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Yellow as "Non-Black": Prosthetics, Semiotics, Hermeneutics, Freedom and Function

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Abstract: Semiotic knowledge is crucial to professionals dealing with both the material and the visual elements of our socio-cultural surroundings: architects, graphic designers and industrial designers, just to name a few. However, in some cases, unique design situations call for a different approach. To understand the changes undergone by prosthesis designers we wish to use a hermeneutic approach, embedded in designers' interpretation of artificial limbs. In this article, we wish to highlight the ways designers convey socio-cultural meaning through their designed products, while combining semiotic and hermeneutic knowledge. Understanding this practice of viewing prosthetic limbs as a combination of visual, material and above all cultural depiction of society, as well as the designer's interpretation, will add a dimension to our understanding of the designer's influence on society. As a conclusion, we will show how this intriguing mixture of semiotic and hermeneutic knowledge could aid designers in the design of better suited medical products.

Keywords: semiotics, design theory, hermeneutics, medical design, interpretation, mimesis

1. Introduction

Material, shape and colour are the classic trinity of semiotic knowledge embedded in various design disciplines. However, in some design practices one should ask if this theoretical dimension is enough to describe contemporary challenges, especially so when dealing with medical design.

In this paper, we wish to highlight some of the ways industrial designers combine semiotic and hermeneutic knowledge in their immediate professional realm, as a practical mediating tool to create and sustain a connection between the manufacturers and the end-users,¹ which is embedded

¹ In medical design, as in other design venues, we tend to define primary users (the patient), secondary users (medical professionals) and tertiary users (family members and other caregivers).

in the designed object. This paper is a part of book dealing with various manifestations of interpretation of medical objects. The common denominator of our research is twofold: first, theoretic knowledge is crucial for design practice; and second, that contemporary designers should focus on design situations, rather than design products. By design *situation* we mean the understanding of a complex interrelation between people and material or virtual products, situated in a specific socio-cultural context. As such, we believe the integration between semiotic and hermeneutic knowledge will benefit new vistas of design research and design innovation.

2. Interpreting Prosthetics

2.1 Research Background

This paper summarizes a lengthy research encompassing Ventura's PhD, postdoctoral research and a recent study, all focusing on the social roles of industrial designers, as well as trying to define the role and impact of design anthropology. The first phase of research is based on in-depth ethnography which took approximately eighteen months (2009-2012). During the ethnographic work, Ventura, has spent a day every week for the said duration, in an alternate order between three different industrial design studios. Following a period of research conducted at the Royal College of Art and at the University of Southern Denmark, Ventura started focusing on the role of the applied anthropologist in the field of medical design, bringing forth the new title of medical design anthropology (2013-4). In the latest research (2015-6) we have conducted in-depth ethnographic research at the rehabilitation ward of Hadassah Hospital in Jerusalem. Focusing on the daily work of physiotherapists (PT) and occupational-therapists (OT) we strive to show the transition from working as an applied anthropologist in a classic industrial design studio, to working in a medical design atmosphere. This article, therefore, will present the essence of theoretical and practical dialogue between semiotics and hermeneutics in medical design, a dialogue which will also serve to define contemporary design in general. The shift from classic design to medical design anthropology will outline the future of industrial design in contemporary material culture.

In the following pages, we will see how the aesthetic attributes of a product (material, colour and shape), combined with the interpretive dialogue between the designer and the user brings forth a new understanding of the designed situation. This interpretive dialogue, standing at the core of what we term situational design, is based on the designed object being continuously interpreted by the designer, as well as the user. As is the case in design methodologies, such as co-design or participatory design, the act of interpretation happens as a lengthy dialogue between these two key-players in the design process. While the user does not always know to translate his preferences, and demands into design practice, the designer completes the act of translation-interpretation. We will start by briefly presenting semiotic and hermeneutic principles and continue to the design of prosthesis legs as a case study. The choice of medical design rather than consumer products stems from our assertion that in such a field, the interpretation of an object will have greater effects on the user's body and daily routine, as part of a socio-cultural designed situation.

