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Procedia Manufacturing 3 (2015) 5570 – 5578

Procedia
MANUFACTURING

6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the
Affiliated Conferences, AHFE 2015

Assistive Technology and User-Centered Design: emotion as element for innovation

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Abstract

The present article approaches as central theme the Assistive Technology. Its main objective is to enhance the understanding of the user-centered design and the emotional dimension involved in the process of innovation of the assistive equipments. The adopted method was the situational analysis. Starting from counterpoints with renowned authors of the literature and emphasizing the fact that disability is an individual experience, pleasure and emotion are approached to clarify the design method in order to provide positive experiences for the necessary affective link between product and user. As a result, it becomes clear the possibility to provide the assistive equipments with style, formal, functional and emotional quality inspiring the innovation processes that harmonize the designer's ideas with the real needs of the users who constantly struggle with the improvisations and the lack of design.

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Peer-review under responsibility of AHFE Conference

Keywords: Assistive Technology; User-Centered Design; Emotion; Innovation.

1. Introduction

Much has been written and spoken about the Assistive Technology (AT), its concepts and applications. Little has been discussed on its meaning under the user's point of view and which emotions it evokes. The researches in design and innovation in the area of the Assistive Technology reveal the urgency of considering the user in all the stages of

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the design process [1, 2, 3, 4]. This is the approach called User Centered Design (UCD). Although the term Assistive Technology has a polysemic characteristic [5, 6], it is defined here as: "(...) an area of the knowledge, of interdisciplinary characteristic, that includes products, resources, methodologies, strategies, practices and services that aim to promote the functionality, related to the activity and participation, of people with disability, incapacities or reduced mobility, seeking their autonomy, independence, life quality and social inclusion [7]¹. While working with this methodology, the objective of the present article is to enhance the understanding on the user-centered design and the emotional dimension involved in the process of innovation² of the Assistive Technologies. Taking in account the design aligned with the user of the Assistive Technology means that the emotion is in the center of the process for the creation of innovations. Functionality, desires and needs are in intimate relationship with the experience of consuming and making use of a product. It is not a matter of manipulation, but the necessity of creating experiences that affect the user positively [8, 9]. According to McCarty [10], heavy and embarrassing designs "reinforce isolation feelings and the people's inadequacy with disability, contributing to their stigmatization for the society". For Borges [11], it is the equipment and not the functional problem that depreciates the person with disability to the eyes of other people. According to the mentioned reports, the emotional experience resulting from the use of AT has not been favorable, especially in the poor countries and those in development. The emotional subject is one of the several dimensions of the experience associated to the perception of a product. For Hekkert (2006) *apud* Tonetto and Costa [12], the expression *product experience* refers to " (...) the whole affective content that it is elicited for the interaction between user and product, including the degree in which the senses are rewarded (aesthetic experience), the meaning attributed to the product (meaning experience) and the feelings and emotions aroused (emotional experience)."

What makes an Assistive Technology innovative and competitive, is not only its product and technical processes characteristics, but also the intrinsic characteristics of the induced experience, including the role of assisting and encouraging a rehabilitation process [13, 14, 15]. The aesthetic aspect of the Assistive Technologies was studied in a literature revision proposed by Alper and Raharindirina [16]. Similarly, the document "Assistive Technology in Brazil", promoted by the World Bank and CNOTINFOR/Portugal in 2003 [17], affirms that the complaints about the inadequacies of ATs are frequent. Therefore, the emotional answers of the users with disability, should be translated into a correct adaptation in which effectiveness, efficiency and satisfaction can be achieved [18]. It is not a matter of making superficial changes, rather it is a true conceptual change that is characterized as an assistive product keeping in mind that the disability is an individual experience. The technical solutions should not increase the mental or the physical efforts of people with disability. The considerations should be concentrate on the user's capacities and in the innovation of technology that will affect his life quality, always looking for an increase on the functional capacity. A more humanized rehabilitation through an aesthetics of processes and free of stigmatizations is possible [18, 19, 20, 21, 22]. In order to intensify the debate, the present article places the user in the center of it as an important element for the innovation in Assistive Technology. It approaches the hedonomics equally in relation to the role it plays to elicit pleasure, emotion and the consistent positive experience arising from the process, going in that way, beyond the subject of AT as a language.

