do so. Animals must do so." (Gibson, 1986, p.203)

It is as inevitable for human infants to produce noises from their throat, mouth, and lung muscle groups, as it is to sense those noises with their ears. Through building on their experiences they experiment with making noises, and by registering the environment's reaction or situational

affect to each type of noise or noise combinations produced infants develop an understanding of what theirs and other noises they hear can possibly mean. As infants grow it seems that their attention shifts from recognition to exploration to reliance on their own voices. This is an anatomic-lingual parallel to Krippendorff primary concepts of *Meaning of Artifacts in Use* (2006, pp. 77-147). A similar process develops with other organs and biological mechanisms that relate to designing and making things, for example - visual control of manipulation:

“Infants, both monkey and human, practice looking at their hands for hours, as well they should, for disturbances of optical structure that specify the niceties of prehension have to be distinguished. All manipulations, from the crudest act of grasping by the infant to the finest act of assembly by the watchmaker, must be guided by optical disturbances if they are to be successful.” (Gibson, 1986, pp. 119-120)

This accumulation of experiences into understandings of what the human body affords seems to be motivated by some sort of biological instinct - being a process of learning that lacks any formal instruction or education. In describing how interfacing with tools happen Krippendorff seem to hit the point:

“Those involved find themselves in a particular sensory motor coordination, acting either to sustain intrinsically motivating sequence of senses, one that is enjoyable or fun to experience; and/or bringing forth an intrinsically motivated sense, goal or objective” (Krippendorff, 2006, p. 82).

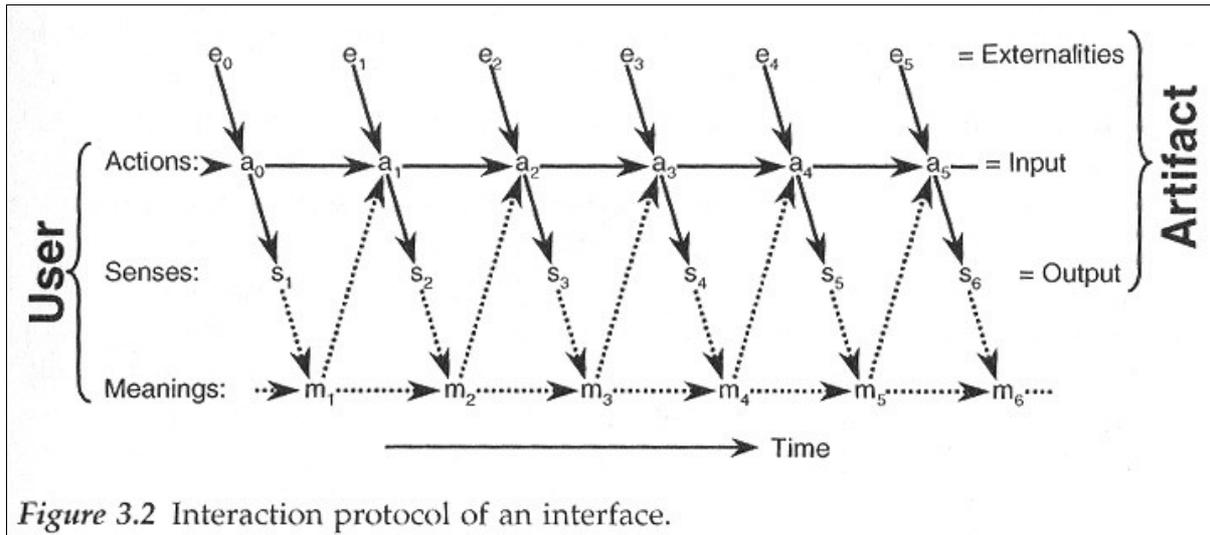


Figure 3.2 Interaction protocol of an interface.

Fig. 4.1: Action - Sense - Meaning - Action Protocol (Krippendorff, 2006, p. 82)

Interaction of human’s mind with its attached (via nerve cells) body parts can be seen in terms of interaction between humans and artifacts:

“For example, when a car is driven, the interface amounts to a person literally sitting in the driver’s seat and using his eyes, ears, hands and feet to preserve the correlation between his conceptions of the car and the destination. In that process, the driver places the choice of an action at - moving the steering wheel, pressing or releasing a pedal, shifting gears - in the context of where he started, m_0 , and where he wants to be, m_{final} . The interaction $s_1 \rightarrow a_1 \rightarrow s_2 \rightarrow a_2 \rightarrow s_3 \rightarrow a_3 \rightarrow \dots \rightarrow s_{final}$, where in the world of the user, s_t is the sense made of the output of the artifact, and a_t is the user’s acting on that sense, serving an input to the artifact - is guided by meanings $m_1 \rightarrow m_2 \rightarrow m_3 \rightarrow \dots \rightarrow m_{final}$ or the user’s conceptual models comprising these meanings. Along the way, s_t might be interpreted as an obstacle to be circumvented, as a traffic sign to be obeyed, or as signaling an opportunity to pass another vehicle. Such interpretations occur in the user’s understanding, not in the mechanism of the artifact. The meaning of driving comes from putting our sense- action-sense sequence in the context of our world construction, the past, the current and the desirable” (Krippendorff, 2006, pp. 82-83).

To that last sentence this research adds - Just as the meaning of sounding our voice and speaking or grasping a pencil and writing.

“When an object grasped by the hand is used as a tool, it becomes a sort of extension of the hand, almost a part of the body.” (Gibson, 1986, p. 121)

3.

Original statement:

“Language is not a cultural artifact that we learn the way we learn to tell time or how the federal government works. Instead, it is a distinct piece of the biological makeup of our brains. Language is a complex, specialized skill, which develops in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic, is qualitatively the same in every individual, and is distinct from more general abilities to process information or behave intelligently. For these reasons some cognitive scientists have described language as psychological faculty, a mental organ, a neural system and a computational model. But I prefer the quaint term “instinct”. It conveys the idea that people know how to talk in more or less the sense that spiders know how to spin webs. Web spinning was not invented by some unsung spider genius and does not depend on having had the right education or an aptitude for architecture or the construction trades. Rather, spiders spin webs because they have spider brains, which give them the urge to spin and the competence to succeed. Although there are differences between webs and words, I will encourage you to see language this way, for it helps to make sense of the phenomena we will explore.” (Pinker, 1994, pp.4-5)

Altered Statement:

¹Design is not a cultural artifact that we learn the way we learn to tell time or how the federal government works. Instead, it is a distinct piece of the biological makeup of our brains. ¹Design is a complex, specialized skill, which develops in the ²child spontaneously, without conscious effort or formal instruction, is deployed without ³awareness of its underlying logic, is qualitatively the same in every individual, and is ⁴distinct from more general abilities to process information or behave intelligently. For these reasons some cognitive scientists have ⁵described

design as psychological faculty, a mental organ, a neural system and a computational model. But I prefer the quaint term “instinct”. It conveys the idea that people know how to design in more or less the sense that spiders know how to spin webs. ⁶Web spinning was not invented by some unsung spider genius and does not depend on having had the right education or an aptitude for architecture or the construction trades. Rather, spiders spin webs because they have spider brains, spider body, and “spider hands” which give them the urge to spin and the competence to succeed. Although there are differences between webs and artifacts, I will encourage you to see design this way, for it helps to make sense of the phenomena we will explore.

Researcher’s notes:

1 Language = design.

2 Common empirical experience shows that children begin to select and combine toys (and other artifacts) at very young age, sometimes even before they are able to speak their mother language.

3 Adults, at times, deploy design in the creation of artifacts without awareness of it, since some artifacts can be created randomly or as unintended result. Also, some compulsive disorders force people to arrange things unconsciously.

4 This research is interested in what Pinker means with “*distinct*” and with “*general abilities to process information or behave intelligently*”? Based on this research’s related investigations in *chapter five* into cognitive functions for language and design, neither language nor design seem to be separate from each other or possibly from other related information processing, reasoning or intelligent behavior abilities involved in human sense making activity.

For example, like language, and design, math is also used in order to make sense of things, in order to conceptualize realities, and in order to represent the physical world. However, when it

comes to output - that is, to what is seen externally from the human abilities to language, to design, to do maths or physics - talking is distinct from making things, or from calculating equations or from exploring our universe. Again, on the inside of the human brain, information processing and decision making are linked with all these abilities as humans deal with open ended and closed ended problems, that is, deal with making sense of things they encounter and perceive.

5 Design seems to be as complex (or even more) as language, and as result it is quite possible to describe it as any of the descriptions noted by Pinker for language. What comes to mind as missing among these descriptions is Nigel Cross's (2011) description of design as natural intelligence. A subject which also connects with the above questions on the distinctiveness of language and design:

“What I have attempted to show throughout this book is that design ability is such a multifaceted cognitive skill. More than that, I have tried to show that there are particularly, ‘designerly’ ways of thinking and working, that set design apart from other forms of cognitive skill. In fact, it seems possible to make a reasonable claim that design ability is a form of natural intelligence, of the kind the psychologist Howard Gardner identified. Gardner's view is that is not just one form of intelligence (as conventionally identified in forms of ‘intelligence tests’), but several, relatively autonomous human intellectual competences. He distinguished six forms of intelligence:

- *Linguistic*
- *Logical-mathematical*
- *Spatial*
- *Musical bodily-kinaesthetic*

- *Personal*

Aspects of design ability seem to be spread through these various forms of intelligence in a way that does not always seem satisfactory. For example, spatial abilities in problem-solving (including thinking in the mind's eye) are classified by Gardner under spatial intelligence, whereas many other aspects of practical problem-solving ability (including examples from engineering) are classified under bodily-kinaesthetic intelligence. So in this classification, for example, the inventor's competence is placed together with that of the dancer and the actor, which doesn't seem appropriate. It seems reasonable, therefore, to try and separate out design ability as form of intelligence in its own right." (Cross, 2011, pp.135-36)

Alternatively design could be seen as a fundamental cognitive ability that is necessary in order for activities related to the forms of intelligence above to take place. Language, which seems to be heavily involved and indeed needed in designing (Dong, 2009), also seems to be, like design, a necessity for enacting activities relating to the forms of intelligence above. The inventor, dancer, actor engineer all need to understand and conceptualize their situation and for that purpose deploy language, possibly as much as they use design to structure their parole and communicate meaning.

6 With his analogy of language and web spinning, Pinker seems to exclude the role of the body in the development of human language, suggesting that language developed in the brain independently from the development of complex organs like the ears, tongue, lips and larynx. This exclusion cannot be repeated when this analogy is directed at design, it is highly unlikely that design developed in the brain independently from the development of complex organs like the hand, or organs aiding the perceptual system, as the following examples indicate:

“In the primate and the human, the five pronged shapes that specify hands are especially meaningful. Their deforming contours and underlying variants make possible what psychologist have called, very inadequately, eye-hand coordination. More exactly, they are the basis of visual control of manipulation. And when an object grasped by the hand is used as a tool, it becomes a sort of extension of the hand, almost a part of the body.” (Gibson, 1986, p. 121)

“For each of the three kinds of optical gradient that I proposed as “stimuli” for seeing depth... - size perspective, disparity perspective, and motion perspective - the nose provides an absolute baseline, the absolute zero of distance from here.” (Gibson, 1986, p.117)

“Where vocal language realization requires dexterous manipulation of orofacial muscles and the larynx to articulate sounds, material design realization requires dexterous proprioceptive manipulation of muscles to handle the position or movement of a part of the body” (Dong, 2009, p.176)

Hence, there is a need to include *“spider body”* and *“spider hands”* into this analogy. These are organs *“which give them the urge to spin and competence to succeed”*. For example, hands possibly also give the urge to hang/climb on trees (primates) and build things (humans). A correction like this also makes the difference between spider webs (spider-made artifact) and man made artifacts smaller, an already smaller difference from the one between of spiderwebs and words.

4.

Original statement:

“Language is no more a cultural invention than is the upright posture. It is not a manifestation of a general capacity to use symbols” (Pinker, 1994, p. 5)

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Altered Statement:

¹Design is no more a cultural invention than is the upright posture. It is not a manifestation of a general capacity to use symbols.

Researcher’s notes:

1 Language = design.

The discussion in the previous equation leads up to this conclusion, which acknowledges the role of the human body and its evolution in the development of design and language abilities. It also points to these abilities being a biological trait similar to the ability of some kinds of bats to use sonar in order to home in on flying insects, or of some kinds migratory birds to navigate great distances by calibrating the position of stars against time of day and year. *“In nature’s talent show we are simply a species of primates with our own act, a knack for communicating for communicating information... by modulating the sounds we make when we exhale”* (Pinker, 1994, p. 5), or by manipulating and combining materials and objects with our hands.

5.

Original statement:

“Language is a product of well engineered biological instinct” (Pinker, 1994, p.6)

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Altered Statement:

¹Design is a product of well engineered biological instinct.

Researcher’s notes:

1 Language = design.

Humans rely on their biology to design and create artifacts as much as they rely on it in order to understand the design of artifacts. Yet, there is a level of complexity beyond which human biology and body proportions could not be used by humans to instinctively understand the design of artifacts. *“The bodies of high-tech artifacts are limited by what human users can do, monitor and understand. What goes inside such artifacts, besides the human sensory-motor coordination with them, is no longer relevant to their users”* (Krippendorff, 2006, p.15), or perhaps no longer understood.

6.

Original statement:

“...two fundamental facts about language. First, virtually every sentence that a person utters or understands is a brand new combination of words, appearing for the first time in history of the universe. Therefore language cannot be a repertoire of responses; the brain must contain a recipe or program that can build unlimited set of sentences out of a finite list of words. That program may be called a mental grammar. The second fundamental fact is that children develop these complex grammars rapidly and without formal instruction and grow to give consistent interpretations to novel sentence constructions that they have never before encountered. Therefore... children must innately be equipped with a plan common to the grammars of all languages, a universal grammar that tells them how to distill the syntactic patterns out of the speech of their parents” (Pinker, 1994, p.9)

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Altered Statement:

Two fundamental facts about ¹design are: First, virtually every ²act of design that a person makes or understands is a brand new combination of ³elements, appearing for the first time in history of the universe. Therefore design cannot be a repertoire of responses; the brain must contain a recipe or program that can build unlimited set of acts of design out of a finite list of elements. That program may be called a mental grammar. The second fundamental fact is that children develop these complex grammars rapidly and without formal instruction and grow to give consistent interpretations to novel design constructions that they have never before

encountered. Therefore... children must innately be equipped with a plan common to the grammars of all design types, a universal grammar that tells them how to distill the syntactic patterns out of pre-existing ⁴acts of design.

Researcher's notes:

1 Language = design.

2 Sentence, an act of language = an act of design. Also, Pinker use of the phrase “*virtually every sentence*” is unclear and must therefore exclude acts of copying and imitation, which are quite common. This means that planing must be involved in the production of acts of parole. The term “*original*” could have been added in order to distinguish between repetition of pre-existing act of communication and original ones.

3 Words; base units of language = elements; inc. forms, shapes, and materials. This is discussed further by this research in its investigation into the underlying differences between structural units used in language and design in the following chapter of this thesis.

4 Speech, meaning spoken parole or act(s) of language = acts of design. Naturally kids can distill syntactic patterns not only from the speech of their parents but also from any other person or acts of language they encounter, new and pre-existing.

The research gives here further attention to the moment in the development of humans where design, as well as language, develops further from being a biological instinct and expands with a repertoire of responses used for the practicing of cultural rituals (from religious ceremonies to conduct in court of justice), the telling of the time, the playing of chess, or like in the classic example made by Donald Schön (1983) of Petra and studio master Quist.

Pinker mentions Darwin's conception of language as a kind of instinct from *The Descent of Man*:

“...language is an art, like brewing or baking; but writing would have been a better simile. It certainly is not a true instinct, for every language has to be learned. It differs, however, widely from all ordinary arts, for man has an instinctive tendency to speak, as we see in the babel of our young children; while no child has instinctive tendency to brew, bake or write.” (Darwin, 1874, as cited by Pinker, 1994, p. 6)

Yet, in the biological development of humans, learning transforms from a series of competence based trial and error experiences in childhood into a systematic performance based method of formal learning in adulthood. Young children tend to select and arrange objects as much as they tend to babel. They also tend to play with all sorts of materials and physical elements (“babel” with their hands?), draw on walls when the “*conversation*”, that is, the situation and its materials (Schön, 1983) affords it, and observe events (Gibson, 1986) such as the running of water and the burning of fire. It seems likely that in between all these activities of play and observation hides the instinct to bake, write, brew, and design, as well as other adult activities simulated in children's play.

7.

Original statement:

"I think it is fruitful to consider language as an evolutionary adaptation, like the eye, its major parts designed to carry out important functions." (Pinker, 1994, p. 11)

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Altered Statement:

I think it is fruitful to consider ¹design as an evolutionary adaptation, like the eye, its major parts designed to carry out important functions.

Researcher's notes:

1 Language = design.

This sentence is embedded within a paragraph dealing with Chomsky's skepticism about Darwinian natural selection being able to explain the origins of a language organ. This idea is possibly based on the similarities shared between the diversity of species and the diversity of languages noted by Darwin, as Pinker later recalls:

"The formation of different languages and of distinct species and the proof that both have been developed through a gradual process are curiously parallel... We find in distinct languages striking homologies due to community of descent and analogies due to a similar process of formation... Languages, like organic beings, can be classed in groups under groups; and they can be classed either naturally, according to descent, or artificially by other characters. Dominant

languages and dialects spread widely, and lead to the gradual extinction of other tongues. A language, like a species, when extinct... never reappears". (Darwin, 1874, as cited by Pinker, 1994, p. 242.)

Thinking of a cognitive skill as an evolutionary adaptation seems to be the main subject in Dong's section of *Looking Far Ahead* (2009, pp. 175-179) where, as mentioned before, he reviews a series of theories and case studies from the fields of genetics, paleontology, neuroscience, biology, and linguistics. These are centered around the biological origins of language and design. Dong notes that *"Modern humans behaviors including design,... arose gradually on an 'as needed' basis. Modern human behavior, which includes abstract and symbolic thinking linked to art based on the archaeological evidence, either preceded language or appeared as a 'package'."* (Dong, 2009, p. 177)

While emphasizing the possibility of inter-connectivity between the genetic origins of language and design Dongs describe the nature of the debate whether design and language are innate or learned by stating that it *"centers on how much specific information about language and design are hard-wired into the brain (by genes) and how much of the knowledge we acquire, that is, learn through social and cultural transmission."* (Dong, 2009, p. 178)

In looking to find inter-connectivity in brain activity during the performing of tasks related with language and design use, researchers Higuchi, Chaminade, Imamizu, and Kawato (2009) cite various functional MRI studies in monkeys that - both when using tools and when observing tool use activity by other monkeys - show how a specific area in the frontal cortex of these animals "lights up" in a region thought to be of shared ancestry to Broca area in humans. These lead them to hypothesize that a specific area in the brain evolved for grammatical aspects of human language, as suggested by Pinker above.

Higuchi and his team note that *“non-human primates can acquire simple grammar skills, but are unable to master “phrase structure grammar level” which is characteristic of human languages”* (Higuchi et al., 2009, p. 1376), as well as that in Humans, functional neuro-imaging showed a dissociation between the involvement of different parts of the Broca’s area in language. One part being responsible for simple grammar processing, and another part, namely Brodmann area 44 (BA44), being responsible for complex grammar processing.

The results of their own fMRI studies show an overlap of brain activity in the Broca area while performing different tasks related to language and design performance. The location of this overlap in the Broca area suggests that language and tool use share computational source for processing complex hierarchical structures, or grammar, common to these two abilities. This points to a shared origin in the development of the brain between human language and tool-manipulation skills.

It is possible to suggest that language capacity has evolved in humans like evolutionary adaptation, where specific part of the brain have evolved to carry out important syntactic aspects of language and design, but also that language has not been the only ability to develop in humans since the species broke away from other primate species. The capacity to design has also evolved, most like simultaneously, if not earlier as Higuchi and his team conclude:

“Our finding of an overlap of activity in BA44 supports the gradual view that the neural correlates of sequentially organized behaviour, exemplified by tool use, were already present in a rudimentary form in our last common ancestors with primates, and were later exapted to support language in humans.” (Higuchi et al., 2009, p. 1381)

Summary: An Instinct to Acquire an Art.

Design seems to be as much the cultural artifact as language is. More than the identity communicated through the designed artifacts that are produced by cultures, design enables humans to align and coordinate their conceptions, to engage in joint action, and to construct and reconstruct their reality. In the use of design, it seems that designing, acting and perceiving are inseparably tied to a constructive understanding. Humans seem to design themselves, their peers, and their creations into being. Human activity results in sense making. Design is one of the cognitive abilities humans deployed when making sense of things. Another cognitive ability being language. The distinctiveness of these abilities as well as other abilities - like the ability to use Mathematics - is based on their outwardly perceived performance and impression. Inside of the human brain cognitive information processing and decision making are linked with all these abilities as humans deal with open ended and closed ended problems, their perception and conceptualization, and work towards making sense of things.

Design is tightly woven into human experience as much as it is tightly woven into language. Humans language and conceptualize themselves and each other into existence (Krippendorff, 2006) but also do the same with their artifacts and theories. Yet, the link between language ability and design ability seems to be deeper, cognitively and historically, than the causality of having the parole enabled by one cognitive ability produce the parole enabled by the other (Dong, 2009; Higuchi et al., 2009).

Humans seem eager to learn how tools work, or what their environment with all its components and the information it constitutes can afford (Gibson, 1986). This eagerness seem to be intrinsically, if not biologically, motivated. Interaction of the human mind with its attached body parts can be seen in terms of interaction between humans and artifacts. It is highly unlikely that language has developed in the brain independently from the development of complex organs like

the ears, tongue, lips and larynx. In the same way it is highly unlikely that design developed in the brain independently from the development of complex organs like the hand and the eye.

Acknowledging the role of the human body and its evolution in the development of design means understanding that design is not a cultural invention, but a result of evolutionary adaptation in the brain (Higuchi et al., 2009). Like language, design is not a manifestation of a general capacity to use symbols but a product of well engineered biological instinct putting human sense- action-sense sequence (Krippendorff, 2006) in the context of human's world construction, the past, the current and the desirable.

Humans rely on their biology in order to design and create artifacts, but also in order to understand the design of artifacts. There is a level of complexity beyond which human biology and body proportion could not be used instinctively by humans in order to understand the design of artifacts (Krippendorff, 2006). What does not allow for human sensory-motor coordination seems to be neither relevant, nor understood.

Arguments regarding language competence and design competence center on how much specific information about language and design is hard-wired into the brain (by genes) and how much of the knowledge is acquired, that is, learned through social and cultural transmission (Dong, 2009). In the biological development of humans, learning transforms from a series of competence based trial and error experiences into a systematic performance based method of formal learning.

The learning processes of sensory-motor coordination and the conceptual constructions of the world can be seen in the way very young children babble with their hands, or select and arrange objects as they play. They can be seen in children observing of events such as the running of water and the burning of fire. It seems that in between all these activities and observations hides the instinct to speak, to bake, write, and brew and design. The rules of engagement that allow for this learning may be innate, as well as universal (Pinker, 1994).

4.2 Chatterboxes.

Abstract:

(8) Design is invaluable for all activities of living in a community of people: preparing food and shelter, tools making and using symbols for communication. Necessity being the mother of all invention, design could have been invented by a resourceful people a number of times long ago. Universal grammar would simply reflect the universal emergencies of human experience and universal limitations on human information processing. All communities have *traditional design elements (and subsequently also designed artifacts) that afford “water containment” and “footwear”* because all people need water and have feet; no culture has a *hand made* element a million *distinct* structural units large because no person would have the time to produce it. Once identified, an affordance of a design element will entrench itself within culture as parents taught their children and children imitate their parents. (9) The crux of the argument is that complex design is universal because children actually reinvent it, generation after generation – not because they are taught, not because they are generally smart, not because it is useful to them, but because the just can't help it.

(10) The universal constraints on grammatical rules also shows that the basic form of design cannot be explained away as the inevitable outcome of a drive for usefulness.... the universal plan underlying design in different cultures with auxiliary-functionalities and combinatorial rules, representations and affordances, users and contexts, entities and interfaces, product diversification/specification and coherence and so on, seem to suggest a commonality in the brains of designers, because many other plans would have been just as useful. It is as if isolated inventors miraculously came up with identical standards for typewriter keyboards, or Morse code or traffic signals.

8.

Original statement:

“Language is invaluable for all activities of living in a community of people: preparing food and shelter, loving arguing, negotiating, teaching. Necessity being the mother of all invention, language could have been invented by a resourceful people a number of times long ago. Universal grammar would simply reflect the universal emergencies of human experience and universal limitations on human information processing. All languages have word for “water”and “Foot” because all people need to refer to water and feet; no language has a word a million syllables long because no person would have the time to say it. Once invented language will entrench itself within culture as parents taught their children and children imitated their parents.” (Pinker, 1994, p. 19)

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Altered Statement:

¹Design is invaluable for all activities of living in a community of people: preparing food and shelter,tools making and symbols for communication. necessity being the mother of all invention, ²design could have been invented by a resourceful people a number of times long ago. Universal grammar would simply reflect the universal emergencies of human experience and universal limitations on human information processing. ³All communities have *traditional* ⁴design elements (and subsequently also designed artifacts) that ⁵afford “water containment” and “footwear” because all people need water and have feet; no ⁶culture has hand made ⁷element a million *distinct* structural units large because no person would have the time to

produce it. Once identified, a set of ⁸affordances for a design element will entrench itself within culture as parents taught their children and children imitated their parents.

Researcher's notes:

1,2 Language = design.

3 Languages = communities. Here, identical wording could not maintain identical logic when this sentence is transitioned into the field of design. The terms "*languages*" and "*words*" presented here each a challenge that sheds light on fundamental differences between language and design.

"*Languages*", if identical wording was to be used, would have been transitioned into "*design types*" (all design types have design elements for "*water*" and "*foot*"). However, the term "*design*" does not share the same attributes and etymology as the term language. After all, people don't produce English artifacts in the same way they produce English sentences - even though both the abilities to design and to use language allow members of the English culture to use English design and lingual sign systems in order to communicate, to encode and decode, to share, and coordinate meanings.

One way to overcome this difficulty is to use the term "*sign systems*" (all sign systems have design elements for "*water*" and "*foot*"). However, such a transition will lead the meaning of the sentence away from the subject of this paragraph, which is the universality of language and design. Moreover once continuing to the second part of sentence - to the issue of syllables and the need to make a seemingly impossible distinction between thinking of "*words*" as "*artifacts*" and "*words*" as "*design elements*" - the concept of sign system can offer little help. Another point with which the use of "*sign systems*" is counterproductive, is its opening of the meaning of the altered, as well as the original statement with its terminology "*all languages*" to include of computer

languages, programming languages, and communication between cells (which function chemically). Thus, emptying this equation from its logic .

Instead of the options above, the choice was made to focus on the subject of the paragraph and produce an identical statement about the universality of design. The term “*community*” became a key term, being mentioned in the earlier statements “*design is invaluable for all activities of living in a community*” and “*design could have been invented by a resourceful people a number of times*”.

The term “*all languages*” seems to refer strictly to various languages used by all human cultures. Each culture does not only invent its own language and how to use it, but also its own unique way of making things, of doing design and of using artifacts. In earlier times the design and subsequently the identity of a culture, of a community, was strongly linked to, if not strictly dependent on, the resources available in its territory and the technology for processing these into goods. Since the beginning of the industrial revolution, as local resources became more and more available globally, the condition of territory dependency for design style or identity of a community has changed. The condition of technology dependency has not. On one hand, the dying out of traditional ways of making things, the standardization of design and of individual identity, and the loss of national identity are very evident. On the other hand, the invention of technologies and their adoption by users form new communities, each with its own newly invented use of language and unique way of making things is also happening.

Therefore, in emphasizing the issue of universal emergencies of human experience, the term “*communities*” was used and supported further with the term “*traditional*”, linking the sentence to the existence of human communities separated by huge distances (like in Japan and in Italy) and vast time (like ancient Greece and Aztec nations). These communities came up with similar solutions to common problems, have identified affordances in the material elements

available for making things, and found various ways to contain and carry water as well as protect feet all over the world.

4 Word, a base structural lingual unit = design element, a base structural design unit.

5 For “*water*” and “*foot*”= that afford “*water containment*” and “*footwear*”. The guiding question in the transition of this section was not how words and design elements convey meaning, but what water and feet signify in terms of human experience. As sign systems, both language and design can communicate “*water*” and “*foot*”, but when people need to refer to water or feet they also refer to what they can do with them and how, that is, drinking water, or moving over the earth’s surface with their feet. The common problems of containing water and protecting the feet seem as universal as the need to refer to water and feet.

6 No language has a word a = no culture has a hand made element a. In order for this sentence’s design equivalent to hold true, in transitioning this sentence from language to the field of design this research identifies the need to limit the scope of creating designed artifacts in term of physical bodily limitations (as exist in the case of language and the physical creation – vocalization – of words). For that reason the involvement of co-creators, work-mates, and use of machines in the creation of designed artifacts are excluded from the activity of human creation referred to in this sentence. Again, the choice is to work towards identical meaning rather than identical wording. The term “*language*”, therefore, has been transitioned with “*culture*” rather than design.

7 The issue of syllables requires establishing a clear distinction between “*words*” as “*designed artifacts*” and “*words*” as “*design elements*”. A distinction that perhaps is not possible to achieve. A syllable is a word or part of a word that can be pronounced with one vocal impulse. In musical terms the syllable “*mi*” signifies the musical note “*Mi*”, as in Do, Re, Mi, etc. In the English language the syllable “*mi*” is a word - “*Me*”, or a part of a word as in - “*mi-cro-wave*”. But it seems

that syllables and words cannot be compared content wise with base design elements and the structural units composing them - (in most cases also) design elements.

Elements in design perform differently as well as combine differently than lingual syllables or words. The meaning of basic lingual units, like words and syllables, is understood in terms of an exact reference, while in the meaning of base design units - elements such as color and shape - is understood in associative terms. A design element such as a round shape, a circle for example, which in Latin languages refers exactly to the sound "O", could be associated with designed artifacts such as a wheel, or a ball, as well as with the affordances of rolling and playing. Yet it could also be a part of designed artifacts such as a bar stool, flag of Japan, or a silver coin - all are artifacts can be referred to with a short sentence.

Design elements such as color, form, texture, etc. could not be considered as "syllables" of larger design elements since they are already associated with a meaning that was constructed through years of human experiences and history. They can be referred to with a set of sounds, which can be represented by a set of visual letters. In the same way, any design element that is composed of many other structural elements can be also considered as a designed artifact.



Fig. 4.2: Football sports uniforms. (retrieved on July 29th 2014 from: <http://www.uksoccershop.com>)

In a designed artifact such as sports uniform, the design element of three parallel stripes performs as conveyor of meaning, signifying the value of "Adidas".

The design element of a logo, for example the Adidas logo, signifies or connotes an artifact

with several meanings associated with a brand (the first, of course that it is of that brand), Yet standing alone - on a white background for example - a logo is an artifact made of several graphic design elements like colors and forms. Each of these may already have its own cultural significance as mentioned above.



Fig. 4.3: Adidas logo (retrieved on July 29th 2014 from <http://famouslogos.net/>)

In comparison the syllable “di” which is an element of the word *adidas* signifies no other value within that word except its sound. The word “Adidas” itself originally signified the name Adolf (aka “adi”) Dassler and is composed from three syllables: “a” “di” and “das”.

In military terms, the syllable “di” signifies the word “Day” as in D-Day, D+1, D+2, etc. It is most likely that in lingual sign systems that are based on visual entities as iconographs (like Japanese, Chinese) “di” would have multiple meanings.

All this points to a situation where a syllable is not as flexible in its performance, or affordance and association to meanings, as much as a design element is. Also, this points to a situation where there are no “syllables” of design elements, only structural units which could be thought of as smaller and bigger design elements by themselves. These conclusions directed the research to transition “*no language has a word a million syllables long because no person would have the time to say it*”, into: “**no culture has hand made element a million distinct structural units large because no person would have the time to produce it**”.

At this point, this research recognizes the issue of language performance versus design performance and that conceptually there are conditions, and many, where this sentence above

does not hold true: a traditional straw roof, a house, a woven element, or elements containing beads are all artifacts which can be hand made, not from millions, but still from thousands of elements. When designing and perceiving complex artifacts the human mind will combine all the smaller elements and nest them (Gibson, 1986) within bigger ones, such as sections of roof, doors, windows, foundations, woven patterns and sequences of beading. The term “distinct” was added into this sentence in order to match the condition under which language performs, that is, syllables combine in sequence of performance into words which can be combined into bigger words or sentence. Thus, distancing the subject away from combinations of small elements into larger elements, sections or patterns.

Further on, unlike vocal symbols, which need to be produced quickly in order to maintain physical or psychological connection in acts of speech between participating parties, design elements can take the time to be produced - much more time than spoken artifacts - despite the higher speed in which they can be perceived and recognized. What it comes down to is perception and universal limitations on human information processing. While Perception hunts for comprehension and clarity (Gibson, 1986, p.219) it also operates with priority of speed and frequency. This could explain why human spatial awareness will detect fast moving dangers, but will fail to detect any danger moving too slow or too fast as evident in series of experiments conducted on *The Brain Game's What's going on?* TV episode broadcast (Davis, Hoben, Kolber and Nigro, 2014). This may also apply for language - lingual paroles that are spoken at extremely slow pace may be unnoticeable, those that are spoken at extremely high speed are incomprehensible. As much as human perception is limited by speed in language, it is limited by size in design (human sensory-motor coordination). Unaided, human perception will fail to notice designed artifacts that are too small to be noticeable or too vast in size to be comprehensible.

Limitation of human information processing seems to be a matter of complexity. Being so,

feasibility - or the lack of it, as suggested by Pinker - seems to be the reason why no language uses a million syllables large word. The existence of such words would be counterproductive in terms of forming the psychological link that is needed for participants in order to enter, maintain, and interact in conversation - where the speed of language production (of a statement or response) is of great importance. If such words have existed it is most likely that - seeing the tendency of humans to opt for shortcuts in language use - these have been shortened to a manageable size, one which enables clarity and comprehension, or clarity and purity of syntax.

The psychological connection that is formed during a lingual conversation is formed in the use of design usually with haptic or visual interaction. Acts of design used in interaction seem to be unrestricted by the speed of parole production compared to the way acts of language do in lingual conversation. Yet, a handmade design element (or an artifact comprising a million distinct structural units), which may take substantial time to produce by a single worker, is limited by human information processing and the amount of information humans can perceive. Above a certain amount of complexity the human brain will resort to nesting elements within more dominant and recognizable structural elements, or to building tree structures, as it searches for clarity and comprehension. For example, it is very unlikely that human user could utilize all of the keys in million keys keyboard or interface, or even be aware of what each and every key corresponds to. It is as unlikely that a human can design such an artifact without the aid of tools and other designers. This research suggests that the reason why no culture has such a parole entrenched within it is because the single human brain and its faculty of perception can not handle extreme amounts of elements without extreme effort.

In an attempt to shed light on the possible limitation of human information processing this research turns to the mathematical constant Pi (π), and to attempts of calculating its value by mathematicians like *Ludolph van Ceulen*. Van Ceulen spent most of life "*calculating the numerical*

value of the mathematical constant π , using essentially the same methods as those employed by Archimedes.... He published a 20-decimal value in his 1596 book "Van den Circke" (Ludolph_van_Ceulen, 2015). Another mathematician, William Shanks "famously took 15 years to calculate π to 707 digits, but made a mistake in the 528th digit, rendering all subsequent digits incorrect" (Pi: Memorizing digits, 2015). Today computer technology has calculated Pi up to trillions of digits, yet reciting even a section may take days, and memorizing its numbers may take years. Also, such acts are done by persons who - if cannot be called genius - can be called memory specialists. The average person, however, unaided by memory methods, will most likely remember only few digits (normally 3).

8 Language, the way in which sequences of vocal sounds can afford the coordination of meaning = a set of affordances for a design element. Again the choice here is to create an identical statement that is valid in the field of design, although this time the research will seek to show similarity between cultural process that happen both with language and design.

For that purpose the research considers the entrenching not of a complete language, but of meaning and its referents or signifiers within culture. Once a meaning has been identified it is more than likely that a lingual or design based signifier for it will be selected or invented. This will lead to its entrenchment within a culture as parents teach their children and children imitate their parents. This also means that once identified, or specified by the human brain, an affordance, or a set of affordances for a design element will follow the same route into culture. It should be kept in mind, however, since culture is always in motion, that designed artifacts, as well as lingual words and sentences are not as rooted in culture as much as affordances are. For example, these days the word "search" can be replaced with the word "google" in the same way that a horse powered carriage - affording mobility - have been replaced by cars.

9.

Original statement:

“The crux of the argument is that complex language is universal because children actually reinvent it, generation after generation – not because they are taught, not because they are generally smart, not because it is useful to them, but because the just can't help it.” (Pinker, 1994, p.20)

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Altered Statement:

The crux of the argument is that complex ¹design is universal because children actually reinvent it, generation after generation – not because they are taught, not because they are generally smart, not because it is useful to them, but because the just can't help it.

Researcher's notes:

1 Language = design. Pinker arguments for the development of complex universal language skills can also be used to motivate the development of complex design skills. Empirical evidence can be found in the babel of children as much as in their play with objects and situation as discussed earlier. Children's babel can be seen as an exercise simulation of real grownups speech in the same way that the children simulate real life objects and situations during their play with toys. Depending on the child's development, it is likely that he or she will move from exploring the affordances of body parts, whether they be the hands or mouth to exploring the ecology around him or her. This research notes that young children are not formally taught how to play, or how to

simulate real grown-ups situation. They are stimulated to and intrinsically motivated to do so either through internal bodily experiences, or through daily interaction with parents and family members. It is likely that attempts to stop such “babel” will affect the lingual as well as the physical development of the child.

10.

Original statement:

“The universal constraints on grammatical rules also shows that the basic form of language cannot be explained away as the inevitable outcome of a drive for usefulness.... the universal plan underlying languages with auxiliaries and inversion rules, nouns and verbs, subjects and objects, phrases and clauses, case and agreement and so on, seem to suggest a commonality in the brains of speakers, because many other plans would have been just as useful. It is as if isolated inventors miraculously came up with identical standards for typewriter keyboards, or Morse code or traffic signals.” (Pinker, 1994, pp. 31-32)

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Altered Statement:

The universal constraints on grammatical rules also shows that the basic form of ¹design cannot be explained away as the inevitable outcome of a drive for usefulness.... the universal plan underlying ²designs with ³auxiliary-functionalities and ⁴combinatorial rules, ⁵representations and ⁶affordances, ⁷users and ⁸contexts, ⁹entities and ¹⁰interfaces, ¹¹product diversification (or user specification) and ¹²coherence and so on, seem to suggest a commonality in the brains of ¹³designers, because many other plans would have been just as useful. It is as if isolated inventors miraculously came up with identical standards for typewriter keyboards, or Morse code or traffic signals.

Researcher’s notes:

1 Language = design. Although design and language use different building block and allow for different structures of interaction (as pointed to earlier in point 7 and 8) they most likely build on the same cognitive capacities that enable communication.

2 Languages = designs. The research understands these terms as used in the context of different cultures, where the term universal plan of language refers to a syntactic structure combined from different parts of speech.

3 Auxiliaries = auxiliary functionalities. In transitioning this and following terms relating to syntactic parts of speech, the research looks to find aspects, like rules and roles, mechanisms, and elements that are conceptually similar in their role and function in design to the role and function of the transitioned term in language.

Auxiliary, in language, is a verb that adds functional or grammatical layer of meaning to the clause in which it appears. For example, Auxiliary is used to express tense, aspect, modality, voice, emphasis, etc. Auxiliary verbs usually accompany a main verb. According to Pinker, auxiliaries are words *“that express layers of meaning having to do with the truth of a proposition as the speaker conceives it. These layers also include negation (as in won't and doesn't), necessity (must), and possibility (might and can)”* (Pinker, 1994, p. 110).

In design, auxiliary can be described as a supporting affordance and can be considered an extra element in the design of the artifact that facilitates the main affordance of the artifact in terms of experience, in order to add another layer of understanding to the artifact in use. For example, the primary affordance of a knife is to cut, but its supporting affordance is to be held comfortably by the hand. The designed shape or physical properties of a knife's handle could be used to add another layer of understanding how to use the knife, such as associations of how the knife should be treated or stored, the intensity with which to use it, specific intended material substance to use the knife on and so on. The finishing, or shape of the blade of the knife has can

also be considered as a supporting affordance - associating it with specific use and making it easier to cut certain specific substances more than others.

In identifying auxiliaries for a design of an artifact, one needs to ask what would the experience of use should feel like, refer to or be associated with, and how will it guide its user. In the case of the knife, the designer might ask: how would it feel to hold it? to cut with it? or how should the knife be held in order to optimize the performance of cutting a certain material.

In design, auxiliaries could be seen as Krippendorff concept of *semantic layers* (Krippendorff, 2006, pp. 129-132). Taking his example of a woman's purse, this research identifies the main affordance as a container of things. "*A woman's purse has a public layer for everyone to see, and a private layer for the owner's personal belongings*" (Krippendorff, 2006, p. 130). It is very likely that inner layer of meaning is the main affordance of the purse, while the outer layer - *a supporting affordance* - adds an aesthetic (auxiliary) functionality aimed at the public, an auxiliary that is taken to suggest what might, won't, or must be inside the purse.

4 Inversion rules = combinatorial rules. It is very unlikely that design has something like an inversion rule where two expressions, normally subject and verb or verb and auxiliary, switch their canonical order of appearance (that is, they invert) in order to form question, or change the sentence form first to third person. However designing comes with its own sets of combinatorial rules like aesthetic codes and ergonomics which guide the creation of the design artifact towards its association by the user with intended meanings, or a set of affordances.

5 Nouns = representation. Nouns are words that typically refer to, or denote, a person, a place, a thing, an event, a substance, a quality, a quantity, etc. "*A noun, for example, is simply a word that does nouny things*" (Pinker, 1994, p. 98). In design, elements that do "*nouny*" things are representation, these denote brands, places, things, qualities, substances, concepts, etc. The three parallel stripes on a sports uniforms, for example, are doing a "*nouny*" thing: they represent, or

denote the involvement of Adidas and link its quality as a brand to the artifact. Artifacts can also do “*nouny*” things. For example, a clock, whether working or not, represents time. An artifact may not afford sitting, but instead can represent the act of sitting. The Mine Kaffon discussed in Timo de Rijk's article “*This Mine Sweeper is Life Threatening*” (2013, p. 17), and subsequently in Louise Schouwenberg's “*Why Design Doesn't Need to Perform*” (2013, pp. 98-105), may or may not solve landmine problem in Afghanistan, still it represents (the hope for) its solution.

6 Verbs = affordances. Verb is a word that conveys an action, an occurrence, or a state of being. Again, rather than identifying an identical structural element in design, this research is seeking to identify a structural element in design that operates with the same role as verbs have in language. “*For a sentence to feel grammatical, the verb's demands must be satisfied.... Because verbs have the power to dictate how a sentence conveys who did what to whom, one cannot sort out the roles in a sentence without looking up the verb*” (Pinker, 1994, pp. 106-107). Affordances have the power to dictate to designers and users how an act of design conveys where to hold, where to sit, how to cut, or what to manipulate, one cannot understand what an artifact means without looking up its affordance. By looking up an affordance of a brand new designed artifact humans actually read the design of the artifact like a sentence and seek to correctly identify what an artifact is or what can it be used for.

7 Subject = User(s). Subject is “*one of the arguments of a verb, typically used for the agent or actor when the verb refers to an action*”(Pinker, 1994, p. 514). In other words, the subject tends to be the agent performing the action expressed by the verb. Looking to design and building on the similarity between the roles of verbs and affordances, this research identifies the user of the artifact as the agent of the affordance in the design of the artifact.

8 Objects = contexts. Object is the conceptual entity that is acted upon by the subject. In design object could be identified as the substance or medium (Gibson, 1986) of the manipulation

afforded, or alternatively the field in which affordance is taking place. One option is to define these as the intended substance of manipulation - the water that is contained in a cup, the hand that is covered by a glove, the part of surface land that is driven through by the car and so on. This research opts for “*contexts*” as a conceptual entity that is acted upon with the artifact - with a cup, users act upon water - the cup is to be used in the context of liquid, or other flowing medium, like grains of sand for example. Wearing gloves users can perform different tasks and act upon different material or environment - the glove, which has the primary affordance of covering or protecting the hand, is to be used in the context of cleaning, or gardening, or surgery. A car acts upon the context of road.

9 Phrases = entities. Phrase is the smallest “*group of words that behaves as a single unit in a sentence and which typically has some coherent meaning: in the dark; the man in the gray suit; dancing in the dark; afraid of the wolf*” (Pinker, 1994, p. 512). “*Phrases refer not just to single things or actions in the world but to a set of players that interact with each other in a particular way, each with specific role. For example, the sentence Sergei gave the documents to the spy is not just about any old act of giving. It choreographs three entities: Sergei (the giver), documents (the gift), and a spy (the recipient)*” (Pinker, 1994, p. 99).

In design, this research suggests the equivalent of lingual phrase to be group of elements that is combined together in the mind of the user to form something that has a real existence, is distinct in terms of character attribution, and is independent or self contained. To summarize, a phrase is a physical entity from which meaning can be constructed.

In language there are various phrase types: verb phrase; noun phrase; adjective phrase; etc. The same rule apply in design. In a designed artifact there are many groups of elements which form entities of meaning and denote a use, a representation, a qualitative character, and so on in the same way lingual phrases do. Easy examples are a single keyboard key which forms an

affordance entity and a logo which forms a *nouny* entity. Elements form into entities, and entities form into an artifacts. In a sentence entities are role players, which are often referred to as arguments - a term used in logic that defines a participant in a relationship. Entities may include connecting elements that allow for inter-artifact relationships (design equivalent of pre/post- or adpositions) with other entities, as well as the formation of larger and more complex designed artifacts.

It is important to note that alone, that is, freestanding, entities can be in many cases single artifacts that are limited in usability and meaning. The headphones of a CD walkman, batteries, or the keyboard key, are just like the phrases "*in the dark*" and the other lingual examples set above. Inter-artifact relationships will be discussed further in point 20.

10 Clauses = interfaces. A clause is "*a kind of a phrase that is generally the same as a sentence, except that some clauses can never occur on their own but inside a bigger sentence: THE CAT IS ON THE MAT; John arranged FOR MARY TO GO; The spy WHO LOVED ME disappeared; He said THAT SHE LEFT*" (Pinker, 1994, p. 505). It is the smallest grammatical unit that can express a complete proposition.

The transition of this term into design revolves around the making of a proposition and is based on the ability of an entity (group of elements) - within the act of design - to form an act of design with its own user and context, substance, or medium for manipulation. The concept of an interface seem to be fitting into this role. "*However, interfaces are everywhere, in the control room of atomic power plants, in the cockpit of cars, in the touch screen of palm pilots, even in the handling of ordinary tools, which can no longer be separated from their use but must be seen as enabling what humans do with them*" (Krippendorff, 2006, p.9). Interfaces seem to be the clauses of design: the handle that opens a door is like the "*who loved me*" in "*the spy WHO LOVED ME disappeared*"; the air-con button in the car's cockpit functions like the clause "*THE CAT SAT ON*

THE MAT".

11 Case = product diversification, modifications made to product to accommodate specific group of users. A case is *"A set of affixes, positions, or word forms that a language uses to distinguish the different roles of participants in some event or state. Cases typically correspond to the subject, object, and the objects of various kinds of propositions"* (Pinker, 1994, p. 505). The value of a case reflects the grammatical function performed by a noun or pronoun in a phrase, clause, or sentence.

In design, cases could be described as modification done to entities, interfaces, and complex acts of design in order to diversify the artifact community of users, or attract specific users. A product may undergo a process of diversification in order to include a more specific group of users, in its intended target group, or to exclude it. For examples, a school bag that comes in blue for boys and pink for girls, computer keyboards settings for different cultures, or the position of the steering wheel in cars that are sold in England, Japan and in mainland Europe.

12 Agreement = coherence. Agreement is a *"process in which a word in a sentence is altered depending on the property of some other word in the sentence, typically the verb being altered to match the number, person and gender of its object or subject"* (Pinker, 1994, p. 503).

In design, elements of a design artifact are usually altered in order for its meaning to be more coherent with its intended number of users, or type of context. The affordance of sitting is different when there is one user sitting or 6 users sitting. A designed artifact such as shirts are altered in order to fit a gender, in more ways than just affording to wrap a certain bust size. A female shirt would also, in most cases, feel and look feminine, a male shirt- masculine. A container of eggs, affording a user to transport eggs home from the supermarket varies in size according to the amount of eggs need to be carried. Here, it is not a matter of *"case"* which changes elements of the designed artifact according to the representation of certain users, it is a matter of altering

the product's affordance to fit the context of the design of the artifact - 6, 10, 12, or 20 eggs.

13 Speakers = designers. The speakers are those who produce the parole, first in thought and then in action - in vocal or written wording. In design, the person or parties producing the design - first in thought and then in action - regardless of whether they will physically produce it directly, or delegate its physical production to others - are the "*speakers*" producing the design parole, they decide what will be said, how it will be said and to whom.

Regarding isolated inventors miraculously coming up with identical standards for specific artifacts, history shows that humans, even when designing the same artifact, do not create or realize it in the same way. The electric telegraph, for example, was invented in 1837 independently on both sides of the Atlantic ocean by Morse (US) and Wheatstone (UK). Although speaking the same language, both inventors applied different mechanisms to facilitate communication with their devices. Language too, if designed to facilitate communication was realized in different ways, by different cultures. It is not clear what "*other plans*" Pinker refers to, but the commonality of syntactic structure he argues for seem to be also common to design and could be compared with common behavior that is specific to other animal species - as suggested earlier with spiders. One could argue further to suggest that humans behavior or culture - like elephant and dog behavior or culture - is universal, that is, all humans, stemming from their biology, behave the same way.

This research finds a case study that can support the statement above in the history of the dog species. Dogs seem to behave the same all over the world, regardless of continent and species. This suggests that a universal dog culture exists. This statement could be validated with the case of the *Native American Salish Wool Dog (now extinct)*: "*...the breakup of the native culture, caused the Salish Wool Dog to interbreed with other dogs and lose its unique identity. By 1858, the Salish Wool Dog was considered extinct as a distinct breed*" (Salish Wool Dog, 2015). Had Native American dog behavior/culture been different from European dog behavior/culture, interbreeding

with other European dogs would most likely have not been possible. Like suggested earlier in points 4 and 7, this behavior seem to be matter of biology rather than invention. How otherwise could the similarity - if not universality - of behavior between two types of dog species that developed independently from each other and on different locations of the world be explained? Again, *“it is as if isolated inventors miraculously came up with identical standards for typewriter keyboards, or Morse code or traffic signals”* (Pinker, 1994, p. 32).

Summary: Chatterboxes.

The universality of language and design seems to originate in the universal constraints of the human body and mind. The universal emergencies of human experience can be seen in the way human communities which were separated by huge distances and vast time came up with similar solutions to common problems. These communities identified similar affordances in different material elements (available locally) for making things and affording various ways to contain and carry water, as well as protect feet all over the world.

The universally common problems of containing water and protecting the feet, for example, are as universal as the problems of signalling or referring to water and feet. In both cases human communities found various vocal solutions, some similar in content, all similar in structure.

Language and design could be differentiated according to the base structural units used in the construction of parole and their physical properties. Syllables are not as flexible in their syntax performance or their affordance of meaning as much as structural units and elements of design are. While the combination of syllables creates words with direct and distinct reference, there are no "syllables" units of design or design elements. Structural units can be thought of as smaller and bigger design elements - each associated abstractly or symbolically with meaning in different ways by different users. Syllables and words cannot be compared in terms of functional content and reference with base design elements and the units composing them - smaller design elements.

Commonality between base structural units used in design and language can be found in the limitation of perception, of human information processing. Being so, feasibility, as suggested by Pinker, seems to be the reason why no language uses a million syllables large word, as well why no culture has a million element large design parole entrenched within it. The human brain and its faculty of perception can not handle the extreme amounts of elements without a substantial lifetime long dedication and effort.

In human communities once a meaning has been identified it is more than likely that a lingual or design based signifier for it will be selected or invented. This will lead to its entrenchment within culture as parents teach their children and children imitate their parents. This also means that once identified, or specified by the human brain, an affordance of a design element will follow the same route into culture. It should be kept in mind, however - since culture is always in motion - that designed artifacts, as well as lingual words and sentences, are not as rooted in culture as much as affordances are.

Pinker's arguments for the development of complex universal language skills innately in children can also be used to motivate the development of complex design skills. Empirical evidence can be found in the babel of children as well as in their play with objects and situations. Children's babel can be seen as an exercise simulating real grownups speech in the same way that the children simulate real life objects and situations during their play with toys. Children move from exploring the affordances of body parts to exploring the ecology around them with their body. They are not formally taught how to play, or how to simulate real grown-ups situation. Yet, they are stimulated to do so and intrinsically motivated to do so, either through internal bodily experiences, or through interaction with parents and family members. It is likely that attempts to stop such "babel" will affect the lingual as well as the physical development of the child.