2.2 (Applied Semiotics)

The symbol leads us to think (Ricoeur, 1988: 480)

Some of Barthes' main theoretical terms, such as the myth, denotative and connotative meanings among others, have become key theoretical concepts known to all (see Barthes, 2012; 1977; 1977a; 1994). In these classic texts, Barthes explains that each representation, visual, textual or material,

has two meanings: a denotative meaning in which the "simple" and obvious traits are illustrated, and a more "complex" and culturally dependent one, called connotative. When analysing material objects, and in our case – medical design objects, one usually highlights the object's connotative dimensions (Penn, 2000). While using Barthes theory in relation to semiotic systems, one can understand the various meanings of colour, material selection, shapes and forms – all of which consist of the practical world of industrial designers' professional work, a view which was ultimately continued and elaborated by Baudrillard (2005 [1968]). Following this train of thought, a prosthetic leg has a denotative meaning (a replacement of a person's limb) and a connotative one (disabled, loss, cyborg etc.). The basic hypothesis (for example, Eco, 1979; 1986) in which socio-cultural linguistic systems, seen as a combination of the signified and the signifier can be implemented in other disciplines, such as visual communication or graphic design. Symbols, gestures, colours and materials, combine to create a complex visual system of meanings embedded in a specific socio-cultural context.

Eco (1979) distinguishes between semiotics of meaning and semiotics of communication, and accentuates the former's interest in code theory. Most semioticians agree upon the principle of a language's structural mainframe (visual, textual or material). A visual language, according to Eco's concept, consists of structure, commentary and hermeneutics. This approach emphasizes the importance of the context in which a product was designed, embodying a specific socio-cultural ritual. Furthermore, the "product's choreography" as an example for the moves and gestures performed by the consumer whilst using the product is a manifestation of a specific semiotic system, as well as a hermeneutic dialogue between the design partners. Lastly, the designer's (semiotic) goal is to create a holistic and consistent rather than arbitrary or vague language.

Baudrillard (1996) addresses the various meanings embedded in the material object, such as the functional, the symbolic, the economic and the signifier aspects. The last one is the closer to this current paper, since the object's signifying attributes associate it with a system of similar objects. Baudrillard ventures to say that modern objects are less functional and more symbolic in nature, hence, the importance of research relating to the ways design studios create and maintain symbolic-visual languages through meaning-making. Indeed, designers have used semiotic principles as a tool for imbuing objects with deeper meanings, from the Art Nouveau, through the Bauhaus, postmodernism and contemporary designers (Figueiredo and Coelho, 2010).

In a recent work, however, we demonstrated the shifting use of semiotics in contemporary design through Barthes' concept of semioclastics (Ventura and Shvo, 2016). While Barthes used the concept to describe a collapse of a sign system, we allocated it to a deeper shift in contemporary design, i.e., the intricate relationship between the designer, user and modes of production. While in classic design, the designed object would be sent to the client and then to the engineering process following a production process and marketing efforts delivering it to the consumer, contemporary changes in the work of designers have cracked this model. Through 3D printing, open-code design and other trends, designers and users share a more direct dialogue through a shared system of interpretation. We believe this interpretive shift is echoed in an important fashion in the practice of contemporary designer, and especially so in the case of medical design, bringing us to the use of hermeneutics in designer's practice.

2.3 (Applied) Hermeneutics

Understanding and interpretation constitutes the method used throughout the human sciences. It unites all of their functions and contains all of their truths. (Dilthey and Mueller-Vollmer, 2006: 23)

A point of change in the view of hermeneutics was established with Heidegger's (2010 [1927]) concept of "being-there" (*Dasein*). In his view, a way to solve the interpretation paradox, i.e., our inability to find the correct interpretation out of the myriad possibilities, was not to exit the hermeneutic circle, but rather to base our interpretation on basic human understanding. Heidegger's student, Gadamer, followed his mentor and ascertained that an interpretation is the result of a dialogue between the past and the present. We want to claim that Design tries to function as an interpretation of a dialogue between the past and the future as well as between the designer and the user, as we shall see. While the former is based on the history and evolution of the designed object, the latter revolves around the abilities of the designer and the design partners to reiterate and interpret the intricacies of the design situation. For example, the design of a prosthetic leg can be reinterpreted not as a medical device meant to correct the fractured body, but rather a fashionable and highly technological addition meant to enhance and empower the user.

Gadamer's main innovation was the assertion of the universalism of hermeneutics, i.e., that understanding unlocks the self and the world while creating a new relation between the two. Language, accordingly, is the horizon of hermeneutic ontology (Gander, 2015), or in Gadamer's own words – "being that can be understood is language" (Gadamer, 2013: 490). Therefore, art or design is not situated in or for itself, but rather *through* the mediation of language. In other words, the relation between visual-material representation, language and comprehensibility creates hermeneutic knowledge or understanding. Naturally, since Gadamer's assumptions are relevant to all human experience (Gadamer, 2012), design falls in these wide margins. In the following pages, we will see how this mediation is manifested in the world of (medical) design through the combination of visual-material semiotic language and interpretation.