2. The user in the center of the attention for the innovation in AT

The term User-Centered Design (UCD) was mentioned for the first time in the studies of the human-computer interaction and today it refers to the reality design which, besides the aesthetic subjects (which are also important!) makes it possible to evaluate it as an efficient and innovative product to reach the objective of assisting the users' needs with an appropriate technological solution [23, 24, 25, 26]. In this conception, the user should be part of the

¹ To deepen knowledge on the state of the art of the term AT in your beginning in the USA, see Cook, A. M. & Hussey, S. M. *Assistive Technologies: principles and practice*. MOSBY/Elsevier, 2008.

² The term Innovation is understood here as: The implementation of a product (a possession or service) new or significantly improved, a new process, a new marketing method, a new organizational method concerning the businesses practices, in the organization of the workplace or in the external relationships (OECD, 2005, p.55).

design process giving feedback during the course of it rather than being asked about his impressions when the process is finished. Thus, it is worth quoting Henry Ford: “Coming together is a beginning; keeping together is progress; working together is success” [25]. Understanding the human being and getting in touch with his universe in order to translate the elements connected to the products leads to an important innovation factor: the impact and the transformation in people's lives through the use of these same products creating an “empathic link” between users and designers. It also relates to a harmonization between demand and usefulness, restrictions and possibility and between need and demand” [27]. The user's experience is one of the focuses of UCD and defined for Royo [28] as a “group of sensations, values and conclusions which are obtained by the user starting from the use of an equipment, including physical and emotional reactions”. In order to achieve success with the project centered in the user it is fundamental to consider the context of the use, the task to be accomplished and the cultural universe involved therefore expanding the understanding of the user's needs [29]. The Assistive Technology should be comprehensible to the user and offer him the functionality studied with the tasks that should be carried out by him. This requires a more detailed study on each disability type. The designer's creativity should be in intimate relationship with the subjects that involve the universe of the functional diversity. Listening to what the user has to say is fundamental to work with an interdisciplinary and multidisciplinary team, in a collaborative way and it is a basic requirement to reach the intended objective [27]. There is no way to talk about projecting the user's experience, but we can think of projecting to provide experiences far beyond the functional appearance for the establishment of links with the user's emotions [27, 30, 31, 32]. Another aspect to be considered relates to turning daily used objects, such as the Assistive Technologies, into desired objects which affect the life quality of those who use them positively [29]. Pleasure and emotion are mixed, they evoke memories, they help to evaluate situations and to take decisions. This process is intimately connected with the human cognition impacting on the way people think and react [33, 34]. Considering the dimension of pleasure and emotion (hedonomics) in the design of the Assistive Technology means helping interaction and rehabilitation. Consequently, objects become part of the user's body [1, 18, 35, 36, 37]. And what could be done to prevent this new part of the body from evoking emotion? We need to establish two new links in the chain of the innovation process of the Assistive Technology: one places the user in the center of the attention and other focus in the emotion to avoid taking the risk of making adjustments instead of bringing innovation to AT projects. The investigation on the dimensions of pleasure and emotion strongly influences hedonomics studies.