This research identified a similarity between language and design in the syntactic roles of word structures in language use and element structures in design use:

Lingual *auxiliaries* can be seen in design as *supporting affordances*, an extra element that facilitates – in terms of user experience - the use of the primary affordance of artifact, or adds another semantic layer of meaning to the artifact in use (Krippendorff, 2006).

Although an exact role of *inversion rules* (combinatorial rules which guide the construction of sentence into its intended meaning) cannot be identified in the structures of design use, design

has its own set of *combinatorial rules* like aesthetic codes or ergonomics, which in turn guide the creation of the design artifact to convey an intended meaning.

Nouns can be seen in design use as *representations* constructed from design elements or artifacts, that denote or are associated with brands, places, qualities, concepts, etc.

Verbs can be seen in design use as *affordances*. Defining the roles within the structure of parole. Without it, the parole will most likely be void of meaning or misunderstood.

Lingual *subject*, the agent(s) performing the action expressed by the verb, can be seen in design as the agent, actor, or user that performs the affordance in the design of an artifact.

Lingual *objects* (entities acted upon by subject) can be seen in design as *contexts* - the substance, medium, field, or environment for manipulation in/upon which the user's action takes place.

Lingual *phrases* are identified in design use as *entities*. These are the smallest groups of elements that can be formed into something that has real existence, is distinct, independent or self contained, and from which meaning can be constructed.

Clauses in language use can be likened to *interfaces* in design use and identified as designed artifacts within designed artifacts. In other words, these are entities (group of elements) within the act of design that form an act of design with its own subject and context (of manipulation).

The role of *cases* in language use can be seen as *product diversification* in design, that is, lingual *cases* could be seen in design as modification done to entities, interfaces and complex acts of design in order to indicate, represent and eventually attract specific users and diversify the community of users of the designed product.

Agreement in language use can be seen in design use in the way affordances are made *coherent* throughout the designed artifact according to quantity or other properties of its user or

context (of manipulation). Elements of a design artifact are usually altered in order for its meaning to be more coherent. Unlike *cases*, in which elements of the designed artifact change according to the representation of certain user or target group, *agreement* means altering the product's affordance to *coherently* fit the "subject" or "object" of the "design sentence" in terms of quantity, gender, etc.

The idea that all languages have these syntactic roles in their structuring of parole implies a commonality in human species biology. This indicates in turn the fundamental differences between the phrases "*culture of humans*" and "*human culture*". While the first results from communities formed by the human species, the latter results from biology of the human species in much the same way as culture of animal species.

History shows that humans even when designing the same artifact do not create, or realize it the same way (electric telegraph, Morse vs Wheatstone). Language too, if designed to facilitate communication, was realized in different ways by different cultures. This commonality of structure seem to be also common to design and could be compared with common behavior specific to other animal specie. One could argue further to suggest that humans behavior, like elephant behavior and dog behavior (who share universal behavior patterns, even being hundreds of years and kilometer apart) is universal.

4.3 Mentalese

Abstract:

(11) Visual thinking uses not design ability but a mental graphics system, with operations that rotate, scan, zoom, pan, displace and even fill in patterns of contours. With it (12) users charitably fill in what the designer leaves unsaid.



Fig. 4.4: License plates (retrieved on December 25th 2014 from <http://www.schaftenaar.nl/>).

11.

Original Statement:

"...visual thinking uses not language but a mental graphics system, with operations that rotate, scan, zoom, pan, displace and even fill in patterns of contours." (Pinker, 1994, p. 63)

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Altered Statement:

Visual thinking does uses not ¹design but a mental graphics system, with operations that rotate, scan, zoom, pan, displace and even fill in patterns of contours.

Researcher's notes:

1 Language = design. This research finds here a strong link to Gibson (1986) statements on perception and Krippendorff (2006) statements on meaning in perception. Below, it investigates Pinker's concept of "*visual thinking*" which seems to describe humans' cognitive processing of visual information as well as its relation to visual perception.

This sentence appears at the end of a long section of text reviewing experiments made by psychologists Roger Shepard and Lynn Cooper. In these experiments, thousands of slides were flash before viewing volunteers, each slide showing a letter of the alphabet appearing upright, rotated, tilted, mirrored etc. The volunteers had to respond by pressing buttons to indicate what type of letter they see. One button for letter appearing normally, another button for letters appearing in mirror reflection, with their reaction times measured. The experimenters concluded with the estimation that letters mentally revolve in the mind at the speed of 56 rpm - possibly a

speed limitation on human visual information processing. Pinker concludes the section of text with this case subject's statement.

This research now revisits following statements for consideration:

“The visual system hunts for comprehension and clarity. It does not rests until the invariants are extracted. Exploring and optimizing seem to be the function of the system.” (Gibson, 1986, p.219)

“On the most basic level, meaning restores perceived difference between what is sensed and what seems to be happening” (Krippendorff, 2006, p. 52)

“Awareness that the drawing can be seen in either way [meaningless figure, head of a rabbit or of a duck], entails being cognizant of the difference between the figure and its two ways of seeing it, which leads one to recognize the drawing as a flip-figure with two meaning.... “Seeing something as...” entails the distinction between something sensed and how something is seen as, and introduces into perception a difference, not otherwise noticed, between sense and meaning” (Krippendorff, 2006, p. 53)

“Obviously, the right -side-up slide (0 degrees) is the quickest, because it matches the letter in memory exactly, but for the other orientations, some mental transformation to the upright is necessary first. Many subjects reported that they, like the famous sculptures and scientists, “mentally rotated” an image of the letter to the upright.”(Pinker, 1994, p. 63)

In accumulating these statements, it seems that the experiments described by Pinker shed light on how the mind sees *"something as"* after sensing that something in the *ecology*, as well as how and how fast perception *hunts for clarity* and comprehension. As a human cognitive ability, Pinker's *visual thinking* does not use the ability to language or to design. In effect, it is possible to suggest the complete opposite: language and design abilities build on *visual thinking* in order to recognize what artifacts mean. *Visual thinking* is deployed by the visual system of perception during interaction in order to explore and optimize the ambient light. In doing so perception extracts invariants, the essential information structure that remains consistent despite changes in the illumination and position of observer, as well as overlap in the viewing angle and other disturbance in structure of the environment.

This *visual thinking* seems to be strongly connected to (if not part of) the human cognitive processes of the perceptual system, which uses - based on experience available to the mind - structures and codes of sign systems, as well as artifacts from language and design, in order to hunt for and achieve clarity and comprehension, that is, in order to differentiate and identify the ambient light from the radiant light (Gibson, 1986), or the meaningful from the sensed (Krippendorff, 2006), as noted by Pinker and Gibson:

"To do the task, the subject had to compare the letter in the slide against some memory record of what the normal version of the letter looks like right side up."(Pinker, 1994, pp. 62-63)

"Object perception can only be based on form perception. First the silhouette is detected and then depth is added, presumably because of past experiences with cues of depth." (Gibson, 1986, p. 219)

This concept of *visual thinking* deployed in perception (as described through the convergence of statements above) can be clearly constructed once another process of perceptual system - "*auditory thinking*" - is brought into the picture:

"...assuming certain familiarity with accents and speech patterns, we tend to recognize the word 'cat' regardless of whether it's spoken by a Scots vet in a lecture, an angry Tasmanian breeder of rare mice, or a New York newsreader with a bad head cold. In order to do this we make an abstraction from what we actually hear. In effect, we decide that certain features of the sounds we are hearing (pitch, individual variation, etc.) are really incidental and can be ignored. What we are left with after all these apparent incidents have been stripped away is the signifier: the pure, abstract mental sound impression 'cat'..... The sign 'cat' doesn't signify because it invokes the image of this or that particular cat.... The sign 'cat' signifies because it invokes a general and quite abstract concept of 'catness'. In summary, the signifier is not the actual sounds heard, or the actual marks seen, but the mental impression of them. Neither is the signified the actual thing referred to, but the abstract concept of that thing." (Thwaites et al., 2002, pp. 34-35)

This research offers an account of how the visual system of perception works for the case studies of Pinker, Krippendorff, and Thwaites et al., of letters, of flip figures and of the written representation "cat". *Visual thinking* is deployed during interaction in order to identify which certain features of the drawings or written word that is seen (thickness of pen, pencil, or marker, individual handwriting variation, angle of rotation, etc.) are really incidental and can be ignored. What is left after all these apparent incidents have been stripped away is - like in case of the auditory system - a pure, abstract mental impression of an artifact category: an ideal type.

“The ideal type defines the center of its category. Boundaries around them are fuzzy, and recognition is a function of the typicality of an artifact.... The ideal type is a cognitive construction from which all incidental and irrelevant features are absent.... When people search for something, a tool, container, a bus stop, or a bank, they search the ideal type with the ideal type in mind and look for a close match, becoming aware of how it deviates, and arriving at a recognized category.”
(Krippendorff, 2006, pp. 92-93)

In conclusion, The above account open up the possibility that just like *visual thinking* there is also *audio thinking*, *haptic thinking*, or even some sort of *perceptual thinking* for exploring and optimizing smell and taste.

Further on, this research finds echo of Pinker’s concept of *mentalese* in Thwaites et al. concepts of *“pure abstract mental sound impression”* as well as in his description of how a *“general and quite abstract concept”* is being evoked by an external stimuli, or sensory data.

The possible existence of perceptual thinking dedicated to sensory in different modalities raises a few questions lying outside the scope of this research (which ventures only as far as to state them). These questions also correspond to the issue of speed synchronization between audio transmitted and perceived signals, as raise in point 8 - too slow or too fast transmission would be either unnoticeable or incomprehensible:

- Does the processing speed of audio thinking matches that of visual thinking (56 rpm)?
- Does the process that connects sensory data from both modalities (or others as well) with their mental meaning (i.e. the process of visual/audio thinking) takes place in the same location of the human brain, or;
- do visual thinking and audio thinking occur in different locations in the human brain?

A parallel auditory experiment to that of Shepard and Cooper could also shed more light on

how audio thinking and its attached mental sound system can rotate, scan, zoom, pan, displace and even fill in patterns of sound.

12.

Original statement:

"listeners must always charitably fill in what the speaker leaves unsaid." (Pinker, 1994, p. 73)

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Altered Statement:

¹Users must always charitably fill in what the ²designer leaves unsaid

Researcher's notes:

1 Listeners = users. Listener(s) in sensing an act of language, produced by a speaker, decode or construct the meaning which is signalled by the speaker in parole produced. User(s) in sensing an act of design, produced by a designer, decode or construct the meaning signalled by the designer in the parole produced.

In doing so, listeners and users use perception related systems of cognitive processes like the visual and audio thinking (as discussed in point 11) in order to hunt for clarity and comprehension - extracting, exploring, and optimizing information structures from the flow of sensory data.

2 Speakers = designers. Both are the agents producing the parole, whether it is an act of language or design.

Perception seem to rely on known structures of information in order to fill in missing details in perceived structures. It is not limited to the visual modality (as seen with theories and methods

such as pointillism, led screen technology, etc.), but also manifests, as Pinker observes with listeners, in audio modality, and with large likelihood in all sensory modalities in general. For that reason, Human perception seems to prioritize structure over detail - Humans visually recognize (and remember) that they have seen the structure of a license plate long before they recognize the numbers or letters it contains, or "*fill in the depth*" - according to Gibson - and commit the numbers to memory (does the reader remember any of the numbers of the license plates shown in fig. 4.4?).

The same is most likely true to sound structures like human speech, sound of waves crushing, instrumental melody, or bird songs. Empirically speaking, it is possible to perceive and recognize communication in Japanese, or distinguish between communications in Finnish, in Dutch and in German without needing to know what each of the words uttered mean. Humans recognize and identify these languages according to their structure of *pure abstract mental sound impression*.

This seems to indicate the existence of a perceptive mechanism responsible for nesting (Gibson, 1983). With it the brain combines smaller base elements - too many to perceive each in detail - into larger perceivable structures according to known information structures. This in turn implicates the involvement of grammar in perception and opens up the possibility of grammar being a perceptual cognitive process that operates with all 5 senses - in smelling and mixing fragrance, in tasting and cooking, in touching and sculpting, in hearing and speaking, and in reading and writing.

Grammar seems to be a process with which perception hunts for clarity and comprehension in order to extract, explore, and optimize information structures from the flow of sensory data. It is possible to consider that the cognitive ability to deploy grammar for language production and creation of artifacts evolved after its function in perception was developed.

Summary: Mentalese.

The concept of mentalese offers a strong link between the structure of language and the structure of thought (Dong). Instead of discussing the concept of mentalese this research explores the cognitive link between visual or auditory sensory input and a mental lexicon containing known structures of information (Pinker, 1994), or abstract mental sensory impressions (Thwaites et al., 2002). Sensory input is then compared to these entries during perception's search of clarity and comprehension (Gibson, 1986).

The mental processes and operations described by Pinker and Thwaites et al. shed light on how the mind sees or hears "*something as*" after sensing that something *is* (i.e. being, acknowledged, present, exists), as well as how and how fast perception hunts for clarity and comprehension by searching for a match in memory records of pure abstract structures. As a human cognitive ability, Pinker's visual thinking does not use the ability to language or to design. It seems that both written language and design build on visual thinking in order to recognize artifacts, while vocal language builds on audio thinking in recognizing spoken acts of language or sounds. Visual and audio thinking - including their graphics and auditory system operations with which input can be explored and optimized - seem to be strongly linked to human cognitive processes of perception.

Based on experiences available to the mind, known structures or codes of sign systems and artifacts from language and design are used by the perceptual system as it hunts for clarity and comprehension, differentiating and identifying the ambient light from the radiant light (Gibson, 1986), or the meaningful from the sensed (Krippendorff, 2006).

It is possible to suggest that the visual perceptual mechanisms used for understanding methods like pointillism or technology like LED screens, have either a similar mechanisms, or operate as well, in auditory perception and perhaps in all perceptual modalities in general. The

idea that brains of listener, viewers, and users fill in what is left unsaid or un-sensed in terms of detail (like picture/screen resolution) seem to indicate the existence of a perceptive mechanism for nesting (Gibson, 1986). With this mechanism the brain combines smaller structural units or elements which are sensed in the ecology - but are too many to perceive each in detail - into larger perceivable structures according to a mental dictionary containing known information structures and sets of possible relationships between them.

Finally, Human perception seems to prioritize structure over detail. These two last conclusions also seem implicates the involvement of grammar protocol in perception.

4.4 How Design Works.

Abstract:

(13) This is the essence of the design instinct: design conveys information. (14) Every English designer has undergone an identical act of root learning in childhood that links material elements to their meaning. For the price of standardized memorization, the members of a design community receive an enormous benefit: the ability to convey a concept from mind virtually instantaneously.

(15) Design makes infinite use of finite media. We know the difference between the forgettable chair and the newsworthy Café Costes chair because of the order in which legs, seat and backrest are arranged. We use a code to translate between orders of elements and combinations of thoughts. That code, or set of rules, is called generative grammar. (16) A grammar is an example of a “discrete combinatorial system”. A finite number of discrete elements (in this case forms, shapes colors, textures, etc.) are sampled, combined, and permuted to create larger structures (in this case, artifacts) with properties that are quite distinct from those of their elements. (17) In a discrete combinatorial system like Design, there could be an unlimited number of completely distinct combinations with an infinite range of properties. (18) The way design works then, is that each person's brain contains a lexicon of material elements and the concept they associated to (a mental lexicon) and a set of rules that combine the material elements to convey relationships among concepts (a mental grammar). (19) When people learn to design within a field or a culture, they are learning how to put elements in order, but not by recording which element follows each other element. They do it by recording which element category – representation, affordance, and so on – goes with which other category.

(20) We now need a mental dictionary that specifies which elements belong to which part of speech categories (representations, affordances, character traits, inter- artifactual relationships, and so on).

(21) But grouping elements into entities is also necessary to connect structured artifacts with their proper meanings, chunks of mentales. (22) A part of artifact, then, is not a kind of meaning; it is a kind of entity that obeys certain formal rules, like a chess piece or a poker chip. A representation, for example, is a simple element that represent things; it is the kind of element that becomes significant when related to context, can appear in an artifact countless times and so on. There is a connection between concepts and part of artifact categories, but it is a subtle and abstract one. When we construe an aspect of the world as something that can be identified and counted or measured and that can play a role in events, design often allows us to express that aspect as a representation, whether or not it is a physical object.... Similarly, when we construe some aspect of the world as an event or state involving several participants that affect one another, Design often allows us to express that aspect as an affordance.... Representations are often used for names and affordances for something being done, but because the human mind can construe a reality in a variety of ways, representations and affordances are not limited to those uses.

(23) There appears to be a common anatomy in all entities in all the world's types of design. (24) Here we have the first principles of building an entity out of the meaning of the elements inside the entity. What the entire entity is "about" is what its head element is about. (25) Within an entity, then, the affordance is a little despot, dictating which of the slots made available by the supe-rules is to be filled. These demands are stored in the affordance's entry in the mental dictionary. For an artifact to feel meaningful, the 2affordance's demands must be satisfied. Because affordances have the power to dictate how an artifact conveys who can do

what to whom, one cannot sort out the entities in an artifact without looking up the affordance.

(26) An artifact, then, must express some kind of meaning that does not clearly reside in its representation and affordance entities but that embraces the entire combination and turn it into a proposition of use, that can be true or false.

(27) Design grammar is a protocol that has to interconnect the eye, the hand, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own.

13.

Original statement:

“This is the essence of the language instinct: language conveys news.” (Pinker, 1994, p. 74)

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Altered Statement:

This is the essence of the ¹design instinct: ¹design conveys ²information.

Researcher’s notes:

1 language = design.

2 News = information. Conveying news is essentially conveying information, *“the stream of words called “sentences” are not just memory prods,... they tell you who in fact did what to whom”* (Pinker, 1994, p. 74).

Conveying information is essentially what happen when users *“read”* the design of artifact: *“Just as the meaning of a text emerges in the process of reading, the meaning of an artifact emerges when interfacing with it”* (Krippendorff, 2006, p. 56).

The information conveyed with design artifacts does not tell who did what to whom in specific, but conveys an affordances to do or to know: *“artifacts mean their affordances, the set of their imaginable uses”* (Krippendorff, 2006, p. 53). This seems to be in line with the general direction of this research, which sees design practice aimed not at solving problems, but at communicating solution through conveying the information and subsequently identifying an intended meaning from designed artifacts.

Another way of looking into this transition is looking at news as “*narrative*”, a lingual artifact, much like “*scientific theories*” and “*designer’s narratives*” (Krippendorff, 2006, p. 30). Building from the previous quote this research identifies a structural connection between design and language, since its possible to look at text as lingual artifacts meaning their affordances - the set of their imaginable information do or to know, that is, a set of imaginable propositions, representations and references. Language seem to convey meaning by structuring lingual artifacts, while design does the same with a material or designed artifacts.

14.

Original statement:

"...every English speaker has undergone an identical act of root learning in childhood that links the sound to the meaning. For the price of standardized memorization, the members of the a language community receive an enormous benefit: the ability to convey a concept from mind virtually instantaneously." (Pinker, 1994, p. 75)

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Altered Statement:

Every English ¹designer has undergone an identical act of root learning in childhood that links ²material elements to their meaning. For the price of standardized memorization, the members of the a ³design community receive an enormous benefit: the ability to convey a concept from mind virtually instantaneously.

Researcher's notes:

1 Speaker = designer.

2 Sounds = material elements. Here Pinker speaks of the meaning linked to structural units of the modality of sound and sound sequences. In design, which manifest in the physical-visual modality, these base units can be defined as material elements, forms, shapes textures, colors, etc. as well as their arrangements.

3 language = design. In design it is more than likely that root learning depends on interaction with artifacts and starts at early age as infants practice perceiving and exploring the affordances of

their body while interacting with their environment (as explored in points 2 and 6). This learned meaning of things, embodied in its beholder (as argued by Krippendorff), cannot be shared with other members of the community. Instead, it is continuously re-constructed, produced, exchanged, and circulated within a community through its ensemble of social practices (Thwaites et al., 2002).

In language, root learning depends on interaction with other language speakers. Still, meanings of words are constructed individually and therefore cannot be identical from one community member to another. Instead, an overlap in concept seems to exist. Through the use of language community members re-work what words mean to them and to others. Communication between community members may enable the sharing of knowledge, like facts and figures but not the sharing of meaning. What communication may achieve is *“a conceptual coordination, a consensual demonstration, and the conversational affirmation of the sense of being understood”* (Krippendorff, 2006, p. 56).

Finally, with this statement, the research considers that through the going of an identical, or similar, act of root learning every member of a community (be it the community of the English people, or of the Portuguese) develops an association of meaning to specific materials, artifacts, animals, trees, mountains, buildings and so on, from a cultural point of view. For the price of a standardized memory record, every Portuguese man and woman receives an enormous benefit: the ability to convey information from the mind virtually instantaneously, whether by using words, or artifacts like clay roosters, carnation flowers, or materials like cork.

15.

Original statement:

"...language makes infinite use of finite media. We know the difference between the forgettable Dog bites man and the news worthy Man bites dog because of the order in which dog, man and bites appear. We use a code to translate between orders of words and combinations of thought. That code, or set of rules, is called generative grammar." (Pinker, 1994, p. 75)

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Altered Statement:

¹Design makes infinite use of finite media. We know the difference between the forgettable ²chair and the news worthy ³Café Costes chair because of the order in which ⁴legs, seat and backrest are ⁵arranged. We use a code to translate between orders of ⁶elements and combinations of thought. That code, or set of rules, is called generative grammar.

Researcher's notes:

1 language =design.

2 Dog bites man = chair. "*Dog bites man*" is an act of language, a lingual artifact, a sentence, replaced here with an act of design, a material artifact, a design statement - a Chair.

3 Man bites dog = Café Costes chair. A news worthy act of language transitioned to a news worthy act of design. That is, isolated from conditions of causality and actuality, at some point of its history, the Café Costes chair has been newsworthy.

4 Dog, man and bites = legs, seat and backrest. Here structural units in language have been

replaced with structural units in design.

5 Appears = arranged. Keeping to man made artifacts, something always appear to someone, and someone always arranges something, this arrangement is the defining force behind seeing a stone as a stone or as a tool. These lingual structural units did not appear as the sentences "*man bite dog*" or "*dog bite men*", free from human intervention, that is, without being arranged in the specific word orders that form the sentences and subsequently their meaning. The same is suggested here about the designed artifact. This Human intervention and thinking which arranges all man made artifacts - whether these are arrangements made of sounds or materials - seem to follow a code or a set of rules, discrete in each human and universal to them all. This in turn, points towards the presence of a Universal Grammar at work both in language and design.

6 Words =elements. These are the structural base units used respectively in language and design.

16.

Original statement:

“A grammar is an example of a “discrete combinatorial system”. A finite number of discrete elements (in this case words) are sampled, combined, and permuted to create larger structures (in this case, sentences) with properties that are quite distinct from those of their elements.” (Pinker, 1994, p. 75)

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Altered Statement:

A grammar is an example of a “discrete combinatorial system”. A finite number of discrete elements (in this case ¹forms, shapes colors, textures, etc.) are sampled, combined, and permuted to create larger structures (in this case, ²artifacts) with properties that are quite distinct from those of their elements.

Researcher’s notes:

1 Words = forms, shapes, colors, textures, etc. structural lingual units are replaced with structural design units. Depending on the modalities of the designed artifact other elements could be suggested.

2 Sentence = artifact. Lingual grammar is based on a combinatorial system, yet combinations both in language and design are not limited to word-sentence or element-artifact hierarchy. Depending on a macro or micro perspective, words and elements may permute into larger words and elements, or into sentences and artifacts - which themselves can serve as elements in the

formation of larger sentences and artifacts.

A combinatorial system, although essential to the sequencing of vocal sounds into elements such as words, does not seem to be the only system of structuring used in designing. This will be discussed further in the point 17.

17.

Original statement:

“In a discrete combinatorial system like language, there could be an unlimited number of completely distinct combinations with an infinite range of properties.” (Pinker, 1994, p.76)

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Altered statement:

In a discrete combinatorial system like ¹Design, there could be an unlimited number of completely distinct combinations with an infinite range of properties.

Researcher’s notes:

1 language = design.

Design can be treated as a discrete combinatorial system. However if treated as such, the designing of color, paint, materials and other base design elements is left out and excluded from the activity of designing. At the same time, choosing to define design a strictly combinatorial system can help distinguish design from other creative activities such as painting and cooking, which are predominantly blending systems.

“Most of the complicated systems we see in the world in contrast, are the blending systems, like geology, paint mixing, cooking, sound, light and weather. In a blending system the properties of the combination lie in between the properties of it elements, and the properties of the elements are lost in the average or mixture.” (Pinker, 1994, p. 76)

Yet, when this research places communication and the explicit intent of conveying meaning as two critical conditions for design activity, cooking and painting cannot be so easily discarded. With the first the designer produces taste structure, with the latter light structure, both structures can be used to convey an intended meaning.

It is more likely that unlike language based sign systems, which uses strictly combinatorial system in its production of parole, design based sign systems use both combinatorial and blending system in producing design parole. Perhaps this is the reason why designing is involved in a large range of cultural and physical activities, and although language may seem as involved, some of these activities cannot always be described verbally or in writing.

18.

Original statement:

“The way language works, then, is that each person's brain contains a lexicon of words and the concept they stand for (a mental lexicon) and a set of rules that combine the words to convey relationships among concepts (a mental grammar).” (Pinker, 1994, p. 76)

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Altered statement:

The way ¹design works, then, is that each person's brain contains a lexicon of ²material elements and the concept they ³associate with (a mental lexicon) and a set of rules that combine the ²material elements to convey relationships among concepts (a mental grammar).

Researcher's notes:

1 Language = design.

2 Words = material elements. Words, structural lingual units are the equivalent of material elements the structural design units.

3 Stand for = associated with. In order to construct meaning base lingual units are understood as stand-ins for concepts rather than as associations to a meanings, while base design are understood as association to meanings rather than as standing-in for a concept. This will be discussed in depth in the next investigation of the thesis.

Since the basis for the statements used in this analysis is lingual structure, known as grammar, this research focuses on identifying a similar structure for design with the addition that

rules need to be based on contextuality and to be rooted in the framing of the situation or goals of the intended design. Hence is the need for explicit intent to convey meaning. Similarly, as in the creation of lingual parole, in design - depending on situation and goals, as well as on detail of elements required for the designed work - material elements are either blended or combined into the intended parole.

19.

Original statement:

“When people learn a language, they are learning how to put words in order, but not by recording which word follows each other word. They do it by recording which word category – noun, verb, and so on – follows which other category.” (Pinker, 1994, p. 85)

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Altered statement:

When people learn ¹to design within a field or a culture, they are learning how to put ²elements in order, but not by recording which ²element follows each other ²element. They do it by recording which element category – ³representation, ⁴affordance, and so on – ⁵combines with which other category.

Researcher’s notes:

1 Learn a language = learn to design within a field or culture. Learning a language, is taken for learning to communicate with a language within a specific culture like English culture, or cultural context like the language used in court or by doctors. In the same way, people learn to design within a specific culture or cultural context like Italian design, the design of ceramics and pottery or designing web applications. Words can be seen as tools with which one can learn to communicate with others in a certain situation, as do material elements, designed artifacts and interfaces.

2 Words = elements. Again base lingual unit equals base design units. Like in language, each field has its own particular elements: *“In language the base materials are words. In design, the*

base materials might be bits and bites as with digital media, doors, walls, windows for architecture, and wood, steel and plastic for industrial design” (Dong, 2009, p.55). These elements may be composed from smaller elements but not necessarily in the way syllables compose words, as discussed in points 8 and 17.

Identifying and selecting what qualifies as base units in design is done in greater flexibility than in language. These units can be identified in the micro scale of making things (like yarns for weaving textile) as well as the macro scale of making things (like pockets as elements in a suit). This flexibility in scale seems to fit a way of communication that uses an associative system of units and structures in order to convey meaning. If something is not understood it cannot be explained until a certain piece of information or experience becomes available. Words and syllables as structural units are strict and fit communication based on a sign system of clear and exact referents, if something is not understood it could be explained and referred to with other words.

3 Nouns = representations.

4 Verbs = affordances.

5 Follows = combines with. Language as a system for communication uses a convention of predetermined timing sequences in order to convey meaning. In Language, words in artifacts are combined in chronological order when produced and when perceived. Understanding the chronological sequence of the words defines how meaning is coded and decoded. Written lingual artifacts are produced in a linear arrangements, which represents the timing sequence of the words. They must be perceived left to right, up to down or vice versa in order for their meaning to be constructed as intended.

Design as a system for communication uses no convention of predetermined sequence. In design, elements in artifacts combine together with other elements, sometimes under each other, sometimes next to each other, in a seemingly logical but free order and possibly in a way allowing

a reasonable sensory-motor coordination. Their meaning can be constructed at an instant, or over a period of time depending on the manner/method in which they are perceived and reflected upon.

20.

Original statement:

“We now need a mental dictionary that specifies which words belong to which part of speech categories (noun, verb, adjectives, prepositions, determiner).” (Pinker, 1994, p. 91)

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Altered statement:

We now need a mental dictionary that specifies which ¹elements belong to which part of speech categories (²representations, ³affordances, ⁴character traits, ⁵inter-artifactual relationships ⁶)

Researcher’s notes:

Here it is evident that nouns and verbs are not words but parts of speech. This implies that representation and affordances are not physically linked to specific base units but parts of the speech that is the designed artifact. These parts of speech consist of various material elements and combine in various ways according to various codes (depending on culture, knowledge available, field of design, etc.).

1 Words = Elements.

2 Nouns = representations.

3 Verbs = affordances.

4 Adjectives = character traits. Adjectives are words that typically refer to a physical property or state of being, like “the FAT cat” or in “he looks SATISFIED”. They are words used for general

description of things, rather than for fine detail. In design adjectives are seen in the emotional effects and key traits of artifacts and elements: impressions, poetic associations and qualities that can not be quantitatively measured, but instead are perceived as qualitative perceptual or experiential properties and states of being that are associated to the artifacts.

“The character of an artifact consists of all adjectival constructions that a community of stakeholders in that artifact deems suitable to that artifact... a character is composed of a set or system of character traits, which are considered appropriate and fitting for whatever reason and can be studied as such a system.” (Krippendorff, 2006, p. 157)



Fig. 4.5: Google image search Philippe+starck+lemon+squeezer, a section (retrieved on August 12th, 2014, from <http://google.nl/>).

Like in language, paroles in design can be rich and filled with adjectives. But, while adjective words tend to be exact with limited flexibility of meaning (through lingual context),

character traits of designed artifacts may be adjusted or even replaced through context and may mean different things to different people. *“In different contexts, different character traits may become relevant. When an artifact is reconfigured or breaks down, character traits may be unevenly affected.”* (Krippendorff, 2006, p. 157)

An example of how character traits manifest is Philippe Starck’s Juicy salif (always a good example). A quick image search for the terms “Philippe+starck+lemon +squeezer” reveals how flexible character traits in designed artifacts can become in different contexts: boyish, spacey, futuristic, alien, elegant, delicate, beautiful, and the list is potentially endless. Further down the search two images that illustrate how character traits differ from affordances were also found. Although affording the function of squeezing juice out of lemon, it very unlikely that the juicy salif could be described as functional:

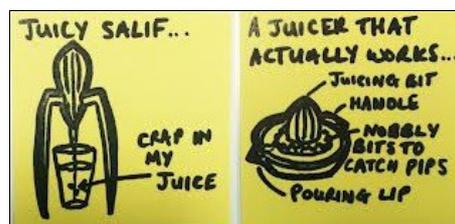


Fig. 4.6: Google image search Philippe+starck+lemon+squeezer, a section (retrieved on August 12th, 2014, from <http://google.nl/>).

With the use of character traits, this research build upon Krippendorff’s concept which tightly links character traits to language use.

“The idea that objects have properties is neither natural, cultural free, nor universal. They are the result of linguistic attribution. Attributes are acts performed in language, and they reflect the perceptual, emotional, or experiential coordinations (linguistic habits or conventions) in a particular community.... Language clarifies, distinguishes, qualifies, and regulates experiences with objects.” (Krippendorff, 2006, p. 155)

This research considers the approaches of constructivism and structuralism in design. The first seems to be at work in perception of parole, while the latter in production of parole. Constructivism does not seem to be able to explain the creation of something where nothing existed before - for example, the creation made by science fiction or fantasy. This research suggests that there are two modes for language: constructive as argued by Krippendorff in the paragraph above, and structural as argued by Dong in *The Language of Design* (2009) with his citing of Lacan, Alexander et al., and Butler:

"It is the world of words that creates the world of things." (Lacan, 1977, p. 65)

"[A pattern language] says that when you build a thing you cannot merely build that thing, but must also repair the world around it, and within it, so that the larger world at that one place becomes more coherent, and more whole; and the thing which you make takes its place in the web of nature, as you make it" (Alexander et al., 1977, p. xiii)

"If a performative action provisionally succeeds - then it is not because an intention successfully governs the action of speech, but only because that action echoes prior actions, and accumulates the force of authority through the repetition or citation of a prior and authoritative set of practices." (Butler, 1997, p. 51)

Designers structure acts of design as acts of communications with an intended meaning which users construct through interaction. In doing so, based on their own empirical experience, designers structure elements in order to convey character traits that correspond to an adjective or

adjective pair with which a community of users can attribute a quality to elements, or can describe a feeling invoked by these elements. However, as result of different contexts and and the different personal experience embodied in each user, many times a gap exists between the character trait or adjective intended by the designer and the one perceived by the user. Both in language and design the meaning gap of an adjective and character trait needs to be bridged or coordinated - it is never the same between two persons. Due to the associative nature of meaning in design, it is likely that gaps in the meaning of character traits in design are bigger than the gaps in the meaning of adjective in language.

Designers who are primarily concerned with what the users of their designs see, touch, feel, come to believe, talk about and so on, work to close that gap in meaning. Krippendorff (2009) names several human-centered design methods that can accomplish that aim. The (re)designing characters of artifacts pioneered by R. Butter, and the Kansei engineering method pioneered by M. Nagamachi are most prominent among these methods.

5 Prepositions = inter- artifactual relationships. Prepositions, or ad-positions are *“words that typically refer to spatial or temporal relationship: in, on, at, near, by, for, under, before, after”* (Pinker 1994, p. 512). In design cables, sockets, input/output elements, modem communicator, physical connectors and connective elements and such are parts of a design parole that typically mean temporal or spatial relationship with other parts of a designed parole.

A CD Walkman affords listening to sound and music, yet without the connection to artifacts (or entities) like CD disk, batteries, and headphones this affordance can not become a real possibility. All the entities of this design parole form a spatial and temporal relationship with each other through *“ad-positional”* or connecting elements. This relationship conditions the usability of main affordance or intended use of a CD Walkman.

Inter- artifactual relationships afford connections between artifacts, which in turn increase

the number of imaginable meanings, senses, and possibilities of use - the number of actual affordances possible to the user. Much in the way that base design elements combine to create larger and more complex elements, designed entities are able to combine into complex entities with elements allowing for inter- artifactual relationship. Inter- artifactual relationships take place in many acts of design with out limitation to technology or size.

6 Determiners, words like a, the, some, more, much, many and so on, are a part of the minor category of words indicating context called articles. These could be thought as cognitive constructions of contextuality. Empirical evidence suggests that no such, or similar, role player exist in design. Entities in a designed artifact can represent concepts like determinators, yet these would be only representations - void of any determinative or similar role to that of determiners in language.

In language these constructs may indicate context. These determine whether the noun is referring to a definite or indefinite element of a class, to a closer or more distant element, to an element belonging to a specified person or thing, to a particular number or quantity, and so on.

In design, entities and large elements are always combined from smaller simpler elements and large and complex artifacts are built from smaller simpler artifacts and entities. There is no part in the parole of design that indicates class, category, distance, ownership, and quantity, beyond what is already there in the actual context of the situation casually perceived.

These type of constructs are needed in language because language is used to structure and construct reality as well as to represent its contextual situations. Design is the physical reality; the reality that exist with objects nested (Gibson, 1986) within larger objects, environments within larger environments comprising an ambient array from which concepts like quantity, distance, class, category and level of importance are constructed in the mind. These constructed concepts are first constructed according to the perception of the situation and the context at hand, as well

as individual experience, and only afterwards are expressed by words such as “few”, “many”, “a” and “the” and so on.

Pinker notes this with his concept of *Mentalese* - a language, or structure of thought, which *“must be simpler than spoken languages; conversation- specific words and constructions (like a and the) are absent, and information about pronouncing words or even ordering them is unnecessary.”* (Pinker, 1994, p. 73).

In perception and interaction, the differences between concepts like “few” and “many”, or “a box” and “the box” are similar to differences between opposing adjectives like “heavy” and “light”. With this observation this research builds on Krippendorff’s explanation of experiencing something as heavy: *“Heaviness makes sense only in relation to what is not heavy. The difference is experienced in lifting one thing as opposed to something else. By contrast, the weight of an object, say in kilograms or pounds, ignores references to human experiences.”* (Krippendorff, 2006, p. 156)

21.

Original statement:

“But grouping words into phrases is also necessary to connect grammatical sentences with their proper meanings, chunks of mentalese.” (Pinker, 1994, p. 93)

=

Altered statement:

But grouping ¹elements into ²entities is also necessary to connect ³structured artifacts with their proper meanings, chunks of mentalese.

Researcher’s notes:

1 Words = elements. Base unit of language equals those of design.

2 Phrases = entities. Both are distinct independent or self contained units of meaning. The first in language, the latter in design.

3 Grammatical sentences = structured artifacts. Grammatical sentences - meaning here grammatical lingual sentences. The equivalents for these acts of language are acts of design, “grammatical design sentences”, or - since grammar can be considered as a meaningful structure and lingual sentences can be considered as artifacts - structured (designed) artifact.

This sentence is situated in a section of text discussing “phrase structure grammar” and explaining how the human mind - using a set of rules and a mental lexicon - creates a superstructure of modular phrases with which the meaning of sentences can be constructed.

Phrases are nested in sentences which are then nested in bigger sentences as acts of lingual parole

grow in complexity.

This explanation suggests that grouping of words into phrases is key process in constructing the meaning linked to phrases - intended and unintended "*chunks of mentalese*" - which in turn leads to constructing the meaning of the entire sentence.

Based on the discussion in point 10, 11, and 12, this research suggests that in constructing the meaning of designed artifacts a similar process in which the human mind forms material-visual elements into entities and links these entities to their set of possible meanings ("*chunks of mentalese*"). Most common of all the entities constructed by the human mind is the "face".

In "*Why do we see faces in everyday objects?*" (Robson, 2014) journalist David Robson explains a psychological phenomena known as *pareidolia* in which vague and random audio or visual stimulus is perceived as significant. Most common manner in which *pareidolia* manifests can be seen in the way the brain constructs illusions of faces in everyday things.

The article features a hypothesis made by Kang Lee (Lee et al., 2014, pp. 60-77) arguing that a top down cognitive process - responsible for making sense of visual stimulation recorded by the retina - leads to *pareidolia*. Lee suggests that the brain makes sense of visual or auditory stimulus by making predictions about what will be seen - based on past experience available - and then subtly projecting those expectations onto what is seen.

Testing his hypothesis Lee scanned the brains of volunteers as they look at images of gray "static". These scans seemed to confirm Lee's hypothesis:

"high activity in the primary visual cortex as people started to pick apart the various aspects of an image, such as its color or contour.... the frontal and occipital regions fire into action when the volunteers thought they saw a face, and these areas are thought to deal with higher-level thinking – such as planning, and memory.... this burst of activity may reflect the influence of

expectation and experience, as predicted by Lee's "top-down processing" theory. That, in turn, seems to have triggered a region called the right fusiform face area – the part of the brain that responds to actual faces" (Robson, 2014).

This description seem to describe how the brain groups elements into entities in the primary visual cortex and proceeds to compare them against some memory record. It then predicts the potential proper *"chunk of mentales"* and projects this expectation – thus linking it - to what is seen. This explanation compliments Krippendorff's concept of meaning according to which, on a basic level, *"Meaning restores perceived differences between what is sensed and what seems to be happening"* (Krippendorff, 2006, p. 52). Lee's hypothesis also points to the brain predicting a meaning based on empirical experience available rather than on the intention of the speaker or designer. If the constructed meaning is exact as intended by the speaker or designer, it may be so because they properly aligned the arrangement of the information structure. The artifact is perceived in terms of color, pattern, texture, and configuration, according to a key piece of information which is shared both by the designer and the user and with which their brains can properly distinguish the information structure, the ambient light, from the stimulus flux of radiant light (Gibson, 1986).

This discussion links with point 11, which previously discussed the subject of a mental graphic system rotating, scanning, zooming, panning, displacing and filling in contours. To that, it is now possible to add the function of grouping visual elements, as well as to indicate the position of this perceptual visual system in the brain.

Further on, this cognitive process described by Lee et al. sheds light on how users and listeners fill in what speakers and designers leave unsaid. On one hand, the perceptual system deploys a bottom-up process, with mental operations that can explore and optimized sensed

information structures - extracting any invariant structures of information and compensating for any disturbances in the process. On the other hand, it deploys a top-down processes projecting an expected possible match between an available memory record and the sensed structure (or what is actually sensed), be it a meaningless doodle, a drawing of a duck, or a head of a rabbit as in Krippendorff exemplifies with flip figures (2009, p. 53).

Finally, this research proposes to make a complementary experiment in language. This time scanning brains of participants as they look at images of lingual “gray static” - a search “word phrase” puzzle - containing hidden phrases. Will these scans show the same brain activity as seen in Lee’s research?

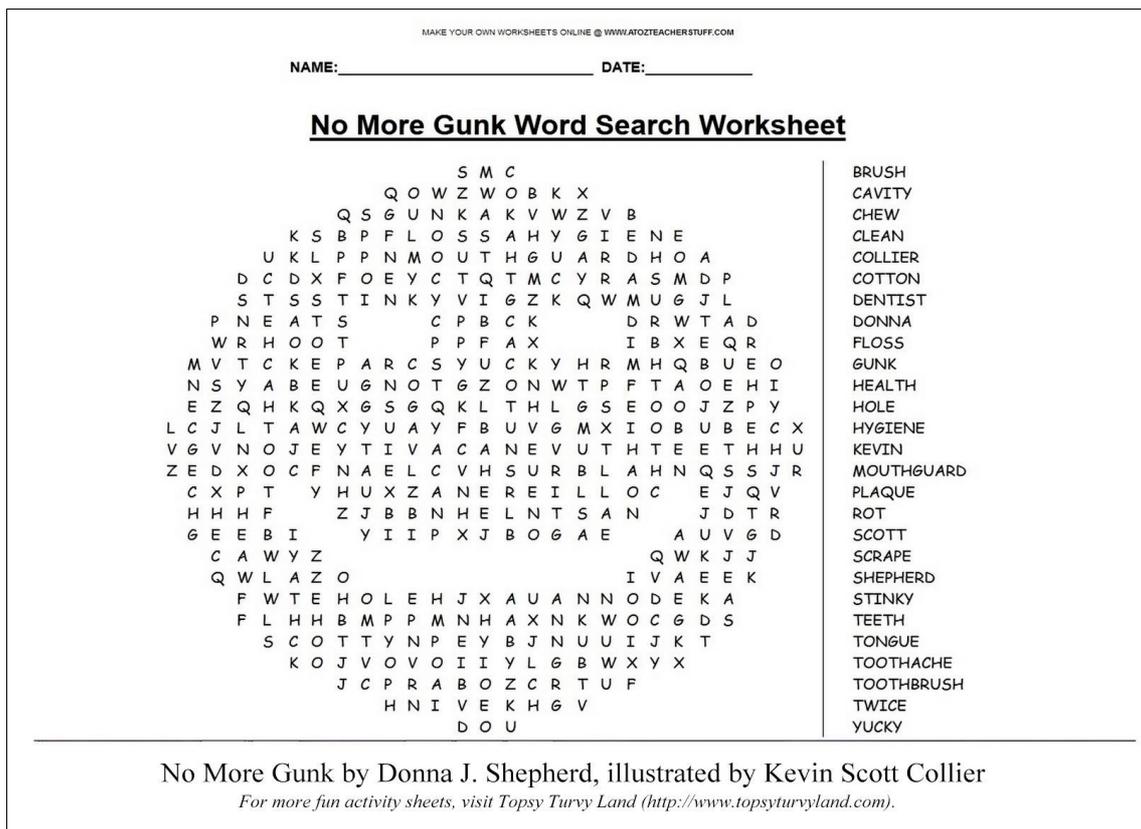


Fig. 4.7: “No More GUNK” search word puzzle by Donna J. shepherd (retrieved on November 11th, 2014, from <http://www.topsyturvyland.com/>)

A similar experiment to that suggested above has been conducted by Joao Correia and a team of researchers from Maastricht University (Correia et al. 2014). They investigated the neural

network of audio stimuli processing responsible for transforming sound to meaning, by exploring the semantic similarities between bilingual word pairs, such as “horse” (English) and “paard” (Dutch) and “duck” (E.) and “eend” (D.). Dutch-English speaking participants listened to four different nouns (all animals), either spoken in Dutch or in English as their brains were scanned for neural activity. These scans showed an identical pattern of activity in a left anterior temporal area – an area in the brain thought to be responsible for semantic/concept decoding - regardless of whether a vocal representation of a concept was heard in either English or Dutch. This suggests that the brain activity patterns pointed to the coordinates where the meaning of the sensed words were located in the brain, i.e., the *“chunk of mentalesé”*, the concept of a “horse” or a “duck”, of “horsness” or “duckness”, or perhaps even their ideal types.

This experiment was conducted with vocal stimulus. Yet, being limited to that modality, when combined with the finding of Lee, it sheds light on fundamental cognitive differences between language and design in the perception of parole. Meanings associated with designed artifacts seem to be located in another area of the brain than meaning associated with a lingual representation of that artifact. For example, perceiving the phrases “the face of Jesus” and actually seeing the face of Jesus in a toast will most likely show different brain pattern activity in fMRI brain scans.

22.

Original statement:

“A part of speech, then, is not a kind of meaning; it is a kind of token that obeys certain formal rules, like a chess piece or a poker chip. A noun, for example, is a simple word that does nouny things; it is the kind of word that comes after an article, can have an -s stuck onto it and so on. There is a connection between concepts and part of speech categories, but it is a subtle and abstract one. When we construe an aspect of the world as something that can be identified and counted or measured and that can play a role in events, language often allows us to express that aspect as a noun, whether or not it is a physical object.... Similarly, when we construe some aspect of the world as an event or state involving several participants that affect one another, language often allows us to express that aspect as a verb.... Nouns are often used for names and verbs for something being done... but are not limited to those uses.” (Pinker, 1994, p. 98)

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Altered statement:

A part of ¹artifact, then, is not a kind of meaning; it is a kind of ²entity that obeys certain formal rules, like a chess piece or a poker chip. A ³representation, for example, is a simple ⁵element that ⁴represent things; it is the kind of ⁵element that becomes significant when related to ⁶context, can appear in an artifact ⁷countless times and so on. There is a connection between concepts and part of ⁸artifact categories, but it is subtle and abstract one. When we construe an aspect of the world as something that can be identified and counted or measured and that can play a role in events, ⁹design often allows us to express that aspect as a ³representation, whether or not it is a physical object.... Similarly, when we construe some aspect of the world as an event

or state involving several participants that affect one another, ⁹Design often allows us to express that aspect as an ¹⁰affordance.... ³Representations are often used for names and ¹⁰affordances for something being done, but because the human mind can construe a reality in a variety of ways, ³representations and ¹⁰affordances are not limited to those uses.

Researcher's notes:

1 Speech = artifact. Speech is an act of language. Artifact is an act of design.

2 Token = entity. Like a phrase, a token is an entity, a role player, an argument - essentially a participant in the relationship that is formed by either the designed artifact or lingual sentence.

3 Noun = representation.

4 Does *nouny* = represent. A noun, an entity that does "*nouny*" things is worked into a representation, an entity that does "representy" things, or in other words: that represents things, abstract concepts, objects, etc.

5 Word = element.

6 Comes after article = becomes significant when related to context. As discussed earlier, in language *articles* are used to imply context. For example, the difference of significance between using "*a*" and "*the*" when referring to an object with the noun word box. Empirical evidence and Steven Pinker suggest that there are no entities or elements in design with a similar role to that of articles (like the determiners above for example). In transitioning this statement this research therefore chose to focus on the situation, the context, that justify the use of this or that article or determiner. The implied significance of both of an object being referred to in a sentence and that of a element in a design artifact is defined by context that exists within the larger lingual or designed artifact, as well as outside of it.

7 Have an -s stuck on it = appear in an artifact many or countless times. The research works

here literally with a representation of many as the use of an “-s” at the end of a noun would imply.

8 Speech = artifact. Act of speech is an act of parole in language, in design act of parole is the designed artifact.

9 Language = design.

10 Verb = affordance.

23.

Original statement:

“There appears to be a common anatomy in all phrases in all the world’s languages.”

(Pinker, 1994, p.99)

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Altered statement:

There appears to be a common anatomy in all ¹entities in all the world’s ²types of design.

Researcher’s notes:

1 Phrases = entities.

2 Languages = types of design. In this comparative analysis, this research, so far, consistently transitioned language (seen as an ability or field of activity) into design, and a specific type of language into a specific style or type of design such as web design, graphic design, Dutch design style etc.

While it is possible to use “*languages*” and mean many types of languages, or systems of communication each with its own sounds and vocabulary, and sets of combinatory rules, it is not possible to use “*designs*” without meaning many types of designed artifacts - the acts of parole themselves. This research opted for “*types of design*” as it seemed more fitting to maintain the focus on design based sign systems since Pinker’s focus is on sign systems.

One line of thought that came up during the process of transitioning this statement, is the common anatomy in all phrases in all the world’s paroles, that is, lingual and designed artifacts.

Pinker could better have opted for a statement like *“there appears to be common anatomy in all the phrases in all the world’s sentences”*. Under this possibility, first, it would have stayed true to the general meaning of the original sentence - since all the world’s sentences are made with all the world’s languages (it would also fit the subject of page 99 - the syntactic principles with which a phrase meaning is constructed). Second it would be valid for any type of sentence, or parole, made by man since phrases seem to serve as entities, role players and arguments both in lingual and designed artifacts. Finally, a transition of the term *“languages”* (types of sign systems) into the term *“designs”* (types of artifacts) would not have made any difference in the meaning of this statement as there is a common anatomy of phrases in all the world’s languages and the sentences / paroles they enable to produce.

24.

Original statement:

“Here we have the first principles of building a phrase out of the meaning of the words inside the phrase. What the entire phrase is “about” is what its head word is about.” (Pinker, 1994, p. 99)

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Altered statement:

Here we have the first principles of building an ¹entity out of the meaning of the ²elements inside the ¹entity. What the entire ¹entity is “about” is what its head ²element is about.

Researcher’s notes:

1 Phrase = entity.

2 word = element.

Here this research considers what the term “*head*” element could mean in design in respect to what head word means in language:

“Noun phrase owes most of its properties to that one noun. For example, the NP the cat in the hat refers to a kind of cat, not a kind of hat; the meaning of the word cat is the core of the meaning of the whole phrase. Similarly, the phrase fox in socks refers to a fox, not socks, and the entire phrase is singular in number (that is, we say the that the fox in socks is or was here, not are

or were here), because the word fox is singular number. This special noun is called the “head” of the phrase, and the information filed with that memory “percolates up” to the top most node, where it is interpreted as characterizing the phrase as a whole. The same goes for the verb phrases: flying to rio before the police catches him is an example of flying, not an example of catching, so verb flying is called its head.”(Pinker, 1994, p. 99)

When it comes to designing and perceiving of designed artifacts, this research suggest that a similar concept to that of a “head” can be identified in the way humans distinguish between representation entities and affordance entities within the designed “sentence”. The reference or essence of entities is signaled by a structural core element from which their meaning is constructed, be it a physical property, or an iconic combination elements.

For example, The head element of a blade - an affordance entity usually found in knives - is a long, flat and sharp edge. Information filed with this element in memory “percolates up” keying a set of affordances connected to affordances that a sharp edge can be used for. In representation entities such as logos, the “head” element upon which the meaning of the entity is constructed from can be a word, a set of letters, or an icon.

Complex entities found in artifacts like a globe or a touch screen are comprised from hybrid relationship in which structural elements head primary affordance entity to enable a form of representation, or where an representational entity to enables a set of affordances. In the first example the representation of the planet as a globe is comprised from a spherical object with a that is surface by map of the planet (either printed, glued or painted on it). While the head element of a map is an illustration of lines representing locations and paths connecting between them, the head element in the representation of the planet featured in a globe is the spherical ball like form which allow the exploration of that map by rotating it on one or two axes.