Later, Stanley Fish (1980) added another brick to the hermeneutic wall, stressing that a single interpretation does not exist, but rather a special, flexible relation between a reader, a writer and a text, culminating in a unique vortex of understanding. Ricoeur (1988) continues this line of thought, claiming that interpretation is possible, since human beings are able to communicate with each other, yet to achieve understanding we must correlate between theory and practice. This is critical when dealing with design, due to its various dimensions and key players.

Ricoeur (2006) warns us of the temptation to articulate an all-encompassing language, focusing instead on the act of translation as a way to bridge between words and their material or visual representations. The designer's work, in other words, lies in the ability to translate socio-cultural norms into material objects, which are then re-translated and interpreted by the end-users (think of de Saussure's classic signifier/signified duality).

3. Prosthesis Design, Semiotics, Hermeneutics, Freedom and Function

In the last decades, medical design has undergone an inherent change, taking into consideration the socio-cultural effects of colours, materials and textures as part of a central tool of designers in the creation of better-suited products (see, for example, Clarkson et al., 2003 and Weinger et al., 2010). As we shall see, medical products invoke an extensive process of dialogic interpretation between the patient and the medical staff. Since the injured or disabled body is assisted by designed objects to return to functioning in daily activities, the object's influence on the patient's socio-cultural surroundings is considerable. Indeed, Gadamer (1996: 112-3) has considered medicine or the relation between the doctor and patient, vis-à-vis questions of health and illness (Svenaeus, 2015).

Gadamer's description echoes basic concepts of anthropology of the body, highlighting the normative aspects of our body's existence in social spaces. As Lock and Scheper-Hughes (1987) outlined it, our behaviour (and by proxy, the medical devices on our body) is a culmination of three bodies: the private body (our own flesh and bones), the social body (sociocultural norms and modes of behaviour) and the political body (our body's reflections of political constraints and modes of control). Yet, apart from the obvious importance of Gadamer's hermeneutics to ethics of medicine or the asymmetrical relation between the doctor and the patient, we wish to highlight the importance of hermeneutics and semiotics in imbuing medical products with societal agency and empowering the patient.

During our research, both the local prosthetic orthopaedist and an expert working at one of the largest prosthetic companies, accentuated the importance of the prosthetic limb's design we chose to focus on the design of prosthetic legs. As Murray (2013) demonstrates, patients developing a healthy involvement with medical professionals regarding their prosthesis described a positive attitude towards their healing process. Naturally, as the patients' and prosthetists' lingua and concerns differ, a mediating factor could be reached through prosthesis design. Visiting in a prosthetics manufacturing facility in Tel-Aviv strengthened our decision, since all said professionals told us of the importance of the prosthetic limb's design to patients, even more so that its functions.² Through highlighting several issues of the evolution of prosthetic leg design we will show the theoretical transition in the designer's practice from semiotics to a more complex stance of hermeneutics.

3.1 The Evolution of Interpretation

For thousands of years, humankind searched for practical solutions for amputees, targeted at getting the injured back to their former selves and in a Cartesian manner, trying to mechanically fix their physical problem. As one can see throughout the Medieval era, the Renaissance and up to the first half of the 20th century, prosthetic limbs were designed to resemble their healthy counterparts. In these times, prosthetics were usually designed in a mixture of functioning aesthetics. This approach is one step forward from the simplest solution of using a straight wooden stick, harnessed to the thigh or crutch, enabling the person to walk - the peg leg. As the peg-leg is a simple, generic and schematic design, focusing on the pure function of connecting the stump to the floor, this simplistic approach leads to stigma (think of Melville's Captain Ahab or Stevenson's Long John Silver) and obvious ergonomic ailments (chafing, muscle and bone aches and more).

² See, for example, UNIQ's prosthetic covers catalogue, reminiscent of a leading sports or fashion brand: <http://uniq.com/>



Figure 1. Simple function as seen in "Moby Dick": Captain Ahab, myth and stigma

Trying to deal with the stigma originated by prosthetics, by hiding the missing leg, the prosthesis imitating a leg and even a shoe is a more sophisticated product, linked to socio-cultural context and fashion, trying to relate to a contextual design situation. We can see examples of both cases from ancient China till now, in different technologies and materials, depending on historical developments. Yet, the common denominator is the considerable efforts in trying to conceal the artificial limb and recreate a somewhat natural look.