3. Hedonomics: pleasure and emotion

The term hedonism originates from the Greek expression *hedonêque* which means pleasure, or desire [38, 39]. It first appeared in Greece and it used to designate the moral philosophy for those who held the pleasure as the most import feeling in life and in a wider conception, the happiness that can reach even a greater number of people [40]. For Damásio [41], the emotion is the “(...) collection of changes in the state of the body that are introduced in an infinity of organs through the nervous cells terminations under the control of a dedicated cerebral system, which answers to the content of the relative thoughts to a certain entity or event”. According to the same author, the emotions are classified as primary (which are the base of the human development such as happiness, sadness, surprise, fear, repulse and anger), as secondary (being those which answer with physical alterations in relation to the experience of the emotion such as perspiration, alteration of the rhythm of the heart, alteration of the muscular force; shame, jealousy, guilty, pride) and background emotions (such as well-being, indisposition, easiness, tension) [41, 42]. Pleasure is defined as a sensation arising from the satisfaction of a necessity [33, 43, 44, 45]. The distinction between pleasure and emotion under the point of view of the design of products was discussed thoroughly by Linden and Guimarães [46] who pointed to the importance of the studies of Ortony et al. [47] adapted by Desmet and Hekkert [48] on his Basic Model of the Emotions with Products. According to this model a product stimulates people in three outstanding ways: as an object, as an agent and as a promise of future use or property. The products evoke several emotions at the same time. The evoked emotions are based on the interpretations of the characteristics of the product. This universe doesn't only links with the aesthetic pleasure but with all the emotions that can be evoked by the product [49]. The basic Desmet's model applied to the Assistive Technology universe helps with the understanding of how the person with disability notices his helping device. As an example, using the model proposed by Desmet, an outline focusing AT was elaborated for every moment. As a result, during the observation of the category *product as an object*, the AT is perceived in terms of its visual appeal and formal

configuration. The evoked reactions are attraction, love or indifference and their opposites. During the observation of the category *product as an agent*, the AT is perceived in terms of the presumed impact on its users. The object should carry out the function for which it was presumably created. This leads to emotions such as admiration, appreciation and their opposites. The basis for evaluation consists of the expected acting or unwanted agent performance. It relates to the ways beliefs, norms and the user's conventions are assisted or not. During the observation of the category *product as an event*, AT is noticed in terms of the anticipation of the consequences of the ownership or not of an equipment, a factor that becomes the event itself. The emotions arising as consequence can be, sensation of obtaining social status in the time of the acquisition of an equipment and of the admiration caused when it is first used. The most important factor concerning this model is the objective it is intended to reach. Therefore, what is observed in the models of Desmet (2002) is that the products arise different and sometimes, conflicting and mistaken emotions at the same time. The AT can be the object of a person's desire with disability: loved by its audacious and well structured design, but annoyingly unattainable for its high price. Another important aspect is the fact that the emotions are evoked by the interpretations of the characteristics of the product and not only by the product itself [50]. For Desmet [51] there are not general rules or a manual of conduct to evaluate the relationship of the product and the users' emotional answers. The idea of the singularity of the experience with a product was approached thoroughly by Tonetto and Costa [12] supported by the revision of the literature of Cacciopo and Gardner [52]. However, there are tools being developed to help with the understanding of the product's emotional potential.³ Consequently, the Assistive Technology will not be useful to a standard person. Several needs of each user's functional universe should be considered. Therefore it is important to mention the role of the user with disability in the center of the design's attention and innovation. According to Preece et al., [53] the real users and their goals are the base for the conception process of the products as a line of thought for the actions. It is not related to people and their ideas but to people loaded with emotions which should be considered as a significant element in the design process, because according to Shedroff [54], "the emotions are in the way of the significant innovation". That significance of the innovation requires the provision of positive experiences in a consistent way.

4. Consistent positive experience

To provide a consistent positive experience to people with disability through AT it is necessary to distinguish the user's needs from the objective of the experience requirements. The requirements are the collected data about the users and their needs. They are important, in the way they will be translated later to functional requirements. The goals of the experience are direct elements linked to what the users look for to obtain in a consistent way with the use of a certain technology. That process demands a disposition from the designer to take risks and to venture in subjects that are not familiar to him [25]. Hersh and Johnson [14, 55] propose the model of Comprehensive Assistive Technology (CAT) to highlight the user's most important requirements as well as the assistive technology involved in the project. Based on the units of analysis (person, context, activities and Assistive Technology), it was conceived with the purpose of organizing the information about the user as well as to provide the designer with structured information for the accomplishment of the project of Assistive Technology. According to the model and relating to the user, it is important to notice the aspects of his characteristics (personal information, disability type, abilities and preferences) social aspects and attitudes. It is important for the assistive technology to notice the specifications of the task to be carried out, design issues, issues about the involved technological system as well as the subjects concerning the final user. Preece et al., [53] propose as current objectives of the user's experience: to be entertaining, satisfactory, pleasant, interesting, profitable, inspiring, aesthetically appreciable, creatively encouraging, worthwhile and emotionally appropriate. A more pleasant experience must go beyond the aspects of

³ Talking about the tools not part of the scope of this paper. For more information see:

Desmet, P.M.A., & Hekkert, P. (2002). The basis of product emotions. In: W. Green and P. Jordan (Eds.), *With Pleasure Products, beyond usability* (60-68). London: Taylor & Francis.