The affordance of a button on a touch screen is comprised from an icon and technological structure or mechanism - sensors, circuits, and programming which translate touch into input. While the technological structure enables a set of affordances connected with a button to be executed, it is the representation of a button - headed by an icon - which link these affordances in the mind of the user with a physical location on the touch screen.

25.

Original statement:

“Within a phrase, then, the verb is a little despot, dictating which of the slots made available by the super-rules are to be filled. These demands are stored in the verb’s entry in the mental dictionary,... For a sentence to feel grammatical, the verb ’s demands must be satisfied.... Because verbs have the power to dictate how a sentence conveys who did what to whom, one cannot sort out the roles in a sentence without looking up the verb.” (Pinker, 1994, pp. 106-107)

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Altered statement:

Within an ¹entity, then, the ²affordance is a little despot, dictating which of the slots made available by the supe-rules is to be filled. These demands are stored in the ²affordance’s entry in the mental dictionary. For an ³artifact to feel ⁴meaningful, the ²affordance’s demands must be satisfied. Because ²affordances have the power to dictate how an artifact conveys who can do what to whom, one cannot sort out the ⁵entities in an ³artifact without looking up the ²affordance.

Researcher’s notes:

- 1 Phrase = entity.
- 2 Verb = affordance.
- 3 Sentence = artifact.
- 4 Grammatical = meaningful. In language the use of grammar allows the meaning of

sentences to be structured and constructed. In order to be meaningful, a sentence needs to be perceived as structurally correct. In order for the meaning of a sentence to be constructed correctly it needs to be structured according to certain “*grammatical*” rules, or structure. The concept “*feel grammatical*” is therefore very close in its meaning to the concept “*feel meaningful*”. Both in language and design, the perception, recognition, and exploration through structural analysis of paroles and according to sets of mental entries and rules (as discussed in points 15, 16, 17 and 18) leads to the construction their meaning. As discussed in point 21, It seems that one of the cognitive processes deployed by perception (as it hunts for clarity and comprehension) is this set of entries and rules. When the brain projects an expected possible match on sensory data it compares these set of entries and rules to sensed information structures in order to identify a significant structure or a pattern of parole in the radiant sensory “*noise*”.

5 Roles = entities. The term “*roles*” is understood here as shortening of the term “*role player*”, which was linked earlier to phrases (in language) and entities (in design), in point 10.

These sentences are nested in a large section of the book dedicated to Chomsky’s core argument of universal grammar: a general conception of grammar first proposed by Chomsky as the “*principles and parameters*” theory. Pinker builds here upon the general blueprint for phrases discussed in points 23 and 24, a blueprint which seem to exist in all languages. It is universal method with which all constructions of phrases and their role players - entities which participate in the concept or action presented by a head element in a phrase - can be found.

According to Pinker, super-rules are general grammatical guidelines or principles of how languages encode or structure acts of parole, and decode or construct their meaning. For example, there is a principle that links between the positions of a verb and its object with the location of adpositions in a phrase: “*if a language has the verb before the object, as in English, it will also have prepositions; if it has the verb after the object, as in Japanese, it will have postpositions*”. This

grammatical principle, or any grammatical principle to that matter, *“is usable only after you combine it with a language’s particular setting for the order parameter”* (Pinker, 1994, p. 104).

It is important to understand how these super rules work as an essential structural guideline enabling parole:

“The principles and parameters of phrase structure specify only what kinds of ingredients may go into a phrase in what order.... Some verbs, like dine, refuse to appear in the company of a direct object noun phrase. Others, like devour, won’t appear without one.... The verb put is not content unless it has both an object NP (the car) and a prepositional phrase (in the garage). The verb allege requires an embedded sentence (that Bill is a liar) and nothing else. Within the phrase, then, the verb is a little despot, dictating which of the slots made available by the super rules are to be filled. These demands are stored in the verb’s entry in the mental dictionary, more or less as follows:...

put

verb

means “to cause something to go to some place”

putter = subject

thing put = object

place = prepositional object...

Each of these entries lists a definition (in mentalese) of some kind of event, followed by players that have roles in the event. The entry indicates how each roleplayer may be plugged into the sentence - as a subject, an object, a prepositional object, an embedded sentence, and so on.”(Pinker 1994, pp. 105-106)

This research suggests that the mind’s mental dictionary - including its lexicon of material

elements and the concept they associate with, as well as its mental grammar of rules that tells how to combine the material elements in order to convey relationships among concepts - contain entries (most likely in mentalese) for affordances listing definitions and relationships of arrangements, or situations of events, followed by actors that have roles in the event. The research now considers the existence of the following design use thinking activities:

- 1 In understanding what artifacts mean, humans explore them by searching for their affordances and looking for situations that fit the mental entry of an affordance.
- 2 In designing an artifact, knowing what affordances will the artifact enable to its users dictates designers the dimensions, entities, and elements required in order for the event or affordance intended to take place.

The validity of first statement was highlighted in the exposition "*Tesouros Feira Da Ladra: the beauty of anonymous design*" (2012). Organized by MUDE, the exposition showcased over 300 objects selected by David Osborne from Feira da Ladra and similar events in Lisbon, England and France. The unifying criteria among these was that they all did not participate in any way in the world of fashion. These objects were mostly tools with sets of affordances - known only to specialized users like butcher, surgeon, hatter, farmer, and so on - that were largely unknown to most of, if not all, the visitors. "*Before referring to the captions in the catalogue, visitors should ask themselves "What is the problem to which this object is a solution?" in most design museums this question is of no interest because the problems addressed are classic ones - the chair, the dress, the lamp, the car*" (Osborne & Rodrigues, 2012, p. 25). A special table in the exposition was dedicated to the exploration and investigation of artifacts, whose affordances eluded the collectors. There, the public was asked to guess and suggest themselves affordances for selected artifacts. To do so visitors needed to look for possible role players in their mental dictionary entries. These possible role players could indicate a possible event, and in turn would lead to constructing the meaning of

entities in the artifacts (other than those intended for gripping by hand or pressing with finger) and of the artifacts themselves.



Fig. 4.8: Table of mysteries at Tesouros Feira Da Ladra, national museum of Soares dos Reis (Image by Polyglouton in August 2013, retrieved September 7th, 2014, from http://www.tripadvisor.com.br/LocationPhotoDirectLink-g189180-d243631-i74147607-Museu_Nacional_de_Soares_dos_Reis-Porto_Porto_District_Northern_Portugal.html)

Validating the second statement is the nature of assignment briefings given to designers by their clients. In these briefings, companies, individuals, and organizations try to describe their desired designed artifact by describing what affordances it will enable themselves or their end users to do. One such example is given in Cross' *Design thinking* (2011) *Designing to Use* chapter and its subsequent experiment and protocol analysis. There, designer Victor Scheinman is required to develop a device according to the following set of affordances described by HiAdventure Inc. in their briefing:

“A fastening/carrying device that would enable you to fasten and carry the backpack on mountain bikes.... The device would have to fit on most touring and mountain bikes, and should fold down, or at any rate be stacked away easily.” (Cross, 2011, p. 82)

Cross then proceeds to describe the preliminary process with which Victor frames the problem. *“The view that Victor began to form of the problem was that of the total task that encompasses the dynamic system in use of the rider plus bicycle plus backpack, and the issues of control of the bicycle that arises in the situation of riding over rough terrain with heavy backpack attached to the bicycle”*(Cross, 2011, p. 84). In doing that, Cross quotes the designer 6 times; three of these quotes are preceded with sentences containing the words *“personal experience”*:

“He was also able to draw on some personal experience that helped him to formulate some of the implicit requirements for a good design solution.”(Cross, 2011, p. 83)

“He also drew upon his own personal experience to make the final decision that the location of the backpack would be over the back wheel.” (Cross, 2011, p. 84)

“Victor’s personal experience of biking with a backpack also led him to identify an issue that only someone who had such an experience might be aware of.” (Cross, 2011, p. 84)

Two other quotes relate to collecting relevant information from external sources, and one quote relates to information received from or collected by the clients.

After another paragraph and two more quotes, all relating to Victor’s personal experience,

the process of problem framing has reached a conclusion: *“Halfway through the session Victor had derived a framing of the problem which directed him to design a stiff, rigid carrier, mounted as low as possible over the rear wheel.”*(Cross, 2011, p. 85)

This account suggests that the designer in formulating the problem is searching in his own mental lexicon and grammar for the entries of affordances set described in the briefing. He looks for definitions of arrangements, or situation of events, followed by actors that have roles in these events, be them the user, or other artifacts which participate in the dynamic system of user, artifact and affordances described above by Cross.

This research finds here similarities between mental dictionary use in language and in design. Like the speaker eager to know the meaning of a word - what it affords to express to himself and to others - the designer is searching what the affordance of designed artifact mean to himself and to others. Both speakers and designers do so by searching both their own mental dictionary entries as well as the mental dictionaries of others - listeners and users. It is also quite evident that personal experience of using an artifact or a word pretty much defines what the entries in the mental dictionary contain, as the following analogy set suggests:

Victor’s personal experience of biking with a backpack also led him to identify an issue that only someone who had such an experience might be aware of.

=

A designer’s personal experience of using an artifact leads them to identify issues that only someone who had such an experience might be aware of.

=

A speaker’s personal experience of using a word leads them to identify issues that only someone who had such an experience might be aware of.

This analogy highlights the language spoken by specialists, like surgeons, and compares it with artifacts designed by specialists like Liston knife, Kochner forceps, Lagenbeck retractors - all tools designed by surgeons. *“Nomenclature of surgical instruments follows certain patterns, such as a description of the action it performs (for example, scalpel, hemostat), the name of its inventor(s) (for example, the Kocher forceps), or a compound scientific name related to the kind of surgery (for example, a tracheotome is a tool used to perform a tracheotomy)”* (Surgical instrument, 2014). In many cases, as intended by facilitators of the *“Tesouros Feira Da Ladra”* exposition, users of everyday language and everyday design - who do not share the experience of surgeons - would not know both what such designed artifacts and such lingual artifacts mean in terms of use, or mean at all. Their mental dictionary for these entries is blank.

“What one knows of an artifact is the stories one has heard and can tell of it” (Krippendorff, 2006, p. 170); stories that depend on one’s personal experience.

26.

Original statement:

“A sentence, then, must express some kind of meaning that does not clearly reside in its nouns and verbs but that embraces the entire combination and turn it into a proposition, that can be true or false.” (Pinker, 1994, p.110)

=

Altered statement:

An ¹artifact, then, must express some kind of meaning that does not clearly reside in its ²representations and ³affordances but that embraces the entire combination and turn it into a proposition of ⁴use, that can be true or false.

Researcher’s notes:

1 Sentence = artifact.

2 Noun = representation.

3 Verb. = affordance.

4 Proposition = proposition of use. Proposition is the act of offering or suggesting something to be considered, accepted, adopted, or done. The addition of the term “*of use*” is meant to emphasize the aspect of physical interaction of touching, playing, and exploring in design use over interaction of seeing or hearing in language use.

Designed artifacts make propositions to users. They propose what can be done, as well as how it can be done, both as a set of functions to be followed and as an attitude or manner of doing

things. These propositions, just like lingual ones, can be true or false, meaningful or meaningless:

“When something looks flexible, it should indeed be flexible. When something looks like a (virtual) button on a computer screen, it should be (virtually) capable of being pushed (i.e. clickable) and have anticipated effect.” (Krippendorff, 2006, pp. 86-87)

Krippendorff's concept of mutual contextualization seem to complement Pinker's ideas of how the meaning of parole does not reside in its parts of speech but in their combination, or arrangement:

“Just as figures and grounds are often interchangeable in that the one provides the context for the other, this also applies to the meaning of artifacts. The meaning of artifact's parts depend on the meaning of their arrangement, just as the meaning of its arrangement depends on that of its parts.... Understanding a complex artifact is like reading a text, though artifacts can be touched and played with, not just seen. Written characters are grouped into words, words are arranged into sentences, sentences form paragraphs, and so on. To understand, the meaning of a sentence, for example, implicates the well known hermeneutic circle. It may start with some initial set of assumed word meanings. One must then hypothesize a grammatical structure to make sense of these words. Assuming a meaningful structure for the whole usually calls for revision of what words mean in that context, leading to a revising word meanings - until an understanding emerges in which all apparent incompatibilities are resolved to the reader's satisfaction. The same is true for figuring out the meaning of an artifact as a function of the relationships among parts, mutually contextualized by their arrangement and as a function of how the whole is related to other artifacts and user's intentions.” (Krippendorff, 2006, p. 61)

The process described above by Krippendorff seems similar to the process responsible for pareidolia as suggested by Lee et al. and discussed in point 21. It seems that in perceiving both lingual artifacts and designed artifacts (the brains of) users make sense of visual or auditory stimulus by making predictions about or hypothesizing what potential (grammatical) structure is seen. It does so by basing its predictions on past experience and available grammar, and then subtly projecting those structures onto what is sensed. Subsequently they assume and revise expected meaningful structures until an understanding emerges in which all invariants are extracted and apparent incompatibilities (in context, in arrangements of parts, in grammatical structure) are resolved to the user's (or reader's) satisfaction. Again the mental dictionary and its grammar seems to be an essential part of a set of cognitive processes used in perception, rather than solely used for language production.

27.

Original statement:

(Lingual-) *“Grammar is a protocol that has to interconnect the ear, the mouth, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own.”* (Pinker, 1994, p. 118)

=

Altered statement:

¹Design grammar is a protocol that has to interconnect the ²eye, the ³hand, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own.

Researchers notes:

1 Lingual = design. The term *“lingual”* was added to the original statement in order to create a clear distinction that its intended subject refers to grammar use in language. It is transitioned to the term *“design”* in order to bring that statement into the field of design.

2 Ear = eye. The ear, the organ primarily used for the perception of (vocal) language acts produced with the mouth. In this statement it is equal to the eye, the organ primarily used for the perception of design acts produced by the hand.

3 Mouth = hand. Mouth, the organ primarily used for production of (vocal) acts of language. In this statement it is equal to the hand, the organ primarily used for the production of (material) acts of design.

The idea that grammar has abstract logic of its own echos also in Krippendorff statement about the concept of *“meaning being invoked by sense”*:

“Meanings are invoked by sense, and sense is always a part of what it invokes. Thus, the current sense is a metonym of what it means, especially of what one can do in its presence.” (Krippendorff, 2006, pp. 56-57)

Naturally there are underlying differences between how different senses work and what they allow to do, however there are also underlying similarities:

“Where vocal language realization requires dexterous manipulation of orofacial muscles and the larynx to manipulate sounds, material design realization requires dexterous proprioceptive manipulation of muscles to handle the position or movement of a part of the body.” (Dong, 2009, p.176)

The mental dictionary is seemingly used for extracting structures of information from radiant light, touch, or sound, as well as for building structures of information in these modalities. There seems to be no difference in grammatical structures used by relating activities such as: reading - writing; hearing - speaking, and; (when it comes to artifacts) interfacing (touching/ playing) - making. All these activities use a universal grammar and all require coordination between sensory input organs (eye, ear), sensory output organs (hand, mouth) and the mind.

Summary: How Design Works.

Design practice seems to be aimed at conveying information through designed artifacts. Language seem to convey meaning by coding it into a lingual artifact, design does the same with the designed artifact. Members of language and design communities undergo an identical act of root learning that links lingual or design structural units to their meaning and builds a standardized memorization of meaning, structures and codes, upon which the ability to convey concepts from the mind, virtually instantaneously, is based.

It is more than likely that root learning in design depends on interaction with artifacts and starts in early age as infants explore the affordances of their body and interact with their environment (Gibson, 1986). This acquired meaning of things is embodied in its beholder and cannot be shared with other members of the community. Instead, it is continuously reconstructed, reproduced, exchanged, and circulated within a community through an ensemble of social practices (Krippendorff, 2006; Thwaites et al., 2002).

In language, root learning depends on interaction with other language speakers. Meanings of words are constructed individually and therefore, like in design, can not be identical from one community member to another, instead an overlap in concept seems to exist. Just like with design, the use of language in social practices allows community members to re-work, produce, exchange and circulate what words mean to them and to others (Krippendorff, 2006; Thwaites et al., 2002).

Both in design and language communication between community members may enable the sharing of knowledge, like facts, figures and tools, but not the sharing of meaning.

Human invention and thinking is involved in all man made artifacts, whether these are arrangements made of sounds or materials. Man made artifacts seem to follow a code or a set of rules, discrete to each human and universal to them all. This points towards the presence of a generative grammar (Chomsky, 1975) both in language and design; a code that enables translating

between orders of elements and combinations of thought.

In a combinatorial system, a finite number of elements are sampled, combined, and permuted to create larger structures with properties that are quite distinct from those of their elements. This allows for an infinite number of combinations, both in language and in design; combinations which are not limited to element- artifact structure hierarchy. Depending on a macro or micro perspective, elements may permute into larger elements or into artifacts, and artifacts can serve as elements in the formation of larger artifacts. However, unlike language, which uses strictly combinatorial system in its production of parole, design uses both combinatorial and blending system in producing design parole. Designing seems to be involved in a large range of cultural and physical (social ensemble) activities, and although language may seem as involved, some of these activities cannot always be described verbally or in writing.

The use of structural sets of rules in design and language seems to be based on contextuality and is rooted in the framing of the situation or goals of the parole. Depending on situation and goals, as well as on detail of elements required for the intended parole, material elements are either blended or combined into the intended parole.

Identifying and selecting base elements in design is done in greater flexibility than in language. These can be identified in the micro scale of making things like yarns for weaving textile, as well as the macro scale with pockets as elements in a suit. This flexibility in scale seems to fit a way of communication that is based on sensual and associative system of units and structures in order to convey meaning. If something is not understood it cannot be explained until a certain piece of information or experience becomes available. Words are strict and fit a way of communication that is based on a sign system using clear and exact referents, if something is not understood it could be explained or referred to with other words.

Design as a system for communication is usually unlimited in time, while the production of

lingual artifact usually is constrained by the speed or frequency needed in order to maintain conversation. Design artifacts have different meanings at different times and for different users (Krippendorff, 2006). In design, elements in artifacts combine together with other elements, sometimes under each other, sometimes next to each other, they are not set up like text from left to right, or arranged chronologically for audio-visual perception. Their meaning can be recognized and constructed at an instant, or over a period of time depending on the manner/method in which they are perceived and reflected upon.

Building on the structure of grammar used in language, this research focuses on identifying similar structure for design, but instead of searching for design equivalents of lingual base units and their categories, this research looks for design equivalents in lingual syntactic roles and parts of speech, that is, parts of parole or of artifact.

It is evident that in language nouns and verbs are not words but parts of speech. A part of speech is not a kind of meaning, but a kind of entity that obeys certain formal rules, like a chess piece or a poker chip. A noun phrase, for example, is an entity that does nouny things. Its design equivalent is representation, an entity that does representational things. This implies that representations and affordances are not physically linked to specific base units, but to parts of the parole that constitutes the designed artifact. These parts comprise from various material elements and structured in various ways according to various structural codes.

Lingual nouns and design based material representations seem to perform similarly as parts of speech. A strong similarity between parts of speech can also be found in the lingual verb and the designed affordance. These parts of speech have the power to dictate how a parole conveys who can do what to whom, and one cannot sort out the entities in the parole without looking up for these parts of speech.

Adjectives are parts of parole that are seen in the emotional key traits of artifacts and

elements such as impressions, poetic associations and qualities, that can not be quantitatively measured, but instead are perceived as qualitative experiential, perceptual or emotional properties or state of the artifacts.

While adjective words tend to be exact with limited flexibility of meaning through lingual context, character traits of designed artifacts may be adjusted or even replaced through context and may mean different things to different people at different times. The idea that objects have properties is neither natural, cultural free, nor universal. They are the result of linguistic attribution to concepts located in the mind of the user (Krippendorff, 2006).

Designers structure acts of design as acts of communication with intended meaning which users construct through use/interaction. In doing so, based on their own empirical experience, designers structure character traits corresponding to an adjective or adjective pair with which a community of users can attribute a quality to artifacts, or can describe a feeling invoked by these artifacts (Krippendorff, 2006). However, as result of different context and actors, many times a gap exists between the character trait, or adjective, intended by the designer or speaker, and the one perceived by the user. Both in language and design the meaning gap of an adjective and character trait pairs needs to be bridged or coordinated as it is never the same between two persons. Due the sensual and associative nature of meaning in design, it is likely that gaps in the meaning of character traits in design are bigger than the gaps in the meaning of adjectives in language. User centered approach to design seems to be aimed at bridging such gaps.

Adposition words are words that typically refer to spatial or temporal relationship, like: *in, on, at, near, by, for, under, before, after*. In design cables, sockets, input/output elements, physical connectors and other connective elements are parts of a design parole that typically mean temporal or spatial relationship with other parts of a designed parole or other artifacts. These Inter-artifactual elements are parts of parole that afford connections between artifacts, in turn

increasing the number of imaginable meanings, senses, and possibilities of use (Krippendorff, 2006) - the number of actual affordances possible to the user. Inter-artifactual relationships take place in many acts of design without limitation to technology or size.

Language is used to structure and construct reality, and to represent its contextual situations. Unlike adposition and their design equivalents of inter-artifactual elements - with which one can infer to a situation involving more artifacts, there seems to be no part in the parole in design like lingual articles and determiners - which indicate class, category, distance, ownership, and quantity - beyond what is already there in the context of the situation perceived. Empirical evidence suggests that there are no entities or elements in design with a similar role to that of articles, or determiners. Design is the physical reality; the reality that exist with objects nested (Gibson, 1986) within larger objects, environments within larger environments. All these compose an ambient array from which concepts like quantity, distance, class, category and level of importance are constructed in the mind (based on human perception of the situation and context at hand, as well as individual experience). In language articles are used to imply this context. The significance implied both of an object being referred to in a lingual sentence and that of a element in a design artifact is defined by the context within the larger lingual or designed artifact, as well as outside of it.

Other parts of parole have been discussed earlier. However, looking back, all parts of parole seem to be structured as phrases or phrase types. In language these are various phrases such as: verb phrase; noun phrase; adjective phrase; etc. In design, this research suggest that the equivalent of the lingual phrase is group of elements that form something that has real existence, is distinct, independent or self contained - a recognizable entity from which meaning can be constructed.

The human mind, using a set of rules and a mental lexicon, creates a superstructure of

modular phrases with which the meaning of parts of parole and subsequently of sentences can be constructed. Both in language and design, phrases are nested in sentences which are then nested in bigger sentences as acts of parole grow in complexity.

In language, grouping of words into phrases is key process in constructing the meaning of sentences. Intended and unintended “*chunks of mentalese*” are linked to phrases which in turn lead to constructing the meaning of the entire sentence. In constructing the meaning of designed artifact this research suggest a similar process in which the human mind groups material-visual elements of artifacts into entities and links these entities to their potential proper meanings, *chunk of mentalese*. It is more than likely that the function of grouping visual elements takes place in the visual cortex (Lee et al., 2014), that it is a part of the visual system, and works together with other cognitive process that enables users to explore and optimize sensed information structures.

Meanings associated with designed artifacts seem to be located in another area of the brain than meaning associated with a lingual representation of that artifact. For example, perceiving the phrases “the face of Jesus” and actually seeing the face of Jesus in a toast will most likely show different brain pattern activity in fMRI brain scans (Lee et al., 2014; Correia et al., 2014).

Users make sense of visual or auditory stimulus by making predictions about or hypothesizing what structure is seen or heard - based on past experience and grammar available - and then subtly projecting those expectations onto what is actually seen. In doing so, users assume and revise expected meaningful structures until an understanding emerges in which all invariants have been extracted and apparent incompatibilities (in context, in part arrangements, in grammatical structure) are resolved to the (reader’s or) user’s satisfaction (Krippendorff, 2006). The brain of the user, thus, groups visual elements into entities in the primary visual cortex and then proceeds to compare them against some memory record before it predicts the potentially

proper chunk of mentalese, and then projects this expectation (linking it) to what is actually seen (Lee et al., 2014). A similar process seem to exist for auditory perception (Thwaites et al., 2002). The brain predicts a meaning based on empirical experience available rather than on the intention of the speaker or designer. If the suggested meaning is exact as intended by the speaker or designer, it is only due to the proper alignment of the arrangement or configuration in the ambient array of the artifact being perceived. It is according to this configuration of structure, pattern, texture, and context, that the brain of the user can distinguish information structures, ambient light, or sound, from the stimulus flux of radiant light, or sound (Gibson, 1986). It is possible to suggest that cognitive processes for perception, which hunt for clarity and comprehension and differentiate ambient “noise” from radiant “noise”, use a mental dictionary - which contains a lexicon and structural sets of rules for different modalities (grammar) - in order to recognize or identify information structure or a pattern in the radiant “noise”. Deploying grammar seems to be a part of a set of cognitive processes used in perception, rather than solely used for language production and performance.

Generative Grammar protocol is seemingly deployed for identifying structures of information form radiant light, touch, or sound, as well as for building structures of information in these modalities. There seems to be no structural difference in grammatical structures used between relating activities such as: reading - writing; hearing - speaking, and; (when it comes to artifacts) interfacing (touching/ playing) - making. All these activities use a generative grammar and all require coordination between sensory input organs (eye, ear), sensory output organs (hand, mouth) and the mind.

The common anatomy in all phrases, or entities, in all the world’s paroles, that is, lingual and designed artifacts, can be seen in syntactic principles with which a phrase meaning is built in all man made acts of parole. Phrases serve as entities, role players and arguments both in

languages and designed artifacts.

The primary reference or essence of entities is identified by a core element, or a head, upon which their meaning is constructed. Complex artifacts may comprise of a complex relationships. For examples, structural elements head key affordance entity in order to enable a form of representation, or a representational entity in order to enable a set of affordances.

The mind's mental dictionary contains entries (most likely in mentalese) for affordances listing definitions of arrangements, or situations of events, followed by actors that have roles in these events. In understanding what artifacts mean humans explore them and search for their possible affordances by looking for situations that fit mental entries and sets of rules associated with possible affordances. In designing an artifact knowing what affordances will the artifact enable its users dictates designers the right dimensions, entities and elements required for the event or affordance intended to take place.

A designer, when formulating the problem, is usually searching in his own mental dictionary for the entries of the affordances set described in the briefing by looking for definitions of arrangements, or situations of events, followed by actors that have roles in these events (be them the user, or other artifacts which participate in the dynamic system of user, artifact(s), affordances (Cross, 2011)).

Personal experience of use of an artifact or word defines what the entries in the mental dictionary contains. Language spoken by specialists, like surgeons, and artifacts designed by specialists need also the experience of specialists in order to use and understand. Users of everyday language and everyday design - who do not share the experience of surgeons - would not know both what surgeon (designed) artifacts mean or are used for, and what surgeon lingual artifacts mean or are used for. Their mental dictionary for these entries is blank.

Designed artifacts make propositions to the user. An artifact, whether lingual or designed,

expresses some kind of meaning that does not clearly reside in its parts of speech, but that embraces the entire combination and turn it into a proposition. These propose what can be done, as well as how it can be done, both as a set of functions to be followed and as an attitude or manner of doing things. These propositions, just like lingual ones, can be true or false, meaningful or meaningless, depending on the user and their mental dictionary.

4.5 Conclusions for Investigation I.

This analysis selected key quotes from Pinker's *The Language Instinct* and converged them with authors and concepts from the field of design. The analysis discovered that in many cases essential mechanisms involved in language activity appear to also be at work in design activity.

During this analysis the following possible similarities and parallels between the workings of language and design were identified and debated:

- The ways a mental dictionary is used in language and design.
- The syntactic roles played by parts of speech in lingual and designed parole.
- The way abstract "*ideal types*" in design use and "*pure abstract sound impression*" in language use link between perceived information structures and concepts in the mind.
- The cognitive processes used in language and design in order to hunt for clarity and comprehension, that is, in order to differentiate structured information from the gradient flow of sensual information and identify it according to personal experience of use.
- The way design and language are both used for the conceptualization of artifacts and identities into being.

A key insight these similarities point to is the possibility that - more than being deployed for the creation of parole - the structural cognitive process known as grammar is primarily used in perception in order to identify structures, the "*ambient light*", from the ongoing flow of sensory data (sound, touch, sight, smell, or taste), the "*radiant light*" (Gibson, 1986). This builds up from the way words are perceived as a possible "*abstract sound impression*" (Thwaites et al., 2002) and artifacts as a possible "*ideal type*" (Krippendorff, 2006). Grammar seems to be a cognitive process deployed for distinguishing between different types of known and unknown information structures. According to this process, sound and 3D structures are identified or put into memory in the perception process that a) associates these structures with a possible meanings, determining

their significance (whether it is a set of imaginable uses, their reference, or knowledge); b) builds up the entries of the mental dictionary of acts, actors, roleplayers and combinatorial rules of grammar itself.

In specific, converging the debates from statements 11, 12, 21, and 26, it is very likely that a structural protocol with discrete combinatorial or blending rules and mental entries is deeply involved in the analysis of sensory data and the identification of structures from that data. In a split of a second the perceptual system hypothesizes, or predicts, information structures in the flow of sensory data - panning, scanning, zooming on the information while comparing it with possible entries - in the mind's mental dictionary - of other seemingly similar abstract structures. It is a circular process through which the meaning of sensed structures is constructed with the least amount of contextual incompatibilities. "*Nesting*" in the ecology (Gibson, 1986) is not nesting of ecology but of structures, where the mind gives priority to dominant structures in the ecology over lesser dominant structures in the sensory information flow (which can be only sensed in detailed attention).

Design as explored in this analysis seems to rely on the human ability to distinguish between different structures in the environment according to different qualities and modalities. Design is a sense making activity (Krippendorff, 2006), not only for oneself, who is seeking to understand what does the environment constitutes, but also for others. The designer's main preoccupation seem to be aimed at helping the users of their designed artifacts make sense from their design. In making sense of design humans perceive, "read", and construct the meaning of designed artifacts. When designing humans structure designed artifacts by drawing upon their personal experience (Cross, 2011; Krippendorff, 2006) and subsequently their mental dictionary (filled with entries of abstract structures - "*ideal types*" (Krippendorff, 2006) - and sets of possible relationships between them (Pinker, 1994)) to base their designs on. They assume that the

structured combination used for the designed artifact will be “read” correctly by others and be linked to the meanings/ uses intended by the designer in the right context.

Finally, Design use seems to follow the same structural mechanisms and cognitive processes as language use, and perhaps also towards the same goals - conceptualization of reality, of artifacts and identities into being. It is as if the same method is deployed in two different fields and capacities, yields structurally similar results. Any differences between the two (and in the way their related sign systems - languages, styles etc. - are used for communication of information and coordination of meaning) seems to originate from the modality of the parole, and of the inner making of base elements used for the structuring of parole.

These points, as well as the cognitive makeup of design and language activity, will be examined in investigations two and three of this research. The first will form a deeper and more coherent inquiry into the key aspects between the relationship of language and design that were touched sporadically, yet consistently, in the analysis above. The latter will seek to show how the artifacts produced in design and language can be analyzed and described according to a key structural model used in linguistics. It will also attempt a first approach towards positing this model into design practice.

Chapter Five

Comparison Between Key Aspects of Language and Design.

The previous investigation of this research discussed a series of equations exploring the relationship between language and design. It touched upon many aspects of this relationship, yet, in no particular order or a conceptually structured engagement. The debates there were arranged not according to theme or a specific aspect but according to the chronological appearance of the original statements from Pinker's *The Language instinct*. In many cases it was not possible to continue debating the different aspects of the relationship beyond the scope of the equation or of the transition points without steering away from the goal and methodology of that investigation, or braking the structural coherence it aims to achieve.

In this second investigation, the research continues the inquiry into the relationship between language and design. This time it aims to construct a concise and coherent picture of the underlying similarities and difference between the two abilities in term of performance and competence. The research forms here a critical approach towards key points in the relationship between language and design that were noted and touched upon in the first investigation. It aims to offer a consistent and focused comparison of the underlying building blocks of language and design abilities by bringing into consideration the following four aspects it has identified:

- Brain activity - the parts of the brain associated with language use and design use, that is, interaction using language, and interaction using perception and sensory motor coordination.
- Cognitive functions - cognitive processes and protocols (or brain functions) used in design and language, and associated with design and language competence.

- Structural units - the base materials, or structural units, used for building lingual artifacts and designed artifacts.
- Perceptual system - the scope, modality and limitations of the way lingual artifacts and designed artifacts are sensed and perceived.

Based on these, The second investigation aims to expand further the inquiry of the relationship between language and design. It will do so, through a structured investigation comparing underlying cognitive and structural mechanisms enabling language and design performance, and will seek to identify similarities and differences between them.

5.1 Brain Activity for Language and Design.

Building from the discussion formed in point 3, 4, 7, 10, and 27 of the previous investigation, the research uses here Klaus Krippendorff for its starting point. With it the research highlights and suggests a strong similarity in the ways human conceptualize meaning from and within lingual and designed artifacts:

“Understanding a complex artifact is like reading a text, though artifacts can be touched and played with, not just seen. Written characters are grouped into words, words are arranged into sentences, sentences form paragraphs, and so on. To understand, the meaning of a sentence, for example, implicates the well known hermeneutic circle. It may start with some initial set of assumed word meanings. One must then hypothesize a grammatical structure to make sense of these words. Assuming a meaningful structure for the whole usually calls for revision of what words mean in that context, leading to a revising word meanings - until an understanding emerges in which all apparent incompatibilities are resolved to the reader’s satisfaction. The same is true for figuring out the meaning of an artifact as a function of the relationships among parts, mutually contextualized by their arrangement and as a function of how the whole is related to other artifacts and user’s intentions.... A hermeneutic circle explains how people render multicomponent artifacts meaningful, be they text or material objects.” (Krippendorff, 2006, pp. 61-62)

This research suggests that this similarity in conceptualization originates from (or extends deeper to) the fundamental biology of the human brain and its development in the human species. It presents the following points for consideration.

In *The Language of Design*, Dong (2009) maintains that both human abilities for language

and design - while requiring a coordination and manipulation of different muscles in the body - evolved simultaneously as a set of cognitive capabilities. Dong bases his view on the work of archeologists and paleontologists Davidson and Noble (1993) who believe that, based on prehistoric tool forms, language has evolved in the same period that tool making was being developed. Dong further links this evidence to Michael Arbib's Mirror System Hypothesis (2005) which suggests the likelihood that the ability to point to an object and to refer to an object have evolved at the same time the brain developed the capacity to refer to an object symbolically.

Psychologist Patricia Greenfield (1991) proposes that tool use and tool making skills are related to language evolution, pointing out that both abilities sharing a similar hierarchical organization. Language uses a hierarchical structure (i.e., grammar) as a set of rules for combining words in a meaningful order, while tool use deploys a similar hierarchical structure, in which simple hand movements are combined in a certain order to achieve appropriate object manipulation. These set of movement follow different sets of rules for different tools.

Experiments in cognitive neuroscience and neuropsychology conducted by Higuchi, Chaminade, Imamizu, and Kawato (2009) build upon this theory. Higuchi and his team hypothesized that a specific area in the brain evolved for grammatical aspects of human language. They cite various functional MRI studies in monkeys that show that both when these animals observed tool use activity by other monkey and when these animals used tools themselves a specific area in the frontal cortex of these animals "lights up" in a region thought to be of shared ancestry to the Broca area in humans. The reserachers note that "*non-human primates can acquire simple grammar skills, but are unable to master "phrase structure grammar level" which is characteristic of human languages*" (Higuchi et al., 2009, p. 1376). In Humans, functional neuroimaging shows a dissociation between the involvement of different parts of the Broca's area during language performance. One part of that area is responsible for simple grammar processing,

and another part, namely Brodmann area 44 (BA44), is responsible for complex grammar processing.

In their own experiments, Higuchi and his team sought to discover whether similar neural activity within the Broca area will show both when human test subjects use language and when these subjects use tools. Accordingly, they scanned the brains of volunteers as these were performing the following tasks:

- Tool use - the participants were asked:
 - to manipulate appropriately a pencil, a scissors or chopsticks with their right hand performing a sequence of actions;
 - to hold the tools and related object of manipulation (paper or beads), and;
 - to imagine using these tools.
- Language use - participants were asked:
 - to listen two times to different parts of a famous fairy-tale, as well as to explanations of the story. These were narrated by a professional storyteller. One time the recording played the narrative in forward play the other time the recording played it in reversed play.

In both types of tasks, fMRI scans results show an overlap of brain activity for perceiving language and manipulating tools in Broca's area. The location of this overlap in the Broca area suggests that language and tool use share computational source for processing complex hierarchical structures, which are common to these abilities. This points to a shared origin in the development of the brain between human language and tool-manipulation skills.

Higuchi et al. (2009) argue that in contrast, if Human language processing - specifically relating to phrase structure grammar level - would have been a unique Human specialization (without any counterparts in animals) different areas in the brain - than those relating to common

ancestry with primates - should have “light” up in FMRI scans during the performance of the tasks during the experiment.

These findings seem to facilitate Arbib’s Mirror System Hypothesis of the development of the brain. This can be supported by Davidson and Noble's prehistoric evidence. Krippendorff’s account of how a key cognitive process is responsible for the construction of meaning from sensory input of different modalities is no mere coincidence, but the result of millions of years in the development of the human brain. A specific area in the brain possibly evolved to support a set of cognitive functions needed for processing structural aspects of both complex language use and complex tool use – the “*reading*” and creating of designed artifacts. This conclusion support this research’s initial framing of lingual and designed artifacts as acts of communication.

5.2 Cognitive Functions for Language and Design.

Building on the discussion around different yet related subjects in points 1, 3, 5, 10, 11, 12, 18, 21, and 26 of investigation one, the research here looks into the aspect of High-level cognitive functions relating to design and language abilities. These functions are uncovered in rare cases when they are impaired through neurological damage to the brain. Neurological evidence seem to confirm that damage to the left hemisphere of brain will result in the loss of some of the functions related to language ability, whereas damage to the right hemisphere can result among other things in loss of design ability. Using the following accounts and theories this research will now compare between cases that are related to design ability and cases related language ability.

Nigel Cross dedicates a section of his book *Design Thinking* (2011) to design intelligence competence and the cognitive functions that are associated with design ability. In it he covers a case study experiment from Vinod Goel and Jordan Grafman (2000). Their study revolved around an architect suffering from damage to his right hemisphere of the brain - in an area associated with high-level cognitive brain functions. In the experiment this architect was given the task of re-designing a laboratory space. The experimenters reported no difficulties in the patient's understanding of the assignment or in using his architectural knowledge during early stages of the design process. However, he has shown an inability to proceed further or deeper in his design process, making a limited amount of preliminary proposals and being unable structure them in detail or into coherent final proposal.

In *The Language Instinct*, Pinker (1994) discusses the cognitive condition of people suffering from Broca's Aphasia syndrome. This condition is caused by damage to the lower parts of the left frontal hemisphere of the brain, which affects the person's language articulation abilities. Though most aphasiac people suffer weakness or paralysis on the right side of their body, they are left unimpaired at performing non-linguistic tasks which require visual-spatial perception like tool

manipulation, making structures, and drawing. On the language side they show great difficulties, or inability, in articulating speech and using grammar when talking, writing or doing grammar analysis. They *"can blow out candles or suck on straws, but their writing suffers as much as their speech; this shows that it is not mouth control but language control that is damaged. Some aphasiacs remain fine singers and many are superb at swearing."* (Pinker, 1994, p. 307) Interestingly enough, in deaf people who suffer from aphasia, the use of sign language (which is expected to depend on visual-spatial abilities and therefore to be computed in the right hemisphere of the brain) is also affected in the same way, that is, deaf signers show the same difficulties or inability in articulating sign language and deploying grammar for language production as mentioned above.

Through these case studies and their related observations about the domains of language and design Pinker and Cross form a conceptual parallel with their thinking (this contact point is discussed in *Literary Geometry*, as well as in *Design and The Language Instinct* (Luxembourg & Alvelos, 2015) which is attached in appendix):

- Both authors cite brain activity studies that have identified specific areas in the right and left hemispheres. These areas are active during design processing and during language processing respectively.
- Both authors agree that the left hemisphere of brain is more specialized with language abilities and lingual reasoning while the right hemisphere of the brain is more specialized with visual-spatial and constructional perception and emotion.
- Both authors maintain a point of view over their subject (design for Cross / language for Pinker) that could be summarized in the following statement respectively:

Design / Language ability in humans is something that everyone has, because it is embedded in our brains as natural cognitive function. Like other forms of cognitive function and ability it may be possessed as a competence, or be

manifested in performance, by some at a higher level than others. And like other forms of cognitive function and ability, design / language ability is not simply a given 'talent' or 'gift' but can be trained and developed.

- Both authors provide no accounts that show - or argue for - a clear separation of cognitive function sets between the two abilities.
- In both case studies mentioned above, these authors run short from or reporting or asking what kind of acts of language could the architect in subject produce? Or what kinds of acts of design could persons, or designers, suffering from aphasia produce?

Dong's theory of *The Language of Design* (2009) connects language with design and theorizes that language use is essential to designing. It proposes that, by being active in reality producing activities during the process of design, language use in design enacts the designed work into existence through key lingual performative operators - aggregation, accumulation and appraisal. *"These performative operators are are reality producing linguistic patterns... They are fundamental components of the language of design that realize design"* (Dong, 2009, pp. 16-17).

These are introduced through the following example:

"J.S. Ackerman's quote of Michelangelo's 'theory' of architecture contains linguistic examples illustrating the performative operators acting together:

When a plan has diverse parts, all those (parts) that are of one kind quality and quantity must be adorned in the same way, and the same style, and likewise the portions that correspond [e.g., portions in which a feature of the plan is mirrored as in the four equal arms of St. Peter's]. but where the plan is entirely changed in the form, it is not only permissible but necessary in consequence entirely to change the adornment and likewise their corresponding portions; Whoever has not been or is not a good master of the figure and most of all, of anatomy, cannot understand

anything of it. (Ackerman 1986, As cited by Dong, 2009)

First, Michelangelo sets up a frame of the situation to which a specific design practice holds through an interrogative or questioning form of language: “When a plan”and “But where the plan”. We will call this linguistic pattern of creating a frame aggregation. Next, he references this frame to create a materiality for the concept. The material of the concept is expressed through linguistic technicalization. He employs a field specific meaning of the term “arms”, as in the four equal arms of St. Peter's”, almost in a metaphorical sense rather than in vernacular meaning. This is a process we shall name accumulation. Finally, he values the concept by sprinkling expressions such as “not only permissible but necessary” and “a good master of the figure”, a pattern we will call appraisal.” (Dong, 2009, p.17)

With this example Dong forms a contact point with Krippendorff's framing of language and design:

“This book introduces a new way of conceptualizing design as a professional practice and as activity that is constitutive of humans in general.... Design is making sense of things. This phrase is conveniently ambiguous. It can be read as “design is a sense creating activity”, which claims perception, experience, and perhaps appearance as its fundamental concern, and this interpretation is quite international. Or it could mean that “the products of design are to be understandable to their users,” and this interpretation is more to the point of this book.”

(Krippendorff, 2006, p. xv)

“Language is a cultural artifact that enables humans to coordinate their conceptions, engage in joint action, and construct and reconstruct the realities they see. In the use of language, languaging, acting and perceiving are inseparably tied to a constructive understanding. It is truism

that one cannot know what exists without conceptualizing it as such. Language is the primary source of conception. It also presupposes the boldly participation of humans. Language is spoken, written and communicated, entering humans into this conception of reality entails this self-reference: Humans are beings who language each other into being.” (Krippendorff, 2006, p.20)

A review of Dong’s operators now follows:

Aggregation is about producing a conceptual space for the designed worked. It is about framing lexical concepts (ideas- which have been expressed in the vocabulary of a given language) that will determine what will qualify as the material for the design. Aggregation involves the alignment of complex multitude of ideas through the selection and combination of base materials like words and other representations. It forms a coherent frame about the designed work: *“the linguistic pattern of aggregation of words frames the designed work in a conceptual structure”* (Dong, 2009, p. 55). It is from this frame that structural realizations of the design concept are enacted linguistically in the process of accumulation.

Accumulation is about building a coherent conceptual and structural volume – or an accumulation of materiality - for the designed work. It is about the transformation of language into an artifact. It is based on constraints imposed on the aggregated lexical concepts by expectations as to how they can be performed or realized. By referring to the information that each word transmits about the design work, as well as by connecting these lexical concepts through propositions made in different levels of abstraction, new design representations emerge and a network of ideas about the designed work is created. *“The accumulation of the words as lexicalized concepts facilitates the 'building up' of words and clauses into fully-developed concepts”* (Dong, 2009, p.84).

For example the lexical concept of a “bike” must include (based common bicycle knowledge and expectation of what is a bike):

- Two to three wheels; a seat; and powering mechanism; navigation mechanism; and a braking mechanism; all connected by the bike's frame.
- The lexical concept of a powering mechanism must include:
 - a construction for feet pedaling ; a chain, tooth wheels, axis, and one or more gears.
- Modern bicycle wheels are objects that consist of rubber tube, circular metal frame, spokes, axis, and (depending on their position on the bike's frame) one or more tooth wheel (gears).
- The braking mechanism is a set of handles; connected by cables or rods to a friction mechanism that is situated at very close distance to the wheel frames.
- The bike frame can be light or heavy weight, it can be sporty or traditional, it may or may not include an adjustable connection for the seat and another for the bike handle.
- etc. etc.

By connecting a set of aggregated lexicalized concepts with the information they transmit and with each other at different levels of abstraction (according to the information transmitted by each one of them) an accumulation of new lexicalized concepts takes place. This subsequently produces a deeper and more detailed description of concepts relating to the form, structure, production materials, colors, etc. for the designed work.

Selecting which of these lexical concepts is more suited to the intended design is the process of appraisal. Appraisal is the linguistic pattern through which designers selects which of the accumulated lexical concepts suits best the intended designed work. It is a response to the

material that is being produced; a response that also supports and facilitates its creation. Appraisal is rooted in the desire and intent of the designer. Whether it is to create, to fulfill a need, or to please, it is always about what the actors who are doing the design want to bring into reality, their motivations for doing so, and their rationality. In design, evaluations of artifacts and actions are routine; they are based on norms such as schools of design, theories of design, and accepted practices. *“Appraisal is the representation through language of favorable and unfavorable opinions towards product, process, or people”* (Dong, 2009, p. 117). These opinions stem out from external and internal beliefs of judgment and appreciation. The first is based on the external norms and standards which form a social-cultural construction of judgment; the latter is based on interpersonal subjectivity which is constructed from personal and background experiences. Connecting emotion with rationalism, the linguistic pattern of appraisal gives designers a method for excluding one idea, concept, or representation in favor of another, and enables them to declare a certain concept more valid than others.

Each performative operator does not work in isolation, but instead all of them are part of a performance that realizes a designed artifact. *“As the language of design enacts design, its actions should not be thought as of implemented solely by an individual performative operator, but rather by an interaction of the operators”* (Dong, 2009, p. 138). When designers co-create, or are asked to think aloud, not only they expose the considerable complexity that this performance has and that exists in designing, but also bring about the creation of the designed work.

Produced texts, or other representational material that aids the designing process are *“intertwined in the ontological circuit of recognition by channeling the performative aspects of the language of design towards enacting design”* (Dong, 2009, p. 46). In harnessing and representing that which can be said, these acts of speech enact design through the performative operators mentioned above, thereby producing the designed work.

Returning to the case study of the architect with damage to the right prefrontal cortex. According to Cross's description, Goel and Grafman compared this patient's post attack design ability with that of another architect, a control subject, with similar age, education and experience, and conducted a protocol analysis study. The difference between the thinking processes of the two subjects was made clear when their "think aloud" comments during the experiment were rendered into graphs. Figure 5.1 shows the time each subject devoted to different cognitive activities (Goel & Grafman, 2000).

"The control subject focused initially on 'problem solving', with periodical returns to this. He then moved to 'preliminary design' and on to 'refinement' and 'detailing'. The graph of the control subject clearly shows a controlled but complex pattern of activities. In contrast, the patient spent a huge amount of time on 'problem structuring', and only small amount of time on 'preliminary design' and 'refinement'." (Cross, 2011, p. 138)

"The patient understood the task and even observed that "this is a very simple problem". His sophisticated architectural knowledge base was still intact and he used it quite skillfully during the problem structuring phase. However the patient problem solving behavior differed from the control's in the following ways: (1) he was unable to make transition from problem structuring to problem solving; (2) as a result preliminary design did not start until two-thirds of the way into the session; (3) the preliminary design phase was minimal and erratic, consisting of of three independently generated fragments; (4) there was no progression or lateral development of these fragments; (5) there was no carry-over of abstract information into the preliminary design or later phases; and (6) the patient could not make it to the detailing phase'. In short the patient simply could not perform a simple design task." (Cross, 2011, pp. 137-139)

Complemented with Dong's theory, what Goel and Grafman (2000) seem to describe is the patient's difficulty in directing or using language in order to realize or advance his intended design from mere words: *"language serves an active role in generating new meaning. Embedded in the language is information regarding the designed work; the language is attempting to communicate, advance, and frame the designed work into a conceptual structure."* (Dong, 2009, p. 54).

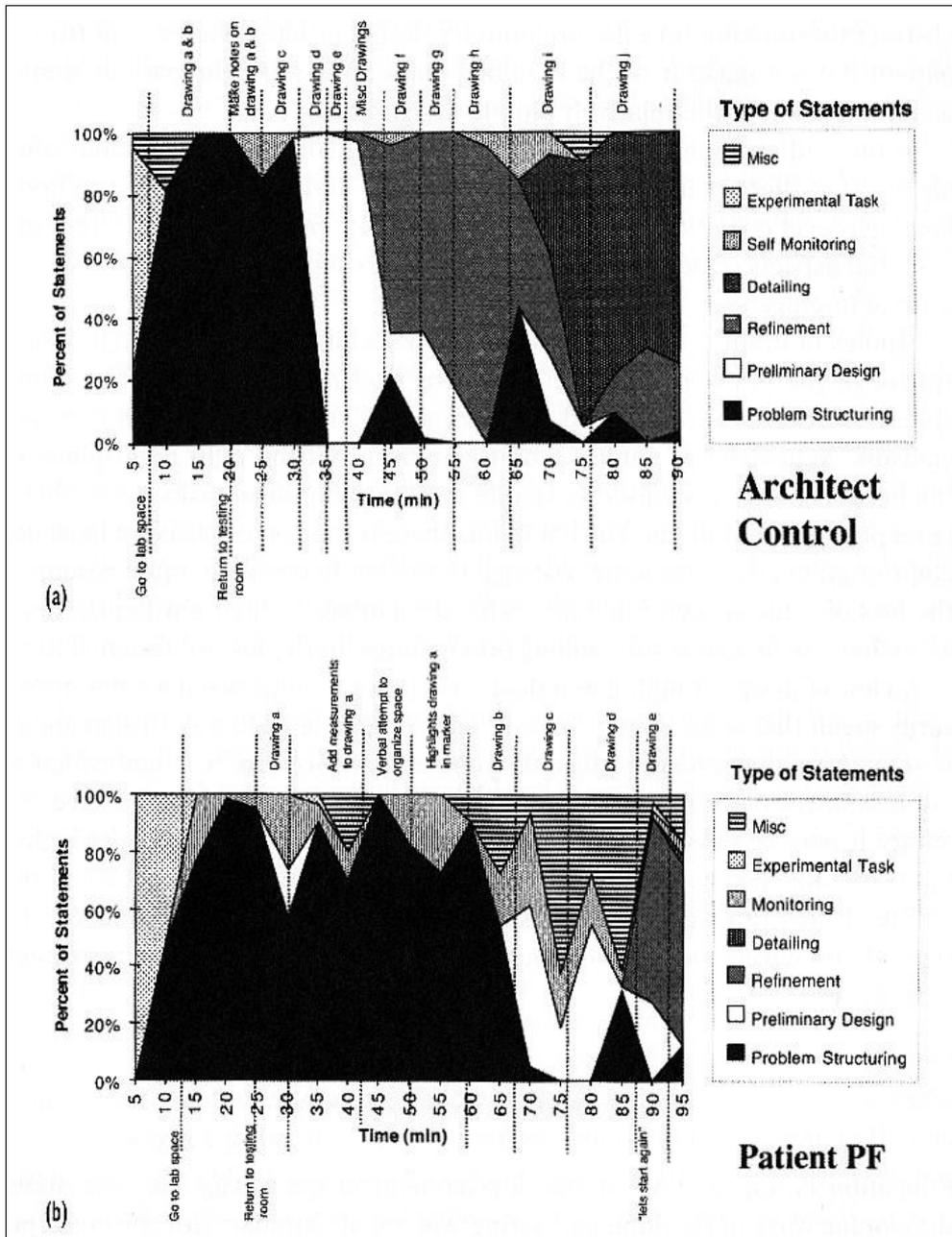


Fig. 5.1: Pattern of design activities as recorded in the think-aloud comments of control subject and patient.” (Cross 2011, p. 139)

According to Goel (1995), design problem solving involves four development phases: problem structuring, preliminary design, refinement, and detail specification. He notes that each phase differs in the type of information dealt with, degree of commitment to generated ideas, level of detail attended to, the number and types of concept transformations engaged in, and the symbol systems needed to support the different types of information and transformations.