These efforts to duplicate a healthy limb or even a shoe via a mimetic approach holds advantages as well as disadvantages, as we have seen. Naturally, the most common stigmas revolve around a non-human or cyborg appearance, while the naturalistic limbs bring forth fears of the uncanny, to use Freud's famous concept. Following this train of thought, designers carefully walk on the margins of creating a prosthesis that resembles a human limb, yet not too closely, while carefully avoid cyborg connotations on the other hand (see, Ventura, 2016).



Figure 2. A mixture of simple function and mimesis of the human leg in different eras

Modernism has brought a new functional and specialized attitude resulting in innovative configurations of a specific function, like running. This change was enabled, of course, thanks to new lighter and stronger materials (carbon fibre or aluminium, for example). As modernism rejected all inspiration, mimesis or citation of nature and past, new abstract configurations were born. This new prototype of functional prosthesis is manifested in what is usually called the “cheetah leg”.³ This limb is a mechanical manifestation of a specific need to run. As such, the limb is designed to face the runner’s challenges while allowing for the fastest speed possible. Another example is Ossur’s Flex-Run, which is designed for active users, with a sole specifically designed with the collaboration of sports mega-brand Nike.⁴ Following a somewhat mechanical approach, solving a specific need of the user, as an added result, the user is treated as a dynamic and vibrant member of the community, rather than a disabled person. This shift created interesting debates on the very definition of “disabled” and “normality”.



Figure 3. Pure functional solution - new technologies, function and new abstract semiotics

³ <https://www.ossur.com/prosthetic-solutions/products/sport-solutions/cheetah-xtreme>.

⁴ <https://www.ossur.com/prosthetic-solutions/products/sport-solutions/flex-run>.



Figure 4. Jaipur Foot

3.2 21st Century: Beyond function - Awareness and freedom of the medium

Interpretation as an inherent tool for designers is expanding due to various changes, such as the development of new technologies, new perceptions of design situations and new ways with which design mediates between the user's body and their socio-cultural surroundings. These changes enable designers to raise new and courageous configurations, materialize new metaphors and harness new materials in a customizable solution enabled by said challenge. Contrary to the successful project of the "Jaipur foot"⁵ which is a classic model of the older definition of a "Leg" (one fits all), the examples we will present next, show the new perception of the prosthesis as a reflection of the individual user, his (or her) character, preferences and self-image.

Open code design, 3D printing, new technologies or material production, as well as the new design revolution enable designers to function as material philosophers and bring back to the user the ability of personal interpretation over his (or her) body, making the prosthesis a new accessory. This approach demonstrates the shift we have outlined from the pure function and semiotics to the more elaborate hermeneutic-oriented design.

This all suggest that we have "overcome" the functional problem of producing prosthesis and can feel free to design more creatively when dealing with prosthesis for individual users. Here we can see the importance of the product choreography and context as per Umberto Eco's theory (see page 6). Per his approach, the new urban user of prosthesis is an active individual that cares about technology, design and style. Therefore, the semiotic system and more importantly, the hermeneutic system in which the user is situated influences the prosthesis design.

⁵ <http://jaipurfoot.org/>



Figure 5. Interpretation in prosthesis design (by Scott Summit)

A major contemporary design strategy is to view the artificial leg as it's decoration. For example, the prosthesis designed by industrial designer Scott Summit (fig. 5) interprets the image of the leg as an independent tattoo skin - it is hollow and it becomes a part of the tattooed body of the wearer. The fact that it is hollow makes sure that we will not misinterpret it as a "normal" physical leg, emphasizing its artificialness. The designer does not try to imitate but rather takes the freedom to be inspired by body tattoos, which are a part of the user's identity. Furthermore, as a part of this specific design situation, Summit interprets this user's overall identity and projects it on his prosthesis' design.



Figure 6. Alexander McQueen's prosthesis for Aimee Mullins

Wooden boots or furniture legs - Alexander McQueen's prosthesis for famous model Aimee Mullins (fig. 6) are carved and refer to historical wood crafting through history, as well as to the classic peg-leg. The designer's aim here was to transform the human body into a living statue, as well as a piece of art. Rather than creating a clear boundary between the leg and the prosthesis, this unique design dissolves this boundary while mixing the prosthesis with a pair of hand-made, designer boots. This moment of bewilderment creates an empowering effect redefining and rephrasing the concept of "handicap" or "disabled".