Goel and Graffman (2000) describe preliminary design as a classical case of creative, ill-structured problem solving, where alternative concepts are generated and explored. This is facilitated by the abstract nature of information being considered, a low degree of commitment to generated ideas, the coarseness of detail, and a large number of lateral transformations. These lateral transformations are movements from one idea to a slightly different idea. These seem to have a key role in the aggregation process, in the creation of a conceptual space for the designed work, and in the exploration and development of core principles for the design.

Goel and Grafman's interpretation of the data suggest that the patient's ability to engage in lateral transformations was compromised. They postulate that his loss of ability was caused by a *"selective impairment of the neural system that supports ill-structured representations [described elsewhere in the text as imprecise, ambiguous, fluid, indeterminate, vague, etc.] and computations. This prevents him from successfully coping with the ill-structured preliminary design phase of our problem, and the ill-structured world at large. His computational and representational mechanisms for dealing with well-structured tasks (as measured by neuropsychological tests) remain intact."* (Goel & Grafman, 2000, p. 433)

Similar case studies, noted by Goel and Grafman (2000), show the same type of patients having difficulties in coping with ill-structured real world situation despite their high IQ and suggest that the right prefrontal cortex plays a special role in open-ended (i.e., ill-structured) inference tasks with no "right" or "wrong" answers.

This research turns now its attention back to cases of Broca aphasia and similar mental conditions caused by brain damage in the left hemisphere:

“Aphasia takes many forms depending on which centers of the brain have been injured and how deeply the patient has been affected. Aphasia leads to communication difficulties in a varying degree. A total loss of the ability to communicate is, however, rare. Aphasia influences a person’s ability to produce and understand speech/language. In addition, the ability to read, write, spell and calculate is affected. The patient may experience problems of recognizing the correct use of judgment terms (e.g. yes/no), and of recognizing and applying words to certain objects. Aphasia may be accompanied by other disorders such as paralysis, impairment of memory, and lack of concentration. The person with aphasia often exists in a world of chaos and confusion using language and interplaying with the surrounding environment is shattered... Based on the fundamental considerations about the link between language and mental activity, it is believed that the aphasia also will affect the victims’ self-understanding and have implications for the identity.” (Konnerup, 2010, p. 31)

For example, a condition like Wernicke’s aphasia complements in some ways that of Broca’s and could be described as a difficulty in naming objects and abstract concepts. According to Pinker, unlike Broca aphasia patients, Wernicke’s aphasia patients can produce language fluently and more or less grammatically, but their speech acts make no sense and are filled with made up words and with word substitutions:

“H. Gardner: “Thank you, Mr. Gorgan. I want to ask you a few-”

Mr. Gorgan: "Oh sure, go ahead, any old think you want. If I could I would. Oh, I'm taking the wrong word the wrong way to say, All of the berbers here whenever they stop you its going around and around, if you know what I mean, that is tying and tying for repucer, repuceration, well, we were trying our best that we could while another time it was with the beds over there the same thing...""(Pinker, 1994, p. 317)

Further on, severe cases of Wernicke's aphasia are known to leave patients eerily repeating what they hear without understanding it and never able to speak spontaneously. Based on these accounts, this research doubts the ability of aphasiacs to design (in the level of the task given by Goel and Grafman) as aphasiacs seem to be unable to produce language well enough in order to direct it towards the advancing of a design with a language of design.

Accumulating these accounts of damage to right, or left, brain hemispheres suggest that in order to perform Dong's operators of aggregation, accumulation and appraisal, designers rely not only on the cognitive functions used for language performance, but also cognitive mechanism that support well-structured and ill-structured mental representation and computation. Damage to the left hemisphere can render a designer unable to produce language well enough in order to perform the linguistic operators of the language of design. Damage to the right hemisphere can render a designer unable to advance produced language well enough in order to perform the linguistic operators of the language of design. This points to a strong likelihood that in order to design designers need cognitive functions located in both left and right hemispheres. The production of language alone, as the case of the architect has shown, is not enough. The person designing must also be able to use or direct his language towards the enacting of the intended design.

5.3 Structural Units for Language and Design?

The aspect of structural units for language and design, is touched upon sporadically in investigation one throughout points 6, 8, 16, 18, 19, 20, 21, 24, and 25.

In examining the aspect of the structural units of language and design the research returns to Dong and *The Language of Design*. Dong touches on the subject of “*base materials*” of language and design. However, he does not try to separate between them, but to bring them conceptually nearer while showing how designers determine what will qualify as the materials or elements of the intended design:

“Designing, like writing, involves the selection and combination of materials to form a coherent work, a process which I call aggregation. In language the base materials are words. In design, the base materials might be bits and bites as with digital media, doors, walls, windows for architecture, and wood steel and plastic for industrial design. O’tool quoting Jørn Utzon summarizes aggregation succinctly. The designer in aggregating base materials “must have in mind that they make a whole or an expression of some kind.” (Dong, 2009, p.55),

Moving from this point on, this research discusses how base materials or *elements* - this research’s preferred terminology - perform in the lingual and designed artifact. It will study these units as isolated units detached from the sentence or arrangement that is the artifact. This research recognizes that - due to the nature of ever changing human culture - it is not possible to clearly define what *base elements* are in language use and in design use, as well as how one type distinguishes from the other. Instead the research focuses on producing the following comparative points for consideration.

As mentioned before, the base elements in language are meta-grouped and called words.

These are a sequence of marks or sounds, functioning as a principal signifier, or referent of meaning. Words consist of one or more spoken sounds, their written or otherwise signaled representation. When perceived as spoken, words may refer to objects and abstract concepts. When perceived written, words represent first their one or more vocal sounds (which the signs, iconographs, or letters refer to) and only after to the object or abstract concept they may represent. In a way words can be distinguished according to character attribution. For example, they may be thought of as sharp, round, long, short, sophisticated, abstract, direct, elegant or shabby. The meaning of the vocal sounds (and their written representation) used as words depends to a very great deal on their context, i.e., the language spoken, position within the sentence and social specific situation in which it is used.

The base elements in design do not have meta group or tag that could identify them in general like words. The basic design units are attached and detached "*structural units of the terrestrial environment*" (Gibson, 1986, p.9). When perceived, these structural units are distinguished by the mind in terms of form, shape, as material characteristic like color (to various levels of explicit or subtle detail), and as principal signifier, or referent of meaning in acts of design. Base elements can also be distinguished according to character attribution (Krippendorff, 2006), that is, their physical properties and the lingual attributed adjectives they correspond with (mass, behavior, or inner qualities, colors and textures), as well as according to categories of mediums, substances and surfaces of the (terrestrial) environment as described by Gibson (1986). For example, Red Cedar wood could be described as a substance of soft quality, light "feel" (mass), red-brown color and brittle texture; its behavior is that it does not rot, is too sensitive for delicate wood work, and has a pleasant smell. What design base elements might mean depends on their properties or physical qualities as well on their context, i.e., the culture within which the sentence exist, their position and arrangement within the designed artifact, and the social specific situations

in which it is used.

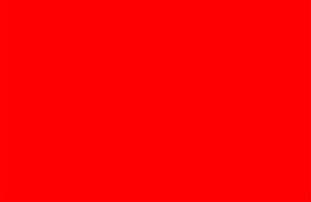
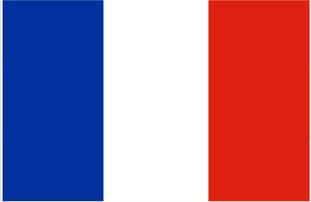
Base elements of language are vocal referents of the reality (as constructed by human thought). When written, or signaled in ways other than vocal, these units require re-representation of their physical phenomena - their vocal sounds. Base elements used in language are primarily associated with references, descriptions of known abstract concepts or previously experienced situation, that is, upon hearing them, humans first recognize them as their function of reference (as being a word or signifier) and then look for their meaning by looking into their actual context through a process of mutual contextualization. Base lingual elements are combined into lingual artifacts exclusively through a discrete combinatorial system where a finite number of lingual words or *“elements are sampled, combined, and permuted to create larger structures (in this case, sentences) with properties that are quite distinct from those of their elements”* (Pinker, 1994, p.75). The created lingual artifacts can - to various levels of abstractness, or accuracy - further express the human world and thinking on which the meaning of words based. Base elements of language can also be combined into larger base elements or into new elements through a combinatorial system and only through a combinatorial system, that is, they cannot be mixed or blended because they need to preserve their properties, their distinct arrangement of vocal sounds, otherwise they may become meaningless, void of their functionality as referents, or miss-understood.

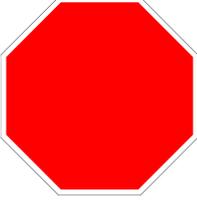
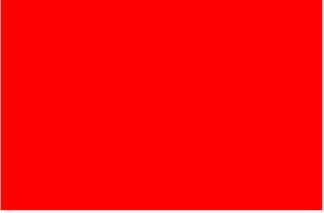
Base elements in design are the immediate physical reality, and require no re-representation in order to be perceived. Beyond meaning their affordances - and to various levels of abstractness or accuracy - these elements too can express and represent the human world and its thinking (abstract concepts, values, and emotion) and function as a stand in, or signifier like words do. Base elements used in design are primarily associated to known abstract concepts or previously experienced situations, that is, upon sensing them humans begin a thinking process of mutually contextualization in order to recognize their function, either as an affordance or



Fig. 5.3: Blended mixtures - mortar, sand cement, concrete (retrieved on 29 May 2014 from http://www.boral.com.au/cementdrymixes/easy_estimator.asp)

As a summary of the above points this research makes a case study analysis comparing between the word “red” and the color red (or the physical phenomena commonly referred to as red color):

Language	Design
<p>“RED”</p> <p>Written representation of spoken word for color, referring to the wavelength of light from approximately 620–740 nm on the electromagnetic spectrum.</p>	 <p>The wavelength of light reflected from the rectangular area above is approximately 620–740 nm on the electromagnetic spectrum.</p>
<p>“This fruit is <u>red</u>.” (english)</p> <p>“red” means color (of fruit).</p>	 <p>Associated with Fraternity in the french flag (liberty, equality, fraternity - motto of French</p>

	republic).
<p>“I read a good story last night.” (English) The verb “to read” or action of reading represented in past tense, phonetically “read” is spoken “red”: [ahy] [red] [ey] [goo d] [stohr-ee] [lahst] [nahyt].</p>	 <p>Associated with the House of Nassau- the Dutch flag.</p>
<p>“Ik red het niet.” (Dutch) (in Eng.: I can not make/salvage it) “Red” is the stem of the Dutch verb “redden”, meaning (depending on context and sentence): to dump ; to save ; to rescue ; to salvage ; to preserve; and keep.</p>	 <p>Associated with danger and the action “to stop!” in traffic signaling.</p>
<p>“Una elaborada red.” (Spanish) (in Eng.: an elaborate network) “Red” is the spanish word noun for network.</p>	 <p>Associated with Socialism in western politics.</p>

This research motivates the choice of (the use of) a color element (and not of wood, metal, or plastic texture or other material) as the base design element for this analysis by noting the limited visual modality in which this thesis manifests in, as well as by the fact that color, whether printed or on screen, is scientifically measured and definable phenomena that can be referred to and identified in terms of interpretation of sensory data with accuracy across social groups and cultures.

In language, when written, the word red is a combination of letters that will always refer to a spoken combination of vocal sounds. The same combination could further mean among many other things a color, “network” in Spanish, or the root of the Dutch verb to save - “redden”. In design, the color red will always mean specific wavelength of light - color, but it may be associated symbolically, culturally, historically, or psychologically with fraternity, fire, the noble house of Nassau, danger, fortune, and so on.

In the above comparison the two top examples deal with contextual relationship where the position or form of the unit within the sentence or combination guides the viewer to construct its meaning. The base elements behave in identical manner, that is, the alteration of meaning is resulted from a change of position, context, or form within the lingual or design sentence.

Krippendorff in highlighting the importance of etymology, argues for a similarity between words and (designed) artifacts: *“after all, words are artifacts as well - can change their meaning as they travel through different uses, different situations, different times and different people’s lives, in the course of their journeys, words designate and accomplish different things”* (Krippendorff, 2006, p. xv). However, although both language and design artifacts call attention to something other than their observer- independent existence, that is, their meaning, while in language the knowledge of the code is all that is needed in order to understand a word’s meaning; in design meaning is more abstract and deduced from a code that is based on available knowledge, which is related to the perceived structure through cultural and historical perspectives.

The bottom examples shed light on the type of relation between the base elements and their constructed meaning. Here, Spanish and Dutch are superimposed as analogies to sign systems used for traffic signaling and western politics. Again, in language the relation between the word and its meaning follows a code of grammar, while in design this relation is based on empirical experience or cultural knowledge. Some may note that the meaning of the color red in the stop

sign is constructed as a result of that artifact structure, but strangely enough a stop sign in blue may still be associated with the action “stop” while in green it is very likely that it will be associated with the action “go”. In the context and cultural convention of traffic, the color red is associated with “stop” or “danger” in any artifact used for the regulation and coordination of traffic.

Finally, in language, base elements relate to the object or concept they refer to or represent in a direct and exact manner. If a meaning is unclear, or unknown, it could be deferred or be explained by using other base elements till an understanding of its exact meaning is coordinated. Also in some cases meaning can be constructed through association between words. Conceptually similar words - like “roll” and “round” in English and “ontwerpen” (to design) and “ontwikkelen” (to develop) In Dutch, is based on empirical experience of their causality - what is round rolls, what is rolled (like wrap) is round and ontwikkelen is something that is done during ontwerpen.

In design, base elements relate to the object or concept they refer to, or represent, through abstract association and symbolism that depends on cultural perspective, prior personal experience and/or other specific knowledge. If a meaning is unclear, it may remain unclear until a key piece of information or a key experience is obtained. For example, knowing about St. Denis - one of the patrons of the city of Paris - will associate the red color in the French flag with that saint. An illustration of reddish stain can be associated either with blood or with rust; this construction is based on the similarity of physical spectral properties of iron molecules.

All these points above give account to a fundamental difference between base elements used in design and language. Not a difference in how meaning is associated to sensory input, but a difference in the functionality of these physical phenomenon: in the way they are produced and arranged into artifacts, and in the way they form acts of communication via oral, gesture, written, or physical performance and interaction. This fundamental difference in functionality stems out from different systems of organs used in the performances as well as perception of acts of

communication in different modalities. The cognitive system which associates sensory input with meaning seem to work the same way whether the act of communication is designed or lingual, as discussed in sections one and two above.

5.4 Perceptual System for Language and Design.

Here, the research expands the discussion around the perceptual system, its functions and the cognitive processes deployed by it and builds on the debate points 3, 8, 11, 12, and 21 of investigation one.

Humans deploy a perceptual system in order to sample their ecology and identify information structures from the flow of sensory data of varying modality - the physical phenomenon or stimulus that one can sense (such as touch, visuals and sound). The perception and exploration of acts of communication, that is, lingual and designed artifacts, depends on the sensor-motoric coordination between the organs used for collecting sensory input.

In the *Ecological Approach to Visual Perception* Gibson (1986) describes the act of perceiving visually:

“The body explores the surrounding environment by locomotion; the head explores the ambient array by turning; and the eyes explore the two samples of the array, the fields of view by eye movements. These might be called exploratory adjustments.... Both the global structure and fine structure of an array constitute information. The observer need to look around, look at, to focus sharply and to neglect the amount of light. Perception needs to be both comprehensive and clear. the visual system hunts for comprehension and clarity. It does not rest until the invariants are extracted.” (Gibson, 1986, p.219)

It is most likely that sound perception happens in a similar way - The body explores the surrounding environment by locomotion; the head explores the ambient array by turning; and by listening the ears explore the two samples of the array, the fields of sounds. Additional head

movements, these might be called exploratory adjustments, can help to reveal both the global structure and fine structure of an array which constitute information. The listener needs to hear what is around, listen to, to focus sharply and to neglect the amount of noise. Perception needs to be both comprehensive and clear. The hearing system hunts for comprehension and clarity. It does not rest until the invariants are extracted.

The perceiving of the environment by means of touch could also be constructed along this line: the body explores the surrounding environment by locomotion; the limbs explore the ambient array with the hands, fingers, and feet sampling the array as well as doing additional exploratory adjustments to help reveal global structures and fine structures which constitute information. The observer needs to feel his way and focus on what is sensed. It is more than likely that a substantial amount of thinking will be dedicated to analyze the sensory information in order for perception to hunt for comprehension and clarity. In doing so, perception does not rest until the invariants are extracted. There seems to be deadly accurate during climbing activity, whether on a rock, a cliff, or a frozen waterfall. The hands, feet, and limbs with the assistance of any tool being held or used, will hunt for clarity and comprehension of the wall or climbing object's surface. Doing so, the climber is able to subsequently construct the significance of every bulge, cavity and stepping stone along their path.

Looking into the ways in which perceiving differs when perceiving lingual artifacts and when perceiving designed artifacts, this research considers the following points:

First, all acts of language follow a chronological sequence both in order for them to be realized or produced (language production), and more importantly in order for receivers to construct and understand their meaning as intended by their speaker. In spoken acts word must follow word, or other gestures. In written acts word must follow word or other written/visual elements, linearly in specific direction on surface.

In contrast, Designed artifact can be perceived all at once, or part after part at any random or casual order.

Second, lingual artifacts, spoken or written, are perceived as events. Drawing from Gibson's definition of fire, lingual artifacts are an *"event, with a beginning and an end"* (Gibson, 1986, p.38) which can be performed and radiate in different intensities of performance.

Designed artifacts seem to fall under Gibson definitions of medium in some cases, or of object in most cases: *"a persisting substance with a closed or nearly closed surface and can be either attached or detached. In this restricted sense, the surface of an object has a definite texture, reflectance, color and layout, the surface layout being its shape."* (Gibson, 1986, p. 39)

Third, when exploring, that is, reading or listening to paroles enabled by language, body movements and head movements are usually kept at minimum. The exploration, or reading, of paroles enabled by design in most cases will require the full set of actions or movements as described above, varying according to ecological conditions.

Forth, the time required to recognize lingual artifacts and the time required to recognize designed artifacts varies greatly, as well as the amounts of information that can be perceived in limited amounts of time. *"Recognition is cognizing again, identifying something by its kind (name) and in view of the use which it could be put"* (Krippendorff, 2006, p.90). Most spoken sequences take time to be heard and usually only after being heard in entirety their meaning could be recognized and subsequently understood as intended. Written acts of language may also take time to be read before their meaning is to be distinguished, but not necessarily as much as their spoken equivalents. Studies conducted in perceptual visual ability shown that *"flashing four words simultaneously on a screen for one five hundredth of a second"* (Buzan, 1991, p.10) was enough to obtain recognition of the word sequence. The same studies shed light on the time required to recognize designed artifacts:

“They started by flashing fairly large pictures of friendly and enemy aircraft at very slow exposures and then shortened the exposure while decreasing the size of the image seen. They found to their surprise that with training, the average person was able to distinguish almost specklike representations of different planes when the image flashed on the screen for one five hundredth of a second” (Buzan, 1991, p.10)

This account suggests that it may take more time to read or hear a 1000 words that it would take to look at a picture in order to recognize what it is about. This research leaves the following questions for further research in cognitive science.

- A) Does it take more time to recognize what is the subject of the following description - *“...made from Mahogany timber; three black tubular steel legs; black leather seat; its dimension are 54cm W x 86cm H x 61cm D; seat height: 50cm; armrest height: 63cm” (Replica Philippe Starck Costes Chair, 2014)*, than it takes to recognize the same subject by looking at the following photo?



Fig.5.4A: Philippe Starck’s Cafe Coste chair (retrieved on 20 Juni 2014 from <http://cdn.mattblatt.com.au/productimages/Replica-Philippe-Starck-Costes-Chair?>

W=440&h=460&id=16677&fullSize=True)

- B) which of the two representations of the subject- one lingual, the other visual - is easier to recognize? A section of its written or spoken description : *“Mahogany timber; three black tubular steel legs”* ? OR - a fraction of its photo, or illustration:



Fig. 5.4B: Café Costes Chair (a section)

- C) Considering the physical-tactile modality, or sensory ability, how long does it take to recognize the above chair by touching it?

Empirical experience and common sense suggest that visual perception is faster than auditory perception and that perceiving artifacts (when blindfolded, for example) with our hands, fingers and skin may take even longer. Please note that, while in visual perception *“first the silhouette is detected and then depth is added, presumably because of past experiences with the cues for depth”* (Gibson, 1986, p.83) sound perception and touch or spatial-haptic perception seem to operate very differently.

This research considers that one set of possible qualitative answers will most likely follow in line with Krippendorff's views of recognition in design: *“it depends”*. It depends on the situation, time, and opportunity, but most of all it depends on the observer's past experiences, common sense and prevailing conventions: *“designing artifacts that are easily recognizable depends on expected user's past experiences, common sense, and prevailing conventions”* (Krippendorff, 2006, p. 90). The interest is there in knowing what will the quantitative answer be. These don't depend on the individual observers, but the process of root learning they have gone through within their culture (as suggested in points 13 and 14 in investigation one). Experiment conductors of the above test will therefore need to make sure their test audience have all the same experiential

background and knowledge available, in order to get accurate and quantitative results.

The final point for consideration is that of aid or amplification of sensory input. This is required in some cases in order to perceive lingual artifacts, but also designed artifacts, that fall outside (in terms of frequency and scale) from the optimal sensory condition or limits of the perceptual system (as discussed in point 8 of investigation one). Mechanical or electronic aid or amplification may be used in audio or visual modalities in order to sense both microscopic and macroscopic sensory arrays. Hearings aid amplify audio sensory, glasses amplify visual sensory. Mechanical aids such as white cane can help blind people in sensing the ambient array by increasing the range of sensory of their limbs. There are also amplifying artifacts - like microscope, telescope, radar, sonar, ultrasound - which allow humans to sense and perceive phenomena existing outside the limits of frequency and speed of human sensory organs and perception mechanisms.

The accounts above point to the diversity of the perceptual system, where different organs have evolved in order to sample and explore the surrounding environment both in terms of modality (as in medium and objects) and frequency (as in events). Hand in hand, a key set of complementing cognitive functions must have also evolved in the brain in order to identify ambient information structures from the flow of radiant sensory information that is sampled by the different organs.

5.5 Conclusions Investigation Two.

In section 5.1, this research suggests that the similarity in hermeneutic circle of conceptualization of meaning of lingual and designed artifacts- by a mutual contextualization of sensory information - originates in the fundamental biology of the human brain and its development in the human species. Through triangulation of theories this research points to the result of millions of years in human evolution, where a specific area in the brain evolved to support a set of cognitive functions needed for processing grammatical aspects of both complex language use and complex interaction or tool use which is associated with design activity. These functions, in great likelihood, are performed in the frontal lobes of right and left hemispheres. *“Neuroscience tend to confirm that the right hemisphere of the brain is more specialized with spatial and constructional tasks, in aesthetic perception and emotions. The left hemisphere is more specialized with language abilities and verbal reasoning”* (Cross, 2011, p. 140). Evidence noted and presented in section 5.1 suggests that lingual reasoning stemmed out from perception and the ability to perform spatial and constructional tasks. This seems to correlate with the conclusions in investigation one which posits grammar protocol in perception, as suggested in points 21, 25, and 26 of that investigation.

In section 5.2, the research conducts a comparative study between the cognitive functions needed for language performance and those needed for design performance. Accounts of brain damage to the frontal lobe of either left or right hemisphere point out to design ability being depended on cognitive functions located both in left and right hemispheres. The theory of *The Language of Design* and its lingual performative operators (Dong, 2009) show that lingual reasoning is essential for idea generation, concept development and evaluation of prototypes.

"Language is more than representational, more than standing in for design concept when no other representation yet exists, more than being pointer to places in the mind to assist in constructing memory about a design concept, more than a passive historical account. Otherwise, language is impossibly estranged from what it is deployed to do - enact design and the design work" (Dong, 2009, p.15).

The converging of this information points to the strong possibility that cognitive sets of functions are not particularly dedicated to either language or design competences and abilities, but work as whole to support reasoning in acts of communication of various modalities. In order to design, designers need cognitive functions located in both left and right hemispheres. The production of language alone, as the case study of the architect has shown, is not enough. The actor designing must also be able to use or direct his language as a *language of design, that is*, towards the enacting and realization of the intended design.

Cases of damage to right prefrontal lobe seem to impair a person's design ability and creativity. These affect the performance of cognitive computations responsible for movements from one idea to a slightly different idea and the formation of detailed concept development as in Dong's operator of accumulation (2009). Also (although not impairing performance of language like damage to left hemisphere would do) damage to right hemisphere may result in impairing the ability to cope with lingual ill-structured problems, like writing a text, a book, or inventing a poem, as well as dealing with the ill-structured world at large (Goel & Grafman, 2000). This can be describes as a slight level of retardedness similar to that seen in the cases of "*chatterbox syndrome*" presented by Pinker (Pinker, 1994).

This research, points out, however, that the accounts studied in section 5.2 come short of reporting the effects of damage to left frontal lobe on the designing ability of aphasics, as well as

the effects of damage to the right frontal lobe on ability to write texts and produce literary work.

The converging of theories and evidence from sections 5.1 and 5.2 suggest that the cognitive capacities enabling the generation of the semantics and syntax of language are not only similar to the ones needed for design (as argued by Dong (2009, p. 176)), but very likely to be overlapping or work in unison. It is possible to claim that language and design share the same cognitive capacities. Subsequently this seems to follow in line with this research's initial structural framing of lingual and designed artifacts as act of communication enabled by singular and all-round human *"ability to represent objects (design) and abstract concepts (language) with arbitrary visual or material (design) and vocal(language) symbols and to act with reference to concepts not limited in time and space"* (Dong, 2009, p. 176). A key set of cognitive processes responsible to the construction of meaning from sensory input regardless of the sensory modality plays essential part in facilitating this ability and seems to be shared both by language competence and design competence.

With this the research forms here a contact point with Pinker's concept of *"mentalese"* which proposes *"a strong link between the structure of language and the structure of thought..."* (Dong, 2009, p. 176) and very likely between these latter two structures and the structure of design (as presented above and accumulated during the analysis discussions in investigation one of this research).

"People do not think in English or Chinese or Apache; they think in a language of thought. This language of thought probably looks a bit like all these languages; presumingly it has symbols for concepts and arrangement of symbols that corresponds to who did what to whom,... But compared with any given language mentalese must be richer in some ways and simpler in others. It must be richer, for example, in that several concept symbols must correspond to a given English

word like stool or stud. There must be extra paraphernalia that differentiate logically distinct kinds of concepts, like Ralph's tusks versus tusks in general, and that link different symbols that refer to the same thing, like the tall blond man with one black shoe and the man. On the other hand, mentalese must be simpler than spoken languages; conversation-specific words and constructions (like a and the) are absent, and information about pronouncing words or even ordering them is unnecessary" (Pinker, 1994. pp. 72-73).

Knowing language, as Pinker explores, is knowing how to translate *mentalese* into strings of spoken words, i.e., language parole or a lingual artifacts, and vice versa.

Knowing design, as this research proposes, is knowing how to translate *mentalese* into arrangements of visual or material elements, i.e., design paroles or design artifacts, and vice versa.

In both cases, humans use a code to translate between orders of structural unit and combinations of thought. *"That code, or set of rules, is called generative grammar"* (Pinker, 1994, p. 75). Accumulating from the relating discussions in investigation one and sections 5.1 and 5.2 in this second investigation. This research considers *Generative Grammar* to be a set of cognitive processes which associates sensory input with meaning in the brain. This set of cognitive processes seems to be at work the same way whether the act of communication is designed or lingual, that is, made of either visual-material units or vocal ones. Converging this with the comparative analysis made in sections 5.3 and 5.4, this research concludes that deploying this set of cognitive processes in different modalities, both in terms of phenomena (sound, touch, visuals) and semiotic terms (oral, gesture, written), constitutes as the fundamental difference between language and design activity.

Further on, studied as singular units de-contextualized from the sentence or arrangement that is the artifact, words - lingual base elements - and visual or material elements - design base

elements - fundamentally differ as phenomena. The first considered an event, the latter an object or medium. This results, in turn, in a fundamental difference in terms of use or functionality, that is, in how lingual and design elements are constructed and combined (or blended) into distinguishable information structures, as well as in the way and intensity of explicitness with which humans associate meaning with these base elements.

Humans deploy different systems of organs for both in the performance of and the perception of lingual and designed acts of communication. *"Where vocal realization requires dexterous manipulation of orofacial muscles and the larynx to articulate sounds, material design realization requires dexterous proprioceptive manipulation of muscles to handle to handle a position or a movement of a part of the body"* (Dong, 2009, p. 176).

In section 5.4 the research builds on Gibson's description of how the perceptual system performs in the context of visual perception and constructs from that description a parallel description for perception in audio and haptic contexts. Perception of different modalities and in different frequencies require different organs, different movement and very likely different cognitive processes (each dedicated to regulating a specific sensory modality or set of organs) with which information structures are sampled in the radiant flow of sensory information. The subsequent deployment of grammar leads to the recognition of lingual and design base elements in terms of physical properties, as belonging to abstract categories of sound impressions or ideal types entries in the user's mental dictionary, as discussed in investigation one.

The work in investigations one and two of this research points to a deep similarity between the performance language and design in terms of the cognitive and biological capacity (that allows for these competences) and in their cognitive structure. This suggests a strong link between the structure of thought and the structure of language and design. It is possible to hypothesize a sequence of evolutionary development in which the cognitive capacity to use language developed

(as Higuchi et al. (2009) suggest) over the cognitive capacity of perception (which possibly would have been used till then to regulate body movement and simple tool manipulation) before (and in unison with the further development of specific sensory organs in the body (as explored by Dong (2009)) both cognitive capacities have began to adapt for more complex structures of thinking. Today these structures allow for the complex phrase structure generative grammar that characterize human language use, as well as human design use.

This research concludes that language seems to be more than design's structuring structure, as Dong (2009) argues. It also notes that language and design capacities strongly seem to have, or share, the same key cognitive structure that enables the production of structurally similar artifacts of communication in different modalities. The third investigation of this research will attempt to show a sameness of structure between lingual artifacts and designed artifacts, as well as an inherent structural similarity in the planning and designing of such artifact. It will do so examining:

- how a key structural model used for the analysis of lingual artifacts can be applied to the study and analysis of designed artifacts, and;
- how the same model can be used as a guiding structure for the process of design, that is, be deployed in design practice and in the planning of artifacts.

Chapter Six

A Universal Model for Design: Exploration of Key Structuralist Model in Design.

In investigations one and two, this research was looking into language competence and use, as well as syntactic role players in parts of speech. It examined possible similarities and parallels between language and design and outline various principles, patterns and mechanisms shared by both abilities and the structures of the artifacts they enable to produce.

The research now directs its attention back to its initial framing of the designed and lingual artifact being acts of communication, or parole. It returns to the model of semiotics constructed and used by Thwaites, Davis, and Mules in *Introducing Cultural and Media Studies* (2002), which is grounded in the Saussurean semiotics and the works of linguists Roman Jakobson and Ferdinand de Saussure.

This source was chosen for the research because of its affinity with the other authors forming this research literary geometry, its comprehensive and clear overview on the field of semiotics and its use of elementary structural principles. The case studies, thinking and empirical examples of language use presented in this book seem to converge with the lines of thought formed by Pinker (1994) and Gibson (1986) and provide insights on both sign system use and the auditory perceptual system. Thwaites, Davis, and Mules framing of acts of language and acts of design as text forms a complimentary conjuncture with Krippendorff's own framing of these acts as artifacts. Further on, their semiotic approach to cultural and media studies seem to resonate with this research own goal to serve as an initial framework for a language based approach to design and its education (design studies).

This third investigation of the research is interested in the framing of parole (an utterance, or act of speech enabled by any system of signs) in term of universal structure. The research draws

here a parallel with Thwaites, Davis, and Mule's model of Semiotics, which *"is not concerned with individual or specific acts of sign use, but with the systems within which they operate and on which any particular sign use must be based. We will not be interested in everything which can be said in English, for example, but in the structures of English which allow us to say these things"* (Thwaites et. al., 2002, p.38). Yet, it tends to focus not on the relations between signs and their referents - between signifiers and signified - but on a universal structure common to all paroles as initially outlined by Jakobson (1960); a set of functions performed in language use, according to which an act of parole could be effectively described, distinguished, and, as this research intends to explore, also built (as is the case with advertising and propaganda).

This research suggests that in design these functions could be thought of as a set of concepts which are constructed by users or perceivers of the parole, and potentially a set of constructs resembling Krippendorff's *"User Conceptual Models"* (UCM):

"A network of operational concepts assumed to tell its beholder how an artifact could work, when to do what with it, and what to expect consequent to any action taken. Just as we rely on ideal types of familiar artifacts to recognize what a particular artifact is, so we rely on a system of equally simplified and skeletal concepts to ascertain what the parts of an artifact could mean in use" (Krippendorff, 2006, p. 105).

This last sentence resonates with Roman Jakobson's purpose as declared in his paper *Linguistics and Poetics* (1960), which is *"to account for what he argues are the properties peculiar to poetic language"* (Thwaites et. al., 2002, p. 28), that is, the *"constitutive factors in any speech event, in any act of verbal communication"* (Jakobson, 1960, p. 353), or the system of equally simplified and skeletal concepts and principles underlying the parole.

This system seem to be universal to all acts of communication, being *“valid not only for the verbal art but also for all varieties of language since language shares many properties with some other systems of signs or even with all of them”* (Jakobson, 1960, p. 351). It is important to note that just like Krippendorff's UCM, in the realization of the designed artifact these *“skeletal concepts”* can also be *“designer’s constructions of what users are capable of doing or learning”* (Krippendorff, 2006, p. 105), or understanding.

Finally, the research builds here upon Dong’s proposition that design activity *“is the enactment of a set of operating principles wherein the actors emphasize different aspects of these principles. It is the varying emphases, which probably exist for a valid reasons, on these principles that lead to various design praxis”* (Dong, 2009, p.9). While Dong turns to the *language of design* in order to create a capacious framework for thinking about design that can deal with the ways design is enacted, this research turns to language’s structural system in order to create its own capacious (language based) framework for thinking about design that can deal with the ways design is enacted. In doing so, it will attempt to show a sameness of structure between lingual artifacts and designed artifacts, as well as an inherent structural similarity in the planning and designing of such artifacts; a structure originating from a key cognitive structure shared by the brain's language and design capacities.

Working towards that aim, this investigation will examine:

- how a key structural model used for the analysis of lingual artifacts can be applied to the study and analysis of designed artifacts, and;
- how the same model can be used as a guiding structure for the process of design, that is, be deployed in design practice, in the planning of artifacts.

In the following pages the investigation revisits certain aspects from relevant key authors that are involved in the development of the selected structural model in order to posit this model

in the field of design. It then continues to conduct a series of exploratory case studies and qualitative interviews, which form its critical approach. Finally and as its final act, this investigation sets new goals for further future investigations in this direction, which fall outside the scope and limitations of this research.

6.1 Introducing the Roman Jakobson Model.

Roman Jakobson's synchronic approach towards the science of language is focused on the way in which language's structure serves its basic functionality to communicate information between speakers. With his approach Jakobson pioneered the structural analysis of language, which became the dominant trend in linguistics during the first half of the 20th century and marked him as one of the most influential linguists of that century.

Roman Jakobson had a decisive influence on Claude Lévi-Strauss and Roland Barthes. He became a pivotal figure in the adaptation of structural analysis to disciplines beyond linguistics, including to anthropology, literature, visual arts, and cinema. His work influenced Nicolas Ruwet's *paradigmatic analysis*, Friedemann Schulz von Thun's *four sides model*, Michael Silverstein's *metapragmatics*, Dell Hymes's *ethnography of communication* and *ethnopoetics*, the psychoanalysis of Jacques Lacan, and the philosophy of Giorgio Agamben.

Jakobson's model is built on Karl Bühler's Organon model which is (according to Jakobson) is confined to three functions according to which linguistic communication can be described - the expressive (emotive), representative (referential), and conative - and to "*the three apexes of this model - the first person of the addresser, the second person of the addressee, and the "third person", properly - someone or something spoken of*" (Jakobson, 1960, p. 355).

In his Essay – *Closing Statement: Linguistics and Poetics* (Jakobson, 1960, p. 350-377), Roman Jakobson expands Bühler's model into a model containing six functions of language (or of communication), according to which an effective act of verbal communication can be described.

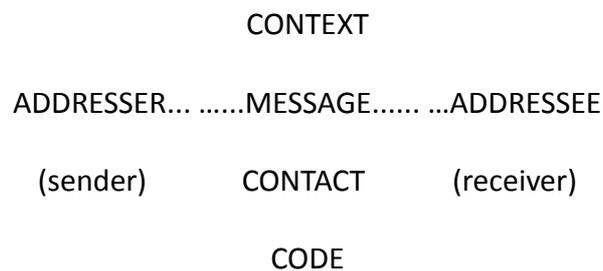
According to Jakobson, in any act of verbal communication where a message is sent between 2 people, to be operative the message requires:

- A CONTEXT referred to, cognizable by the receiver of the message, and either verbal or

capable of being verbalized;

- a CODE fully, or at least partially, common to the sender, the coder, and receiver, the encoder, of the message;
- and finally a CONTACT, a physical channel and psychological connection between the sender and receiver, that enables both of them to enter and stay in communication.

Jakobson presents these factors as the following scheme (Jakobson, 1960, p. 353):



Jakobson works these six factors and inquires into their orientation in any given speech event. He notes that *“Each of these six factors determines a different function of language”* and that *“The verbal structure of a message depends primarily on the predominant function”* (Jakobson, 1960, p. 353). Below is a short summary of the six functions and of Jakobson's observations about each of them in language use.

- The requirement of CONTEXT is further oriented in the text as the REFERENTIAL FUNCTION. Here language use functions in order to describe a situation, object(s) or mental state referred to/by/in the message.
- The sender or ADDRESSER is oriented as the EXPRESSIVE, or EMOTIVE FUNCTION. With it, language use adds information to message about the ADDRESSER's internal state by aiming *“a direct expression of the speaker's (ADDRESSER'S) attitude towards what he (or she) are speaking about. It tends to produce an impression of a certain emotion whether true or feigned (insincere)”* (Jakobson, 1960, p. 354). For example: *“Wow, what a view!”*.

- The receiver or ADDRESSEE is oriented as the CONATIVE FUNCTION. It is the ADDRESSEE who is engaged by the message. This function is best illustrated with pure grammatical expressions of vocatives and imperatives that are aimed at engaging a specific listener in language. Simple examples are “Tom, Come inside and eat.” or the command “Drink!”.
- The requirement of CONTACT is oriented with the PHATIC FUNCTION. It is demonstrated by language use for the sake of interaction and is usually displayed by an abundant exchange of ritualized formulas like greetings and casual discussions about the weather. *“There are messages primarily serving to establish, prolong, or discontinue communication, to check whether a channel works (“Hello, do you hear me?”), to attract the attention of the interlocutor (a conversational partner) or to confirm his attention (“Are you listening?”)”* (Jakobson, 1960, p. 355).
- The requirement of CODE is oriented into the METALINGUAL FUNCTION. *“We practice metalanguage with out realizing the metalingual character of our operations. Whenever the addresser and / or addressee need to check up whether they use the same code, speech is focused on the CODE: it performs a metalingual (i.e., glossing) function, “I don't follow you – what you mean?” asks the addressee”*(Jakobson, 1960, p. 356).
- The MESSAGE itself is oriented as language's POETIC FUNCTION. *“The Poetic function is not the sole function of verbal art, only its dominant”* (Jakobson, 1960, p. 357). That is because the empirical criterion for the POETIC function in language use is the indispensable feature inherent in any speech event. *“The two basic modes of arrangement used in verbal behavior, selection & combination... ..The selection is produced on the base of equivalence, similarity and dissimilarity, synonymity and*

anonymity, while the combination, the build up of the sequence, is based on contiguity (adjacency). The poetic function projects the principle of equivalence from the axis of selection into the axis of combination” (Jakobson, 1960, p. 358). Without the poetic function, the arrangement (the selection and combination) of the words themselves, none of the other functions can take place.

With these, Jakobson's compliments the above scheme of the fundamental factors involved in verbal communication by a corresponding scheme of language's fundamental functions (Jakobson 1960, p. 257):

REFERENTIAL
 EMOTIVE...POETIC..... ...CONATIVE
 PHATIC
 METALINGUAL

6.2 Jakobson's Model and Thwaites et al. Functions of the Sign Model.

Noting Krippendorff's objection to the exclusion of human agency in semiotics, this research will attempt to present Thwaites, Davis and Mule's model in terms compatible to the views outlined in the semantic turn. In further instances, this research will short *Thwaites et al.* to simply *Thwaites* in order to ease the flow of the text.

In *Introducing Cultural and Media Studies: a Semiotic Approach* (2002), Thwaites presents an adaptation of Jakobson's model (containing 7 functions rather than the original six) as the foundation of their construction of semiotics. He changes the scope of Jakobson's model from poetic language use into general sign-system use.

In his book, Thwaites starts with defining the "*sign*" as anything that produces a meaning. He then continues to frame and define - by drawing examples from language use - each of the functions in his model, according to which an effective act of communication, that is of sign use, could be described.

Thwaites divides these functions into two groups; those used by users/readers of the sign in order to construct its content (functions of significance), and those used by users/readers of the sign in order to construct its "*sender*", its "*receiver*", and the relationship or attributes of their contact (functions of address). Further on, he separates content and context following Dell Hymes's "*Foundation of Sociolinguistics*" (as cited by Thwaites), and reworks Jakobson's POETIC and EMOTIVE functions respectively into the FORMAL and EXPRESSIVE function. This is motivated as follows:

"..following Hymes's revision, we have separated out content and context. Our formal function is a reworking of Jakobson's poetic function: we have generalized its meaning somewhat, and renamed it to mark the difference (and also to avoid the implication that this function is

synonymous with ideas such as a conative aesthetic pleasure, or the metalingual coding of text as poetry). For similar reasons, our expressive function reworks what Jakobson calls the emotive function, which may misleadingly imply it is concerned with emotionality.” (Thwaites et al., 2002, p. 22)

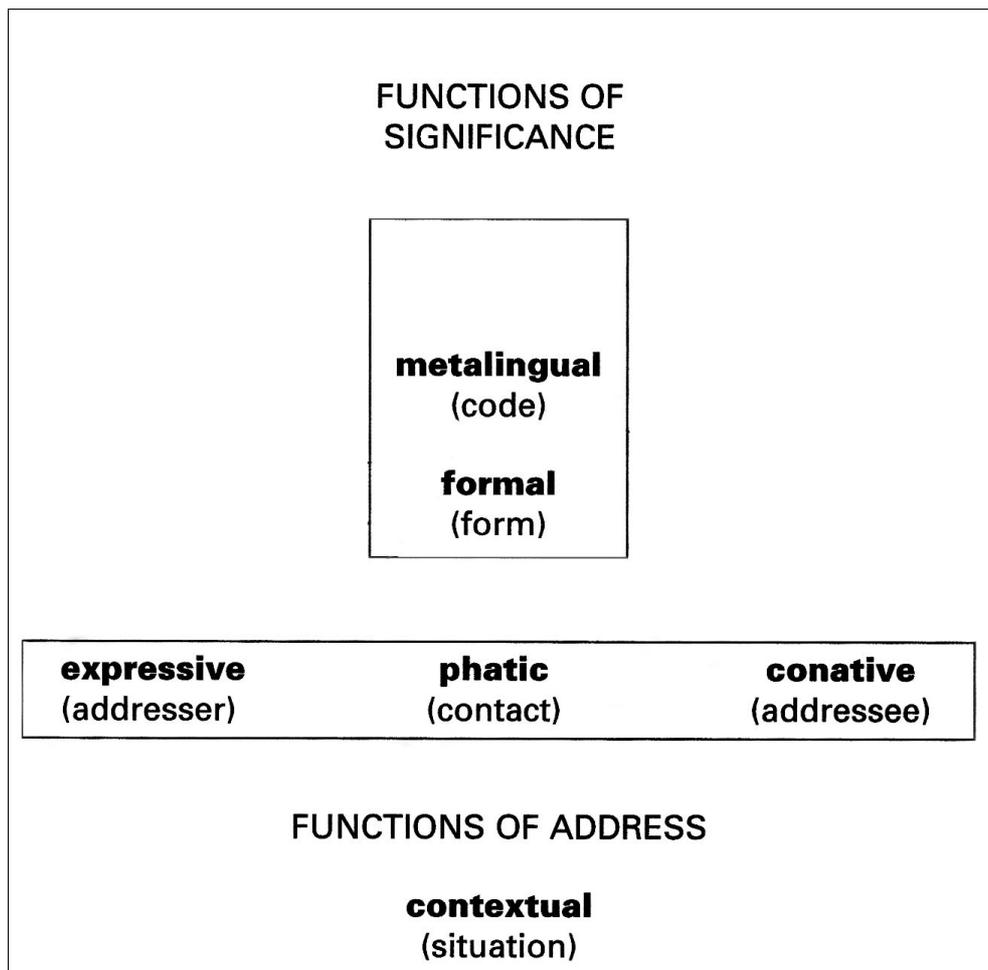


Fig. 6.1: The functions of the Sign (Thwaites et al., 2002, p. 22)

According to Thwaites, these fundamental 7 functions are necessary in order for sign use to take place within culture - *“the ensemble of social practices by which meanings are produced, circulated and exchanged”* (Thwaites et al., 2002, p. 1). Therefore, any given sign or act of communication comes into realization when the following conditions are fulfilled:

“A sign must:

- *work within a system of references and coding;*
- *be describable in terms of formal attributes which allow us to distinguish it from other signs;*
- *set up a relationship of address; and*
- *operate within, and vary according, specific concrete situations.”* (Thwaites et al., 2002, p. 21)

The list below is a summary from Thwaites’ first chapter, describing each of the functions from figure 6.1, respectively framing their performances, or factors, which are associated with the use of signs.

- FUNCTIONS OF SIGNIFICANCE:
 - The REFERENTIAL function of sign use means that users can use a sign to refer, represent, depict, or propose something as real, in different ways and to varying extents, whether true or not.
 - The METALINGUAL function of sign use means that users can distinguish and identify ways in which a sign may be read or understood - by relying on cues in codes for interpreting it. *“This indicates that a sign's meaning is far from a given fact. Instead it is something to be actively worked out or negotiated, and always subject to renegotiation.”* (Thwaites et al., 2002, p. 15)
 - The FORMAL function of sign use means that users can distinguish and identify a sign according to its perceived information structure - its features in terms of form, including the space (i.e., physical dimensions and layout) and medium (i.e., the media or material from which it is made) in (and from) which it exists.

- FUNCTIONS OF ADDRESS:
 - The EXPRESSIVE function of sign use means that users can construct a sign's addresser, "*where it says it is from*" (Thwaites et al., 2002, p. 16), the position it proposes as its source and not its actual source (sender).
 - The CONATIVE function of sign use means that users can construct a sign's addressee, "*where it says it is going*" (Thwaites et al., 2002, p. 17) or where it is aimed to, the position it proposes as its destination and not its actual destination (or receiver).
 - The PHATIC function of sign use means that users can construct the relationship between the sign's addresser and the sign's addressee. The PHATIC function links addressers and addressees in all sorts of degrees of social inclusion and exclusion. For example, "*A letter in English will exclude non-English user. A particular way of speaking may bind a group together and give it an immediately recognizable identity, to itself and others. PHATIC functions can be enormously complex and subtle ways of discerning insiders, and the degree of their belonging.*" (Thwaites et al., 2002, p. 19)
- Functions of CONTEXT
 - The CONTEXTUAL function of sign use means that users can construct a sign's intended context, event, or situation, in which it is deployed. "*It only remains to say that all of these (above) functions depend on the social context of the sign. The social situations in which a sign is used may determine the appropriate content, type of sign and coding, who is being addressed, by whom and how, and the phatic community it constructs.*" (Thwaites et al. 2002, p. 19)

Although all of the functions above are needed for any sign event to take place, in any given

act of sign use some of these functions may be more dominant than other. Further on, these functions are never independent of each other, but constantly interrelate:

- Certain functions may work very closely together. For example, the FUNCTIONS OF ADDRESS in a love letter, which may work in a cohesive way to indicate a contact of close affection between addresser and addresser.
- Some functions may overlap each other, like in a job application letter where the EXPRESSIVE and REFERENTIAL functions coincide in order to convey information about the same thing.
- Other functions may work against each other. For example a passionate and overly emotional first person addresser (EXPRESSIVE) will possibly contradict the purpose of a scientific paper (CONATIVE), which, in order to be properly scientific, must be dispassionate and unemotional.
- Finally in some cases one function may trigger another. A font and a layout of a letter cues in its FORMAL function, subsequently these may trigger off meanings associated with its METALINGUAL function suggesting what sort of letter it is and how to “*decode*” it.

6.3 Case Studies: Deploying the communication model in the analysis of designed artifacts.

After presenting Jakobson's model and Thwaites et al. adaptation of it, this research explores how this structural communication model can be deployed in the description and analysis of design parole. By using different examples of real, actual and concrete uses of design parole - arrangements of material and visual elements used for the communication of meaning - this research attempts to posit Jakobson's model as a universal structure, or a set of parameters underlying all designed artifacts.

The range in form and type of designed artifacts (the design parole) is potentially infinite. This research cannot possibly thoroughly cover all the different examples of design use (what may be a diachronic approach). Therefore it intends to use specific empirical examples of design use - design parole - from varying degrees of complexity, modality, and cultural use in its attempt to posit Jakobson's model. In doing so this research aims to infer the structure of the design langue - an underlying system that enables acts of design use - by inquiring for Jakobson's principles and their aspects (according to which all acts of communication could be described) in the examples used.

As such, the research will analyze and describe four designed artifacts and use the model to inquire into the functions fulfilled by structures of materials and visual elements. It will form and describe different aspects of each artifact along the lines described in the sections above and orient the observer towards the construction of User Conceptual Models in terms of formal attributes, code, intended reference, addresser, intended addressee, connection, and intended context(s).

The selection of the examples used is intuitive in and reflects the contemporary nature of

design, which is very much based on the serendipity and openness to contextual experience in daily life. In this sense, the intuitive core of this selection is faithful to today's design experience.

6.3.1 Case Study One.



Fig. 6.2: case subject one, front, back and side silhouette views (item from researcher's own collection, image made on 12th June, 2013)

The subject is a flat man-made object of circular dimension made of white plastic. It is 21.2 cm in diameter with its edge elevated 2 cm in height. This elevated edge contains a rim of 1.3 cm in width with the text *“Na ieder hapje ontdek je een nieuwe vriendje”* (After each bite you discover a new little friend) printed in light blue colour. Printed in the middle of the plate are illustrations of different animals (Dog, pig, horse, sheep, duck, cow and chicken) painted in pastel colors, grouped and surrounded by a light blue dashed line forming an outline similar to that of a slice of bread.

The back of the plate has a circular footing relief made from a 3 mm thick line running in a circle along the edge of the plate's bottom surface. This relief is divided into four sections with 1.5 cm of space in between each section. With a center top alignment there is an informative text about *Blue Band* butter: *“Blue Band Goede Start! Is verrijkt met extra calcium en de volgende zeven essentiële vitamines: A, B1, B2, B6, B12, D en E. Met Blue Band Goede Start op brood krijg je*

hiervan al 20 tot 50% van de aanbevolen dagelijkse hoeveelheid binnen. Voor een goede start van de dag!" (Blue band good start! Is rich with extra calcium and the following essential vitamins: A, B1, B2, B6, B12, D and E. With Blue Band Good Start on bread you already get 20 till 50% from the recommended daily quantity of these. For a good start of the day). Below the text there is the *Blue Band Goede Start Logo* and far below it is a pictogram of a wine glass and a fork.

Structural analysis of case subject one:

- Functions of Significance:
 - FORMAL – This combination of selected elements which forms the subject functions FORMALLY - allowing users to distinguish this artifact from other everyday products according to the quantitative description of the artifact provided above. Building on this information, users can further understand what the subject is and what it is not. The formal attributes of these elements coherently cue in meanings related to other aspects of this artifact or the constructs evoked by it.
 - METALINGUAL – This arrangement of elements functions in several METALINGUAL ways. It cues in different codes with which this artifact could be understood, or read as intended. The first code which is cued in, that of dimension, is supported by human sensory-motor coordination; the subject's form, shape and proportion, all are seen as a cue in a code indicating that the subject, in terms of ideal type, can be recognized as a dining plate used by humans (and not as a fruit bowl, a cup, a hat, or a Frisbee and so on). The second code is constructed by the illustration type and color range. With its dominant use of pastels the combination of colors leads to the later association of a child's object or a toy and triggers further the conative aspects of this artifact. The third

set of elements to serve as a code is made of Latin letters and structured text. It indicates a language code, which will too, at a later point, trigger further conative aspects. The fourth code is constructed by the explicit use of a logo code, which can be used in constructing the expressive aspects of this artifact - *Blue Band* are not manufacturers of plastics or of children's apparel - as well as in constructing a contextual aspect of an advert which this artifact may afford.

- REFERENTIAL – The arrangement of the artifact cues in possible activities, concepts or situations referred to by the the artifact - more strongly by the visual elements on the plate than by its other FORMAL attributes. These are further linked with meanings related to the contextual aspect of this artifact. The front illustration refers to a concept of game, where with each bite from a sandwich, suggested to be located within or upon the blue dash contour line referring to a slice of bread, another animal “friend” will be revealed on the plate. The text on the back of the plate refers to a proposition of the good and and healthy benefits of having *Blue Band Goede Start* on your bread - suggesting this artifact is an advert. Another reference to specific dish cleaning method of the artifact is seen by the small pictogram appearing far below the *Blue Band* Logo.
- Functions of Address:
 - EXPRESSIVE – The logo of blue band functions EXPRESSIVELY leads the construction of an intended addresser: the company *Blue Band* who is behind the production and dissemination of this mass produced artifact. Here, the signs functioning REFERENTIALLY trigger or overlap with signs that are functioning EXPRESSIVELY. On the back of the plate the addresser's (Blue Band) brand image comes across clearly and directly through the type, colour and layout of the text,

and the company logo. These are much more serious and direct in comparison to the illustrations and text presented on the front of the plate- A duality in style, which leads to the construction of different users.

- CONATIVE – Various elements in the artifact function CONATIVELY and lead to the construction of two intended human users (both Dutch speakers). The first is the final user or recipient intended for this object – a child who will at one stage play with it. This is suggested both in the material chosen for the plate (plastic does not break so easily like ceramic), the plate's size, and the colors, font and illustration types presented on the front of the plate. The second user of this product is situated as the middlemen between the addresser and the intended addressee, since it is unlikely that children at young age, can read or understand what calcium and vitamins are, the text at the back of the plate is aimed at the caretakers or parents of the child. They have the skill and know-how to understand the text and power to decide what will those under their care eat.
- PHATIC – Looking for the means by which the addresser made sure his message would reach the intended addressees, this research identifies the following elements as functioning PHATICALLY. The first - facilitating the construction of advertisement context, of the source of this plate, and of its intended users - the text at the back of the plate also leads to the construction of psychological contact. The message narrative from the addresser of this object is clearly understood by its intended addressees, clearing up any misunderstanding that might occur if it was not there (the product would be just a plate for kids and not an advertising tool). Another conative aspect in the text is its use of Dutch and the dashed outline of a slice of bread which exclude non westerners and

specifically non-Dutch speakers from understanding/associating themselves with the message (in Asia bread has different form). The third way of constructing a contact is the use of pastels, font and illustrations types, which while functioning CONATIVELY also functions PHATICALLY making it easier for children and caretakers of children to associate it with themselves. It is doubtful that a banker, a construction worker, or a delivery man (unless they have kids) will associate themselves with such a plate.

- Function of Context:
 - Contextual – The arrangement of elements in this artifact functions CONTEXTUALLY as a result from entities set in other UCMs that were constructed from this artifact. These are converged together to allow the construction of Intended situations and contexts of use. In this case it is very clear that even though the most common context in which the plate will operate is the dining table (Triggered by METALINGUAL, REFERENTIAL, and CONATIVE functions of sign use) this plate by itself operates as an advertising/promotion tool and its predominant context is the marketing and sale of *Blue Band* products (triggered by REFERENTIAL and EXPRESSIVE functions of sign use). Another context of use is cleaning of the plate in a dishwasher (triggered by REFERENTIAL function of sign use). Of course these contexts could be ignored - based on different codes (METALINGUAL) like sensory motor coordination, or functionality of its shape - the plate could be put into a good use as a flower pot or a Frisbee, depending on idiosyncratic events and situations. Also the addressee could very simply ignore what the addresser is intends to say (and sell), or be offended by it - if all they wanted is a plate for their kid to eat from.

6.3.2 Case Study Two.



Fig. 6.3: ARO Centerpieces items (retrieved 26th August, 2013, from: <http://miguelvieirabaptista.com/>)

The second case subject is part of the MATERIA design collection, an initiative by the Portuguese cork company Amorim and Experimenta design, a Portuguese cultural non-profit association geared towards the promotion of design and its role as a tool for positive change. Designed by Miguel Vieira Baptista, this artifact is made from agglomerated cork and lacquered steel. The Aro is described on www.materia.amorim.com in the following words:

“Simplicity belies its eloquence. Aro is a centerpiece as well as a statement, a bold assumption of cork’s personality. In the same way as cork stoppers are compressed into place becoming an airtight seal, Aro takes a substantial hunk of cork and binds it with a graceful metal ring. Highlighting its texture and density, the combination with another material denies nothing of cork’s physicality and aesthetic weight. Aro shows off and celebrates these characteristics, putting

cork center-stage in your living environment.” (ARO, retrieved 26 August 2013 from:

<http://www.materia.amorim.com/en/collection/complete-collection/aro>)

Structural analysis of case subject two:

- Functions of Significance:
 - FORMAL - The subject is formed from the combination of two round elements, one thick (“*a substantial hunk of cork*”), the other thin (“*a graceful metal ring*”), and is combined through binding and compressing the thick with the thin. The color range is composed from 3 colors: wood, white, and gray. The elements do not feature a logo or any other form of text on them. Although these elements function FORMALLY as quantitative attributes according to which users can understand how the ARO can be distinguished from other objects (and in turn understanding what it is not), they can not facilitate a clear understanding of what it is. The formal attributes of these elements facilitate meanings that are related to other aspects of this artifact or to the constructs that could evoked by it, but a lot is left “unsaid”. This makes the construction of the other UCMs a matter of qualitative guess and speculation.
 - METALINGUAL - This arrangement of elements functions in a METALINGUAL way with which a satisfying understanding of this artifact is can be constructed. The subject’s form, shape and proportion is perceived as a circular, almost graphic, contour line separating an inner raised area from the space surrounding it. This in turn is linked to a code according to which the subject can be understood: a code of artifacts associated with abstract ideal types of “basin” and of “platform”. The proportion and size of the subject help to narrow down the type

of basin and the type of platform to specific ideal types and possible affordances. This leads to the recognition that the subject is a placement container and a stage. In subsequent - yet long before the label “*centerpiece*” is recognized as its meaning in terms of use - the Aro is understood in the functionally category of a decorative bowl. The Aro is not and by no means looks like a decorative bowl, but its arrangement of elements is linked to the ideal type of a “presentation” bowl in terms of use. This ideal type is a mental entry that lists a container object - that presents its content and gives a stage to what it contains - as the code according to which an understanding of the ARO can be constructed.

- REFERENTIAL - This arrangement’s FORMAL and METALINGUAL attributes function REFERENTIALLY in various ways. First, since this artifact looks nothing like a “bowl” - in terms of user expectations of what a “decorative bowl” should look like - this arrangement facilitates the construction the reference of a “decorative bowl” in terms of use, referring in turn to an intelligent sophistication inherent in the subject. Then, in a subtle way, it provides a recollection to the history of cork use in artifacts by the compression of the metal ring into place on the cork platform. To those familiar with cork this is associated with the subject in terms of experience and knowledge of the method in which “*cork stoppers are compressed into place becoming an airtight seal*”. Further on, the simplicity of its elements’ forms, the quality of materials from which they are made, the minimal use of color, and smooth finishing, refer to aesthetic concepts of sophistication (less is more), contemporaneity, authenticity, and luxury, while the formal attributes of its elements - thick cork

pad, and thin metal rings suggestively refer to experience of warmth and playfulness.

- Functions of Address:

[Please note: The absence of key elements - like a) a clear sign such as logo which could be used to construct an addresser; b) a clear sensory-motoric code of size and proportion which could be used in the construction of both addresser and addressee and; c) the use of text (as seen in case study one) which could be used to construct contact between them, as well as the addresser and addressee themselves - leaves the construction of the functions of address to detailed observation, intuition, and calculated guess.]

- EXPRESSIVE - The selection of forms, colors, shapes, materials and methods of finishings, as well as the complexity (on one hand) and simplicity (on the other hand) in their combination, function EXPRESSIVELY in the construction of an addresser in qualitative terms. In this case a metalingual code is associated solely with the addresser's signature, style, or attitude of action - displaying the addresser's aesthetic and ethic attitudes towards cork, cork stoppers, cork seals, and decorative bowls (the referents of this arrangement). These possibly suggest that the addresser is a perfectionist, who gives great attention to detail as seen in the use of geometric shapes and flawless finishing of materials (which suggest they possess higher education). The graphic, almost iconic, use of elements suggest a personal connection with pop culture and graphic design. The use of slick and bold forms suggests a confident character and sharpness of mind. Finally, their way of translating the ideal type or concept of "decorative bowl" into a playful and welcoming object suggest the addresser to be a functionalist with a child's heart. Another type of addressers that could be suggested (by the creation and

combination of materials elements and the presence or absence of mark resulting from their production methods) are the industries involved in the artifacts creation. These exclude any hand made work in terms of craftsmanship and suggest instead, but not necessarily, mass production. The use of sophisticated tools like molds, airbrush, and welding can also be used to indicate that the artifact is produced in different locations, by different actors, and assembled into completion.

- CONATIVE - Looking beyond sensory motor coordination - with which one cannot construct with 100% certainty that humans are indeed this subject's addressee - and relying on its currently known context, this research places this artifact in human culture. The construction of an addressee is then formed along the lines of aesthetic appeal. The REFERENTIAL attributes of this arrangement function CONATIVELY to appeal to persons, or users, who would like to surround themselves with modern and sophisticated luxurious objects. Possibly, these users are interested in authentic items with rich stories. The Aro centerpiece is not a gadget, a mechanical device (or appliance), or an *"object that is interesting for its ingenuity or novelty rather than for its practical use."* (retrieved from www.dictionary.com 21st August 2013), but an object of intelligent sophistication and simplicity that would "radiate" these qualities on its owner and enter them into conversation with their peers.
- PHATIC - The way in which this arrangement functions PHATICALLY seems to work along the lines of its REFERENTIAL aesthetic appeal rather than a code of sensory motor coordination. The REFERENTIAL attributes of this arrangement function PHATICALLY to build a contact between addresser and addressee around a shared set of aesthetic values between the addresser and address. A set of aesthetic values which is respectively, "expressed in" and "constructed from" the ARO's formal

attributes, META-data, and their reference.

- Functions of Context:

- CONTEXTUAL – The formal attributes of the ARO work CONTEXTUALLY in a very limited way. From its generic form one can suggest that the subject is to be placed on a flat surface, as well as the size limits of that surface within which the ARO could be supported stably. Together with the METALINGUAL association of the subject with placement containers, stages and decorative bowls – it seems that the ARO is to be used in interior decor and presentation. The subject’s minimalism, the simplicity of its formal attributes, and the lightweight emphasis of aspects in its function of address make it very likely that the ARO will be use in completely different contexts, that are very far from the intention of its addressers. Idiosyncratic situations and detailed actual contexts will have great influence on how users will understand the ARO. The lightweight emphasis on aspects of its functions of address and formal minimalism, increase the amount of imaginable uses, rather than narrow it down (as seen with the earlier case study and its strong emphasis on its function of address). Finally, the scale and volume of this artifact suggest a strong association with a “lifestyle” or “interior design” environments where it can be used to stage its contents. This make the contents of the ARO centerpiece centerpieces themselves.

6.3.3 Case Study Three.



Fig. 6.4: Case subject three on location in Heezerweg, Eindhoven (Photo taken on 22nd May, 2014)

This case subject appeared in several location in the city of Eindhoven between 2011 and 2013. Adapting from Krippendorff (2006, p. 61), the researcher here hypothesizes a grammatical structure to make sense of the elements that form the subject. Such an assumption for a meaningful structure for the whole usually calls for revision of what these elements mean in that context. This leads to revising the subject's meanings until an understanding emerges in which all apparent incompatibilities are resolved to the researcher's satisfaction. This case study analysis motivates the constructions of the subject's meaning by the researcher's own personal experience - a person with elementary knowledge of the Arabic language, and who is informed in world politics and emerging situations.

Structural analysis of case subject three:

- Functions of Significance:
 - FORMAL - The subject is formed from series of graphic 2D (straight, curving, and

braking) lines and dots sprayed in black, placed or displayed on a various vertically standing surfaces in different street locations. Building on these, users can further understand what the subject is and what it is not. The formal attributes of these elements can be used coherently as cues to meanings that relate to other aspects of this artifact or the constructs evoked by it.

- METALINGUAL - The FORMAL and CONTEXTUAL attributes of the subject function METALINGUALLY to facilitating the understanding of the subject according to the code of a tag or a wall graffiti as in street art. The use of spray can in creating the subject and the selection of street wall as context suggest it to be a provocation and associates the subject mostly with street art or activism. The subject's formal attributes can also be related to an Arabic language code and to the letters used in it. This code can be used as the basis for understanding these marks as a script, as well as what this script may REFER to. The last mark on the left seems very similar to question mark that is flipped horizontally (as is used in written Arabic text). However, the contextual locations in which the subject appears seem incompatible with Arabic speakers location in the city. Further on, the formal use of dots for punctuation of letters, rather than the traditional line marks of hand written Arabic, cast strong doubts that what is seen is actually Arabic. This call for a revision of the code. With that in mind, the researcher hypothesizes that these marks are actually Latin letters disguises as Arabic script. With this new hypothesis Dutch and English language codes can be considered as the METALINGUAL key for decoding or understanding the script. The flipped question mark also functions METALINGUALLY. It can be taken to suggest that the viewer needs to horizontally flip the order of the marks, mentally visualizing

their order from left to right. Finally, some marks seem to repeat themselves and can be understood as identical letters in different positions on the script, fitting a structural code of a word: the second and fifth marks from the right, and the fourth and sixth marks form the right; the fourth mark seems to be a simplified version of the sixth mark.

- REFERENTIAL - Subsequently, building on the meta code assumed above, the marks seem to refer to the Latin letters (from right to left): the letter “b” , followed by an “A”, “g”, a “d”, another “A”, and another “d” at the end. The flipped question mark suggesting the viewer needs to flip the order of the marks, mentally visualizing the following situation “bAgdAd?”. The use of “Arabic like” script to draw these letters function REFERENTIALLY to link the sensed script with the Dutch word “Bagdad” (Baghdad in English). The script is then understood as a question - Baghdad? (bAgdAd?) - and as a reference to the city in Iraq (or to the situation there). The subject can then be understood as a comparison between the cities Eindhoven and Baghdad, or between life in Eindhoven and life in Baghdad.
- Functions of Address:
 - EXPRESSIVE - The construction of addresser is constructed from the codes used to structure the message as well as to decode it, and the locations in which the subject appears. Further on, the writing style of script can be understood as a METALINGUAL code that is associated solely with the addresser - as his or hers signature, or “attitude”. The addresser seems to be a person, resident of Eindhoven, who is immersed both in Arabic script as well as in Latin, English or Dutch scripts, but is not necessarily an Arab speaker as most observer would

think. The addresser has some sort of relation to the situation in Iraq. For example, they could be related to Iraq physically (family origins), or ideologically (Political left). The use of spray can as well the choice of street art in order to convey the message suggest the person to be artist, while the message itself - as interpreted above - suggest the person to be connected ideologically with the left or radical left. This can be used to construct his or hers motivations, from spreading subversion to showing sympathy, or perhaps the intention is to increase awareness of the Dutch locals to situation Iraq while making them also more aware of the influence it projects towards the Netherlands.

- CONATIVE - The intended addressee is constructed by considering the aspects of accessibility and effect. The researcher asks who are the persons who will have the most access to the subject's message, as well as who will be affected by it. The addressees are those who walk the streets and move around where the subject appeared, but not necessarily Arab speakers. It is very likely that to most persons (who are not as informed or knowledgeable as the subject's current analyzer) the subject would seem to address Arab speakers - which are associated to the artifact by its formal attributes. But Arabic speakers may see of it as an incomprehensible "doodle" on the wall. Therefore it seems that the addresser aims the subject at non Arabic speakers, provoking sensitivities to Arab or Muslim population in the Netherlands.
- PHATIC - The surfaces on which the subject was placed, including their location on different streets, the Languages used in the structuring and eventual decoding of the subject, as well the reference of "BAGDAD?" itself, function phatically to build the contact channel between addresser and addressees.

- Functions of Context:
 - CONTEXTUAL - The FORMAL and REFERENTIAL attributes of this arrangement function CONTEXTUALLY to suggest the use of the subject in the context of street art, as well as in socio-political context.

6.3.4 Case Study Four.



Fig. 6.5: Case subject four, top, and perspective views (item from researcher's own collection, image made on 24th July, 2015)

The analysis below is based on an extremely tiny amount of knowledge relating to the subject. The subject has found its way into the researcher's home, and has been an item of interest and mystery ever since - the researcher misses a key experience or piece of information with which they can conceptualize the correct or intended meaning of the artifact.

Structural analysis of case subject four:

- Functions of Significance:
 - FORMAL - The subject is formed from a thin, flat and soft sheet of wood, approximately 27 cm long and 23 cm wide. Its shape is deformed in different intensities along its edge, which is slightly raised from the rest of the surface.
 - METALINGUAL - This arrangement function METALINGUALLY to facilitate the understanding of this artifact as type of a tray. This code of dimension (supported by sensory-motor coordination) seem to strengthen the notion that the subject can be understood as hand held tray. Yet, its formal attribute of

softness makes such functionality very limited. At best all the subject could carry is few hundred grams. This suggests the possibility that the subject could be better used hand held fan on a hot day, or even as a head cover.

- REFERENTIAL - This arrangement does not seem to be functioning REFERENTIALLY in terms of association to a coherent concept, or a meaning other than its own formal attributes and code for use. If anything, the subject's formal attributes seem to suggest its own history: the subject is weak and incomplete, perhaps it was a failed attempt to produce a tray. It might have belonged to a design experiment, or have been a simple exploration in wood.
- Functions of Address:
 - EXPRESSIVE - The construction of addresser is dominated by detail formal attributes - marks made during the realization of the subject. These seem to indicate the use of molds, water and steam in order to deform the sheet of wood into a desired shape. The randomness of intensity of the deformation along the edge and the lack of a uniformed shape suggest the item is hand made or crafted, and that the craftsman did not pay much attention to detail suggesting in turn a student, an apprentice, or a craftsman busy experimenting.
 - CONATIVE – The construction of addressee is dominated by METALINGUAL sensory motor coordination. Through the scale and proportion of the subject it is possible to suggest that the item is aimed to be used by humans.
 - PHATIC - The formal attributes of the subject form the method of contact between the craftsman or design student who made physically and a possible user. All belong to the human species.
- Functions of Context:

- **CONTEXTUAL** - The **FORMAL** as well as the **METALINGUAL** attributes function **REFERENTIALLY** to suggest that the subject can be used as tray for paper letters, some cookies, bags of tea, but nothing heavier than that. Alternatively it could be used as a fan, a hat, box cover, and so on according to varying situations. The lightweight emphasis on the aspects of code, reference, sender, receiver, and contact give the subject ambiguous meaning. The search of its meaning can very easily become a debate, which possibility can position this item as a piece of art.

6.4 Case Studies Conclusion: Positing Jakobson's model in design.

Based on the analysis above, as well as on the work accumulated in investigations one and two of this thesis, the research produces here its proposal for a "*Functionalities of Design*" model. This model is an adaptation to design of Jakobson's Model. In it, this research posits the adaptation used by Thwaites et al. (for their semiotics model) into the field of design and attempts to conceptually re-frame each of the functions and factors of the Thwaites et al. model according to terms compatible with Krippendorff primary concepts about meaning, conceptualization, and user conceptual models.

According to Krippendorff, meaning is a set of possibilities that enables the handling artifacts, is invoked by sensory input, and constructed from a network of expected senses. Meaning is embodied in the beholder and cannot be shared, but can only coordinated between people. Meaning has no physical location but emerges through human participation in interaction with text (language use) and in interaction with artifacts (design use). Meaning is constructed through hermeneutic circle in which a meaningful structure is assumed and revised by the user until all inconsistencies and incompatibilities between what is sensed and what is seemed to be happening are resolved to the user's satisfaction. In the participation of humans, sensing, manipulating and conceptualizing are complementary operations performed during interaction and are inseparably tied to a constructive understanding. The meaning of any given artifact is conceptualized as a function of the assumed relationships between its parts - mutually contextualized by their arrangement - and as a function of how the whole is related to other artifacts, concepts, and parties. As such, the meaning of any given artifact, in its whole, is a network of operational concepts assumed by the user: a system of simplified and skeletal concepts or principles with which users can ascertain what the parts of the artifact, as well as the artifact as a whole, could mean in use, refer to, or represent (Krippendorff, 2006).

Krippendorff's concept of UCM has two cores. The first is oriented towards designers - *“It is important to note that UCMs are designers’ constructions of what users are capable of doing and learning”* (Krippendorff, 2006, p. 105). The second towards users - *“To support meaningful interfaces between artifacts and their users, who can be expected to bring different conceptual models to the scene, artifacts need to be designed to accommodate ideally all those (UCMs) available among potential users, or face discouraging disruptions”* (Krippendorff, 2006, p.107). The research added UCMs in parenthesis as to clarify the logic of the sentence, as well as the concept of User Conceptual Model in general as originating from the users. In this section the research bases its conclusion according to the second framing.

The research does not break away from its framing of the designed artifact as an act of communication, or its conceptualization of design into langue and parole. The produced proposal, much like Jakobson’s original model, is intended to serve as a universal structure underlying all designed artifacts (design parole). It is also intended to provide a system of simplified and skeletal concepts, or a set of principles and their aspects (design langue), according to which all acts of design could be described as well as structured. And finally, it attempts to account for how perceived information structures (Gibson, 1986) - consisting of arrangements of materials and visual elements – are linked to different aspects in the meaning of the artifact, as well as are used by users in order to construct their Conceptual Models in terms of: formal attributes, meta code, intended reference, addresser, intended addressee, connection, and intended context(s).

Adapted from Thwaites et al. (2002, p. 21), in the conceptualizing the meaning of the designed artifact and subsequently the constructing of its CM, users:

- work with a system of references and codings;
- describe the artifact in terms of formal attributes which allow them to distinguish it from other artifacts;

- set up a relationship of address; and
- operate within, and vary their understanding of the artifact according to, specific concrete situations.

Below is a description of a skeletal system made of the principal "*functionalities of design*" with which the design of any given artifact - consisting of various information structures - is utilized by the users in their construction of the artifact's meaning during interaction. The research names this proposed model as "*Functionalities of Design*", rather than adopting Jakobson's and Thwaites et al. functions of language/sign format. The change of terminology is rooted in the wide range of meaning associated with the term "function" which is taken by this research to mean "serve as", and not "operate". Since in the evoking of meaning or purpose, it is neither the artifact, nor its design that are operating or acting, but the users who act and give the latter two their structural function, this research therefore opts for "*Functionalities of Design*" as a fitting title for the proposed structural model.

6.4.1 Functionalities of Design Model.

When users are able to recognize (Krippendorff, 2006) and construct an understanding of an artifact and its parts according to their FORMAL attributes - their selection and combination of materials, or their dimensions and features in terms of form, including the space (i.e., physical dimensions and layout) and medium (i.e., the media or material from which it is made) in which they exists - then the design of the artifact has a FORMAL functionality.

The user's recognition of these FORMAL attributes further facilitates their understanding of what the designed artifact and its parts *are* and what they *are not*, but not how they work. In doing so, users operate along a FORMAL - METALINGUAL axis of meaning in which they compare the sensed artifact (and its parts) with mental entries of categories of other artifacts, artifact parts and ideal type from their mental dictionary. They construct an understanding of the artifact either as a variation of a similar artifact or artifact parts, or as an original - which in turn allows them to hypothesize a new code, or a meaningful structure for the artifact and its parts.

In the user's mind the design of an artifact functions FORMALLY to facilitate their recognition of the artifact in terms of its arrangement - a selection of materials and their combination (according to Jakobson the two basic modes of arrangement) – and its physical measurable qualities. In doing so, users rely on their past experiences, common sense, prevailing conventions of perceptual conceptions of geometry (or shape), color, and material (or medium), as well as on an ability to use lingual attribution - not only conceptions like square, cork, plastic, or round, but also conceptions like smooth, curved, thick, thin, sharp and so on. *“Attributions are acts performed in language, and they reflect the perceptual, emotional, or experiential coordinations (linguistic habits or conventions) in a particular community”* (Krippendorff, 2006, p. 155). Users construct a FORMAL understanding of the artifact, that is, a conceptualization of its arrangement that grants them the possibility to create the artifact literally (as in Dong's performance of

accumulation). In a FORMAL functionality this understanding reflects perceptual coordinations of physical properties because the construction of this conceptual models of formal attributes is based mostly quantitative measurable data. In interaction, understanding an artifact and its parts in terms of formal attributes, is less sensitive to the availability of key experiences or pieces of information, since every sensed information structure can be described more or less accurately according to these perceptual conceptions.

Without this principle of recognizing meaningful coordinations of the arrangement (its selection and combination) none of the other functionalities of design can take place. Obscure or unintelligible information structures will render an artifact's FORMAL attributes unrecognizable and in turn - the artifact as - meaningless, irrelevant or insignificant to its user.

When users are able to conceptualize and recognize ways, codes, meaningful structures, and grammatical rules in which an artifact, as well as its parts, can be read or understood accordingly, then the design of the artefact has a METALINGUAL functionality.

In doing so, users construct a conceptual model of a code - a focal point - according to which the subject could be understood. As the account of the cognitive hermeneutic circle in case study three exemplifies, users filter the artifact's FORMAL attributes according to mental entries of Ideal type categories (like codes, structures, systems, or layouts) and then assume, change, and revise a hypothesized code for the artifact, until they construct an understanding of the artifact in which all inconsistencies and incompatibilities between form, reference, use, and context are resolved to their satisfaction.

As mentioned above, users draw upon personal experience and information available in their mind's mental dictionary in their search of known similar meaningful structures according to which the artifact can be understood. In doing so, users work with different aspects (as well as sensory motor coordination and multi-sensory redundant modalities (Krippendorff, 2006)) of

coding and conceptions such as dimension, scale and proportion. They seek to recognize the artifact according to a mental entry of sensory-motoric code - user hypothesize whether it is in the right size and proportion for interaction with the human body (if not, users may hypothesize to which specific body part, animal or entity does it fit in interaction); language - users look into ideal types of language structures, marks, sequences and layouts, both spoken and written, in order to recognize references to syllables, words and known alphabet systems, or to references of artifacts, sound impressions and script; color and shape - user draw upon their conceptions and prevailing conventions of colors and shapes in order to recognize the artifact according to context, emotion, or identity; and structure of layout or sequence - seeking to recognize the perceived according to abstract layouts of ideal types and sequences of sounds, experiences, or events relating to known artifacts or sets of affordances.

When no key experience and piece of information related to coding is available, the design cannot be associated with known structures of information and eventually with a REFERENTIAL functionality - the construction of the artifact's intended meaning is then impossible. The artifact's formal attributes, its selected and combined materials, and arrangement are then put into memory and classified as a new, original, or unknown ideal type. The user then either waits for, or hypothesizes the ideal type of experience or information needed for constructing a metalingual focal point which could offer indication for the significance of the artifact or its parts.

Case study three exemplifies this very well. There, users who have absolutely no knowledge of Arabic, or experience with such language, will consider the script as a strange "doodle" or a mark unknown, noting its formal attributes, its arrangement of type of line, dots and colors, as a new ideal type (to which similar marks can be associated to). Case study three also exemplifies how metalingual focal points work at different constructions of UCMs. Users who have seen Arabic script before, but have no intimate knowledge of its use, will hypothesize the subject as Arabic

script and use this knowledge as a focal point for hypothesizing that a deeper knowledge of that language will facilitate their understanding of the script's intended meaning. This will in turn facilitate (along a METALINGUAL-PHATIC axis of meaning) the design's PHATIC functionality with which users can conceptualize the artifact's intended community of users. Another example with case study three could be imagined in a situation where users experience interaction with another artifact of the exact same EXPRESSIVE attitude (the EMOTIVE aspect of EXPRESSIVE functionality which is discussed below), but instead of "Arab script" the Dutch word phrase "BAGDAD?" is displayed in Latin script. Building on the UCM of addresser, users will then use this Latin script artifact as metalingual focal point to subsequently facilitate the REFERENTIAL functionality with which the meaning of the "Arab like" artifact instance could be decoded.

In the user's mind the design is given a METALINGUAL functionality as a focal point according to which different referential UCMs can be constructed. As seen in the case studies above, users can identify more than one focal point in an artifact, each bringing another conception into view according to the user's past experiences, common sense, conceptions and prevailing conventions. When these focal points reflect perceptual coordinations (as in some what measurable sensory data), the construction of other conceptual models of the artifact seems to be more quantitative. When these focal points reflect emotional or experiential coordinations (as in abstract lingual attributions), the construction of other conceptual models of the artifact seems to be more qualitative.

As in the FORMAL functionality, obscure or intelligible layout, sequence or structure, will render an artifact meaningless to its user.

When users are able to construct meaning from an artifact (that is, the different conceptual models of the artifact as well as of its parts) the design of the artifact has a REFERENTIAL functionality - an imaginable set of affordances, concepts, ideas and activities to

know or to do, with which users can further act, refer to, represent, depict, or propose something as real or significant by using the artifact in different ways and to varying extents, whether true or not.

According to Krippendorff, meaning *“is built in sense, rooted in the recognition of alternative ways of seeing on one hand and acting on the other, and dependent on the context of the artifact’s use”* (Krippendorff, 2009, p. 63). This indicates that an artifact's meaning is far from a given fact, *“Instead it is something to be actively worked out or negotiated, and always subject to renegotiation”* (Thwaites et al., 2002, p. 15). These two statements resonate in the construction of an artifact’s user conceptual models of its REFERENTIAL functionality, which deeply depends on the artifact’s FORMAL attributes (*“based in sense”*), METALINGUAL focal points available to the user (the recognition of alternative *“ways of seeing on one hand and acting on the other”*) and actual CONTEXTS, situations, or events (*“the context of the artifact’s use”*). Through the application of a compatible METALINGUAL focal point (a code, meaningful sequence, or structure), and depending on actual contexts of interaction, users associate FORMAL attributes with meaning, transforming them into networks of operational concepts with which users hypothesize how the artifact and its parts work, how to use them (that is, when to do what with them), what to expect consequent of any action taken, as well as the abstract concepts and lingual attributions they can be associated with in terms of emotional or experiential coordination - as in Krippendorff's section on Characters (2009, pp. 155-162).

As mentioned earlier, building from either a quantitative or qualitative metalingual focal points users construct a conceptual model of meaning - an understanding of the artifact and its parts as something other than what is perceived. When the focal points used reflects perceptual coordinations, this understanding of the artifact is more likely to be quantitative - as in exact reference to measurable data or information. When the focal points used reflects emotional or

experiential coordinations, this understanding of the artifact seems to be more qualitative - open to debate and coordination of meaning between community members.

Working with different METALINGUAL focal points, users “*mutually contextualize*” (Krippendorff, 2006) different formal aspects and aspects relating to actual contexts in order to construct different conceptual models from an artifact. Dimension, scale and proportion, language, color and shape, and structure of layout or sequence, are perhaps the most common METALINGUAL focal points. These, depending on the formal attributes and the actual situation of interaction, form conceptualization axes and lines of thinking, with which users construct conceptual models such as affordance or reference, addresser or sender, addressee or receiver, contact channel between the latter two constructions, and suitable contexts of use in terms of imaginable situation or event. In turn, this suggests that the “FUNCTIONALITIES OF ADDRESS” and the “CONTEXTUAL” functionality are user conceptual models that could be REFERRED to by the artifact, or its parts. Another possible point of view is that some formal attributes, under certain contexts and while using specific meta focal points, can be put into a REFERENTIAL functionality which is solely dedicated to the construction of concepts like addresser, addressee, contact, and context. Therefore, these concepts can be grouped within a larger REFERENTIAL framework as the EXPRESSIVE, CONATIVE, PHATIC AND CONTEXTUAL functionalities of design. The research will return to this point later on, when discussing these functionalities.

This research is not conclusive on whether all of the user conceptual models, or their dedicated functionalities are needed to be utilized by users in order for any artifact or artifact part to become meaningful. Instead it will suggest that in interaction some of these functionalities may be more dominant than others, and that users will always construct a conceptual model, like that of an addresser even if the emphasis on aspects of the respective functionality (for this example - EXPRESSIVE) in the design is extremely weak (as seen in case studies two, three and four). Further

on, these user conceptual models are never independent of each other, but seem to constantly interrelate. Certain conceptual models may work very closely together, as seen in case one where the UCM of addresser and UCM of “Blue Band Goodstart” support the contextual UCM of advertising. Some models may overlap each other, as seen in case study two where UCMs of reference to aesthetic values overlap in the construction of addresser and addressee UCMs and even seem similar to the contact UCM – the attributions that bring addresser and addressee together. Finally it is important to separate between UCMs and their dedicated functionalities in the design of an artifact and mention that unlike functionalities of design, UCM cannot work against each other (artifacts may have more than one meaningful reference, addresser, addressee, contact points and context of use) and do not trigger each other, but instead build upon each other as seen in the case studies above.

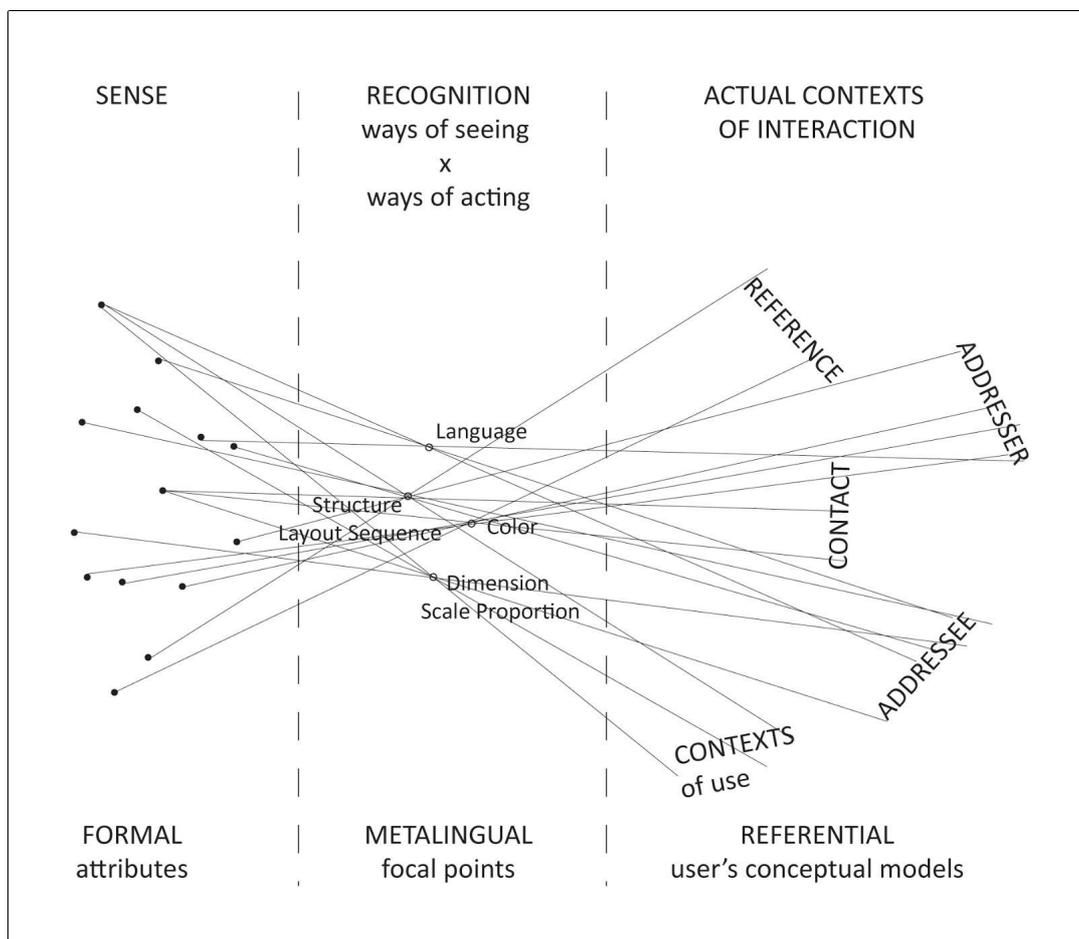


Fig. 6.6: Krippendorff-Jakobson conceptual parallel at the core of the Functionalities of Design Structural model.

In the above diagram (fig. 6.6) this research attempts to visualize the parallel, or perhaps even the similarity suggested above, between Krippendorff's primary concept of meaning (built in sense, rooted in recognition and depending on context) and the structural model used by Thwaites (Formal attribute, filtered according to Metalingual focal points, are associated with meaning and Reference in an actual context). It shows how by filtering various combinations of sensed information structure (FORMAL attributes) according to available knowledge of alternative meaningful structures, layouts and sequences (METALINGUAL focal points), user associates the sensed with conceptual models according to a certain context that allow them to REFER to or act according to abstract set of concepts, affordances, senders and receivers, contact channels, and eventual situations of use. In other contexts, the same formal attributes may be associated with a varying set of meaning, that is slightly or substantially different. In such cases the relationship between the constructions of conceptual models will also differ.

Finally, it is more than likely that an artifact with unintelligible or obscure formal attributes or meaningful structure, as with dimensions and frequency falling outside the limits of human sensory-motor coordination and perception, or that are covered by radiant information (Gibson, 1986), will not function REFERENTIALLY, that is, could not be associated with meaning by the user, who will most likely will find the artifact confusing or irrelevant.

6.4.1.1 Referential Functionalities Dedicated to Conceptual Models of Address:

When users are able to construct a conceptual model of addresser for the artifact or any of its parts, then the design of the artifact has an EXPRESSIVE functionality.

Addresser, as in "*where it says it is from*" (Thwaites et al., 2002, p. 16), the position it proposes as its source and not always its actual source (sender/owner). This conceptual model is constructed according to specific metalingual focal points from formal attributes in either quantitative terms - such as with Logos, or text as seen in case study one, and

evident marks of production/realization method as in cases two, three, and four; or in qualitative terms - such as with character attribution of aesthetic values as seen in case study two.

From the case studies above it seems that Jakobson original use of “EMOTIVE” function is very applicable for the field of design. In users minds, both quantitative formal attributes (such as a logo), and qualitative formal attributes can be used for the same EMOTIVE goal - to associate a group of products with an addresser. Users, working with a specific metalingual focal point, identify various formal attributes as EXPRESSING a style of doing things, an (expressive) attitude, or “signature”, which is associated to a designer (like Marc Newson for one example) or a brand (like IKEA or Muji, for another example). These are a direct expression of the designer’s or Brand’s (ADDRESSER’S) attitude towards what they are speaking about or referring to with their artifacts (Jakobson, 1960, p. 354). This EMOTIVE aspect of the EXPRESSIVE functionality (or conceptual model) tends to produce an impression of a certain emotional network of coordinations, whether true or feigned.

In identifying a designer’s or a brand’s attitude, users use a specific metalingual focal point, with which iconographs are understood as logos representing an addresser, and formal attributes are understood as a unique marking, or style of doing things with which it is possible to refer to an addresser in qualitative terms. This focal point is based on users’ past experiences and specific available information, without which specific formal attributes could not be distinguished and associated with an addresser. For example, in case study two, observers who unfamiliar with Miguel Vieira Baptista will not associate the minimalistic intelligent and playful arrangement of the artifact with that designer, and attribute the style to another designer, another brand, or leave it anonymous. Further on, to observers who are unfamiliar with Experimentadesign or Amorim MATERIA collection,

the use of cork in the case subject would not be associated with these addressers.

In exemplifying how an EMOTIVE conceptual model of an addresser is constructed the research returns here to the example used for framing the METALINGUAL functionality in case study three. After noting the script's formal attributes - its arrangement's type of line, dots and colors - as belonging to a new ideal type (a metalingual focal point), the users will then associate similar marks they see (actual context of interaction) as belonging to the same addresser (meaning or of the same origin) - in this case a singular artist or an ideological group. Further on, a strong similarity in the type of line used between perceived different instances of the script or spray, that is, exact use of color AND similar marks left by brush, will strengthen the concept of an individual addresser behind these different instances. This account also serve as a general example for REFERENTIAL functionality of the design, as the research mentioned above - *"through the application of a METALINGUAL focal point (a code, meaningful sequence or structure), and depending on actual contexts of interaction, users associate FORMAL attributes with meaning"*.

When users are able to construct a conceptual model of an addressee, an intended user, for the artifact or any of its parts, then the design of the artifact has CONATIVE functionality. Addressee as in *"where it says it is going"* (Thwaites et al., 2002, p. 17) who or where it is aimed to, or the position it proposes as its destination, but not necessarily its actual destination (or receiver/user). This conceptual model is constructed from specific formal attributes and according to specific metalingual focal points in either quantitative terms - such as with text, dimension of plate and illustrations as seen in case study one and script and language structure as seen in case study three; or in qualitative terms - such as with colors, font type, illustration types as seen in case one and with character attribution of aesthetic values as seen in case study two.

When users are able to construct a conceptual model of the relationship between addresser and addressee of an artifact, an understanding of how the two link to each other, then the design of the artifact has a PHATIC functionality. The PHATIC function links addressers and addressees in all sorts of degrees of social inclusion and exclusion. *“PHATIC functions can be enormously complex and subtle ways of discerning insiders, and the degree of their belonging.”* (Thwaites et al., 2002, p. 19). The case studies above show how formal attributes, metalingual focal points, actual context of interaction as well as possible contexts of use and referred meanings are all combined by users to connect addresser and addressee - designers and brands with the users of the artifacts themselves, or other users/perceived.

In case study one, a multitude of quantitative formal attributes (dimensions, text, illustration, logo) and metalingual focal points (Dutch language, color type, illustration type, western type of bread) facilitate the connection between Blue Band, and its intended community of users - parents and children. In case study two, it were the qualitative concepts constructed from the combination of minimalist formal attributes and aesthetic metalingual focal point, as well as a context of interior lifestyle, that facilitated the connection between the designer and users of the subject. This, in turn, facilitated the communication of ideas from the designer to a group of users - a community of people with shared aesthetic values. In case study three, it were the formal attributes (lines, script), metalingual focal points (Arab and Dutch languages), and actual context of interaction that facilitated the connection between the designer of the script and its target audience - local Dutch speakers. In case four, the phatic functionality of the subject is minimal - only the dimension of the subject can be used to relate it to a possible application by a human user. Yet, the possibility that a dog will find the dimension fitting its

mouth and chew on the subject for some sort of doggish intrinsic motivation is as likely.

The research will offer a reasoning of that observation later on.

6.4.1.2 Referential Functionality Dedicated to Conceptual Models of Context:

*When users are able to construct a conceptual model of an intended context, event, or situation, in which an artifacts or any of its parts are deployed and used in, then the design of the artifact has a **CONTEXTUAL functionality**.* The research moves here away from the contextual function framed by Thwaites et al., which seems to refer to the actual context of interaction, that is, the context, situation or event within which the artifact is perceived. This is understood as the social and perceptual situations in which the artifact is interacted with and which may determine its set of meanings: type of design and coding, who is being addressed, by whom and how, and the phatic community it constructs. Instead this research opts for a referential functionality of the artifact with which users - depending on the sensed formal attributes, available metalingual focal points and that same context referred to by Thwaites et al. - construct a conceptual model with which they can identify a context of use for the artifact and its parts, whether it refers to an actual context or a possibility of use in other specific contexts.

6.4.2 Functionalities of Design Model Closing Conclusions.

As closing conclusions of this analysis and the produced model, this research will not go as far as to claim that all these functionalities above are needed for any act of design to be seen as significant. Instead, it will suggest that in interaction users seek to operationalize the relationship of sense, meaning and action through heuristic constructions by answering questions like: what am I sensing? (FORMAL) What does information structure look like? (METALINGUAL) What concept can it mean or be associated to? (REFERENTIAL) Where does this come from/to whom this belongs? (EXPRESSIVE) Who is it intended for? (CONATIVE) Within which culture, or community, could this be used?(PHATIC) And how and when this can be used? (CONTEXTUAL). In interaction, based on the situation, the abundance of relating formal attributes, and knowledge available to the user, users are able to work out some of these answers more fully than others, emphasizing different aspects in the ways the design structurally functions.

Further on, the functionalities discussed above are never independent of each other, but constantly interrelate:

First, like the UCMs produced as a result of these functionalities;

- In some situation certain functionalities may work very closely together, like in the FORMAL - METALINGUAL axis of meaning with which users categorize formal attributes into ideal types; or, in the REFERENTIAL - CONATIVE axis of meaning, where association of meaning serve to form a UCM of community or contact between UCMs of address.
- In some cases certain functionalities may overlap each other, like in case of a logo design, which functions both REFERENTIALLY and EXPRESSIVELY in order to convey information about the same thing - an addresser UCM.

Second, unlike the UCMs produced as a result of these functionalities;

- In some cases certain functionalities may work against each other. For example, in case study four, where the FORMAL attributes of the material of the subject did not support the METALINGUAL ideal type of a tray suggested by the structure of its mold.
- These functionalities seem to work in causality and always trigger other functionalities into operation. In many cases, the FORMAL functionality triggers the METALINGUAL one, in turn triggering the REFERENTIAL functionality and the dedicated REFERENTIAL functionalities of ADDRESS and CONTEXT, which may trigger each other until all possible UCMs are conceptualized to the user's satisfaction.

Finally, in the construction of the functionalities of design model, the research accumulated on the work conducted in investigations one and two, building on concepts and ideas discussed in there. Most notable points of contact are:

- The discussion in points 11 can offer an explanation of how users form the FORMAL-METALINGUAL axis in their mind, as well as distinguishing and developing an understanding of the physical properties of the artifact and its parts.
- In point 21, Lee's theory and the discussion that follows, as well as the discussion on complementing concepts of mutual contextualization in point 26, offer an explanation on the formation of METALINGUAL focal point in describing how the mind projects an expectation of a known mental entry on what is sensed. In doing so, the users assume meaningful structure of sensory input and eventually (through mutual contextualization process) construct REFERENTIAL UCMs.
- Point 25 seems to discuss the creation of CONTEXTUAL UCMs, as well as the creation of METALINGUAL focal points, from entries (most likely in mentalese) of affordances, definitions, and relationships of arrangements or situation of events and including actors that have roles in these events.

- In point 10 and point 25, the example of the electric telegraph and the protocol analysis of designing in action, offer a point of reflection on the EMOTIVE aspect in the EXPRESSIVE functionality of design.
- The discussion in point 12 and 19 offers a possible connection between lingual attributions - reflecting perceptual coordinations - and the perceptive mechanism which “nests” (Gibson 1986) detailed information structures into simplified perceivable constructions, as well as with the (macro-micro) flexibility of structural units used in design. When this discussion is converged with point 21, it is possible to consider that the recognition of an artifact or its entities in term of lingual attribution of physical properties, that is, according to perceptual constructions of physical properties that can be expressed language, is facilitated with METALINGUAL focal point that gives priority to certain structure (which fit a certain ideal types of category of a qualitative concept like thick, red, dark or soft) over the structures entities contained in it. In turn, in order to facilitate this focal point, the brain must have a mechanism that the distinguishes between information structures according to ideal type of qualitative perceptual categories – prioritizing according to relationship and identifying through mutual contextualization which of the structures perceived is more red, less soft, more dark or thinner, and so on. For example, in case study two the “thick” element is made of an unperceivable amount small cork pieces and grains glued together into a single object. Looking at the rest of the of artifact as a whole, the mind forms an understanding of this element as being “thick” once it is mutually contextualized with the other thinner object in the same artifact – the thin metal ring.

Further on, the functionalities of design model presented by this research were aimed at addressing man made artifacts (or objects created from human involvement). It seems, however, that the model is as applicable in the developing an understanding of natural made objects, mediums or substances as it is of man made artifacts. Humans do not stop interacting with their

environment from the moment they wake up till the moment they sleep. In that regard for humans everything can become significant depending on present perceived formal attributes, available metalingual focal points, and actual context of interaction.

In conclusion, this section of the research has produced a universal structural model consisting of a set of principal functionalities according to which:

- one can effectively described an act of design, and;
- one can trace how meaning could be constructed at different levels of detail from any given artifact - be it natural or man made - used for communication, or with a designated a goal in mind.

Based on the case studies and the models presented above, this research hypothesize that most likely any goal directed use of artifacts will be understood, in different level of consciousness, in ways outlined by the functionalities of design.

Expanding the scope of Jakobson's *Functions of Language* model into design strongly suggest that the only distinguishable difference between acts of communication is their modality - their physical properties - whether they are structured (grammatical) sequence of sound, or a structured arrangement of visual or material elements. The meaning of *languaged* sentences and designed artifacts is conceptualized and constructed in the same way - by humans sensing an information structure, filtering it through assumed series of known meaningful meta-structures, until all contextual incompatibilities are resolved to the actor's satisfaction.

A universal structural way of looking at designed artifacts as presented by functionalities of design model seems to be inherent from a structure of thought, a sets of cognitive processes - very likely associated to perception - which are shared across all humans, enabling them to understand artifacts in terms of conveyed meaning, as well as structure and plan artifacts according to an intended meaning.

Forming a capacious language based framework for thinking about design, this research so far showed how a key structural model used for the analysis of lingual artifacts can be applied to the study and analysis of designed artifacts. This research will now continue grounding this framework by exploring how the same set of principles can be used to describe the act of designing, as a universal guiding structure for the process of design (in the planning of artifacts), and be deployed in design practice. Doing so this research takes first steps towards the establishing of a systematic and synchronic approach to the study of design, design artifacts and design thinking.

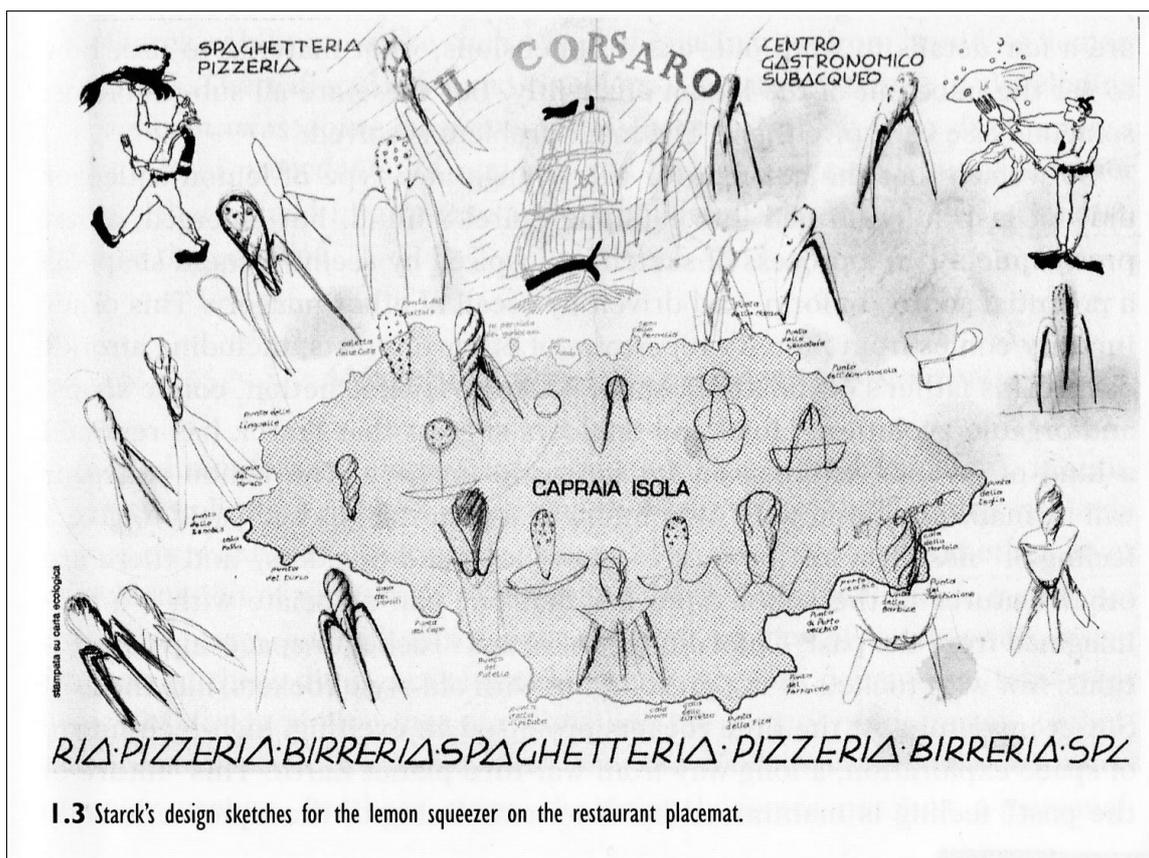
6.5 Jakobson's Model as a Design Tool

In the previous section, this research revisited Jakobson's model and its adaptation by Thwaites, Davis, and Mules. It further posited it in design as a tool of analysis for acts of design, and as a way to infer an underlying universal structure in design. In this section the research will attempt a first approach into establishing this model in the practice of design by looking into ways in which this model can be used to describe design thinking (the thinking people do when designing), as well as be deployed as a design tool during the design process.