Figure 7. Sophie de Oliveira Barata for Viktoria Modesta

Sophie de Oliveira Barata, (Alternative Limb project) for Viktoria Modesta, uses the hollow prosthesis as a volume of a loudspeaker, reflecting the performer's personality and persona and suggests new functions to the prosthesis (fig. 7). Furthermore, instead of trying to camouflage the artificial limb, this design accentuates its presence on the user herself, as well as on her immediate surroundings.



Figure 8. US Army sniper

The US marksman depicted in fig. 8 is an example of how far can interpretation go when looking for secondary functions to the artificial leg. This somehow grotesque proposal offers the prosthetic leg itself as a tripod for the weapon, when the sniper is focusing on his shot. Rather than viewing the missing limb as a problem, this prosthesis enhances the sniper's professional abilities in the combat field.



Figure 9. Sophie de Oliveira Barata

Horror and Glam star in another artificial limb from the same project, designed by Sophie de Oliveira Barata (fig. 9). This prosthesis reveals the metal "bone", or the mechanical centre of the prosthesis, coating it with Swarovski artificial stones resembling the muscle tissue. Again, rather than creating a robotic, or medical image, this prosthesis rather looks somehow like one of Damien Hirst's art pieces.



Figure 10. Designed by Sophie de Oliveira Barata and Kaos art

In fig. 10, Viktoria Modesta wears this “Spike” high heel, designed by Sophie de Oliveira Barata and Kaos Art, stemming from the knee and making it look impossible to walk in. This minimalistic leg does not try to look like a human physical limb in any way, and not due to functional reasons. We can refer to this heel as a classic peg-leg elegantly redesigned and streamlined. One can see that in this fashionable redesign, the spike represents the missing high-heel of the shoe, removing the prosthesis from the medical realm and placing it in the more glamorous world of high fashion.

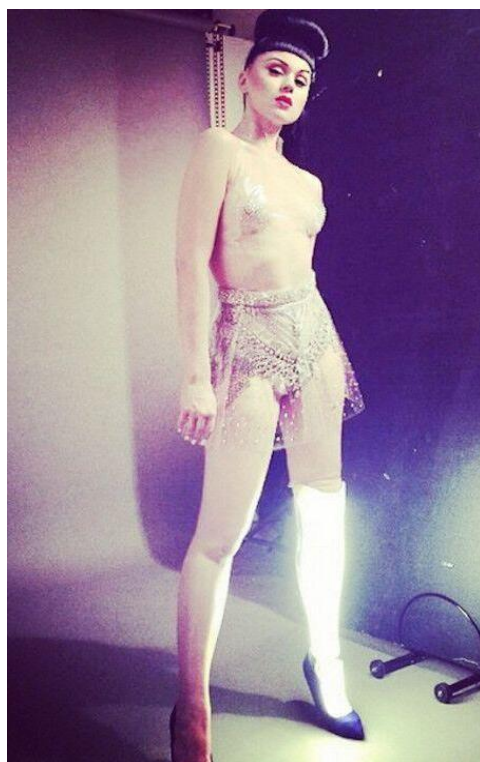


Figure 11. Viktoria Modestas' illuminating prosthesis

In another project (fig. 11), Viktoria Modestas' illuminating prosthesis suggests new functions to the prosthesis as a fashion "accessory", following the same pattern we have shown in the previous examples. This one, as well, seeks to challenge our perception and use the tempting opportunity to reinvent the limb as a lighting fixture. Again, rather than serve as a light fixture, this redesign echoes the post-human essence, empowering the user as a more than "normal" person.



Figure 12. Scott Summit prosthesis

Another example of the post human approach to prosthesis design can be seen in fig. 12. In this design, car-like prosthesis by industrial designer Scott Summit makes Roland Barthes text about smoothness and perfection more relevant than ever: "smoothness is always an attribute of perfection because its opposite reveals a technical and typically human operation of assembling" (in Pasztory, 2005: 19). This streamlined artificial leg becomes a medium between the human body and the motorcycle, echoing the material interpretation of the user's identity.



Figure 13. Sophie de Oliveira Barata, *Alternative Limb Project*

In the last example (fig. 13), this artificial limb designed by Sophie de Oliveira Barata, (*Alternative Limb project*) uses all methods in one product - mimesis, construction and pure function. This design reveals the connections and enhances the seams between the various design languages and layers, making the viewer fully aware of the artificial and eclectic limb. By combining hyper-realism with abstract constructivism and citation of past methods of prosthesis manufacturing (leather work and a somewhat Victorienesque or steam-punk design) this is the most sophisticated example in our opinion. Following this line of thought, we will conclude this paper by an overview of the designer's new role.

3.3 The Designer as Cultural Surgeon - from the Peg Leg to the Bionic Man

Conversely, the foremost intent of social design is the satisfaction of human needs (Margolin and Margolin, 2002: 25).

The prominent members of the Frankfurt School warned us of the devastating effects of the ever-growing shallowness of mass communication. Indeed, while the classic Marxist approach did not include designers in the devastating capitalist generator of modes of production, we can clearly add design as a discipline of "the bad guys". However, we believe that while the commodification of cultural products is a dangerous path, in the case of medical design, this process could have a positive effect. As prosthesis design progressed from the mere function of enabling patients to function normally, so did the role of the designer. As we have seen throughout this paper,

contemporary prosthesis design can be seen as mirroring the “handicap principle” - offering designs that could even hinder or encumber the patient. However, we see these changes not as frivolous or random, but rather as a positive and healthy evolution of early 21st century design efforts. Transforming the prosthesis from a medical device into a designed commodity imbues this object with new element of fashion, strength, luxury and even playfulness in the service of self-esteem and self-confidence.



Figure 14. Dolls with prosthetic legs, from <http://www.weareastepahead.com/community/doll-prosthetics/>

A good example of this process is described at length through the pendulum motion from designing furniture to designing for disability (Pullin, 2009; Hall and Orzada, 2013). As designers delve deeper into the intricacies of designing for disability, their understanding of this unique design situation alters. From a purely function ethos to a more elaborate worldview, embedded in the intricacies of interpretation.

As prosthesis design progresses from the pure function to the status of fashionable apparatus (Pullin, 2009), patients are encouraged to think of their body in a different manner. The commodification of the artificial limb transforms this technological product to just another consumer product, just as an iPad or designer jeans. Through the customization of artificial limbs, along their marketing strategies (UNIQ, for example), the prosthetic limb does not function merely as a “problem solver”, but rather as a re-definer of one’s identity. The designer, therefore, functioning as a cultural surgeon rather than a mere problem-solver, enables a reconnection to the patient’s body through design. The designer’s new role calls not for merely constructing a new function, but for an act of rewriting the perception of the patient’s body. As such, the designer shifts from a Cartesian stance of replacing a body part into a more holistic path of redefining the body’s limits and attributes. This stance will only grow in volume, as engineers move forward towards enhanced prosthetics (the bionic limb is a well-known example) allowing the patients such abilities as night-vision or augmented strength and agility.

From peg leg to the bionic body



Figure 15. Prosthesis evolution

By following this path, we see design as a discipline capable of not only serving the industry but indeed changing our socio-cultural surroundings. This approach follows a similar path, described by Folkmann (2013: 15): “Thus I define design as a means for human beings to envision and realize new possibilities of creating meaning and experience and for giving shape and structure to the world through material forms and immaterial effects”. Therefore, the potential of designers lies in a substantial shift from problem-solvers or brand marketers to that of social agents. By that we mean the agentic ability (Gell, 1998) to inherently influence our daily activities and conceptions of the relation between objects and users. Therefore, through design, interpretation-oriented prosthesis can alter the very definition of “impairment” from the WHO’s definition of “a complex interaction between features of a person’s body and features of the environment and society in which he or she

lives.”⁶ I.e., by changing the design situation via the redesigned prosthesis the person’s body is redefined in relation to his or her immediate socio-cultural surroundings.

This shift holds considerable implications both to the practice of design, as well as design pedagogy. As design practice changes, vis-à-vis contemporary manufacture advances through open-code design, 3D printing and the growing awareness of the abundance of materiality in the Western countries, contrary to the ever-growing socio-economic gap in developing countries. In such a global climate designers need to focus on design that matters, first and foremost in their abilities to influence communities that can truly benefit from their unique skills and abilities. As such, we need to change out pedagogical focus while teaching students, shifting our priorities to a theoretical and methodological toolkit that will enable us to better understand contemporary design partners. We feel the myriad ways designers could benefit from this theoretical and practical shift is clear, however, it could change the way applied medical design anthropologists operate as well. Contributing as part of the design team, medical design anthropologists could deepen theoretical as well as practical understanding of a design situation, therefore striving to create a product that is better for all the design partners, since it is embedded on the interpretation of the design dialogue. Finally, it is important to not the importance of applied theories to better understand our practice as designers and anthropologists, as well as to strive to create a better medical environment.

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⁶ World Health Organization, *International Classification of Functioning, Disability, and Health* (54th World Health Assembly, ninth plenary meeting, May 22, 2001).

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