An essential line of investigation in this approach is a qualitative research aimed at recognizing patterns of thinking that enable the functionalities of the design and produce their constructive factors or aspects of meaning. In effect, this qualitative research explores the dynamics of this model and its limitations. It continues to build on Dong's proposition of design activity being "*the enactment of a set of operating principles wherein the actors emphasize different aspects of these principles*" (Dong, 2009, p.9). Yet, instead of performative principles of language use as Dong explores, this research will work with a set of principal functionalities, as outlined in the model it produced above, where during the design process actors emphasize - with their attention to detail - different aspects of these functionalities.

6.5.1 Design Thinking within the Functionalities of Design Model.

Exploring this framework for thinking about the act of designing according to an underlying universal structure - with which designers conceptualize the designed artifact into being and consider how users will construct meaning from its arrangement - this research will demonstrate how design thinking facilitates the creation of a designed work by enabling the functionalities of design. It will also demonstrate how designers work according to this set of principles during their thinking process. For that purpose, this research uses again the example of Philippe Starck's *Juicy Salif*, building on the deconstruction of the designer's thinking process as presented by Nigel Cross in *Design Thinking: Understanding how designer think and work* (2011):



1.3 Starck's design sketches for the lemon squeezer on the restaurant placemat.

Fig. 6.7: Figure 1.3 in *Design Thinking* (Cross, 2011, p. 17)

"Alessi invited Starck to offer a new product in the 'designer' series, a lemon squeezer.

Starck went to visit Alessi and discuss the project, he then took a short break on the small island of Capraia, just off the Tuscan coast, and went to dine in a pizzeria restaurant, Il Corsaro. He was

obviously already thinking about the lemon squeezer project, because, as he waited for his food, he began to sketch on the paper place mat. At first, the sketches were just very rough images of a fairly conventional form of lemon squeezer (see the centre right area of the place mat, Figure 1.3), but then something happened to inspire a leap to making sketches of something quite different - his anti-pesto plate of baby squid had arrived, and Starck began to get his 'vision of a squid like lemon squeezer'! His sketches on the place mat now become images of strange forms with big bodies and long legs, and eventually (bottom left in Figure 1.3) something emerged that is now recognizable as the Juicy Salif concept...

So we see that the concept of the strange new type of lemon squeezer did not leap fully formed into Philippe Starck's mind, but emerged, albeit pretty quickly, in a process of sketching inspired by a squid shaped as a potential source of form, and driven by the recall of other imagery. This other Imagery comes from Starck's repertoire of other interests, including aircraft design (his father's occupation), space rockets, science fiction, comic strips and organic evolution. The lemon squeezer will be made of aluminium." (Cross, 2011, pp. 16-18)

This processes of thinking seems to be working in reverse of the way in which meaning is associated to artifact, as explored in the previous section. The designer here begins with a REFERENCE, a mental entry of a concept which details an artifact affording the extraction of juice out of lemons by squeezing them with the hand, This REFERENCE sets up constructions such as CONATIVE user, CONTEXT of use (when people do lemon squeezing), and PHATIC dimensions. The designer then proceeds to conjure various conventional ideal types that fit this affordance, before adopting the form of a squid as a focal point - *way to see x way to act* in order to fulfill the intended affordance - and merging it with with other focal points derived from science fiction culture. By filtering the set of REFERENCES through a set of METALINGUAL focal points the designer finally arrives at the physical properties of the artifact, its FORMAL attributes in which all

conceptual incompatibilities are resolved to his satisfaction. The choice of aluminum as material is also a result from using this set of METALINGUAL points as Cross cites:

“Aluminium as material has been said to give a feeling of a “nostalgia for the future”, ‘say Lloyd and Snelders, ‘and there are other features of the lemon squeezer that one can associate with a future imagined from the past. Chief amongst these is its rocket or spaceship associations. Not with rockets of the present, but with old-style rockets, like those of Soviet inventors. at the time rockets promised an exciting, high-tech future of space exploration, a long way from war-torn planet earth.” (as cited by Cross, 2011, p.18)

The construction of EXPRESSIVE addresser is a reflection of the choice of focal points with which the convention of a “lemonsqueezer” - a generally shared mental entry of this abstract concept across large community of people - has been interpreted and enacted into an arrangement of visual and material elements.

This is but only one way in which design thinking, in this case deployed in the design process of a product designer, can be seen as addressing the aspects of the *functionalities of design*. In searching for how a lemon squeezer need to be, or feel (emphasis in attention on FORMAL aspects), the designer tries to grasp how its information structure should look, or be, like (emphasis in attention on METALINGUAL aspects), while still signalling the concept intended, or meant, could be associated to it (emphasis in attention REFERENTIAL aspects). The designer does not give attention in particular to the EXPRESSIVE aspect of addresser (neither applying Allesi's form language or considering its logo), while the addresser's (Allesi's) intention is that their quality and image will be expressed by the attitude or approach of the designer towards the the artifact's REFERENTIAL functionality. This emphasis in attention on the EMOTIVE aspect is aimed at positioning, or signaling where does the artifact come from, or to whom this belongs? (EXPRESSIVE). The designer does not give much attention to whom the artifact is intended for

(CONTIVE), or within which culture, or community, could it be used (PHATIC), and how and when this can be used (CONTEXTUAL), beyond what is specified in his mental entry of "lemon squeezer".

6.5.2 The Functionalities of Design Model in Design Practice.

The research focuses its attention now on a qualitative investigation made through a series of interviews with active designers and design researchers. Exploring together the dynamics of this model and its limitations, during these interviews the intention was that both researcher and interviewee seek to recognize patterns of thinking (in the latter's practice or field of design) which can be seen as directed at enabling the functionalities of the design and producing their constructive factors or aspects of meaning.

The criteria for the selecting the interviewees was aimed at accessing wide range of both work experience and field of work. A list of potential participants was then woven and cross referenced in order to narrow it down to a strategic selection and a call was sent to potential subjects. The researcher got a limited response and eventually relayed on subjects showing manifestation of interest that could allow to potentially follow it up and ensure easy and facilitated continued access. The research lists the people participating in the interviews as well as their capacities over which they were interviewed:

- Stijn van der Vleuten - product designer involved in critical design (6 years of experience).
- Heather Daam - designer involved in co-design and design for social change (9 years of experience).
- Jens Dyvik - industrial designer involved with FABLAB (6 years of experience).
- Irene Fortuyn - artist and designer for public space (32 years of experience).
- Tim de Boer - user experience designer and researcher (7 years of experience).
- Ari Versluis - fashion and lifestyle photographer involved with social-cultural anthropology (21 years of experience).

- Marjolein Vonk - fashion and lifestyle stylist (25 years of experience).
- Richard Beumer - industrial designer at Brabantia, Dutch interior design brand, (8 years of experience).
- Jeroen de Bruin - Architect at Van Aken Architecten (14 years of experience).
- Jacques Terken - Associate professor at User Centered Engineering research group at Industrial Design Department Technical university of Eindhoven (13 years of experience).
- Matthias Rauterberg - Professor, Head of Designed Intelligence research group at Industrial Design Department Technical University of Eindhoven (17 years of experience).
- Pi rre Levy - Assistant professor at Design Quality in Interaction research group at Industrial Design Department of Technical University of Eindhoven (9 years of experience).
- Ingrid van der Wacht - Project manager and design facilitator and manager at Capital D (14 years of experience).

The interviews lasted on average one hour. This discussion formed during the interviews was geared at opening up the interviewee. As such, the interviews were informal and covered a large range of subjects, more than originally intended. The interviews usually began with a short revisit of the model, followed up with a discussion about the work of the interviewee, their practice of design and framing of their design field. As interviewees opened up, the interviews moved on to a discussion on the model, where eventually the researcher and interviewee looked together to identify the model in different stages of the design process, using case studies from the interviewee's own field of work, and including a general discussion on designing, fields of design and relating interests.

These interviews were held prior to the four case studies featured above and had a contributing effect to the positioning of this research as a whole. Given the abundance of material encountered, which was necessary in order to open up the discussion as well as the nature of the topic of the interviews, which applies to design in a broad way, the research had to work according to a fundamentally horizontal approach.

The exercise produced below is a first attempt aimed at a critical approach towards the discussions. The research interweaves the contribution of the various interviewees and the information discussed during the interviews according to different levels of association with the investigation above, as well as touch on investigations one and two.

This qualitative investigation presents now a summary of reflective insights and axiomatic proposals drawn from the interviews. With it the research intends to present a list of statements and targets for further investigations, a first step toward future validation and establishment of a language based approach to design thinking and education. The research lists these topics according to their association with the different disciplines in the practice of design, designing, and the parts of the model previously discussed.

6.5.2.1 Functionalities of Design model.

Insights and topics regarding the application of the model in design practice, as well as its context:

- The choice of the elements composing the artifact has a certain kind of semantics (FORMAL functionality) that expresses a kind of message (REFERENTIAL value, concept, quality or identity). Designing can be seen as a matter of coherence between physical properties that facilitates the construction of FORMAL attributes. Designers select and combine form elements, but when working for a brand they need to work with elements that fit or suit the brand's (addresser's) intended group of consumers

(CONATIVE functionality). Even if the designer dislikes the brand's form language (its set relationship between physical properties and METALINGUAL focal points), they must make sure that they convey the intended REFERENTIAL information coherently in that context. The designer is given a set of aspects by the addresser, the brand. The designer needs then to structure a coherent method of conveying the intended information for the addresser's community, group of users, within the context set by the addresser. For example, its form language, its type of users and their contexts of use. Conveying information across to users depends on the type of information and the context of the design. For example, design driven innovation and user driven innovation. The first can be a radical innovation allowing for the invention of a new form language – setting a relationship between physical properties and METALINGUAL focal points, while the latter can be an incremental innovation requiring implantation of existing conventions of form language.

- The physical properties of the design are constant and always stay the the same. The construction enabled by the functionalities of the design always differ from user to user, between contexts and times, as different personal experience means different set of METALINGUAL focal points.
- This model is an analytical tool and can be used for reflection during the design process and for appraising (Dong, 2009) the initial prototypes and material/combination experiments. Using this model designers can develop of an understanding on how the arrangement of the designed artifact facilitates the functionalities of its design.
- In exploring the possibility of working from blank with this model, it seems that designers need an entry point towards the structure - some sort of input, or goal to start with - setting and clarifying at least one of the aspects of the model, with which

the designer can align or structure the other functionalities with the artifact accordingly.

- Designers create “action possibilities”, but every designer enters the design process with a clear intention, whether intrinsic or formed from briefing, that guides and aims their process. This set of intentions forms the entry point into the *Functionalities of the Design* model, determining which aspects are to be emphasized more dominantly in the design process.
- A briefing may set up the intent of the designer and their goals, but seems to always need critical scrutiny. Very often the designer discovers that what the commissioner or facilitator of the artifact wanted is hidden underneath the fine wording. Designers need to study the context (CONATIVE AND CONTEXTUAL functionalities) set up in the brief in order to construct their UCMs. In some cases the briefing sets up the designer as the addresser of the designed work, while the actual addresser is its facilitator.
- Emphasizing any of the *Functionalities of Design* means giving attention to the arrangement of formal details in the artifact so that the user will be able to construct the intended meaning associated to the arrangement of these details - the factors, or aspects of each functionality. Designers can plan different sets of arrangements – structures of information – in the artifact in order to signal with varying intensity the functionalities of design in an artifact.
- Seemingly, this research tries to extend the scope of Jakobson's model to something which this model was not made for - the interaction between user and artifact. The Jakobson model is originally meant for interaction between human beings, yet humans use lingual artifacts for communication, and Jakobson himself stated that “*many poetic features belong not only to the science of language but to the whole theory of signs...*”

language shares many properties with some other system of signs or even with all of them (pansemiotic features)“ (Jakobson, 1960, p. 351).

- There is a need to separate the construction of an addresser and the actual addresser of an artifacts. The real addresser is the party that commissioned the artifacts, or facilitated its design, it can be the designer, the actual addresser as well as the intended addresser. Different contexts reflect on the EXPRESSIVE functionality, they lead to the construction of different addressers. For example, a company may hire a designer to design an artifact to be used by its marketing workers in demonstrating future scenarios - facilitated by the designed artifact - to users who may buy it.
- A CONATIVE functionality seems to be the condition for design. Artifacts in which the EXPRESSIVE functionality is emphasized up to a point where the artifact seems to expresses a personal sentiment can be seen as belonging to the contexts of art.
- Users seem to have pre-constructed expectation (UCM) from different parts of the design as well as from its addressers. The way these expectations are answered by the first, reflects what people think on the latter, and vice versa. Building on Krippendorff, meaning seems to be the difference between these expectation and what is really happening. Cycles of interaction build on these experience of interaction and adjust the expectations. As explored in point 21 of investigation one, in a cycle of interaction the brain projects expectations on sensory input in order to make sense of the sampled information structures. Possibly, what *seems to be happening* is then compared in the brain with the starting point or value of the expected senses. In doing so, the brain distinguishes similarities with known structures of information according to which the sensory input is associated as pleasant or unpleasant. This association leads to satisfaction or dissatisfaction of the user and to further association of the sampled

artifact with emotional effect. It seems that children in learning how to interact, as well as through interaction, commit to memory the meaning associated with sampled artifact in different contexts. That meaning preserves the way to interact with the sampled artifact in the mind of the child, becoming either a conceptual entry, or a set of structural rules, in the child's mental dictionary.

- The act of designing is limited in time, technology, culture, context and intent of designer. Users, in constructing an understanding of their artifacts, as well as a context for their artifacts, are also limited in timing, technology, culture, context and intent. The difference between intent on context of the designer, and the context dependent understanding of the user suggest that in practice designers need to use a stacked number of models - each per intended context of use - in which they analyze how different users appropriate or adopt the design of the artifact. In other words, each context of use need a dedicated model for analysis.

6.5.2.2 Product Design.

General insights and topics which may apply to design practice in general:

- Designers can work with different CONATIVE constructions of intended user according to a 1st, 2nd and 3rd person approach: 1st person as in designing for yourself (as user); 2nd person as in designing for someone (user) you intimately know; and 3rd person as in designing for a construction of a user, be it formed in a briefing, a model, or in a documentary on the user. Classical ergonomics is one extreme example designing for 3rd person user. Designing in 2nd person approach seems to requires an effort, or a strong emphasis, in the attitude of the designer and produces an EMOTIVE aspect. Designing in 3rd person approach relies on a description which fits a lot of people, but that not one specific person fits it. The thought of similar needs in a construction of a

community of users seems to be nothing more than wishful thinking. While designing in 2nd person will construct a 3rd person user who fits the product, designers for 3rd person user may never find a 2nd person user who is satisfied with their product.

- Designing can be seen as a dialogue, a reflective conversation (Schön, 1983) which covers or addresses all the aspects of the model. In many cases the dialog is focused on (PHATIC) relationship between addresser and addressee within a context of use. For example, in scrutinizing a briefing the designers may form a reflective conversation between context, addresser, and addressee, aggregating (Dong, 2009) a conceptual framework for the artifact. By conceptualizing the latter as actors and role players in the given context (CONTEXTUAL) the designer sets up a desired set of values or ideas (REFERENTIAL) that they want to communicate about the artifact or context, and identifies the right codes (METALINGUAL) needed to do so. This thinking process seems to be accumulative (Dong, 2009), or happening mostly in “at once”, that is, this process is not linear in terms of causality but can be described as fitting things, concepts, and ideas together like in a puzzle.
- There seems to be a similarity between the way designers conceptualize their understanding of a situation, or a problem, and Gibson’s form perception: At times designers “circle” the problem - constructing its silhouette first - before adding depth to their understanding, “*presumably because of past experiences with similar situations*” (Gibson, 1986, p. 83).
- The construction of addressee (CONATIVE) and the construction of a problem are interrelating. Because problems, like meanings, do not exist outside of human cognition, it is the addressees, people and users, who experience “problems” and conceptualize them as such.

- Values are intrinsically felt through interaction and experience of acting according to an imaginable set of affordance. Product design seems to focus on a sort of FORMAL- CONATIVE- REFERENTIAL axis of functionality, where physical properties of the artifact (FORMAL) - when entered to the participation of user (CONATIVE) - produce or facilitate the construction of REFERENTIAL values through sensory redundant interaction. The REFERENTIAL functionality seems to facilitate the construction of values and meaning that build upon each other and accumulate into larger or deeper design statements.
- As explored in investigation one, artifact are associated with concepts that contain sets of role player and actors which are context dependent. For example, when a product is intended as a gift - a social practice within culture - it joins a complicated system of addressers and addressees. Each of the participants in this system, from the giftshop to the final receiver of the gift, uses the product EXPRESSIVELY towards another addressee who repeats the cycle. The designer addresses the product both towards the shop - who addresses the product towards its audience users - and towards a specific user, who may keep it or give it away. At each step, the product is used in order to associate its addresser with the referential values associated with it.
- Every entity forming the designed artifact has its own *Functionalities of Design that* facilitate the construction of contexts of use (inter connective parts, position in artifact etc.) in terms of where does the entity belongs (EXPRESSIVE) or what mechanical function it fulfills (REFERENTIAL). In designing entities in an intended context, “*less is more*” seems to be a predominant rule, otherwise users might get confused and misunderstand the intended meaning of the entity.
- The incorporation of different METALINGUAL focal points in designing different parts of an artifact - each with its own set of entities - can form a complex PHATIC functionality,

in which the artifact itself sets a METALINGUAL structure for entities within it. This can be seen as a sort of “a package” - users will need to first to “decode” or “unpack” one meaningful structure in order to be able construct the meaning of another.

- In complex artifacts such as Cockpits or control stations emphasizing METALINGUAL aspects for different groups of entities seem to facilitate the construction of a context of use for each group of entities.
- In some cases, when designer's intent is to emphasize an aspect of a REFERENTIAL functionality, they don't always think on emphasizing aspects of the EXPRESSIVE functionality. This makes the addresser UCM appear as anonymous or brandless. In designing product interaction, designers do not emphasize aspects of the EXPRESSIVE functionality at large - as in applying form language of addresser or its logo - but work extensively on the emotive aspects by structuring qualities or values that will unfold in interaction to suggest an addresser.
- User driven innovation seems to work on a CONTIVE-METALINGUAL-PHATIC axis of functionalities, which seems to also to be essential part of the designing process in general. In designing interaction for products designers solve the issue of contact. With a set addressee in mind, the question/problem turns into how to reach them with an intended affordance and a set of REFERENTIAL values.
- It seems that every designer sets themselves, either initially or during a certain stage, in the design process as the CONATIVE UCM, that is, placing themselves as the intended user. This is natural since, as discussed in point 25, designers look into their own mental dictionary and their personal experiences in order to understand various aspects of the affordance or value intended in a product, as well as how to address its PHATIC functionality.

- The EMOTIVE aspect of the EXPRESSIVE functionality, can be seen as a qualitative attitude - what the designers “put” or bring into the design process. In some cases these qualities can represent the designer as an entire person. This attitude seems to be dependent on the context of the designer, rather than on the intended context of use. The tools or methods of production play a role in the emotive aspect, but it is the way the designer uses the tools that defines the EMOTIVE aspect – testament of attitude seen in the designed artifact. Therefore, in materializing the design artifact it is the relationship between the designer and their tools that plays a great role in defining the attitude towards the design work. To a large extent, this relationship also depends on the designer's intention and goals (of what to produce and for whom) and on available tools or production methods. To conclude, in the design process the designer applies their qualities as a designer and emphasizes the EMOTIVE aspect of the EXPRESSIVE functionality, and subsequently their attitude, through a contextual relationship between their goals, intent, methods, and tools for production.
- The attitude of designers - evolves, or progresses, in the sensitivity and reflection of the designer on what he or she does in producing the artifact. This translates to an intimate knowledge on the artifact, leading to its design driven innovation. In this cycle the designer's performance, use of tools and ways of material manipulation grow better with each new generation of the product(s). Improving the understanding of an artifact means improving the functionalities of design in the artifact as well as of how users experience it. Emphasizing the EMOTIVE aspect in the design process reflects on the CONATIVE-PHATIC axis of functionality which facilitates the REFERENTIAL functionality, that is, construction of meaning in terms of qualities attributed to, imbued in, the product.

- The intention of designers as to context of use is not the same as the actual context of use, designer cannot plan for every actual context in the life of the designed artifact. A deep emotional connection happens, in many cases, outside the intent or plan of the designer - in cultural and social interaction involving the artifact. Users therefore seem to create context for each of their artifacts and while designers only create the artifacts, they cannot exercise control on the context associated to it by the user.
- METALINGUAL focal points, as constructed from dimension and proportion, facilitate the PHATIC functionality. By structuring different focal points, and emphasizing this functionality in different intensities, the community of users of the artifact can be contracted or expanded.
- The METALINGUAL focal point of dimensions facilitates the constructions of CONATIVE, EXPRESSIVE and CONTEXTUAL UCMs. Designers, though they cannot always address all the possible METALINGUAL focal points for an artifact, will most likely always form the dimensions focal point - since this focal point is closely interrelated with the artifact's physical properties.
- Design can be evaluated according to two standards - how well a product sells, and how well the intended information is conveyed through a product. Over-emphasizing the METALINGUAL-PHATIC axis, may limit the community of users or the contexts of use of the product.

6.5.2.3 User experience design (for online interaction).

Here the designer's role seems to be aimed at facilitating the user's performance of a task within a certain interface, as well as defining this task and the steps needed for the user to fulfill it.

- By being limited to a specific user interface – a web page, user experience designers emphasize aspects of the PHATIC functionality through aligning form language

(METALINGUAL) to fit intended users. The interface itself already has a very dominant PHATIC functionality, being a contact point between addresser (brand), REFERENCE (product) and addressee (online shoppers). The performance of FORMAL and METALINGUAL functionalities of design in such an interface, depend on users cultural point of view, but also on their aesthetic values (identity). Representation (REFERENTIAL functionality) of an artifact online (PHATIC channel) makes it hard to understand how it performs in different contexts, like what is a lamp's type of light and its luminosity in different interiors. A website interface's PHATIC functionality as a contact channel can solve a problem in communication by enabling users to perceive the qualities – the meaning - of the product it features and simulate the product at different contexts.

- Working in a team, user experience designer seem to be dedicated to fulfilling one role in structuring the interface – its phatic functionality. Other members of their team are responsible for the interface's expressive functionality (applying the brand's house style, or form language), or programming/producing physical properties of the interface. All of the designers in the team work within a pre-set METALINGUAL structure of a web page. The briefing sets up the goals of the team, as well as the EXPRESSIVE and CONATIVE functionalities, while technology seems to be the prime setter of the context.
- The CONTEXTUAL functionality of an online interface seems to be dependent on the type of physical console or interface used in order to access it, as well as the location of that console - for example, at home, or at the showroom - which denotes its own types of intended users: a shopper or a showroom salesman. A physical console may PHATICALLY exclude a community of users from accessing the interface. It's also important to consider that the console's technology also plays a PHATIC role.
- Qualitative research with users (CONATIVE) highlights how the contact channels

- (PHATIC functionality) can be better structured to facilitate user understanding of the product featured (what the interface REFERS to). User experience designers aim at affording user conceptions of a smooth, friendly easy etc. interaction with the interface, and facilitate user perception of the tasks afforded in the web page, as well as how it functions. Therefore every change in the interface is looped through a quality group as a testing bed – upon the results of the test (qualitative concepts attributed to experience of use) the interface's PHATIC functionality can be improved. Sometimes users of the interface may conceptualize, from formal attributes, an expected affordances that are not there. In such cases the designer attempts to align the METALINGUAL focal point in the interface that is responsible for this expectation.
- Online culture has a constant shift in the behavior of online users. This change in behavior reflect on the PHATIC functionality of the interface, in turn requiring a META change in structure of websites. If a web page is not updated in terms of structure and sequences of actions needed to fulfill tasks, users tend to become disappointed, misunderstand the interface, or experience it as too challenging in terms of user effort. User effort means a set of actions needed to be completed in order for the user to reach their goal. These actions facilitate user's understanding of the qualities of the products featured (as simulated on web page) and in turn reflects on the quality of the experience. Interfacing can be of low or high user effort, offering respectively medium and high quality of experience. Each intensity of user effort has its own PHATIC functionality that excludes some kind of user or featured product. Misunderstanding how buttons work or being unable to perceive them as buttons (not finding them) means that users are stuck in exploration mode and cannot reliably use the interface, for instance, to continue with their purchase in an online shop.

- Form languages in online culture play a strong PHATIC role. Designers need to pay attention to conventions that apply, rather than to type of physical console used for access and how it works. These convention (relationships between physical properties and METALINGUAL focal points) differ between generations of technology, where each generation bring its own standard, users - who get familiar with particular set of conventions, and designers - who use sets of conventions as a PHATIC functionality with which they aim at affording users an almost instinctive understanding of how to interact. Each new set of technologies defines a new standard for use and creates a new generation of users. Some of the old generation users may adopt and adapt to the new conventions, learn their key METALINGUAL structures, form language, etc., and use the artifacts from the focal point of the new conventions. Still, other user will remain with the old conventions.
- Form languages can be created in in order to bridge between old and new generations. For example, in the beginning of website design designers made sure that clickable buttons looked and “behaved” like real button, creating them as a metaphor for reality. The next generation buttons became much more minimalist and abstract in their design. As artifacts of the new technology became a convention in terms of form or visual language, there was no longer a need to use metaphors from reality in order to signal an affordances on a website.

6.5.2.4 Fashion design

- Fashion language is extremely context dependent because intended users create their own statement and syntax by selecting and combining clothing items. Fashion language is used to convey identity – this language is relative to every user and never “constant” between 2 users.

- Fashion design has changed from conveying or affording users a social function, or position, to conveying users or affording them to create their own statements (and in turn, to convey their identity to other addressees). These affordance (and their context of use) are separated from that of the physical use of cloths (to cover the body).
- In fashion culture the shift in behavior of users and in the way meanings (mental entries of concepts, actors and role players) are changed and associated to clothing garments is fast, but affordances (in terms of physical use) stay still in items such as pants, shirts, hats etc. or shift in slow cycles.

6.5.2.5 Designing in FAB LABs, or with Fabrication technology

- User construction of an addresser depends on focal points formed by personal experience – if someone is familiar with FAB LAB technology they will recognize the origins of artifacts produced there. For example, the structure of layers in produced artifact - as if the artifact was sliced and then put back together - adds emphasis on the expressive functionality aspects of the artifact and can be easily associated by the user as a result of FAB LAB technology.
- Working with fabrication technology means doing a lot of experiments. In FABLABS, designers are mainly preoccupied with the EXPRESSIVE qualities that the machines bring into the fabricated product. This context of designing is very similar to student's work at school - exploring the range of “expressions” of the technology - rather than the work of a commercial designer. Therefore, in many artifacts fabricated in FAB LABs, there is no construction of intended user, only the potential of an intended user, this potential does not seem to require working on CONATIVE-PHATIC axis of functionality, beyond the designers own construction.

6.5.2.6 Critical Design.

- Designers for critical approach seem to look at the things that are already there, in terms of an artifact and its contexts of use, its actors and roles and then design something new which expresses a statement about the whole situation, or about one aspect of it in specific. Critical designers use METALINGUAL structures in order to bring into attention and emphasize a single aspect in a product - usually a FORMAL one - that in turn associates the product with a REFERENTIAL statement on the relationship in which it and its users participate.
- In this method, designers do not always need to emphasize an intended group of users or think on PHATIC contact in detail. They rely on pre-existing artifacts and common social situations in a community. This means that these aspects are more or less already set into the design process.
- By creating a new statement from the artifacts or situation, and by bringing in new METALINGUAL focal point into the user-artifact relationship, designers work on an EXPRESSIVE functionality and form an EMOTIVE aspect of addresser.
- The gallery, museum, or commissioner of the designed work can have several roles, each according to different addresser-addressee relationships and contexts. For designers who present mostly in galleries or similar platforms, these platforms have a PHATIC functionality - serving as PHATIC-CONTEXTUAL axis with which intended addressees (visitors to these platforms) can construct different addressers.
- A gallery, a festival or an event, a museum, or an exhibition space - each with their own audience of users - are usually both a facilitator of the designed work as well as its addressee. In such cases, it seems that the addressee chooses the designer by commission in order to generate or strengthen the expressive functionality of the addressee AS an addresser in its relationship with its own audience of users

6.5.2.7 Designing for Social Change.

Social designer are seen here as facilitating the construction of an understanding (of a problem) with group of peoples, stakeholder, and as coordinating joint design thinking discussion towards a solution, or behavioral change.

- Micro narratives for designing in third person, that is according to a construction of a community of users, are used by designers to construct the problem as well as set the values for aspects of the REFERENTIAL, CONATIVE, PHATIC, CONTEXTUAL functionalities.
- Designing with a structure of product-service-system requires dealing with the logic of the relationship that exists between these levels of planning. In many cases, a functionality, whether its CONTEXTUAL or FORMAL is already set by the stakeholders.
- The processes facilitating communication between group members, cannot be transferred or copied from one social designer to another – even if their toolkit (sets of models), group of participants, as well as intended users are the same. Through discussion in the group each designer adjusts their attitude - emphasizing different aspects in their toolkit - in order to achieve their aims in a way they feel is best and make their tool kit work optimally. This is how the EXPRESSIVE functionality and its EMOTIVE aspect are emphasized in designing within social context.
- Every time a social designer uses their toolkit, they do so with different attitude - EMOTIVE aspect. That is because the tools are used in different groups of stakeholders, situation, build on new knowledge, and are directed at different goals.
- Facilitating communication within a group of stakeholder, requires a metalanguage, or focal point made of concepts and words, that must fit the right kind of stakeholders or participants in group. This use of metalanguage facilitates the PHATIC functionality of the toolkit of the designer as a designed artifact. Designers adjust a “code” to form a

phatic functionality of their toolkit towards different types of participants. In effect, the tool kit performs as model that is aimed at facilitating the group in developing an understanding of a situation. This adjustment in META-LANGUAGE (according to the designer's newly gained experiences and interaction with group's participants) facilitates an evolution in use or sensitivity of the toolbox as model by designers.

- Building a PHATIC frame of contact between designs and participants require setting up a relationship of trust that will allow to use the toolkit and facilitate communication in a group.
- Intended users as well as group members behave differently in different contexts. For example, kids in school will behave differently than kids in playground, forming different narratives.
- Working with people is an interactive process is a hermeneutic circle of sorts. With every new understanding about the subject (REFERENTIAL) of the discussion or context of use a new looping into the process is required in order to better the model's productivity. This provides a better understanding of the subject of the discussion. The METALINGUAL-PHATIC axis of functionality seems to be essential to social design. In group discussion, the designer makes an assumption about the group of participants – assuming what meta-language will motivate them to speak up – and then constantly adjusts and updates his assumption until the participants show that they can comfortably participate in the discussion. In doing so, the designer searches up for a shared metalingual focal point that would facilitate a smooth coordination of meaning between all participants. Language barrier may effects this axis between designer and group participants, or within the group itself, especially when participants are not comfortable performing, or knowledgeable enough to speak up in another language.

- In the process of social design attention is given not only to the participants and to what the joint action aims to co-design/create, but also to the way the social designer achieves this cooperation. Each designer has their own contextual relationship, or attitude, which is visible only in group interaction. This EMOTIVE aspect is the value of the designer, who is the driving force of the interaction. It reflects the qualities the designer bring into the process.
- The construction of the problem - the field or subject of discussion in the group - emphasizes aspects of the REFERENTIAL functionality. The designer tries to frame this concept, in order to bring forth from the group a solution. The process of co-designing with a group of participants (which represent future intended users of the solution) emphasizes aspects of the CONATIVE functionality and means working on a REFERENTIAL- CONATIVE- CONTEXTUAL axis. For example, the subject of mobility (REFERENTIAL) will have different contexts of use according to different groups of users (CONATIVE), Mobility of children is very different to mobility of elderly people. Designers can research the elderly (CONATIVE) but it is different when they focus on the aspect of mobility (REFERENTIAL, CONTEXTUAL) for elderly people (CONATIVE). Framing the topic and goals of a group discussion, therefore, forms key focal point facilitating co-design in a certain context. Also, by defining and framing of a topic, designers can aim the co-designing in the group towards addressing an intended context (CONTEXTUAL). Doing so, designers build the contact channels that facilitate communication between themselves and group members, or participants and facilitators of the discussion in general.

6.5.2.8 Graphic Design.

- Graphic design as a practice works very closely with language creation, primarily producing

symbols that represents concepts – almost in the same way words do. Graphic design seems to be extremity involved with propaganda and marketing. By designing packages, adverts, posters and so on, graphic designers work on weaving a PHATIC contact channel between the product designer, an intended statement, and intended user. Graphic designers make sure that all that is needed to be heard by the user is there. Doing so, they work on a REFERENTIAL-PHATIC functionality axis with a set of artifacts - all referring to a single product and its qualities.

6.6 Conclusions for Part Three.

Based on its case studies investigation, this research concludes that it is very likely that any goal directed use of artifacts will be understood - in different level of consciousness - in ways outlined by the *Functionalities of Design* model.

In expanding the scope of Jakobson's *Functions of Language* model into design this research strengthen its previous conclusion that the only distinguishable difference between acts of communication is their modality - their physical properties. The main condition of these acts is whether they are structured (grammatical) sequence of sound, or structured are arrangement of visual or material elements. The meaning of *languaged* sentences and designed artifacts is conceptualized and constructed in the same way - by humans sensing an information structure, filtering it through assumed series of known meaningful meta-structures, until all contextual incompatibilities are resolved to the actor's satisfaction.

A universal structural way of looking at designed artifacts as presented by *Functionalities of Design* model seems to be inherent from a structure of thought - a set of cognitive processes most likely associated to perception - which is shared across all human, and that enables them to understand artifacts in terms of conveyed meaning, as well as to structure and to plan artifacts according to an intended meaning.

Forming a capacious language based framework for thinking about design this research has shown that the same set of principles can be used as a universal guiding structure for the process of design, in the planning of artifacts, as well as be deployed in design practice. Exploring this framework for thinking about the act of designing according to an underlying universal structure, this research demonstrated how design thinking facilitates the creation of a designed work and enables the functionalities of design. It also demonstrated how designers work according to that set of principles during their thinking process.

From a qualitative investigation with designers, practitioners, and researchers, this research produces a list of reflective insights and axiomatic proposals exploring the validity and relevance of this structural model in the field of design. Doing so, the research sets up a list of topics and goals to be works out in further investigations that will be aimed at establishing a systematic and synchronic approach to the study of design, design artifacts and design thinking.

The researcher acknowledges the need for a further consensual unraveling of the above qualitative investigation, therefore relying on a broader future scrutiny. A critical specific analysis of these interviews, their insights, and proposals will be performed in the future - together with experts and practitioners in the different disciplines and contexts that form the field of design. This too will be part of the continuing work towards the establishing of a language based approach to the study, teaching and practice of design.

Chapter Seven

The Grand Totals: Summary and Conclusions

The final chapter of this thesis serves as a grand review for this research. It revisits the knowledge produced during this thesis, as well as the journey that was taken. It further notes the challenges that were faced during the research and list suggestions for improvements in future investigations. Finally it looks to the future and considers the potential of this work.

7.1 Revisiting Design and Language.

The present research was aimed at exploring the possibility of Universal Structures (US) in design, as well at showing the relevancy, or validity, of US associated with the study of language to the field and study of design. This research built on the deep relationship between language and design abilities in order to posit language US concepts and models into design, or alternatively, to compellingly and conclusively show the relevance of the first in the latter.

7.1.1 Goals and framing.

In doing so, this research sought to clarify a complex situation in modern culture which seems to blend the border between the use of designed artifacts and the use of *languaged* sentences and texts. A “blending” in terms of use which also seems to reflect a “blending” in terms of cognitive capacities needed for language and design. The latter perspective resonates from the relationship between language and design in terms of competence and performance, as explored and proposed by Andy Dong in *The Language of Design* (2009).

Building on Dong's work, this research primary hypothesis was that if indeed language and design are the same (as in a singular identical condition), then it will be possible to use knowledge originating from the study of languages - in particularly universal principles and parameters - in the study and practice of design, as well as to contribute and to develop a better understanding of

design ability and activity.

In validating this hypothesis the research sought to inform and explore the relationship between language activity and design activity, their competence and performance. It inquired into the structural dynamics with which these two seemingly distinct human abilities manifest and are applied in order to facilitate communication. Further on, the research proposed and sought to establish a systematic and synchronic approach to the study of design, design artifacts, and design thinking. It worked to form an approach that was grounded in the framing and the theoretical foundation of universal structures used in the fields of linguistics, semiotics and structuralism.

The research therefore aimed to presents a solid and compelling argument that language and design are more than just conceptually the same in terms of their *reality-producing* nature. It offered a reviewing of design from linguistic perspective and established the needed theoretical foundation (accessible and applicable in design practice) for developing the proposed synchronic approach to the study of design.

The research conceptualized a framing for design according to Saussure's principles of *parole* and *langue*. The first being any artifact or act of communication conceived and enacted by men and his involvement, whether it is a combination of sounds, visuals or materials; the latter being the system that enables the production and circulation of paroles. While the parole produced is made up of real, actual and concrete uses of sound, material and visual elements, and is potentially infinite, the langue is finite, but also abstract, it is something that is inferred behind the examples of *languaged* and designed artifacts that can be observed .

Building on this framing of parole, the research looked at any given designed artifact not as a functional solution (aimed at changing one situation into another preferred situation), but predominantly as an act of communication that performs as a “message” between the designer of the artifact and its user. A “message” that is aimed at producing, circulating, and coordinating

meaning - be it something to do, or to know - between a community of users.

In that regard, this research did not discuss the concept or framing of affordance in depth; instead, it built on the framing of affordances that was inherent from the sources of design thinking used in the literary geometry.

7.1.2 Methodology.

In working towards its goals, this research produced a series of comparative studies of the relationship between language and design. While building on each other, each study deployed a different methodology towards different goals, as well as dealt with different aspects of the relationship between these two seemingly distinctive abilities.

Investigation one inquired into the structural dynamics with which language and design abilities manifest and are applied with. It also inquired to the possibility of universal grammar in design and attempted to infer, or shed light on a design langue. It did so not through examining every individual or mass produced example of design parole, but by forming a comparative analysis that was aimed at identifying patterns, principles, and parameters – associated with language langue in key sources of design thinking - and by re-purposing or positing the descriptions of such lingual concepts into design. The latter was accomplished through adjustment, or transition, of key terminology in the description of these patterns, principles, and parameters.

This comparative analysis worked with Steven Pinker's *The Language Instinct: How the mind creates language* (1994) as source for linguistic information. It used the following key sources of information for the fields of design thinking, cognitive studies, visual perception and semiotics – all fields which are relevant to the study of design:

- *The Ecological Approach to Visual Perception*, by James J. Gibson (1986);
- *Introducing Cultural and Media Studies: a semiotic approach*, by Tony Thwaites, Lloyd David and Warwick Mules (2002);

- *The Semantic Turn: A new foundation for design*, by Klaus Krippendorff (2006);
- *The Language of Design: Theory and Computation*, by Andy Dong (2009); and
- *Design Thinking: Understanding how designers think and work*, by Nigel Cross, (2011).

Focusing on creating a clear and coherent vision through a dynamic comparison between statements on language and design and subsequently developing an understanding of the relationship between these abilities, the scale of the analysis consisted of selected statements from the first four chapters of *The Language instinct*. These were selected according to their relevance and contribution towards constructing a concept of design ability as language or communication based - building on the framework established earlier.

These statements were then converged into logical equations consisting of the original linguistic statement and its transitioned design posited equivalent. This formed an axis of synchronized meaning between the fields of language and design. The transition of each statement was followed by a discussion and series of notes. These motivated the terms used in the transitioning. Doing so, the research examined the logical validity of the transitioned statements by contrasting against or converging the selected statements made by Pinker with statements from the works mentioned above, relevant case studies, and articles.

This analysis consisted of four sections, one for each of the first four chapters. Each section began with a manifest composed of the different transitioned statements. This was then followed by the individual equations and subsequent discussions. Each section ended with a summary of key points discussed, building up to a final summary of investigation one and to the listing of its conclusions.

Building on the discussion in investigation one, Investigation two worked on forming a concise and coherent picture of the underlying similarities and differences between the two

abilities (in term of performance and competence). It presented a conclusive argument for the sameness of these abilities and their link to a structure of thought. Investigation two formed a critical approach towards key points relating to the universality of language and of design. These points were noted and touched upon sporadically in investigation one. It offered a consistent and focused comparison of the underlying building blocks of language and design abilities with four sections, each considering one of the following aspects:

- Brain activity associated with language use and design use;
- cognitive processes and protocols associated with design and language competence;
- the base materials, or structural units, used for building lingual artifacts and designed artifacts, and;
- the scope, modality and limitations of the ways lingual artifacts and designed artifacts are sensed and perceived.

Investigation three showed how designed and lingual artifacts share a universal structure of principles. It worked on forming a capacious language based framework for thinking about design. Here, the research revisited Jakobson's *Functions of Language* - a key model in structuralism, communication and semiotics according to which an act parole could be effectively described - and examined how can it be used for the study of designed artifacts, in design thinking. It also explored how this model can be used in the practice of design as a guiding universal structure of principles underlying all design parole. The research used a series of case studies to posit this model in the field of design. It adapted the model according to terms compatible with Krippendorff's primary concepts of meaning, conceptualization, and user conceptual models (2009), and renamed it the "*Functionalities of Design*" model.

The last section of part three introduced a series of qualitative interviews that were aimed at identifying the principles outlined by Jakobson's model (and in an adaptation of it used for

semiotics) in the practice of design practitioners and in design practice in general. These interviews, which were conducted at an early stage during the research, were eventually used both to test the positioning of Jakobson's model in design as well as to position the research itself in the field of design thinking. The research attempted a first approach towards processing the vast amount of material encountered in the interviews by producing a list of primary insights that were formed during these discussions. Doing so, it showed both the resonance of the *functionalities of the design* model, as well as the model's own relevance to the practice of design and design thinking. Keeping the research's long term goal of establishing a systematic and synchronic approach to the study of design, design artifacts, and design thinking, the produced list serves as a set of new targets and goals for future investigations in this direction.

7.1.3 Conclusions.

In investigations one, two and three, the research drew different sets of conclusion, each aimed at facilitating the next stage of investigation.

From the analysis in investigation one the research concluded that in many cases essential mechanisms involved in language activity appear to be also at work in design activity. It identified possible similarities and parallels between the workings of language and design, such as in:

- The ways a mental dictionary is used in language and design.
- The syntactic roles played by parts of speech in lingual and designed parole.
- The way abstract "*ideal types*" (Krippendorff, 2006) in design use and "*pure abstract sound impression*" (Thwaites et al., 2002) in language use link between perceived information structures and concepts in the mind.
- The cognitive processes used in language and design with which brain hunts for *clarity and comprehension* (Gibson, 1986), that is, in order to differentiate structured

information from the radiant flow of sensual information and identify it according to personal experience of use.

- The way design and language are both used for the conceptualization of artifacts and identities into being.

The research concluded that more than being deployed for the performance of language, the structural cognitive process known as grammar is primarily an essential part of the perceptual system with which the brain identifies structures of information - the "*ambient light*" - from the ongoing flow of sensory data (sound, touch, sight, smell ,or taste), - the "*radiant light*" (Gibson, 1986). Grammar seems to be a cognitive process deployed for distinguishing between different types of known and unknown information structures according to which sound and 3D structures are identified or put into memory. This perception process: a) associates these structures with a possible meanings, and determines their significance - whether it is a set of imaginable uses, a reference, or knowledge; b) builds up the entries of the mental dictionary of acts, actors, role players, and combinatorial rules.

Converging the debates from the statements produces in investigation one, the research concluded that it is very likely that a structural protocol, such as a mental dictionary with discrete combinatorial or blending rules and sets of mental entries, is deeply involved in the analysis of sensory data and the identification of structures from that data. In a split of a second the human perception hypothesizes, or predicts, which part in the flow of sensory data is a significant information structure - panning, scanning, zooming on the information while comparing it with possible entries of other seemingly similar abstract structures in the mind's mental dictionary. This is performed in a circular process through which the meaning of the structures sensed is constructed with the least amount of contextual incompatibilities. In order to deal with overwhelming amount of information the mind gives priority to dominant structures over lesser

dominant structures - that can be only sensed in detailed attention - in the sensory information flow. Doing so, it effectively “*nest*” information structures into each other in the perceived ecology (Gibson, 1986).

The research noted that design, as explored in the comparative analysis, seems to rely on the human ability to distinguish between different structures in their environment according to different qualities and modalities. Design “*is a sense making activity*” (Krippendorff, 2006), not only for oneself, who is seeking to understand what does the environment constitutes, but also for others. The designer’s main preoccupation is aimed at helping the users of their designed artifacts make sense from their designs. In making sense of design humans perceive, “read”, and construct the meaning of designed artifacts. When designing, humans structure designed artifacts, drawing upon their personal experience (Cross, 2011; Krippendorff, 2006) and subsequently a mental dictionary (Pinker, 1994) that is filled with entries of abstract structures - “*ideal types*” (Krippendorff, 2006) - and sets of possible relationships between them (Pinker, 1994) in order to base their designs on. Doing so designers assume that the structured combination used for the designed artifact will be “read” correctly by in the right context others and be linked to the meanings/uses intended by the designer.

Design use - the creation and perception of visual or material parole - therefore seems to follow the same structural mechanisms and cognitive processes as language use, as well as be deployed towards the same goals – the conceptualization of reality, of artifacts and identities, into being - as if the same method is deployed in two different fields, in different capacities, yet yielding structurally similar results. Any differences between the two, as well as in in the way their related sign systems (languages, styles etc.) are used for communication of information and coordination of meaning, seems to originate from the modality of the parole, and of the inner makings of base elements used for the structuring of the parole.

In investigation two, from the inquiries into key similarities and differences between shared aspects of language and design, and its four sections, the research drew the following set of conclusion.

From the convergence of theories and evidence from the first two sections of investigation two, the research concluded that the cognitive capacities enabling the generation of the semantics and syntax of language are more than similar to the ones needed for design (as suggested by Dong (2009, p. 176)) and very likely overlap or work in unison. It is possible to strongly argue that language and design share the same cognitive capacities, where a key set of cognitive processes - responsible to the construction of meaning from sensory input regardless of the sensory modality - plays an essential part in facilitating the ability to use combinations of sounds, visuals and materials for communication. These processes, based on accounts from cognitive science, seem to be shared both by language competence and design competence. With this conclusion the research formed here a contact point with Pinker's concept of "*mentalese*" and argued that its suggested strong link between the structure of language and the structure of thought, must also extend to the structure of design as well

Knowing language, as Pinker explores, is knowing how to translate mentalese into strings of spoken words, i.e., language parole or a lingual artefact, and vice versa. Knowing design, as this research proposed, is knowing how to translate mentalese into arrangements of visual or material elements, i.e., design parole or a design artefact, and vice versa.

In both cases, humans use a code to translate between orders of structural units and combinations of thought. This code, or set of rules, which is identified by this research as grammar, seems to be universally shared across all humans regardless to culture or age. This research considered Generative Grammar to be a set of cognitive processes which associates sensory input with meaning in the brain. This set of cognitive processes seems to be at work the same way

whether the act of communication is designed or lingual, that is, made of either visual-material units or vocal ones. Converging this with the comparative analysis made in sections three and four, this research concluded that deploying this set of cognitive processes in different modalities, both in terms of phenomena (sound, touch, visuals) and semiotic terms (oral, gesture, written), constitutes as the only, yet fundamental, difference between language and design activity.

Lingual base elements and design base elements fundamentally differ as phenomena, the first considered an event, the latter an object or medium. This results, in turn, in a fundamental difference in terms of use, or functionality, that is, in how lingual and design elements are constructed and combined or blended into distinguishable information structures, as well as in the way and intensity of explicitness with which humans associate meaning with these base elements.

Humans deploy different systems of organs in the performance of and the perception of lingual and designed acts of communication. Perception of different modalities and in different frequencies require different organs, different movement and very likely different cognitive processes, each dedicated to regulating a specific sensory modality or set of organs. With these, information structures are sampled in the radiant flow of sensory information. The subsequent deployment of grammar leads to the recognition of lingual and design base elements in terms of physical properties belonging to abstract categories of sound impressions or of ideal types of entries in the user's mental dictionary.

Building on the deep similarity between the performance of language and of design, in terms of the cognitive and biological capacity that allows for their competence, as well as in their cognitive structure, the research hypothesized the following sequence of evolutionary development. The cognitive capacity to use language could have developed (as Higuchi et al. (2009) suggest) over the cognitive capacity of perception (used so far to regulate body movement as well as simple tool manipulation) before, in unison with the development of specific sensory

organs in the body (as explored by Dong (2009)), both cognitive capacities have begun to adapt for more complex structures of thinking that allowed for thinking in complex phrase structure grammar - the characteristic of human language use as well as design use.

With this hypothesis, the research attempts to explain how language and design build on the same thought structures and enable structurally similar artifacts of communication. It concluded further that language is more than design's structuring structure (as Dong (2009) argues), because language and design capacities have or share the same key cognitive structures and allow the production of structurally similar artifacts of communication (in different modalities).

In investigation three, the research expanded the scope of Jakobson's *Functions of Language* model into design and concluded that it is very likely that any goal directed use of artifacts will be understood, in different level of consciousness, in ways outlined by the *Functionalities of Design* model.

This supported this research's previous set of conclusions that the only distinguishable difference between acts of communication is their modality in terms of physical properties - whether these acts are structured (grammatical) sequences of sound, or structured arrangements of visual or material elements. Again, the meaning of *languaged* sentences and designed artifacts is conceptualized and constructed in the same way: by humans sensing an information structure, filtering it through assumed series of known meaningful meta-structures, until all contextual incompatibilities are resolved to the actor's satisfaction.

A universal structural way of looking at designed artifacts as presented by *Functionalities of Design* model seems to be inherent from a structure of thought. Again, a sets of cognitive processes - most likely associated to perception - which is shared across all human, enables humans to understand artifacts in terms of conveyed meaning, as well as structure and plan

artifacts according to an intended meaning.

Working towards the forming a capacious language based framework for thinking about design this research concluded that the same set of principles can be used as a universal guiding structure for the process of design - in the planning of artifacts - and be deployed in design practice. Exploring this framework for thinking about the act of designing according to an underlying universal structure, this research demonstrated how design thinking facilitates the creation of a designed work as enabling the *Functionalities of Design*, as well as how designers work according to that set of principles during their thinking process.

Finally, from a qualitative investigation with design practitioners and researchers the research produced a list of statements exploring the validity and relevance of this structural model in the field of design. While noting the need for a further consensual unraveling of that qualitative investigation – and therefore relying on a broader future scrutiny - this research formed this list of targets to be explored in further investigations into a systematic and synchronic approach to the study of design, design artifacts and design thinking.

7.2 Revisiting the Research.

The research began with a large and diverse question: how can possible universal structures in design contribute to the enhancement of craft activity in Portugal? Through the first study year (a substantial amount of time) the researcher worked to cut the question down to what was a perceived as manageable size a single PhD course. He focused on validating the possibility and relevance of US associated with the study of language in the field design.

Working as a lone researcher limited this research:

- in terms of the mental capacity needed to contain this mount of information;
- in terms of keeping a structured, coherent, and conceptually stable investigation, and;
- in terms of subjects and areas of research that could be covered and in a specific unit of time (3 years).

As such the researcher could not have address all that is discussed in the books used for the literary geometry and other sources that were used by this research. He addresses only what seemed to strongly contribute to the construction of a clear, consistent and coherent vision over design and and its relationship with language.

Trying to overcome these limitation, as well as find funding for this research, the researcher made a few unsuccessful attempts to form a larger network of researchers with other educational and research institutes in Netherlands and Portugal during the first year of the course. The researcher believes that a team made of himself (researcher from the field of fine art and design), a semiotician (a researcher of human communication), a cognitive psychologist, and one more design researcher from the field industrial design engineering could have produced better results in terms of content structure, research production, fields of knowledge and academic resonance.

As soon the research was set with clear goals and milestones the researcher began working on the qualitative interviews featured in part three. The list of participants for the interviews

consisted of people who are either in the social circle of the researcher, or were extremely interested in the research as a part of their own research and investigation activity. All of them have been accessible in terms of distance and availability.

This researcher feels that he lacked experience in moderating these interviews as well as in analyzing them. The first issue of moderation resulted in the informality of the interviews which - although being geared at opening up the subject for a constructive discussion of the model - caused for a large amount of subjects to enter the discussion. Some of these can be deemed as personal, most of these contributed to the positioning this research's path in the field of design. The latter issue of analysis resulted in the research providing only a list of topics discussed - rather than a structured analysis of the interviews themselves - and leaving the working out of these topics to future investigations. This was done both due to the sensitivity of some of the material discussed as well as to safeguard the coherence, manageability, and structure of the thesis at large.

The researcher wonders if the interviews were conducted too early in the research process. Perhaps it may have been better to do the interviews after constructing the *Functionalities of the Design* model.

Finally, since most of them are still alive, the researcher adds that this research would have had a very different outcome if the key authors of the literary geometry were more involved in the research. In the beginning of 2015, once a key manifest of intentions and the content featured in investigation one were completed, the researcher contacted Steven Pinker, Klaus Krippendorff, Andy Dong and Nigel Cross and asked for their comments. He received response from all, but from some more in depth than others. *Appendix (i)* details the communications with these authors and its results.

7.3 Visiting the Future.

Investigation one of the research has validated that anything that can be said about language can be also said about design - with a minor alignments to compensate for changes in terms of modality to visual material elements. Investigation two offered a strong argument over the sameness of language and design capacities. It demonstrated how these capacities operate on the same set of cognitive processes with which meaning is associated and constructed from information structures sampled by the perceptual system. The research moved there from using the term "similarity" - which still suggest a level of differentiation - to the term of "same" - suggesting a singular and identical condition. Investigation three builds on the sameness of language and design to form a framework for thinking about design and designing - the planning of designed artifacts - that is rooted in the study of languages and in the theoretical foundation of universal structures used in the fields of linguistics, semiotics and structuralism.

These three comparative studies form a theoretical foundation, accessible and applicable both to design thinking and to design practice. They form a first approach towards a language based perspective, approach, or even a discipline to design and its education - a systematic and synchronic approach to the study of design, design artifacts and design thinking.

Still there are some differences left to be considered between language use and design use. For example, meaning constructed from material-visual language is quite different than the meaning of spoken languages. Another issue is that design has no clear true or false value, especially outside of utilitarian perspective, but it can convey and coordinate negative or positive qualitative values. Language can be inflective, that is sentences can refer to gender and refer to past and future. Design seem to be non inflective, although artifacts may refer to gender, it seems they cannot refer to the past or future (other than their own) as lingual statement can. On the other side of the comparison, it seems that lingual artifacts cannot evolve with technology (since

every variation is a literally new sentence) or get “old” with use, unlike artifacts which can evolve with technology and get “old” with use.

Continuing this investigation and working towards the establishment of a language based approach to the study of design, the researcher intends to disseminate this thesis, across various academic and research platforms, and contacts, through a series of workshops, master classes and lectures, as well as with producing and presenting academic papers. All these activities will build on this research and the knowledge it had produced.

In doing so the research hopes to map and identify the right networks people and institutions which can serve in the further investigation of the different aspects covered by the research, as well as of the of topics and targets for future investigation set in part three. The researcher intends activate his professional network, as well again contact Pinker, Krippendorff, Dong, and Cross and see what debates and topics can be carried further with their cooperation and involvement.

The resonance of this research and its findings is not limited to the field of design in the context fine arts. The researcher finds that with his ambition to contribute to the development of new understanding of design he has formed a bridge that connects with many of the scientific contexts of design. The research highlights below two of such contact points.

The first is the way in which Simon's view of the evolutionary model - as discussed within his framing of economic rationality - helps to understand the limitation of *Functionalities of Design* model, as well as of designers in light of the immense and ever changing ensemble of social practices of culture. According to his model “*The simplest scheme of evolution depends on two processes: a generator and a test. The generator produces variety, new forms that have not existed previously, whereas the test culls out the generated forms so that only those that are well fitted to environment will survive*” (Simon, 1996, pp. 46-47).

This research sees designers as generators of new artifacts and culture as a test that culls out the generated artifacts so that only those artifacts which form a positive match with contextual needs, requirements, and desires of specific communities survive. Naturally, a lot happens in the life of a designed artifact. Designers, in most cases, are able to conjure a strong positive match between the designed artifact and contextual needs, requirements and desires of intended users. In some case this even happens unintentionally, as Krippendorff says: artifacts mean different things to different people and at different times. Even if a designers and facilitators of a designed artifact would work with *Functionalities of Design model* to map out every eventuality, in the end they will need to decide which of eventualities mapped forms the best positive match between their needs, requirements and desires, be them financial or ideological, and those of the intended users. This statement brings this point a full circle back to the subject of Economic rationality, a direction of investigation which this research and its goals can strongly contribute to in the future, but for now it is a subject that fall out of the research's current scope.

The second point of contact is what this research would like to term as *The Perception Game*. At the time when these lines are being written a heated debate over “*can machines design*” takes place in the forum or conversation list PHD-Design@jiscmail.ac.uk. Building on Alan Turing’s Test (1950), it is an intense and lengthy debate which right now seems to revolve on whether the limited digital context of the test made - with mathematical representation of user’s needs and of the material base elements (for selection and combination) - can constitute an actual act of designing, as well as what exactly constitutes as machine and how these limitation can be compared with a living and breathing designer.

The arguments, theories and evidence accumulated by this research propose that the capacities to design and language (which rely on the ability to processes complex phrase structure grammar) have evolved over the perceptual system. Where once sensing and perceiving allowed

for organ movements, sensory-motoric coordination and manipulation of simple tools, it now allows for the creation of complex structures of tools as well as complex structures of sounds in order to facilitate joint action and the coordination of information across community members.

In the past 10 years significant steps were made with artificial intelligence and pervasive technology. Today artifacts can communicate with each other and even have perceptual behavior programmed into their operating system. Computer robots can play football and computer programs can imitate intelligence by transmitting structured sequences of words better than ever before.

This research has proposed that the real criteria for design intelligence would be a perceptual system that can commit to memory, catalog and categorize sensory input according to structures, situations and events; that can build its own dictionary and identify role players and actors in any given situation, and; that can interact with new information structures it encounters according to their identified similarities to known and previously encountered structures.



Fig. 7.1: The Perception Game (Photo taken on 21nd September, 2015)

This research therefore argues that the real debate in design, should be not “*can machines design?*”, but “*can machines perceive?*”. It proposes to set up a test in the spirit of real life escape games where participants have to use elements of the room to solve a series of puzzles, find clues, and escape the room within a set time limit. A machine would need basically to recognize concepts such as a key, a lock and a door, from a multitude of elements within the room, construct or understand the relationship between these objects and use them in order to leave the room. Relying only on its systems of sensory input “organs” and of “perceptual” analysis. If a machine can “think” as described above and leave the room then this research hypothesizes that it can also be intelligent enough to perform designing, perhaps at very simple level, perhaps more.

Seeing the giant leaps made by human technology and artificial intelligence in recent years, it is possible that both this proposal and hypothesis will be outdated by the time this thesis is defended. The researcher still wonders whether artificial perception could constitute evidence for a real personality? As in a set of qualitative factors that cannot be captured by science, but are attributed to the behavior of animals and people.

With these last thoughts the researcher projects the present thesis towards further continuity, both in own developments and in inspiring and laying groundwork towards a future scientific culture of Design and Language.

Appendix I

RE: Your comments on a comparative extrapolation of "The Language Instinct" into design.

In the beginning of 2015, once a key manifest of intentions and the content featured in investigation one were completed, the researcher contacted Steven Pinker, Klaus Krippendorff, Andy Dong and Nigel Cross and asked for their comments on the work so far. He received response from all, but from some more in depth than others. This Appendix details the communications with these authors and its results. It demonstrates the relevancy of this research and its potential in contributing to design theory and field. Safeguarding the structural integrity of the thesis the researcher opted not to incorporate these contributions into the body of the thesis, but to unfold them as appendix in its tail. It is the intention of the researcher to follow up on this communications in order to initiate further investigation towards the research's goals.

I.1 Making Contact.

The following is a generic email sent to all authors, with some variation taking place in terms of addressing each of the receivers, as well as the context of the email. This sample was addressed to Prof. Andy Dong:

From: Yoad David Luxembourg [hello@yoad.info]

Sent: Tuesday, 10 February 2015 11:33 PM

To: Andy Dong

Subject: Your comments on a comparative extrapolation of "The Language Instinct" into design.

Dear Professor,

I am Yoad David Luxembourg, a PhD Design student at the University of Porto. My research project explores the existence of universal structures in design. The research concerns such structures in the ways humans are able to design, how they perceive and produce design, and the structures and codes they use for their artifacts.

The main premise is that the same universal structures and cognitive processes that account for language perception and production could be identified in design perception and production as well, suggesting language and design abilities are one and the same method used for communication applied in different modalities, or are a part of another larger human ability for communication.

A large part of this research is a comparative extrapolation of Steven Pinker's 1994 manifest "The Language Instinct" in which a parallel manifest "The design Instinct" is constructed for the purpose of discussion and mutual conceptual advancement. In a way, this analysis could be described as a testbed to examine if anything that is said about the inner workings of language can hold true to design as well.

The 30,000 word long text forms a dialog between a core geometry of sources, with which the various statements of the manifest are contrasted. You can find a full abstract of this analysis at <https://phdd201113.wordpress.com/projects/universalstructure/>.

Before submitting and defending my thesis, my supervisor Professor Heitor Alvelos and myself

feel that it would be interesting to gauge the potential of the work by opening it for external scrutiny, looking into a broader and a more textured feedback that could confirm or counter-claim the premises.

Therefore we kindly ask if you'd be willing comment on a brief version of the text. It is our intention that this feedback will be attached to the thesis as an appendix. Ultimately I am looking for a feedback of about 500 - 1000 words, and hoping to receive it within the month of February.

If you are willing to participate I will provide a link to the essay.

I thank you in advance for your time and consideration.

With kind regards,

--

Yoad David Luxembourg

BA ([DAE](#),2004), MA ([MAHKU](#),2006)

Ph.D student at [University of Porto](#), Portugal

I.2 Responses Steven Pinker.

Steven Pinker initially declined to give any response:

On 11-2-2015 04:11, Pinker, Steven wrote:

Dear Yoad,

I'm delighted to hear that you found inspiration for your work in *The Language Instinct*. I suspect you'd find even more parallels in my last book, *The Sense of Style*, which in several places draws explicit parallels between writing and design.

Unfortunately, because of my commitments to my own students, and other writing and teaching commitments, I will not be able to provide you with feedback on your project.

I wish you the best of luck with it.

Sincerely,

Steve Pinker

However, he agreed eventually to give his shorts comments on two key questions formulated from investigation one. Below is his response and the questions formulated from the investigation:

Dear Yoad,

Those are insightful observations, but I'm afraid I won't be able to comment on them in the detail they deserve. Clearly language has some things in common with design (as you ably point out), but also some things that are different (it doesn't exist in 3D space, its medium does not consist of physical matter, the demands on it are rather different, it's mastered instinctively by babies, and so on). For some more parallels, see chapters 3 and 5 in *The Sense of Style*.

Best of luck with your thesis, and sorry I could not write at greater length. It's certainly a rich area.

Best,

Steve Pinker

From: Yoad David Luxembourg [mailto:hello@yoad.info]

Sent: Monday, February 16, 2015 7:39 AM

To: Pinker, Steven

Subject: Re: Your comments on a comparative extrapolation of "The Language Instinct" into design

Dear Steven

I understand your situation and commitments, we are very grateful for your time and presence.

Below my signature are the two questions (in bold). Each question is followed by the conceptual frame from which it originates (to be used/read as you see fit to). I also add a reference list of sources at the end of the email.

If you could answer me back with your comments on these two issues I'd be extremely grateful.

Thank you again and with kind regards,

--

Yoad David Luxembourg

BA ([DAE](#),2004), MA ([MAHKU](#),2006)

Ph.D student at [University of Porto](#), Portugal

Q1: You mention drawing parallels between writing & designing in the Sense of Style, what is your opinion about the possible "one-ness"/sameness of language and design, or of these being capacities rooted into another deeper fundamental human instinct or competence?

Q1 framing:

As of yet I did not get my hands on The Sense of Style yet, though I found through my research explicit parallel between writing and language in Roman Jakobson's model of communication (Jakobson, 1960 , Thwaites 2002). Interviewing about a dozen of designers and design professors in Eindhoven, (the "design city" of the Netherlands) we saw how the designed artifact and written sentence and must fulfill the same functions outlined by Jakobson and Thwaites, and how designers as much as speakers need to address these functions in production of their artifacts/sentences.

Klaus Krippendorf draws parallel between understanding language and understanding design:

"Understanding a complex artefact is like reading a text, though artifacts can be touched and played with, not just seen. Written characters are grouped into words, words are arranged into sentences, sentences form paragraphs, and so on. To understand, the meaning of a sentence, for example, implicates the well known hermeneutic circle. It may start with some initial set of assumed word meanings. One must then hypothesize a grammatical structure to make sense of these words. Assuming a meaningful structure for the whole usually calls for revision of what words mean in that context, leading to a revising word meanings - until an understanding emerges in which all apparent incompatibilities are resolved to the reader's satisfaction. The same is true for figuring out the meaning of an artifact as a function of the relationships among parts, mutually contextualized by their arrangement and as a function of how the whole is related to other artifacts and user's intentions." (Krippendorff, 2006, p. 61)

Converging your accounts (in *The Language Instinct*) of the results of brain damage to left lobe with Nigel Cross's (in *Design Thinking 2011*) account of the results of brain damage to right lobe, Andy Dong's theory of *The Language of Design* (2009), and various fMRI scans case studies regarding similar hierarchies in cognitive processes [cognitive linking sensory input to mentalese/mental dictionary and the understanding of tools and sentences](Lee, 2014; Corriea 2014; Higuchi 2009), I come at the conclusion that Design as cognitive ability encompass all of the brain. Damage to either lobe will affect the ability to use language to do design - either language production to coordinate design, or the ability to use language for design through the performance of aggregation, accumulation and appraisal (Dong, 2009).

Q2: My research points to the possibility that generative grammar is a protocol rooted in the processes of the perceptual system, which in turn can explain the universality of generative grammar in humans. What are your thoughts about the link between grammar and the perception?

Q2 framing:

This question originates from your use of spiders "...spiders spin webs because they have spider brains, which give them the urge to spin and the competence to succeed" to form an analogy to innate ability of humans to communicate. You seem to give little importance to their spider body and their sensory perception.

Gibson in *The Ecological Approach to Visual Perception* (1986) outlined his theory of affordances

as well as the meticulous learning process infants do in exploring the affordances of their body (especially the hands), possibly before the exploring the rest of their ecology/environment. Perception seems to be used to distinguish between different objects, substances and mediums in the ecology as well as linking them to mental dictionary entries of activities, actors and roles.

In cases of birth deaf-mutes it seems that when perception of language is impaired the vocal production of language is also impaired (I admit I possibly don't know as much about deaf-mutes as you). Possibly a spider with impaired perception would also "spiderweb mute".

You yourself call Grammar "...a protocol that has to interconnect the ear, the mouth, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own" (Pinker, 1994, p. 118). Building on Dong's "Where vocal language realization requires dexterous manipulation of orofacial muscles and the larynx to manipulate sounds, material design realization requires dexterous proprioceptive manipulation of muscles to handle the position or movement of a part of the body." (Dong, 2009, p.176), In design grammar is a protocol that has to interconnect the eye, the hand, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own (allow me to emphasize that ear, mouth, eye, hand are organs used for perception).

I.3 Response Klaus Krippendorff:

On 12-2-2015 21:56, Klaus Krippendorff responded to the first email; he wrote:

thanks,
yoad david,
for sending me the abstract of your dissertation, I guess. the topic is very interesting to me.
surely, I am curious how you extend pinker's language instinct to design practices. personally, I
think pinker pursues a very narrow conception of language and cognition and therefore comes to
all kinds of strange conclusions. I hope you do not carry them over into the domain of design. to
my way of thinking the domain of design is expanding quite radically. the evolution of language,
its vocabulary and metaphors are surely part of it. to me, design is a process that is impossible
without cognition, but cognition explains hardly anything, culture and communication does.
best wishes
klaus

Up to the moment when these lines were written, Klaus Krippendorff did not respond to any further communication on the subject.

I.4 Response Nigel Cross:

Nigel cross also declined to give any comment initially, but sent the following response on 24-2-2015 18:53:

I am neither a neuro-scientist nor a philosopher, so I really cannot comment on the topics you raise. I have only drawn upon these other fields to make propositions of my own about the scope and nature of 'design intelligence'.

I don't like the idea of the ear, mouth and mind being considered as 'kinds of machine'!

Best wishes,

Nigel Cross

From: Yoad David Luxembourg <hello@yoad.info>

Date: Saturday, February 21, 2015 13:10

To: "Nigel.Cross" <nigel.cross@open.ac.uk>

Subject: Re: Your comments on a comparative extrapolation of "The Language Instinct" into design

Dear Professor Cross,

Thank you for your message. I understand how busy you are.

Yet we feel your voice would be decisive for this research.

Will it be possible for you to clarify your position on the 2 main issues of the thesis - regarding Design intelligence (2011, Ch. 5)?

I framed these into the 2 questions below (my signature) and I am hopeful you could answer me back with a short comment.

We would be very grateful.

With kind regards,

Yoad David Luxembourg

BA (DAE,2004), MA (MAHKU,2006)

Ph.D student at University of Porto, Portugal

Q1: What is your opinion about the possible "one-ness"/sameness of language and design, or

of these being capacities rooted into another deeper fundamental human instinct or competence?

Q1 framing:

Converging your accounts (in *Design Thinking, 2011*) of the results of brain damage to right lobe with Pinker's (in *The Language Instinct, 1994*) account of the results of brain damage to left lobe, Andy Dong's theory of *The Language of Design (2009)*, and various fMRI scans case studies regarding similar hierarchies in cognitive processes [cognitive linking sensory input to mentalese/mental dictionary and the understanding of tools and sentences](Lee, 2014, Corriea 2014, Higuchi 2009), I come at the conclusion that Design as cognitive ability encompass all of the brain. Damage to either lobe will affect the ability to use language to do design - either language production to coordinate design, or the ability to use language for design through the performance of aggregation, accumulation and appraisal (Dong, 2009).

Q2: [My research points to the possibility that generative grammar is a protocol rooted in the processes of the perceptual system, which in turn can explain the universality both of generative grammar and of design in humans.] What are your thoughts about the link between grammar, perception and design?

Q2 framing:

Gibson in *The Ecological Approach to Visual Perception (1986)* outlined his theory of affordances as well as the meticulous learning process infants do in exploring the affordances of their body (especially the hands), possibly before the exploring the rest of their ecology/environment. Perception seems to be used to distinguish between different objects, substances and mediums in the ecology as well as linking them to mental dictionary entries of activities, actors and roles.

Pinker call Grammar "...a protocol that has to interconnect the ear, the mouth, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own" (Pinker, 1994, p. 118). Building on Dong's "Where vocal language realization requires dexterous manipulation of orofacial muscles and the larynx to manipulate sounds, material design realization requires dexterous proprioceptive manipulation of muscles to handle the position or movement of a part of the body." (Dong, 2009, p.176), In design, grammar is a protocol that has to interconnect the eye, the hand, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own (allow

me to emphasize that ear, mouth, eye, hand are organs used for perception).

On 17-2-2015 13:06, Nigel.Cross wrote:

It sounds a very interesting project, but I do not have time to comment in any depth. I would be prepared to comment on matters of accuracy where you cite or relate to my own work.

Best wishes,

Nigel Cross

I.5 Response Andy Dong:

On 10-2-2015 23:40 Andy Dong wrote the following response:

Dear Yoad,

Your research sounds very exciting, and, indeed, it is a topic that is very dear to me. I truly wish that on this occasion I could write a response for you. However, the timeframe that you requested, within the month of February, is not possible. This is “grant season” in Australia, and I am pretty much tied up with that.

With two colleagues of mine who are comparative psychologists, we will soon publish a new paper on the cognitive skills that are core to the conceptual system of design (thinking) and that are shared with the great apes: Dong, A., Collier-Baker, E., & Suddendorf, T. (Accepted 21 Jan 2015). Building blocks of human design thinking in animals. *International Journal of Design Creativity and Innovation*. doi: 10.1080/21650349.2015.1011700

I’ve attached for you the pre-press copy. I hope you find it interesting.

Is there any possibility for say mid-March?

Regards,

ANDY DONG | Warren Centre Chair for Engineering Innovation and ARC Future Fellow
Faculty of Engineering and Information Technologies
THE UNIVERSITY OF SYDNEY

Following up on Dong’s response, the researcher sent to Andy Dong a paper for commenting. The paper consisted from the abstracts and the summaries from part one, and was titled “*The Design Instinct: a comparative extrapolation of Steven Pinker’s 1994 manifest for the purpose of discussion and mutual conceptual advancement*”. It is featured in Appendix (ii):

Dear Andy,

Sorry for delayed reply, I find your text is very interesting and I felt I should read it and send some points before presenting you with my text, which you find in attachment as secured PDF file.

As you will find out, my point of orientation towards design thinking, in humans and as you suggest to some extent in animals, is the presence of a (cognitive) grammar protocol and a perceptual system. For example, your mentioning of starlings, which seem to display that their grammar is developed enough that it allows them to distinguish between known and new phenomena in their ecology.

I am glad to see that on page 4 you mention as requirement the ability to participate in an ensemble social practices by which meanings can be produced circulated and coordinated. I am wondering, however, why have you not mentioned more explicitly as requirement the existence of the ability to communicate, or to produce/use language. I can't help but to relate this text to your book (2009) and wonder about the presence of your performative operators in the great apes or bowerbirds, considering they use some sort of method for communication. I also wonder how does evidence of cognitive skills in nonhuman animals can be contrasted against "language" use in nonhuman animals.

This is certainly an area I would like to return to once I'm done with my thesis, as is the link between the perceptual system and language production in all animals.

Finally, you did not mention when and where will your text be published. Also, may I mention, quote, this text in my thesis conclusions (For example your mentioning of Hoffecker (2007), which seems to frame artefact in terms of language structure)?

Thank you so much for your help.

With kind regards,

Yoad David Luxembourg

The discussion that has followed was extracted from the researcher's mailing and is

presented below:

On 22-2-2015 23:59, Andy Dong wrote:

Hi Yoad,

Your question about “language” in nonhuman animals is a difficult one — especially since it is highly debated whether nonhuman animals possess a language in the way that we, humans, understand language and the conceptual system of language. Certainly, there are examples of some great apes that appear to have been able to learn a human language, but it is very unclear whether it is simply condition. I will let the comparative psychologists argue over this matter. My co-authors, both of whom are comparative psychologists, would not agree that there is sufficient evidence to claim that nonhuman animals have a language. In any case, there is absolutely no evidence that nonhuman animals possess a language that is suitably complex to transmit the “design of” something. In fact, there is no evidence that they have suitable representation skills (meta-representation) to take a design stance toward objects — see Daniel Dennett. If that is the case, then there is no known mechanism by which nonhuman animals could ‘know’ the reasoning and intention underlying an object and they would not have sufficient expressiveness in a language to communicate these ideas. At least so far as we know! That’s why it’s omitted from the paper.

What is not controversial, however, is that animals certainly have the ability to imitate. Imitation is a very important aspect in the social transmission of ideas that does not require a language per se. In case you haven’t read it, a book I highly recommend is *Animal Innovation*:

<http://ukcatalogue.oup.com/product/9780198526223.do>

The article will be published ...

Dong, A., Collier-Baker, E., & Suddendorf, T. (Accepted 21 Jan 2015). Building blocks of human design thinking in animals. *International Journal of Design Creativity and Innovation*. doi:10.1080/21650349.2015.1011700

ANDY DONG | Warren Centre Chair for Engineering Innovation and ARC Future Fellow
Faculty of Engineering and Information Technologies

THE UNIVERSITY OF SYDNEY

From: Yoad David Luxembourg [hello@yoad.info]

Sent: Monday, 23 February 2015 11:11 PM

To: Andy Dong

Subject: RE: Your comments on a comparative extrapolation of "The Language Instinct" into design.

Dear Andy,

Thank you for your elaborate reply. It certainly is an interesting subject! I hope to examine it further in the future. As my current hypothesis places grammar protocol and its use mental dictionary in the perceptual system, it also opens up a horizon to the existence of these cognitive process in other animals.

I have a little bit more pressing question which I hope will very little amount of your time.

In page 6 you write: "The first is structural recursion, which is the combination of physical elements such that each element is nested within an overall hierarchy like a subordinate clause (Hoffecker, 2007). For example, the handle (**the main clause**) contains an adhesive element and leather strips (**subordinate clauses**); in turn, the hand axe contains the handle and the blade."

The structuring of an artifact in terms of sentence structures is a subject my research touches upon, so I would like to know where did you draw the representational system from or on what frame work or authors is it based.

Following the logic of my research I could describe the handle as an interface (clause) with an affordance as its head entity (headed by a verb) and a sub-affordance (auxiliary), the adhesive element and leather strips element which give the handle an extra meaning in terms of use .

I thank you again for your help,

With kind regards,

Yoad David Luxembourg

On 23-2-2015 22:16, Andy Dong wrote:

Hi Yoad,

To answer your question, "where did you draw the representational system from" ...

The example is simply an example of recursion. In the example, I make no claim that there is a formal grammar going on in relation to the axe or any specific/normative representational system that expresses "axeness" -- which I think is what you're aiming to demonstrate. The example is simply showing that there are recursive relations between constitute/physical elements of the handaxe, and that the recursive relations are not possible without a brain capable of recursion. As you are probably already aware, even Chomsky is now suggesting that recursion may be the only unique aspect of the human faculty of language. If I were to go out on a limb, I would argue that recursion started with humans designing and then moved onward to language. There is evidence of recursive thinking in the construction of complex artefacts long before we believe humans had language.

As I understand it, it seems as if you're trying to demonstrate that there are elements of the axe that represent its function (defined as its intended purpose) and other elements intended to communicate its mode of operation (the manner in which a function is enacted = affordance [alternative way of saying the same thing as Gibson but in design language]) and then other elements that exhibit its semantic category (meaning). This is much more complex than the example of recursion in the paper.

Hope this answers your question.

Regards,

ANDY DONG | Warren Centre Chair for Engineering Innovation and ARC Future Fellow
Faculty of Engineering and Information Technologies
THE UNIVERSITY OF SYDNEY

From: Yoad David Luxembourg [hello@yoad.info]

Sent: Monday, 24 February 2015 10:02 PM

To: Andy Dong

Subject: RE: Your comments on a comparative extrapolation of "The Language Instinct" into design.

Dear Andy,

Thank you again for your quick and informative reply.

I would go out with you on that limb. My point of view, if I was to expand it a little, would suggest the perceptual sensory system developing prior to perceptual grammar protocol (with which beings learn to identify and distinguish between the various phenomena they perceive in their ecology - as well as construct its meaning/what it allows them to do). Perceptual grammar protocol is basis for design and language. However, living creatures have manipulated their physical environment (by body movements) into their desired affordances before the production of sound enabled the development of language. Looking at the evolution of Life on earth, it began in aquatic environment (excluding chemistry based communication between cells) early communication between living creatures was initially (like in fish) based on visual/haptic system (required for design), before sound system (required for language) became a tool for communication (like in aquatic mammals).

Again the perceptual system with a working grammar protocol seem to be the requirement for communication abilities. For a possible example, though I don't know much about the cognitive conditions of deaf-mute people, it seems there that when the perceptual system is impaired so is the production of language. I admit you may be better positioned to address such a question.

I am curious ,however, why were you using terms such as main clause and subordinate clause to describe the structure of the axe when, as you written below, it could have been spelled out otherwise. Are these terms used in psychology?

With kind regards

Yoad David Luxembourg

BA (DAE,2004), MA (MAHKU,2006)

Ph.D student at University of Porto, Portugal

P.S. please tell me if you are more comfortable with the casual "Hi Andy".

On 24-2-2015 22:48, , Andy Dong wrote:

Hi Yoad,

Some comments in-line:

> perceptual sensory system developing prior to perceptual grammar protocol (with which beings learn to identify and distinguish between the various phenomena they perceive in their ecology - as well as construct its meaning/what it allows them to do).

I agree with the former, but the latter is controversial. There is no solid evidence that animals can perceive of objects in the environment in such a way as to extract something as complex as a meaning. For example, studies of rat brains have shown that rats can only perceive a particular type of nest even when shown examples of other things that can be considered as nest -- as having "nesting" affordances:

Lin, L., Chen, G., Kuang, H., Wang, D., & Tsien, J. Z. (2007). Neural encoding of the concept of nest in the mouse brain. *Proceedings of the National Academy of Sciences*, 104(14), 6066-6071. doi:10.1073/pnas.0701106104

"Higher" mammals have demonstrated more behavioral flexibility and curiosity in relation to objects, but we don't know if they're trying to "construct its meaning". There is a ton of research on behavioral flexibility.

Glickman, S. E., & Sroges, R. W. (1966). Curiosity in Zoo Animals. *Behaviour*, 26(1/2), 151-188

Perceptual grammar protocol is basis for design and language. However, living creatures have manipulated their physical environment (by body movements) into their desired affordances before the production of sound enabled the development of language.

There is the problem, though, that what we see as a design behaviour in animals may simply be a programmed behaviour. It's like having a "gene for" making nests in the extended phenotype concept (Dawkins). In this study, Bernstein showed that chimpanzees will try to make nests, but the nests increase in quality with social learning. So, likely that making nests is somewhat

programmed.

Bernstein, I. S. (1962). Response to nesting materials of wild born and captive born chimpanzees. *Animal Behaviour*, 10(1-2), 1-6. doi:10.1016/0003-3472(62)90123-9

> Looking at the evolution of Life on earth, it began in aquatic environment (excluding chemistry based communication between cells) early communication between living creatures was initially (like in fish) based on visual/haptic system (required for design), before sound system (required for language) became a tool for communication (like in aquatic mammals).

Certainly, there is likely to have been an evolution toward human language and possibly toward more sophisticated communication abilities in other nonhuman animals. You have to be careful though that when you compare species and evolution it has to be within a lineage. There may be evidence of convergent evolution toward language/communication, but, the cognitive skills and brain structures & processes that enable communication in animals may differ across species. We have no evidence that they are necessarily the same, and no good reason why they should be the same. We can say that, e.g., the great apes share a set of cognitive skills that lead toward language in humans, but making the claim further down the evolutionary chain is much harder -- and less likely to be accepted by comparative biologists.

> I am curious ,however, why were you using terms such as main clause and subordinate clause to describe the structure of the axe when, as you written below, it could have been spelled out otherwise. Are these terms used in psychology?

No, not used in psychology. I wanted to relate the example of the axe back to language. People are more likely to be familiar with recursion in language. So, the main clause and the subordinate clause are linguistic references, not psychological ones.

> P.S. please tell me if you are more comfortable with the casual "Hi Andy".

I prefer it!

--Andy

Finally, on 4-3-2015 00:18, Andy Dong sent his comments on a the comparative extrapolation of "*The Language Instinct*" into design, that was sent to him earlier:

Hi Yoad,

Attached is my feedback. Hope you find it useful — and a basis for further discussion.

Regards,

ANDY DONG | Warren Centre Chair for Engineering Innovation and ARC Future Fellow

Faculty of Engineering and Information Technologies

THE UNIVERSITY OF SYDNEY

The research presents hereafter Dong's feedback on what can be considered as the core statement of investigation one - "*The Design Instinct*" paper:

Yoad Luxembourg's thesis presents the principle claim that there exists a design instinct. This universal design instinct is comprised of two components, a mental lexicon and a mental grammar.

The mental lexicon is a finite set of base, material or conceptual elements, and the mental grammar is a set of rules to combine the elements into meaningful groups that convey the relationships between them.

The thesis draws parallels between the design instinct and the language instinct through a series of arguments grounded upon the scholarship in the biological origins of the human faculty of language as argued by Stephen Pinker and the scholarship on the interconnection between language and design. In so doing, the thesis draws toward a grammatical system that expresses the functions that each of the elements of the design lexicon and the design grammar play in expressing meaning. While Mr Luxembourg may not have been aware of it, this system shares philosophical elements with systemic functional linguistics, which places the functions of language as central and how the elements of a linguistic grammar achieve these functions as opposed to the elements of language and their combinations.

If appropriately argued, this thesis has the potential to make a significant contribution to the scholarship of design. As Mr Luxembourg discusses, the evolutionary origin of the human faculty of design is an important question for the design thinking research community. When compared to our capacity for language, we know surprisingly little about the evolutionary origin of the capacity for design, yet this capacity would have been similarly crucial in shaping the modern world. In terms of the evolution of language, evidence for and theories of its origins are debated. At present, knowledge about the evolution of design thinking is scant, but certainly design thinking is crucial to our survival today just as it was to our early ancestors.

The thesis makes several provocative claims, which could be more convincingly argued either by appealing to evidence in comparative psychology or by acknowledging the counter arguments. I will provide examples of each.

First, the thesis makes the claim that human language is a “distinct piece of the biological makeup of our brains.” It is unclear from the short essay whether this intended to construe a separate ‘part’ of the brain necessary for language or a certain set of uniquely human cognitive capabilities. Current scholarship tends to argue away from the former and more toward the latter. In any case, this claim is supported by conceptual arguments such as “every sentence that a person utters is a brand new combination of words” rather than evidence. I believe that part of the weakness in these provocative claims is that they are based on broad, conceptual arguments as opposed to evidence. Recursion, for example, has been argued by Michael Corballis (The recursive mind: the origins of human language, thought, and civilization) as the “recipe or program that can build unlimited set of acts of design out of a finite list of elements.” There is fairly strong evidence that recursion is a uniquely human cognitive skill (doi: 10.1080/15326900701399947). As argued by Hauser, Chomsky, and Fitch in their article in Science (doi: 10.1126/science.298.5598.1569), “Linguists and biologists, along with researchers in the relevant branches of psychology and anthropology, can move beyond unproductive theoretical debate to a more collaborative, empirically focused and comparative research program aimed at uncovering both shared (homologous or analogous) and unique components of the faculty of language.” Similar, this thesis’s

conceptual claims could be bolstered with appropriate empirical evidence.

Second, the thesis takes some claims by Pinker as uncontested when they are by no means agreed by consensus. The concept of a universal grammar is intensely debated, and not all scholars and scientists agree that one exists. Referring back to Hauser et al.'s article again, they distinguish between the concept of the faculty of language in the narrow (FLN) and in the broad (FLB). They hypothesize that it is only FLN that is unique to humans, in contrast to scholars such as Pinker who claim that FLB is unique to humans. A more careful parsing of the claims put forth by Pinker in relation to this thesis's claims would permit Mr Luxembourg to accept some aspects of Pinker's claims as being supportable by evidence while perhaps not agreeing to others, which are in any case not salient to the thesis. Indeed, it does not appear to be necessary to agree to Pinker's more controversial claims to draw toward the "element structures in design use".

I think that one of the most meaningful contributions to design theory and scholarship will be in the claim that designs express a 'meaning' – what it is (a semantic category), what it does (its intended purpose of function), and how to enact its function (its affordance). In this line of thought, this thesis extends the concepts presented by Daniel Dennett on the design stance (Dennett, D. C. (1987). *The intentional stance*. Cambridge, MA: MIT Press.) and more recent scholarship by Nathan Crilly (doi: 10.1162/DESI_a_00102) on the manner by which end-users reason that something has been intentionally designed. If it would be possible for the thesis to 'circle back' to the main claim that there is a design instinct 'to design', it may also be equally important to hypothesize that there is a 'mirror system' to recognize designs. Understanding the "element structures in design use" through which designers create meaning and with which users construct meaning may be the aspects of this thesis that will most meaningfully contribute to design scholarship. While these ideas originated from the orization about a 'design instinct', it is probably important to note that it is not entirely relevant whether there is or is not a design instinct and if there were whether it takes on the form presented in this thesis. Rather, what matters is that the design instinct is a cognitive and critical model upon which a conceptualization of the "element structures in design use" becomes possible.

Professor Andy Dong
The University of Sydney
March 4, 2015

Appendix II

A Comparative Extrapolation of "The Language Instinct" into design.

This appendix presents the paper that was sent to Andy Dong for commenting and feedback. It was written in the beginning of 2015 and was never published or disseminated outside the scope of this research and the communications presented before. It is important to remember that this research and its thesis have evolved and progressed since this content was created and that many of the details presented below are no longer the same in the thesis. The paper, therefore, is provided here only as reference in order to sharpen the perspective of Andy Dong's feedback presented in Appendix I.

The Design Instinct: a comparative extrapolation of Steven Pinker's 1994 manifest for the purpose of discussion and mutual conceptual advancement.

Author: Yoad David Luxembourg

PhD Design Student, University of Porto 2011-2015

Supervisor: Professor Heitor Alvelos

Course Director, PhD Design, University of Porto

This document is solely intended for Andy Dong Prof. at Faculty of Eng. & I.T., University of Sydney

Introduction:

The following article is a summary of a larger analysis conducted within the framework of a larger research exploring the possible existence of universal structure to design. This present research aims to inform and explore the relationship between language activity and design activity, their competence and performance, inquiring into the structural dynamics with which these two seemingly distinct human abilities manifest and are applied as well as to the validity of universal grammar (generative grammar) in design.

The core of this research is a comparative analysis, which discusses and composes a selective vision that aims to remove the distinction between material artefacts, informative artefacts, and lingual artefacts. These three categories are viewed as subgroups of man made designed artefacts, and framed as acts of communication.

The analysis scrutinizes the applicability of lingual principles, parameters and structures in design, attempting to validate theories, arguments and observations, rooted in the fields linguistics, in the field of design, subsequently identifying in what ways language and design are similar. As a part of the present research, the analysis seeks to recognize or identify patterns, which are associated with language activity, in design activity – with language use, in design use.

As source of information on linguistics this analysis works with Pinker's "The Language Instinct" (1994), chosen for its wealth of data and clarity of information. Focusing on creating a clear and coherent vision, the scale of this analysis consists of selected statements from the first four chapters of that work. These were selected according to their relevance and contribution towards constructing a concept of design ability as language-based in a structural perspective.

The analysis consists of four sections, one for each chapter. Each section contains a set of logical equations. Each equation consists of both an original statement and its transitioned form and is followed with a discussion motivating the axis of meaning formed, and the choice of terms and concepts used in the transitioning of the original statement into design. While examining under which conditions each altered statement means the same about design as meant by Pinker about language, Pinker's statements are contrasted against statements of authors from the field of design and fields relating to it, such as Dong (2009), Thwaites et al. (2002), Cross, (2011), Krippendorff (2006), and Gibson (1986).

During the analysis similar patterns between language and design were identified; in the ways mental dictionary is used in language and design; in syntactic roles played by parts of speech in lingual and designed parole; in the way abstract "ideal types" (Krippendorff, 2006) from design use and "pure abstract sound impression" (Thwaites et al., 2002) from language use evoke general and abstract concepts in the mind, and; in cognitive processes used in language and design in order to hunt for clarity and comprehension – in order to differentiate structured information from the radiant flow of sensory information input. These point to the possibility that rather than being used for the creation of parole, grammar is a cognitive process primarily used in perception in order to extract structures, the "ambient light", from the ongoing flow of sensory data (sound, touch, sight, smell, or taste), the "radiant light" (Gibson, 1986).

The following article contains both original and altered manifests composed and based on Pinker's work, and the summary of the discussions that formed during their comparative analysis as described in the methodology above.

The Design Instinct: a comparative extrapolation of Steven Pinker's 1994 manifest for the purpose of discussion and mutual conceptual advancement.

Author: Yoad David Luxembourg

PhD Design Student, University of Porto 2011-2015

Supervisor: Professor Heitor Alvelos

Course Director, PhD Design, University of Porto

The Manifest:

<u>Design</u>	<u>Language</u>
<p>(1) Design is so tightly woven into human experience that it is scarcely possible to imagine life without it. When there is no one to design to people design for themselves, for their pets, even for their plants. (2) This manifest will not address exclusively the English type of design or any other type of design, but something much more basic: the instinct to learn, create and understand design.</p> <p>(3) Design is not a cultural artefact that we learn the way we learn to tell time or how the federal government works. Instead, it is a distinct piece of the biological makeup of our brains. Design is a complex, specialized skill, which develops in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic, is qualitatively the same in every individual, and is distinct from more general abilities to process information or behave intelligently. For these reasons some cognitive scientists have described design as psychological faculty, a mental organ, a neural system and a computational model. But I prefer the quaint term "instinct". It conveys the</p>	<p>(p. 3) Language is so tightly woven into human experience that it is scarcely possible to imagine life without it.... When there is no one to talk with people talk with themselves, to their pets, even to their plants.</p> <p>(p. 3) I will not be writing about the English language or any other language, but about something much more basic: the instinct to learn, speak and understand language.</p> <p>(pp. 4-5) Language is not a cultural artefact that we learn the way we learn to tell time or how the federal government works. Instead, it is a distinct piece of the biological makeup of our brains. Language is a complex, specialized skill, which develops in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic, is qualitatively the same in every individual, and is distinct from more general abilities to process information or behave intelligently. For these reasons some cognitive scientists have described language as psychological faculty, a mental organ, a neural system and a computational model. But I prefer the quaint term "instinct". It conveys the idea that</p>

idea that people know how to design in more or less the sense that spiders know how to spin webs. Web spinning was not invented by some unsung spider genius and does not depend on having had the right education or an aptitude for architecture or the construction trades. Rather, spiders spin webs because they have spider brains, *spider body*, and "*spider hands*" which give them the urge to spin and the competence to succeed. Although there are differences between webs and artefacts, this manifest encourages the reader to see design this way, for it helps to make sense of the phenomena it will explore.

(4) Design is no more a cultural invention than is the upright posture. It is not a manifestation of a general capacity to use symbols. (5) Instead, design is a product of well engineered biological instinct. (6) Two fundamental facts about design are: first, virtually every *original* act of design that a person makes or understands is a brand new combination of elements, appearing for the first time in history of the universe. Therefore design cannot be a repertoire of responses; the brain must contain a recipe or program that can build unlimited set of acts of design out of a finite list of elements. That program may be called a mental grammar. The second fundamental fact is that children develop these complex grammars rapidly and without formal instruction and grow to give consistent interpretations to novel design constructions that they have never before encountered. Therefore, children must innately be equipped with a plan common to the grammars of all design types, a universal grammar that tells them how to distil the syntactic patterns out of pre-existing acts of design. (7) Consequently, it is fruitful to consider design as an evolutionary adaptation, like the eye, its major parts designed to carry out important functions.

(8) Design is invaluable for all activities of living in a community of people: preparing food and shelter,

people know how to talk in more or less the sense that spiders know how to spin webs. Web spinning was not invented by some unsung spider genius and does not depend on having had the right education or an aptitude for architecture or the construction trades. Rather, spiders spin webs because they have spider brains, which give them the urge to spin and the competence to succeed. Although there are differences between webs and words, I will encourage you to see language this way, for it helps to make sense of the phenomena we will explore.

(p.5) Language is no more a cultural invention than is the upright posture. It is not a manifestation of a general capacity to use symbols (p. 6) Language is a product of well engineered biological instinct. (p. 9) ...two fundamental facts about language. First, virtually every sentence that a person utters or understands is a brand new combination of words, appearing for the first time in history of the universe. Therefore language cannot be a repertoire of responses; the brain must contain a recipe or program that can build unlimited set of sentences out of a finite list of words. That program may be called a mental grammar. The second fundamental fact is that children develop these complex grammars rapidly and without formal instruction and grow to give consistent interpretations to novel sentence constructions that they have never before encountered. Therefore... children must innately be equipped with a plan common to the grammars of all languages, a universal grammar that tells them how to distil the syntactic patterns out of the speech of their parents. (p. 11) I think it is fruitful to consider language as an evolutionary adaptation, like the eye, its major parts designed to carry out important functions.

(p. 19) Language is invaluable for all activities of living in a community of people: preparing food and shelter,

tools making and using symbols for communication. Necessity being the mother of all invention, design could have been invented by a resourceful people a number of times long ago. Universal grammar would simply reflect the universal emergencies of human experience and universal limitations on human information processing. All communities have traditional design elements (and subsequently also designed artefacts) that afford “water containment” and “footwear” because all people need water and have feet; no traditional hand made element is a million distinct sub-elements large because no person would have the time to produce it. Once identified, an affordance of a design element or will entrench itself within culture as parents taught their children and children imitate their parents. (9) The crux of the argument is that complex design is universal because children actually reinvent it, generation after generation – not because they are taught, not because they are generally smart, not because it is useful to them, but because the just can't help it.

(10) The universal constraints on grammatical rules also shows that the basic form of design cannot be explained away as the inevitable outcome of a drive for usefulness.... the universal plan underlying design in different cultures with sub-functions and combinatorial rules, representations and affordances, users and (manipulated) environments, entities and interfaces, product diversification/ specification and coherence and so on, seem to suggest a commonality in the brains of designers, because many other plans would have been just as useful. It is as if isolated inventors miraculously came up with identical standards for typewriter keyboards, or Morse code or traffic signals.

(11) Visual thinking uses not design ability but a mental graphics system, with operations that rotate, scan, zoom, pan, displace and even fill in patterns of contours. With it (12) users charitably fill in what the

loving arguing, negotiating, teaching. Necessity being the mother of all invention, language could have been invented by a resourceful people a number of times long ago. Universal grammar would simply reflect the universal emergencies of human experience and universal limitations on human information processing. All languages have word for “water” and “Foot” because all people need to refer to water and feet; no language has word a million syllables long because no person would have the time to say it. Once invented language will entrench itself within culture as parents taught their children and children imitated their parents. (p. 20) The crux of the argument is that complex language is universal because children actually reinvent it, generation after generation – not because they are taught, not because they are generally smart, not because it is useful to them, but because the just can't help it.

(pp. 31-32) The universal constraints on grammatical rules also shows that the basic form of language cannot be explained away as the inevitable outcome of a drive for usefulness.... the universal plan underlying languages with auxiliaries and inversion rules, nouns and verbs, subjects and objects, phrases and clauses, case and agreement and so on, seem to suggest a commonality in the brains of speakers, because many other plans would have been just as useful. It is as if isolated inventors miraculously came up with identical standards for typewriter keyboards, or Morse code or traffic signals.

(p. 63) Visual thinking uses not language but a mental graphics system, with operations that rotate, scan, zoom, pan, displace and even fill in patterns of contours. (p. 73) listeners must always charitably fill in what the speaker leaves unsaid.

designer leaves unsaid.

(13) This is the essence of the design instinct: design conveys meaning. (14) Every English designer has undergone an identical act of root learning in childhood that links material elements to their meaning. For the price of standardized memorization, the members of the a design community receive an enormous benefit: the ability to convey a concept from mind virtually instantaneously.

(15) Design makes infinite use of finite media. We know the difference between the forgettable chair and the newsworthy Café Costes chair because of the order in which legs, seat and backrest are arranged. We use a code to translate between orders of elements and combinations of thought. That code, or set of rules, is called generative grammar. (16) A grammar is an example of a “discrete combinatorial system”. A finite number of discrete elements (in this case forms, shapes colors, textures, etc.) are sampled, combined, and permuted to create larger structures (in this case, artifacts) with properties that are quite distinct from those of their elements. (17) In a discrete combinatorial system like Design, there could be an unlimited number of completely distinct combinations with an infinite range of properties. (18) The way design work then, is that each person's brain contains a lexicon of material elements and the concept they associated to (a mental lexicon) and a set of rules that combine the material elements to convey relationships among concepts (a mental grammar). (19) When people learn to design within a field or a culture, they are learning how to put elements in order, but not by recording which element follows each other word. They do it by recording which element category – representation, affordance, and so on – goes with which other category.

(p. 74) This is the essence of the language instinct: language conveys news. (p. 75) ...every English speaker has undergone an identical act of root learning in childhood that links the sound to the meaning. For the price of standardized memorization, the members of the a language community receive an enormous benefit: the ability to convey a concept from mind virtually instantaneously.

(p. 75) ...language makes infinite use of finite media. We know the difference between the forgettable Dog bites man and the news worthy Man bites dog because of the order in which dog, man and bites appear. We use a code to translate between orders of words and combinations of thought. That code, or set of rules, is called generative grammar. (p. 75) A grammar is an example of a “discrete combinatorial system”. A finite number of discrete elements (in this case words) are sampled, combined, and permuted to create larger structures (in this case, sentences) with properties that are quite distinct from those of their elements. (p. 76) In a discrete combinatorial system like language, there could be an unlimited number of completely distinct combinations with an infinite range of properties. (p. 76) The way language work then, is that each person's brain contains a lexicon of words and the concept they stand for (a mental lexicon) and a set of rules that combine the words to convey relationships among concepts (a mental grammar). (p. 85) ...when people learn a language, they are learning how to put words in order, but not by recording which word follows each other word. They do it by recording which word category – noun, verb, and so on – follows which other category.

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(20) We now need a mental dictionary that specifies which elements belong to which part of speech categories (representations, affordances, character traits, inter-artefactual relationships, and so on).

(21) But grouping elements into entities is also necessary to connect grammatical design sentences with their proper meanings, chunks of mentales.

(22) A part of artefact, then, is not a kind of meaning; it is a kind of entity that obeys certain formal rules, like a chess piece or a poker chip. A representation, for example, is a simple element that represent things; it is the kind of element that becomes significant when related to context, can appear in an artefact countless times and so on. There is a connection between concepts and part of artefact categories, but it is subtle and abstract one. When we construe an aspect of the world as something that can be identified and counted or measured and that can play a role in events, design often allows us to express that aspect as a representation, whether or not it is a physical object.... Similarly, when we construe some aspect of the world as an event or state involving several participants that affect one another, Design often allows us to express that aspect as an affordance.... Representations are often used for names and affordances for something being done, but because the human mind can construe a reality in a variety of ways, epresentations and affordances are not limited to those uses.

(23) There appears to be a common anatomy in all entities in all the world's types of design. (24) Here we have the first principles of building an entity out of the meaning of the elements inside the entity. What the entire entity is "about" is what its head element is about. (25) Within an entity, then, the affordance is a little despot, dictating which of the slots made available by the supe-rules is to be filled. These demands are stored in the affordance's entry in the mental dictionary. For an artefact to feel meaningful, the affordance's demands must be satisfied. Because

which words belong to which part of speech categories (noun, verb, adjectives, prepositions, determiner).

(p. 93) But grouping words into phrases is also necessary to connect grammatical sentences with their proper meanings, chunks of mentales. (p. 98) a part of speech, then, is not a kind of meaning; it is a kind of token that obeys certain formal rules, like a chess piece or a poker chip. A noun, for example, is a simple word that does nouny things; it is the kind of word that comes after an article, can have an -s stuck onto it and so on. There is a connection between concepts and part of speech categories, but it is subtle and abstract one. When we construe an aspect of the world as something that can be identified and counted or measured and that can play a role in events, language often allows us to express that aspect as a noun, whether or not it is a physical object.... Similarly, when we construe some aspect of the world as an event or state involving several participants that affect one another, language often allows us to express that aspect as a verb.... Nouns are often used for names and verbs for something being done... but are not limited to those uses.

(p. 99) There appears to be a common anatomy in all phrases in all the world's languages. (p. 99) Here we have the first principles of building a phrase out of the meaning of the words inside the phrase. What the entire phrase is "about" is what its head word is about. (pp. 106-107) Within a phrase, then, the verb is a little despot, dictating which of the slots made available by the super-rules are to be filled. These demands are stored in the verb's entry in the mental dictionary,... For a sentence to feel grammatical, the verb 's demands must be satisfied.... Because verbs have the power to dictate how a sentence conveys who did what to whom,

affordances have the power to dictate how an artefact conveys who can do what to whom, one cannot sort out the entities in a artefact without looking up the affordance.

(26) An artefact, then, must express some kind of meaning that does not clearly reside in its representation and affordance entities but that embraces the entire combination and turn it into a proposition of use, that can be true or false.

(27) Design grammar is a protocol that has to interconnect the eye, the hand, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own.

one cannot sort out the roles in a sentence without looking up the verb.

(p. 110) A sentence, then, must express some kind of meaning that does not clearly reside in its nouns and verbs but that embraces the entire combination and turn it into a proposition, that can be true or false

(p. 118) Grammar is a protocol that has to interconnect the ear, the mouth, and the mind, three very different kinds of machine. It cannot be tailored to any of them but must have an abstract logic of its own.

Discussion Summary:

Summary: 1-7 (an instinct to acquire an art)

Design seems to be as much the cultural artefact as language is. More than an identity communicated through the designed artefacts that are produced by cultures, design enables humans to align and coordinate their conceptions, to engage in joint action, and construct and reconstruct their reality. In the use of design, it seems that designing, acting and perceiving are inseparably tied to a constructive understanding as humans seem to design themselves, each other and their creations into being. Human activity results in sense making. Design is one of the cognitive abilities humans deployed when making sense of things, another cognitive ability being language.

Like design and language, math is also used in order to make sense of things, to conceptualize realities, and to represent the physical world. Inside of the human brain information processing and decision making are linked with all these, as well as other abilities, as humans deal with open ended and closed ended problems - making sense of things they encounter and perceive. However on the surface of things language use, design use, as well as the use of math and physics can be clearly distinguished from one another.

Design is tightly woven into human experience as it is tightly woven into language. Humans

language and conceptualized themselves and each other into existence (Krippendorff) but also do the same with their artefacts and theories. Yet, the link between language ability and design ability seems to be deeper, cognitively and historically, than the causality of having the parole enabled by one cognitive ability produce the parole enabled by the other (Dong).

Humans seem eager to learn how tools work or what their environment with all its components and information it constitutes afford (Gibson). This eagerness seem to be intrinsically, if not biologically, motivated. Interaction of human's mind with its attached body parts can be seen in terms of interaction between humans and artefacts. It is highly unlikely that language have developed in the brain independently from the development of complex organs like the ears, tongue, lips and larynx. In the same way it is highly unlikely that design developed in the brain independently from the development of complex organs like the hand and the eye. Acknowledging the role of the human body and its evolution in the development of design means understanding that design is no more a cultural invention than is the upright posture. It is not a manifestation of a general capacity to use symbols but a product of well engineered biological instinct putting human sense- action-sense sequence (Krippendorff) in the context of human's world construction, the past, the current and the desirable .

Humans rely on their biology in order to design and create artefacts, but also in order to understand the design of artefacts. There is a level of complexity beyond which human biology and body proportion could not instinctively direct humans in understanding the design of artefacts (Krippendorff). What does not allow for human sensory-motor coordination is neither relevant, nor understood.

Arguments regarding language competence and design competence center on how much specific information about language and design is hard-wired into the brain (by genes) and how much of the knowledge is acquired, that is, learnt through social and cultural transmission (Dong). In the biological development of humans, learning transforms from a series of competence based trial and error experiences into a systematic performance based method of formal learning.

The learning of sensory-motor coordination and the conceptual constructions of the world can be seen the way young children babble with their hands, select and arrange objects as they play. They observe events such as the running of water and the burning of fire. It seems that in between all these activities and observation hides the instinct to speak, to bake, write, and brew and design. The rules engagement that allow learning may be innate, as well as universal (Pinker, Chomsky).

Summary: 8-10 (Chatterboxes)

The universality of language and design is validated in the universal constraints of the human body and mind. The universal emergencies of human experience can be seen in the way human communities separated by huge distances and vast time came up with similar solutions to common problems and identified similar affordances in different material elements available locally for making things, finding various ways to contain and carry water as well as protect the feet all over the world.

The universally common problems of containing water and protecting the feet, for example, are as universal as the the problems of signalling or referring to water and feet. In both cases human communities found various solution, some similar in content, all similar in structure.

Language and design could be differentiated according to the base units used in the construction of parole and their properties. Syllables are not as flexible in their syntax performance, or meaning, as much as design elements are. While the combination of syllables creates words with direct and distinct reference, there are no sub-elements of design elements, just smaller and bigger design elements each associated, abstractly or symbolically with meaning in different way by different users, or observers. Syllables and words cannot be not compared content and reference wise with base design units and the units composing them - design elements.

Commonality between base units used in design and language can be found in limitation of perception, of human information processing, which seems to be a matter of complexity. Being so, infeasibility, as suggested by Pinker, seems to be the reason why no language uses a million syllables large word, as well why no culture has such a million element large design parole entrenched within it. The human brain and its faculty of perception can not handle extreme amounts of elements without more than substantial lifetime long effort.

In human communities once a meaning has been identified it is more than likely that a lingual or design based signifier for it will to be selected or invented, leading to its be entrenchment within culture as parents teach their children and children imitate their parents. This also means that once identified, or specified by the human brain, an affordance of design element will follow the same route into culture. It should be kept in mind, however, since culture is always in motion, that designed artefacts, as well as lingual words and sentences, are not as rooted in culture as much as

affordances are.

Pinker arguments for the development of complex universal language skills innately in children can also be used to motivate the development of complex design skills. Empirical evidence can be found in the babel of children as much as in their play with objects and situations. Children's babel can be seen as an exercise simulating real grownups speech in the same way that the children simulate real life objects and situations during their play with toys. Children move from exploring the affordances of body parts to exploring the ecology around them with their body. They are not formally taught how to play, or how to simulate real grown-ups situation. Yet, they are stimulated to do so and intrinsically motivated to do so either through internal bodily experiences, or through interaction with parents and family members. It is likely that attempts to stop such "babel" will affect the lingual as well as the physical development of the child.

Similarity between language and design is identified in the syntactic roles of word structures in language use and element structures in design use:

Lingual **auxiliaries** can be seen in design as sub, or extra functions, that facilitate, or define in terms of user experience, the use of the main affordance of artefact, or adds another layer of meaning to the artefact in use (Krippendorff).

Although an exact role of **inversion rules** (combinatorial rules which guide the construction of sentence into its intended meaning) cannot be identified in the structures of design use, design has its own set of combinatorial rules like aesthetic codes or ergonomics which in turn guide the creation of the design sentence into its intended meaning.

Nouns can be seen in design use as representational design elements or artefacts denoting, or associated with, brands, places, qualities, concepts, etc.

Verbs can be seen in design use as affordances. Both define the roles within the structure of parole, which without it the parole will most likely be void of meaning, or misunderstood

Lingual **subject**, the agent(s) performing the action expressed by the verb, can be seen in design use as the agent, or actor, of the affordance in the design sentence.

Lingual **objects** (entities acted upon by subject) can be seen in design use as the substance, medium, or environment for manipulation or field in/upon which action taking place.

Lingual **phrases** are identified in design use as entities or the smallest groups of elements that from something that has real existence, is distinct, independent or self contained, from which meaning can be constructed.

Clauses in language use can be likened to interfaces in design use and identified as design sentences within design sentences, in other words an entity (group of elements) within the act of design that form an act of design with own its subject and environment for manipulation.

The role of **cases** in language use can be seen as product diversification in design use, that is, lingual **cases** could be seen in design as modification done to entities, interfaces and complex acts of design in order indicate or attract specific users.

Agreement in language use can be seen in design use in the way affordances are made coherent throughout designed parole according to quantity or other properties of its user or environment/substance/medium of manipulation. Elements of a design artefact usually are altered in order for its meaning to be more coherent. Unlike **case** in which elements of the designed artifact change according to the needs of certain user(s) or target group, **agreement** means altering the product's affordance to fit the subject or object of the design sentence in terms of quantity, gender, etc.

The idea that all languages have these syntactic roles in their structuring of parole implies again toward a commonality in human species biology, indicating in turn the fundamental differences between the phrases 'culture of humans' and 'human culture'. While the first is results from communities formed by the human species, the latter results from biology of the human species in much the same way as culture of animal species.

History shows that humans even when designing the same artefact do not create, or realize it the same way. Language too, if designed to facilitate communication was realized in different ways, by different cultures. This commonality of structure seem to be also common to design and could be compared with common behavior specific to other animal specie. One could argue further to suggest that humans behavior, like elephant behavior and dog behavior (who share universal behavior patterns, even being hundreds of years and kilometer apart) is universal.

Summary: 11-12 (mentalese)

The concept of mentalese offers a strong link between the structure of language and the structure of thought (Dong). Instead of discussing the concept of mentalese this research explore cognitive link between visual or audio sensory input and the mental dictionary with which this input is compared to in perception's search of clarity and comprehension (Gibson).

The mental processes and operations described by Pinker and Thwaites shed light on how the mind sees or hears "something as" after sensing that something is (i.e. being, acknowledged, present, exists), as well as how and how fast perception hunts for clarity and comprehension by looking for pure abstract structures. As a human cognitive ability Pinker's visual thinking does not use the ability to language or to design, in fact it is possible to suggest the complete opposite as written language and design build on visual thinking in order for users to recognize what artefacts mean, while vocal language builds on audio thinking for listeners to recognized what is spoken acts of language or sound mean. Visual and audio thinking - including their graphics and sound system operations with which input can be rotated, scanned, zoomed in and out, panned displaced and filled in its boundaries with patterns - seem to be strongly linked to human cognitive processes of perception which use, based on available experience available to the mind, structures or codes of sign systems and artifacts from language and design in order to hunt and achieve clarity and comprehension, differentiating and identifying the ambient light from the radiant light (Gibson), or the meaningful from the sensed (Krippendorff).

It possible to suggest that the visual perception mechanisms used in for pointillism, led screen technology, etc. have similar mechanisms that operate in audio perception and perhaps in perception in general. The idea that brains of listener, viewers, and users fill in what is left unsaid or un sensed in terms of detail (like picture/screen resolution) seem to indicate the existence of a perceptive mechanism with which the brain combines smaller structural units or elements which are sensed in the ecology - but are too many to perceive each in detail, into larger perceivable ones. Human perception seems to prioritize structure over detail.

Summary: 13-27 (how design works)

Design practice seems to be aimed at conveying the meaning of designed artefacts. Language seem to convey meaning by coding it into a lingual artefact, design does the same with the

designed artefact. Members of language and design communities undergo an identical act of root learning that links lingual or design base units to their meaning. A standardized memorization of meaning, structures and codes, upon which the ability to convey concepts from the mind, virtually instantaneously, is based.

It is more than likely that root learning in design depends on interaction with artefacts and starts in early age as infants explore the affordances of their body and interact with their environment (Gibson). This acquired learnt meaning of things is embodied in its beholder and cannot be shared with other members of the community, instead it is continuously reconstructed, reproduced, exchanged, and circulated within a community through an ensemble of social practices (Krippendorff, Thwaites).

In language, root learning depends on interaction with other language speakers. Meanings of words are constructed individually and therefore, like in design, can not be identical from one community member to another, instead an overlap in concept seems to exist. Just like with design through the use of language in social practices community members re work, produce, exchange and circulate what words mean to them and to others (Krippendorff, Thwaites).

Both in design and language communication between community members may enable the sharing of knowledge, like facts, figures and tools, but not the sharing of meaning.

Human invention and thinking is involved in all man made artefacts, whether these are arrangements made of sounds or materials, man made artefacts seem to follow a code or a set of rules, discrete to each human and universal to them all, pointing towards the presence of a generative grammar (Chomsky) both in language and design, a code that translate between orders of elements and combinations of thought.

In a combinatorial system like grammar finite number of elements are sampled, combined, and permuted to create larger structures with properties that are quite distinct from those of their elements. Allowing infinite number of combinations, both language and design are not limited to element- artefact structure hierarchy. Depending on a macro or micro perspective, elements may permute into larger elements or into artefacts, and artefacts can serve as elements in the formation of larger artefacts. However, unlike language which uses strictly combinatorial system in its production of parole, design uses both combinatorial and blending system in producing design parole. Designing seems to be involved in a large range of cultural and physical (social ensemble)

activities, and although language may seem as involved, some of these activities cannot always be described verbally or in writing.

The use of lingual grammar and design grammar sets of rules seems to be based on contextuality and rooted in the framing of the situation or goals of the parole. Depending on situation and goals, as well as on detail of elements required for the intended parole, material elements are either blended or combined into the intended parole.

Identifying and selecting base units in design is done in greater flexibility than in language, these can be identified in the micro scale of making things like yarns for weaving textile as well as the macro scale with pockets as elements in a suit. This flexibility in scale seems to fit a way of communication that is based on sensual and associative system of signs and codes in order to convey meaning, if something is not understood it cannot be explained until a certain piece of information or experience becomes available. Words are strict and fit a way of communication that based on a sign system using clear and exact referents, if something is not understood it could be explained or referred to with other words.

Design as a system for communication is usually unlimited in time, while the production of lingual artefact usually is constrained by the speed or frequency needed in order to maintain conversation. Design artefacts have different meanings at different times and for different users (Krippendorff). In design elements in artefacts combine together with other elements, sometimes unders each other, sometimes next to each other, they are not set up like text from left to right, or arranged chronologically for audio-visual perception. Their meaning can be recognized and constructed at an instant, or over a period of time depending on the manner/method in which they are perceived.

Building on lingual grammar, this research focuses identifying similar structure for design, but instead of searching for design equivalents of lingual base units and their categories this research looks for design equivalents in lingual syntactic roles and parts of speech, i.e. of parole, of artefact. A part of artefact is not a kind of meaning, but a kind of entity that obeys certain formal rules, like a chess piece or a poker chip.

It is evident that in language nouns and verbs are not words but parts of speech. A noun phrase, for example, is an entity that does nouny things. Its design equivalent is representation, an entity that does representational things. This implies that representation and affordances are not

physically linked to specific base units but to parts of the parole that are the designed artifact, each part comprising from various material elements and structured in various ways according to various codes.

Lingual nouns and material representations seem to perform similarly as parts of speech. A strong similarity between parts of speech can also be found in the lingual verb and the designed affordance. These parts of speech have the power to dictate how a parole conveys who can do what to whom, and one cannot sort out the entities in the parole without looking up for these parts of speech.

Adjectives are parts of parole that are seen in the general “feel” and key traits of artefacts and elements, impressions, poetic associations and qualities that can not be quantitatively measured, but instead are perceived as properties or state of the artefacts.

While adjective words tend to be exact with limited flexibility of meaning through lingual context, character traits of designed artifacts may be adjusted or even replaced through context and may mean different things to different people at different times. The idea that objects have properties is neither natural, cultural free, nor universal. They are the result of linguistic attribution (Krippendorff).

Designers structure acts of design as acts of communications with intended meaning which users construct through use/interaction. In doing so, based on their own empirical experience, designers structure character traits corresponding to an adjective or adjective pair with which users attribute a quality to artefacts, or describes a feeling invoked by these artefacts (Krippendorff). However, as result of different context and actors many times a gap exists between the character trait, or adjective, intended by the designer or speaker, and the one perceived by the user. Both in language and design the meaning gap of an adjective and character trait pairs needs to be bridged or coordinated as it is never the same between 2 persons. It is likely that gap in the meaning of character traits in design are bigger than the gaps in the meaning of adjective in language, due the sensual and associative nature of meaning in design. User centered approach to design seems to be aimed at bridging such gaps.

Adpositions words are words that typically refer to spatial or temporal relationship, like: *in, on, at, near, by, for, under, before, after*. In design cables, sockets, input/output elements, physical connectors and other connective elements are parts of a design parole that typically mean

temporal or spatial relationship with other parts of a designed parole or other artefacts. These Inter-artefactual elements are parts of parole that afford connections between artefacts, in turn increasing the number of imaginable meanings, senses, and possibilities of use (Krippendorff), the number of actual affordances possible to the user. Inter- artefactual relationships take place in many acts of design without limitation to technology or size.

language is used to structure and construct reality, and to represent its contextual situations. Unlike adposition and their design equivalents of inter-artefactual elements - with which one can infer to a situation involving more artifacts, There seems to be no part in the parole in design, like lingual articles and determinators, indicating *class, category, distance, ownership, and quantity*, beyond what is already there in the context of the situation perceived. Design is the physical reality, the reality that exist, with objects nested (Gibson) within larger objects, environments within larger environments comprising an ambient array from which concepts like quantity, distance, class, category and level of importance are constructed in the mind, based on human perception of the situation and context at hand, as well as individual experience. In language articles are used to imply this context. Empirical evidence suggests that there are no entities or elements in design with a similar role to that of articles, or determinators. The significance implied both of an object being referred to in a lingual sentence and that of a element in a design artefact is defined by the context within the larger lingual or designed artefact, as well as outside of it.

Other parts of parole have been discussed earlier. However, looking back, all parts of parole seem to be structured as phrases or phrase types. In language these are various phrases such as: verb phrase; noun phrase; adjective phrase; etc. In design, this research suggest that the equivalent of the lingual phrase is group of elements that form something that has real existence, is distinct, independent or self contained - an entity from which meaning can be constructed.

The human mind, using a set of rules and a mental dictionary, creates a superstructure of modular phrases with which the meaning of parts of parole and subsequently of sentences can be constructed. Both in language and design, phrases are nested in sentences which are then nested in bigger sentences as acts of parole grow in complexity.

Grouping of words into phrases is key process in constructing the meaning - intended and unintended "chunks of mentalese" - linked to phrases which in turn leads to constructing the meaning of the entire sentence. In constructing the meaning of designed artefact this research suggest a similar process in which the human mind groups material-visual elements of artefacts

into entities and links these entities to their proper meanings, chunk of mentalese. It is more than likely that the function of grouping visual elements takes place in the visual cortex (Lee).

Meaning associated with designed artifact seems to be located in another area of the brain than meaning associated with a lingual representation of that artefact. For example the perceiving the phrases 'the face of Jesus' and actually seeing the face of Jesus in a toas will most likely show different brain pattern activity in fMRI brain scans (Lee, Corriea).

Further, the brain makes sense of visual or audio stimulus by making predictions about or hypothesizing what structure will be seen or heard, based on past experience and grammar available, and then subtly projecting those expectations onto what is seen, assuming and revising meaningful structures until an understanding emerges in which all apparent incompatibilities (in context, in part arrangements, in grammatical structure) are resolved to the reader's or user's satisfaction (Krippendorff). In doing so, the brain groups visual elements into entities in the primary visual cortex, then proceeds to compare them against some memory record before predicting the proper chunk of mentalese, and projecting this expectation, i.e., linking it, to what is seen (Lee). A similar process must exist for audio input (Thwaites). The brain predicts a meaning based on empirical experience available rather than on the intention of the speaker or designer. If the suggested meaning is exact as intended by the speaker or designer it is only due to the proper arrangement or configuration of the ambient array of the artefact being perceived, its structure, pattern, texture, and context according to which the brain of the user can distinguishes information structures, ambient light, or sound, from the stimulus flux of radiant light, or sound (Gibson). It is possible to suggest that cognitive processes for perception which hunt for clarity and comprehension differentiates ambient "noise" from radiant "noise" using grammar in order to recognize or identify information structure or a pattern in the radiant "noise". Grammar seems to be a part of a set of cognitive processes used in perception, rather than solely used for language production.

Generative Grammar protocol is seemingly used for extracting structures of information form radiant light, touch, or sound, as well as for building structures of information in these modalities. In a way there is no structural difference between the relating activities of reading - writing; hearing - speaking, and when it comes to artefacts; interfacing (touching/ playing) - making. All use a generative grammar and all require coordination between sensory input organs (eye, ear), Sensory output organs (hand, mouth) and the mind.

The common anatomy in all phrases, or entities, in all the world's paroles, that is, languaged and designed artefacts, can be seen in syntactic principles with which a phrase meaning is built in all man made acts of parole - phrases serve as entities, role players and arguments both in languages and designed artefacts.

The reference or essence of entities is signaled by a core element, or head, upon which their meaning is constructed. Complex artefacts may comprise of complex relationship in which, for examples, structural elements head key affordance entity in order to enable a form of representation, or a representational entity headed by an icon in order to enable a set of affordances.

The mind's mental dictionary contains entries for affordances listing definitions of arrangements, or situations (most likely in mentalese) of events, followed by actors that have roles in these events. In understanding what artefacts mean humans explore them, searching for their possible affordances by looking for situations that fit the mental entry of these possible affordances. In designing an artefact knowing what affordances will the artefact enable its users dictates designers the right dimensions, entities and elements required in order for the event or affordance intended to take place.

A designer in formulating the problem is usually searching in his own mental dictionary for the entries of the affordances set described in the briefing, looking for definitions of arrangements, or situation of events, followed by actors that have roles in these events, be them the user, or other artefacts which participate in the dynamic system of user - artefact(s) (Cross).

Personal experience of use of an artefact or word pretty much defines what the entries in the mental dictionary contain. Language spoken by specialists, like surgeons, and artefacts designed by specialists need also the experience of specialists in order to use and understand. Users of everyday language and everyday design - who do not share the experience of surgeons - would not know both what surgeon (designed) artefacts mean, or are used for, and what surgeon language artefacts mean. Their mental dictionary for these entries is blank.

Designed artefacts make propositions to user. An artefact, whether lingual or designed, expresses some kind of meaning that does not clearly reside in its parts of speech, but that embraces the entire combination and turn it into a proposition. These propose what can be done, as well as how it can be done, both as a set of functions to be followed and as an attitude or manner of doing

things. These propositions, just like lingual ones, can be true or false, meaningful or meaningless, depending on the user and their mental dictionary.

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Appendix III

Design and The Language Instinct.

The following work is originated from the literary review of this research and will be published as part of the proceedings of the 8th International Conference Senses & Sensibility in Lisbon, Portugal, where it will be presented during the conference between the 5th and the 7th of October 2015. As such the rights to right to reproduce and distribute this article has been transferred to EUROPEIA ID - UNIDCOM/IADE.

The main goal of this article is to argue for the relevance of Pinker's work. It does so by accounting for the parallels and convergences present in this thesis, and finally presenting a short manifesto which follows from selected points in investigation one. By adding its pre-press version here the research again wishes to demonstrate the relevance of this thesis and its potential contribution to design theory and field.

Design and *The Language Instinct*

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ABSTRACT

This paper argues for the relevancy of linguistic information to design thinking and design practice, pointing in particular to one source - Steven Pinker's *The Language Instinct* (1994). This paper reviews the aspects in which Pinker's work converges and compliments other authors associated with design thinking and examines how selected de-contextualized statements from *The Language Instinct* can be valid or relevant to the field of design. In doing so this paper aims to: a) inform and explore the relationship between language and design, inquiring into the structural dynamics with which these two seemingly distinct human abilities manifest and are applied in practice; b) seeks, recognize or point to patterns, which are associated by Pinker with language activity, in design activity; with language use, in interaction, further termed in this paper as design use. As a final act, this paper will produce a short and paralleling manifest for design, providing a starting point for a discussion of design and its operation process. This manifest consciously offers itself to further specific input, beyond its own formulation, for the purpose of discussion and conceptual advancement.

Keywords: Linguistics; Universal Structures; Design Thinking; Manifest.

INTRODUCTION

This paper lays out the literary foundations for a linguistic approach to design thinking and design practice, introducing a larger body of work directed at investigating the possibility of universal structures in the field of design, working towards forming a linguistics based approach to design and design education. This paper aims to inform and explore the relationship between language and design, their competence and performance, inquiring into the structural dynamics with which these two seemingly distinct human abilities manifest and are applied in practice.

In specifically, this paper argues for the validity of ideas and concepts outlined by Steven Pinker (1994) in his extensive manifest *The Language Instinct*. In the following text the paper motivates the choice of this source over other books about language on a macro level by drawing four contact points where Pinker's thinking, concepts, and observations over language converge with the thinking and ideas of key authors in the field of design, like Nigel Cross and Klaus Krippendorff. In a micro level, this paper will examine how de-contextualized statements the from *The Language Instinct* can be valid or relevant to the field of design through a comparative analysis seeking to identify patterns, which are associated by Pinker with language activity, in design activity; with *language use*, in design use.

DESIGN AND *THE LANGUAGE INSTINCT*: A LITERARY GEOMETRY.

Pinker's (1994) *The Language Instinct: How the mind creates language* provides a comprehensive overview on the field of linguistics and argues for the universality of language, suggesting that key super-rules (grammar) needed for acquiring language are innate and shared universally across all humans, like a "biological instinct". It includes a wealth of theoretical and empirical data and deploys a flowing and amusing way of writing which conveys Pinker's thinking with much clarity. Pinker's work is considered both controversial and influential, having a great impact on the debate on and around lingual competence - the cognitive capacity to use language, as well as on what people from a wide range of background know about language, and how they think about it.

This paper draws its first contact point between the field of design and Pinker's work with *The Language of Design: Theory and computation* from design thinker and researcher Andy Dong (2009). In it, Dong builds an extensive and meticulous theory for design outlining the importance of language use and the way language is deployed in the process of design by key performative operators – a process of the "becoming of language into a designed work, a thing something other than itself" (Dong, 2009, p. 170). Dong draws upon influential authors (Cross, Simon, Schön, Austin, Butler, and Lacan are only a short list of examples) for his theoretical frame work, while connecting his research with linguistics, semiotics and structuralism, as well as with many other areas of investigation, in order to use his constructed point of view to frame, on one hand, the concepts which institutionalize design practice, and on the other hand, the relationship between design and language across a wide range of knowledge fields.

One of the key arguments in Dong's theory of *the language of design* is the similarity in a reality-producing nature between language and design, a similarity which he argues for with the rule of transitivity: "we must start with the agreement that language (A) is performative, that is reality-producing (B). Certainly, language 'is' lots of other 'things' but its reality-producing effects could not be argued away contemptuously. I doubt that few would disagree that reality-producing (B) is the nature of design (C). Then language and design should be considered, perhaps at least conceptually, the same" (Dong, 2009, p. 170).

Dong dedicates a small section of his book to review the debate around linguistic competence, which "remains one of the most contested theories in human development. A key question is whether language is innate in the sense of Universal Grammar (UG) shared across all humans, suggesting that UG is encoded genetically, or whether language is purely an empirically evolved (human) phenomenon. In one camp are the so called linguistic nativists, starting with Noam Chomsky and more recently Stephen Pinker with his book *The Language Instinct*. In the other camp are the empiricists, most forcefully argued by Geoffrey Sampson and his response to Pinker's book specifically, and nativism broadly, in his book *The "language" Instinct Debate*". Dong's review of this debate ends with acknowledging the position of nativists and Pinker's concept of "mentalese" - a language of thought – which "propose a strong link between the structure of language and the structure of thought" (Dong, 2009, pp. 175- 176).

Dong extends the scope of this key question as well as of Pinker's concept of *Mentalese* to the field of design. First, by arguing for a similarity between cognitive capacities needed for language and those needed for design, concluding that the "consequence of these capacities is humans' ability to represent objects (design) and abstract concepts (language) with arbitrary visual or material (design) and vocal (language) symbols and to act with reference to concepts not limited in time and space"(Dong, 2009, p. 176).

Second by debating through a review of evidence and theories from the fields of biology, cognitive science, paleontology and genetics the possibility of design competence being linked to linguistic competence, as well as being innate, concluding that “It is therefore possible that the genetic origins of language and design are interconnected. The debate over whether language and design are innate or whether they are learned centers around the question of how much specific information about language and design are hard-wired into the brain (by genes) and much of the knowledge we acquire, that is, learn through social and cultural transmission” (Dong, 2009, p. 178).

This paper draws its second contact point between the field of design and Pinker's work by pointing to a conceptual parallel formed by the thinking of Pinker about the universality of language and the thinking of Nigel Cross about the universality of design, as expressed in *Natural Intelligence in Design* (1999), *Designerly Ways of Knowing* (2006), and in *Design Thinking: Understanding how designers think and work* (2011). The latter work provides comprehensive yet concise overview of Cross' work and thinking and touches also on earlier developments and studies made by Dong.

Pointing to a parallel in thinking this paper considers the following comparison between complimenting key quotes taken from each author:

“Language is invaluable for all activities of living in a community of people: preparing food and shelter, loving, arguing, negotiating, teaching. Necessity being the mother of all invention, language could have been invented by a resourceful people a number of times long ago. Universal grammar would simply reflect the universal emergencies of human experience and universal limitations on human information processing.” (Pinker, 1994, p. 19)

“Everyone can – and does – design. We all design when we plan for something new to happen, whether it might be a new version of a recipe, a new arrangement of the living room furniture, or a new layout of a personal web page. The evidence from different cultures around the world, and from designs created by children as well as by adults, suggests that everyone is capable of designing. So design thinking is something inherent within human cognition; it is a key part of what makes us human.” (Cross, 2011, p. 3)

“Language is not a cultural artifact that we learn the way we learn to tell time or how the federal government works. Instead, it is a distinct piece of the biological makeup of our brains. Language is a complex, specialized skill, which develops in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic, is qualitatively the same in every individual, and is distinct from more general abilities to process information or behave intelligently.” (Pinker, 1994, pp.4-5)

“What I have attempted to show throughout this book is that design ability is such a multifaceted cognitive skill. More than that, I have tried to show that there are particular, 'designerly' ways of thinking and working, that set design apart from other forms of cognitive skill. In fact, it seems possible to make reasonable claim that design ability is a form of natural intelligence, of the kind that psychologist Howard Gardner identified.” (Cross, 2011, p. 135)

This similarity in thinking of two seemingly unrelated authors, in unrelated literary works, seem to suggest, like Dong, a similarity between their subjects of investigation – human's capacities to use language and do design.

What is also interesting is a parallel in methodology formed by these authors in their use of evidence to support their quoted arguments above. Both authors highlight the nature of these

cognitive capacities by using case studies of rare and tragic cases where these capacities have been impaired through neurological damage to the brain, such as through stroke or severe head injury. While Pinker covers cases relating to left hemisphere damage in the brain, Cross covers cases relating to right hemisphere damage to the brain, each using their positioning - Pinker in language, Cross in design – to respectively highlight the effects on these capacities, while run short from reporting or asking what kind of lingual artifacts - texts, acts of speech and such - could the design case subject produce, or what kinds of designing could persons, or designers, suffering from aphasia perform.

The third contact point between the field of design and Pinker's work is drawn with Gibson (1986), and with Krippendorff (2006) forming a theoretical meeting point respectively around “visual thinking” (Pinker, 1994, pp. 61-63), “visual system” (Gibson, 1986), and “meaning in perception” (Krippendorff, 2006, pp. 52-56). Their accounts, use of case studies, and theories complement each other and converge to provide a picture on meaning in perception and the cognitive functions facilitating its construction from sensory input.

In pages 62-63 of his book, Pinker gives a detailed account of experiments made by Roger Shepard and Lynn Cooper. These cognitive psychologists flashed thousands of slides, each displaying a letter of the alphabet, to volunteers with letters appearing upright, tilted, mirrored etc. Volunteers had to respond by pressing one button if a letter was displayed normally, another button if a letter was displayed in mirror reflection, with their reaction times measured. The experiment concluded with the estimation that letters mentally revolve in the mind at the speed of 56 rpm - possibly suggesting a speed limit for human visual information processing. Pinker concludes the section stating that “Many other experiments have corroborated the idea that visual thinking uses not a language but a mental graphics system, with operations that rotate, scan, zoom, pan displace, and fill patterns of contours.”

This conclusion is complemented by Gibson who specifies one of these operations, stating that “object perception can only be based on form perception. First the silhouette is detected and then depth is added, presumably because of past experiences with the cues of depth” (Gibson, 1986, p.83). Gibson also draws his own conclusions on visual thinking and functions of the visual system, stating that “Perception needs to be both comprehensive and clear. The visual system *hunts* for comprehension and clarity. It does not rest until all the invariants are extracted. Exploring and optimizing seem to be the function of the system” (Gibson, 1986, p. 219).

What Pinker and Gibson seem to describe is how the visual system of perception facilitates the construction of meaning by restoring the “perceived difference between what is sensed and what seems to be happening”. According to Krippendorff. “In perception, meaning arises in the awareness of the *possibility of different ways of seeing*”. Using the example of flip-figure, Krippendorff states that “awareness that the drawing can be seen in either way [meaningless figure, head of a rabbit or of a duck], entails being cognizant of the difference between the figure and its two ways of seeing it, which leads one to recognize the drawing as a flip-figure with two meaning.... “Seeing something as...” entails the distinction between something sensed and how is something is seen as, and introduces into perception a difference, not otherwise noticed, between sense and meaning” (Krippendorff, 2006, p. 52-53)

The experiments described by Pinker shed light on how the mind sees “something as” after sensing that something is present. To do the task, according to Pinker, “subjects had to compare the letter in the slide against some memory record of what the normal version of the letter looks like right side up.... Many subjects reported that they, like famous sculptures and scientists, “mentally rotated” an image of the letter to the upright” (Pinker, 1994, p 63).

The picture formed from these three complimenting accounts and thinking seem to suggests that visual thinking is interrelated to the perceptual (visual) system (if not being the visual system) and is deployed in order to explore and optimize sensory input while *hunting* for comprehension and clarity, extracting invariants such as change of illumination, change of observation point, overlap in fields of sight, and disturbance of structure, in a cognitive process with which meaning is associated with sensory input during interaction with artifacts.

This picture of a visual system and meaning in perception, as described through the convergence above can also be found in another part of perception - the auditory system:

“...assuming certain familiarity with accents and speech patterns, we tend to recognize the word ‘cat’ regardless of whether it’s spoken by a Scots vet in a lecture, an angry Tasmanian breeder of rear mice, or a New York newsreader with a bad head cold. In order to do this we make an abstraction from what we actually hear. In effect, we decide that certain features of the sounds we are hearing (pitch, individual variation, etc.) are really incidental and can be ignored. What we are left with after all these apparent incidents have been stripped away is the signifier: the pure, abstract mental sound impression ‘cat’.... The sign ‘cat’ doesn’t signify because it invokes the image of this or that particular cat.... The sign ‘cat’ signifies because it invokes a general and quite abstract concept of ‘catness’. In summary, the signifier is not the actual sounds heard, or the actual marks seen, but the mental impression of them. Neither is the signified the actual thing referred to, but the abstract concept of that thing.” (Thwaites, Lloyd & Warwick, 2002, pp. 34-35)

Bringing this point into conclusion, this paper can now construct a parallel mechanism for the visual system for both Pinker's and Krippendorff's case studies, in which using visual thinking users identify and decide that certain features of the drawing that is seen (Invariants such as thickness of pen or pencil, or marker tip, individual handwriting variation, angle of rotation, etc.) are really incidental and can be ignored. What is left after all these apparent incidents have been stripped away is - like in the case of the auditory system - a “pure, abstract mental impression” of the ideal type of an artifact category:

“The ideal type defines the center of its category. Boundaries around them are fuzzy, and recognition is a function of the typicality of an artifact.... The *ideal Type* is a cognitive construction from which all accidental and irrelevant features are absent.... When people search for something, a tool, container, a bus stop, or a bank, they search the with ideal type in mind and look for a close match, becoming aware of how it deviates, and then arriving at a recognized category” (Krippendorff, 2006, pp. 92-93).

The final contact point drawn by this paper between the field of design and Pinker's work is formed by highlighting the positions of Pinker and Klaus Krippendorff on framing language and on the concept of mutual contextualization (Krippendorff, 2006) or on the way meaning is expressed from a sentence structure (Pinker, 1994).

“Language is a cultural artifact that enables humans to coordinate their conceptions, engage in joint action, and construct and reconstruct the reality they see. In the use of language, languaging, acting, and perceiving are inseparable tied to a constructive understanding. It is a truism that one cannot know what exists without conceptualizing it as such. Languaging is the primary source of conceptions. It also presupposes the bodily participation of human beings. Language is spoken, written, and communicated. Entering humans into this conception of reality entails this self reference: Humans are beings who language each other into being. This self-reference is remarkable by implicating language as a condition for understanding oneself as a human human being...” (Krippendorff, 2006, p. 20).

By framing language as a cultural artifact Krippendorff differs from Pinker in his position on language ability, and possibly on its cognitive origins. This paper proposes that this difference of position is due a difference in the larger perspectives between these two authors. In line with his *Semantic Turn* theory, Krippendorff seems to see language as a tool, highlighting its development and use by human cultures, while Pinker sees design as a species related ability the same way that “some kinds of bats home in on flying insects using Doppler sonar”, or “some kinds of migratory birds navigate thousands of miles by calibrating the positions of the constellations against the time of the day and the year. In nature's talent show we are simply a species of primates with our own act, a knack for communicating information... by modulating the sounds we make when we exhale” (Pinker, 1994, p. 5).

Still, both authors seem to agree on the essential role of language in human culture, forming a position similar to that of Dong:

“A common language connects the members of a community into an information- sharing network with formidable collective powers. Anyone can benefit from the strokes of genius, lucky accidents, and trial and error wisdom accumulated by anyone else, present or past. And people can work in teams, their efforts coordinated by negotiated agreements” (Pinker, 1994, p. 3)

In another complimenting convergence, Pinker's structural observation that a sentence “must express some kind of meaning that does not clearly reside in its nouns and verbs but that embraces the entire combination and turns it into a proposition, that can be true or false”. (Pinker, 1994, p.110) can be explained through Krippendorff's account of mutual contextualization in which he points to key similarity in the way that lingual artifacts and designed artifacts are associated with meaning:

“Just as figures and grounds are often interchangeable in that the one provides the context for the other, this is also applies to the meaning of artifacts. The meaning of artifact's parts depend on the meaning of their arrangement, just as the meaning of its arrangement depends on that of its parts. There is no simple entry into this circle of mutual dependencies. Understanding a complex artifact is like reading a text, though artifacts can be touched and played with, not just seen. Written characters are grouped into words, words are arranged into sentences, sentences form paragraphs, and so on. To understand, the meaning of a sentence, for example, implicates the well known hermeneutic circle. It may start with some initial set of assumed word meanings. One must then hypothesize a grammatical structure to make sense of these words. Assuming a meaningful structure for the whole usually calls for revision of what words mean in that context, leading to a revising word meanings - until an understanding emerges in which all apparent incompatibilities are resolved to the reader's satisfaction. The same is true for figuring out the meaning of an artifact as a function of the relationships among parts, mutually contextualized by their arrangement and as a function of how the whole is related to other artifacts and user's intentions” (Krippendorff, 2006, p. 61).

CONCLUSIONS: BUILDING INTO A DESIGN MANIFEST.

With these four contact points above, relating to classic literature in the field of design, this paper shows how Pinker's *The Language Instinct* can be relevant to the field of design. Since the publication of Krippendorff's *The Semantic Turn* (2006) and Dong's *The Language of Design* (2009), the most recent works used in this paper, a lot has been developed in the field of design. This paper acknowledges that beyond its own limitations, many more points of contact between

Pinker's work and design could be drawn with other authors and more recent publications. Pinker (2014) himself has drawn explicit parallels between writing and design in 2014's *The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century*, while Dong, together with Collier-Baker and Suddendorf (2015), published a paper about building blocks of the human capacity for design thinking in animal species earlier this year.

In drawing its arguments this paper presented how, in different levels of scrutiny, several de-contextualized statements from *The Language Instinct*, can be valid or relevant to the field of design through a comparative analysis which identified patterns of thought and of thinking, associated by Pinker with language, in designing, and design thinking.

Building upon these statements this paper will now produce a short manifest for design by creating a design based parallel to Pinker's thinking. The scale of this produced manifest is expanded to consists of a set of statements, which while relating to the contact points drawn above, contribute towards constructing a coherent vision of design from linguistic-based perspective, which is the purpose of the larger body of work in which this paper is rooted.

It is this paper's intention that this manifest will serve as a starting point point for a discussion of design and its operation process. As such, this paper consciously offers itself to further specific input, beyond its own formulation in order to develop a constructive discussion and advance its intended conceptual framework.

Table 1. Design manifest drawn from key sentences from Pinker's *The Language Instinct* (1994)

Design Manifest for purpose of discussion and conceptual advancement in design thinking.	Original quotes from <i>The Language Instinct</i>
Design is not a cultural artifact that we learn the way we learn how artifacts work or how an apple computer functions. Instead, design is inherent within human cognition; a key part of the biological makeup of our brains. Designing is a complex, specialized skill, it develops in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic. Design intelligence is qualitatively the same in every individual, and is distinct from more general abilities to process information or behave intelligently. For these reasons design thinking can be described as a psychological faculty, a mental organ, a neural system and a computational model. However this manifest argues that the term "instinct" can also be considered as a fitting description. It conveys the idea that people know how to design in more or less the sense that some kinds of bats can home in on flying insects using Doppler sonar, or some kinds of migratory birds can navigate thousands of miles by calibrating the positions of the constellations against the time of the day and the year.	(pp. 4-5) Language is not a cultural artifact that we learn the way we learn to tell time or how the federal government works. Instead, it is a distinct piece of the biological makeup of our brains. Language is a complex, specialized skill, which develops in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic, is qualitatively the same in every individual, and is distinct from more general abilities to process information or behave intelligently. For these reasons some cognitive scientists have described language as psychological faculty, a mental organ, a neural system and a computational model. But I prefer the quaint term "instinct". It conveys the idea that people know how to talk in more or less the sense that... some kinds of bats home in on flying insects using Doppler sonar", or "some kinds of migratory birds navigate thousands of miles by calibrating the positions of the constellations against the time of the day and the year.
Design is invaluable for all activities of living in a community of people: preparing food and arranging shelter, inventing tools and using objects for communication. The evidence from different cultures around the world, and from designs created by children as well as by adults, suggests that everyone is capable of designing. Universal structures identified in man made artifacts would simply reflect the universal emergencies of human experience and universal limitations on human information processing.	(p. 19) Language is invaluable for all activities of living in a community of people: preparing food and shelter, loving, arguing, negotiating, teaching. Necessity being the mother of all invention, language could have been invented by a resourceful people a number of times long ago. Universal grammar would simply reflect the universal emergencies of human experience and universal limitations on human information processing.
In design use, acting and perceiving are inseparably tied to the perceptual system. Visual thinking is not related with designing but with a mental system of visualization, with operations that rotate, scan, zoom, pan, displace and even fill in patterns of contours of sensory input, facilitating a constructive understanding of artifacts in terms of	(p. 63) Visual thinking uses not language but a mental graphics system, with operations that rotate, scan, zoom, pan, displace and even fill in patterns of contours.

distinguishable categories.	
This is the essence of the design instinct: design conveys information, as a set of imaginable affordances to do or to know. Every Portuguese man and woman have undergone a similar if not identical act of root learning in childhood that links materials, artifacts, animals and so on, to their meaning from a cultural point of association. For the price of standardized memory record, the members of the Portuguese community receive an enormous benefit: the ability to convey a concept from mind virtually instantaneously, whether by using a clay rooster, “Pastel de Nata”, carnation, a piece of cork, or an embroidered napkin.	(p. 74) This is the essence of the language instinct: language conveys news. (p. 75) ...every English speaker has undergone an identical act of root learning in childhood that links the sound to the meaning. For the price of standardized memorization, the members of the a language community receive an enormous benefit: the ability to convey a concept from mind virtually instantaneously.
An artifact, then, must be associated with some kind of meaning that does not clearly reside in its structural elements but that embraces the entire combination and turns it into a proposition, true or false, to do or to know, through a cognitive process of mutual contextualization.	(p. 110) A sentence, then, must express some kind of meaning that does not clearly reside in its nouns and verbs but that embraces the entire combination and turn it into a proposition, that can be true or false.

The table above is an attempt to posit the similarities between language and design abilities, highlighting the deep and dynamic relationship that exist between these two abilities and their fields of knowledge. The chart offers a viewing of design in terms of activity and competence from a lingual perspective shedding light on how, through a comparative analysis, statements rooted in linguistics can help in the development of an understanding of design, while introducing into design research the possible validity of structures, mechanisms and protocols associated with language use, its competence, and performance in design thinking, its competence and performance.

The parent research, within which this paper is rooted, continues this investigation into similarities and parallels between language and design abilities, as well as investigating the validity in design of other universal structures concepts associated with linguistics, semiotics, and structuralism. It uses a comparative analysis to scrutinize the applicability of lingual principles, parameters and structures in design, while attempting to validate theories, arguments and observations, rooted in the field of linguistics, in the field of design, subsequently identifying in what ways language and design are similar, overlap or function in parallel.

This paper and its parent research seek to look at design in terms of language, working toward establishing a framework for a language based approach to design and design education. By laying this ground work and saving further detailed investigation for further studies, this paper can both serve as a macroscopic viewpoint as well as withstand detailed contrasting, both aimed at conceptual advancement of its approach and its discussion.

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Glossary.

Ability. The power and means to act or to do.

Activity. The specification or sphere of the performance of an action, set of actions, functions, etc

Act of Communication. The use (production and comprehension) and of a set or system of symbols in order to intelligibly convey meaning (thought, emotion, reference, affordance, etc.) within a group of people.

Act of Speech. An utterance or artifact performed or produced by an actor according to a set or system of symbols that can be used in order to intelligibly communicate within a group of people.

See **Design Artifact** and **Lingual Artifact** below.

Adjectives. Words that typically refer to a physical property or a state of being, like in “the FAT cat” or in “he looks SATISFIED”.

Affordance. An action, an occurrence, or a state of being. A set of imaginable uses; according to Krippendorff: “affordance is the perception of one's ability to do something with what is sensed” (Krippendorff, 2009, p. 43).

Affordance, supporting. An element (or elements) in the design of the artifact that facilitates the main affordance of the artifact in terms of experience in use, or in order to add another functional or meaningful layer to the understanding to the artifact.

Agreement. “A process in which a word in a sentence is altered depending on the property of some other word in the sentence, typically the verb being altered to match the number, person and gender of its object or subject” (Pinker, 1994, p. 503).

Arrangement. The combination and selection of audio, visual and material elements.

Artifact. Any arrangement of elements that is produced or used by human beings.

Auxiliary. A verb that adds functional or grammatical layer of meaning to the clause in which it

appears—for example, to express tense, aspect, modality, voice, emphasis, etc.

Character traits. Emotional effects and key traits of artifacts and elements: impressions, poetic associations and qualities that can not be quantitatively measured, but instead are perceived as qualitative perceptual or experiential properties and states of being that are associated to the artifacts.

Capacity. The potential to act or to do.

Case. *“A set of affixes, positions, or word forms that a language uses to distinguish the different roles of participants in some event or state. Cases typically correspond to the subject, object, and the objects of various kinds of propositions”* (Pinker, 1994, p. 505).

Clause. *“A kind of a phrase that is generally the same as a sentence, except that some clauses can never occur on their own but inside a bigger sentence...”* (Pinker, 1994, p. 505).

Coherence. A process in which elements of a designed artifact are altered in order for its meaning to be more coherent and match with the artifact's intended number of users, type of users, intended number of contexts, or a specific context.

Combinatorial rules. Codes and conventions which guide the creation of the design artifact towards its association by the user with intended meanings, or a set of affordances.

Competence. Having the means or knowledge that enables oneself to act or to do.

Context. The conceptual entity that is acted upon with the artifact, the substance or medium (Gibson, 1986) of the manipulation afforded, or alternatively the field in which the affordance is taking place.

Design element. The base material unit for the designed artifact. It can be produced and sensed visually, by touch, by smelling and taste, and in audio depending on the intended modality of the design artifact. This base unit is entered into the relationship that forms the part of speech of the designed artifact by being selected and combined with other base elements in the process of

designing.

Designed Artifact. Any man made artifact that requires any amount of thought and planing as to its purpose, subsequent use, and its production into the physical reality. Produced from base units according to a system of formalized symbols, signs, sounds, gestures, or the like used or conceived as a means of communicating thought, emotion, affordance, reference, etc.

Designing. The the planning and production of designed artifacts - usually from visual-material elements, but not excluding any other modality - towards a set of explicit and intended goals.

Design use. The use (production and comprehension) of designed artifacts in a more more less consistent manner that enables a group of people to interact, convey, coordinate, and exchange meaning, knowledge or information. An act of sign use.

Diachronic Approach. The study of language through the study of the history and development of words (as well as in the use) in different languages through the history of man kind.

Entities. A group of elements that is combined together in the mind of the user to form something that has a real existence, is distinct in terms of character attribution, and is independent or self contained.

Functionalities of the Design. Formal, Metalingual, Refential, Expressive, Conative, Phatic and Contextual structural principles in any act of communication. The intensity of their presence in a designed or lingual artifact as well as other parameters with which they are put into use can vary. In deign, these functions are given to the arrangement and parts of the designed artifact by the users interacting with it. Thinking along theses lines of functionality, users explore and construct their User Conceptual Models of formal attributes, system of codings, and possible associated references including addressers, addresees, community or culture of use as well as possible situations of use for the artifact. When designing artifacts, designing actors structure their artifacts according to these different principles by selecting and combining different elements for the

designed artifact, subsequently facilitating users construction of some or all of UCMs by emphasizing different aspects (parameters) of this or that functionality.

Grammar. A set of cognitive functions related to perception which builds a discrete system of rules that determines how humans identify and associate meaning to perceived information structures.

Inter-artifactual elements. Connective elements and the such in the design parole that typically mean or allow the construction of temporal or spatial relationship with other parts of a designed parole, or other designed artifacts.

Interface. An entity within the designed artifact (act of design) that forms an act of design with its own user and context, substance, or medium for manipulation.

Invariants. The essential information structure that remains consistent despite changes in the illumination and position of observer, as well as overlap in the viewing angle and other disturbance in structure of the environment.

Inversion rule. A rule where two expressions, normally subject and verb or verb and auxiliary, switch their canonical order of appearance (that is, they invert) in order to form question, or change the sentence form first to third person.

Languaging. The use of language in order to develop concepts and propose them as real. Based on Krippendorff's use of that word p. 20 of *The Semantic Turn* (2006).

Language use. The use (production and comprehension) of spoken, written or otherwise signaled lingual artifacts in a more more less uniform manner that enables a group of people to interact, convey, coordinate, and exchange meaning, knowledge or information. An act of sign use.

Lingual Artifact. Any man made artifact that requires any amount of thought and planing as to its purpose and its production into the physical reality. Produced from base units according to a system of formalized symbols, signs, sounds, gestures, or the like used or conceived as a means of communicating thought, emotion, affordance, reference, etc.

Literary Geometry. A relationship between different authors and a selection of their works that serves as a conceptual framework for an intended proposition, question, statement, inquiry, research etc.

Mental Dictionary. Hypothetical grammar stored unconsciously in the brain that details the meaning of concepts as well as the relationship between these concepts through sets of roles, role-players, and actions.

Modality. The physical phenomenon or stimulus the one can sense (such as sound, touch, visuals, taste and smell).

Noun. A word that typically refer to, or denote, a person, a place, a thing, an event, a substance, a quality, a quantity, etc.

Object. The conceptual entity that is acted upon by the subject.

Pareidolia. Perceiving vague and random audio or visual stimulus as significant. Most common manner in which *pareidolia* manifests can be seen in the way the brain constructs illusions of faces in everyday things.

Parameter. *“A constant or variable term in a function that determines the specific form of the function but not its general nature”* (Parameter, 2015). According to Pinker (1994) a parameter is one of the ways in which something can vary.

Parts of Speech. The syntactic role of a word (lang.) or entity (des.)

Prepositions. *“Words that typically refer to spatial or temporal relationship: in, on, at, near, by, for, under, before, after”* (Pinker 1994, p. 512)

Perception. A cognitive system which enables a continuous action of sensory information pick up, as well as the recognition of significant information structures from the data flow of sensory information. It consists from sensory organs with which information is sampled and sets of cognitive structures in the brain that are responsible for regulating the sampling activity as well as

for processing sensory information, distinguishing essential and invariant information structures from it, and linking these structures with meaning.

Performance. The research builds here on the term *linguistic performance* that was used by Noam Chomsky (1965) to describe the actual use of lingual artifacts in concrete situations. It is used to describe both the production of language parole, as well as the comprehension of language. Chomsky defines performance in opposition to “competence”; the latter describes the mental knowledge that a speaker or listener has of language

Phrases. The smallest *group of words that behaves as a single unit in a sentence and which typically conveys some coherent meaning.*

Principle. “A *fundamental, primary, or general law or truth from which others are derived*” (Principle, 2015).

Product diversification. A set of modifications done to entities, interfaces, and complex acts of design in order to diversify the artifact's community of users, attract specific users to the artifact, or distinguish their role or manner of using the artifact.

Representations. Entities, or combinations of design elements, that denote place, a thing, an event, a substance, a quality, a quantity, concept, etc.

Sameness. An exact condition, or set of conditions, existing in different fields, entities, domains, structures, etc.

Semiotics. The investigation of sign use in human culture through the construction of frameworks and models that are aimed at explaining some of the aspects of sign use and the things that happen in them.

Sign. Any thing which can be linked with a meaning. It is a mental relationship between a concept (signified) and an information structure (signifier) that is conceptualized by humans.

Sign System. A structure of relationships between different signs that regulates sign use in a more

or less uniform manner and that enables communication within a group of people.

Speaking/Writing. The planning and production of lingual artifacts - usually from audio elements, or visual-material elements representing these audio elements - towards a set of explicit and intended goals.

Structuralism. *“The methodology that elements of human culture must be understood in terms of their relationship to a larger, overarching system or structure. It works to uncover the structures that underlie all the things that humans do, think, perceive, and feel”* (Structuralism, 2015).

Subject. *“one of the arguments of a verb, typically used for the agent or actor when the verb refers to an action”* (Pinker, 1994, p. 514).

Syllable. Lingual element. The base material unit for the lingual artifact. It is usually produced by vocal performance and sensed by hearing, but can also be represented, sensed and produced visually or by touch, depending on the intended modality of the lingual artifact. This base unit is entered into the relationship that forms the part of speech of the lingual artifact by being selected and combined with other base elements in the act of speaking/writing.

Synchronic Approach. The study of language through the study of the way in which language's structure serves the basic function of communicating and conveying information between speakers.

Syntax. The component of thinking in phrase structures that arranges elements into entities and entities into artifacts (des.), as well as words into phrases and phrases into sentences (lang.).

Universal Grammar. The basic design of thinking in phrase structures that underlies all the grammars used for human language and design. Pinker (1994) refers to it as the circuitry in children's brain that allows them to learn the grammar of their parent's language. This research thinks of it as a set of cognitive functions in the brains of babies and children that allows them to learn and develop an understanding of structures of objects, mediums, and events they perceive,

be them their parents language or their parents car.

User. The agent, or actor, performing or participating in the affordance intended by the design of the artifact.

User Conceptual Models. A system of simplified and skeletal concepts or principles with which users can ascertain what the parts of the artifact, as well as the artifact as a whole, could mean in use, refer to, or represent.

Verb. A word that conveys an action, an occurrence, or a state of being.

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