Dias, M. A. R. C. (2009). Perception of the materials by users: evaluation model Permatius. 2009. Doctoral Thesis (Engineering and Knowledge Management). Federal University of Santa Catarina. Florianópolis, SC, 2009.

attention, rhythm, playfulness, interactivity, conscious and unconscious control, involvement and narrative style (these last ones borrowed from the theory of the e-games). All those elements are in high interdependence with the context in which the object will be used, the tasks that will be carried out as well as with whom the users are involved (directly and indirectly), as already demonstrated previously. With the objectives clearly established, the user's satisfaction should still be subordinated to the following subjects of: safety, functionality, usability, pleasure with the experience and individualization [56, 57]. Although emotions are subjective, in agreement with [58], the process of evoking the emotions is universal, because to project in order to move requires an analysis of the evaluations and concerns. That process is not different for AT. An important study of Desmet and Dijkhuis [49] stands as reference showing that a wheelchair can be entertaining and its project guided for the emotion consequently reaching surprising results. To provide the user with a product with elements of his own personality results in bringing the artificial closer to the human. According to Walter [59], "personality is the platform for emotion". It is a designer's task to know how to identify and to translate the aesthetic-formal elements to the project of AT giving personality to the assistive products [60, 61]. Desmet [62] points out that positive emotions stimulate the acceptance of the objects and the negative emotions stimulate its rejection. In order to make the consumer engage in a process of selection and acquisition of AT, several aspects should be considered carefully: humor state, previous experiences, judgment and preferences, perspectives (vision of his current and future situation), abilities, skills and attitudes [55, 63, 64]. Besides the subjective feeling there is still the expression factor (facial and corporal), the change in the excitement levels and the inspiring tendency as constituent elements of the emotion [65]. Varela and Oliver [66] demonstrate in a study with children that AT is rejected or welcomed in agreement with the context and life history of each individual. To understand precisely this mechanism of rejection or acceptance of a product it is interesting to notice the users' answers in relation to three basic functions of the products: practical function, aesthetic function and symbolic function adding to that the semantic specification [24, 67]. Those elements comprise a language for the objects and the Assistive Technologies also hold the function of informing.

5. The Assistive Technology as a language

The function of informing through a product was described by Theodor Ellinger in the 1960's. In 1973 Gert Selle, German historian presented the capability of the product as a "daily language", as an element which not only communicates its functions, but also has plenty of information [68]. Donald Norman, a leading exponent of the approach to daily objects and their relation with the emotions, states in his work the reasons why people either adore or hate those objects combining emotion and cognition [35, 69]. During the use of a certain product much of the users' needs should be satisfied. Keeping that in mind, the designers provide their objects with basic functions: practical, aesthetic and symbolic. On the subject of the practical function the view of the use of the product is the prominent element attempting to verify whether the user's basic needs were satisfied. According to Löback [67], "All the physiologic aspects of the use are practical functions of the products". In relation to AT that means: Does AT design encourage correct good posture? Does it prevent fatigue and eschar? Does it provide good locomotion? Regarding the aesthetic function the aspect of the sensorial processes is the most significant element in which the conception of the product is verified in relation to the specific conditions of the human perception, multisensory, offered to the user. According to Löback [67] op. cit., "the aesthetic function of the products is a psychological aspect of the sensorial perception during its use". This function is in intimate relationship with the user's previous experiences as well as with the conscious perception of those characteristics. In relation to AT that means: Does the final aspect of the product causes emotion? Are the colors pleasant? Do the forms express beauty? As to the symbolic function the distinctive mark is the meaning attributed to the product. In relation to AT those elements can be translated into some considerations: The AT which is in use promotes a stigma? Would it be appealing to other people? Is it compatible with the local culture? For Löback [67], the symbolic function of the products is determined by all the spiritual, psychologic and social aspects of the use". In the subject of the triangulation of the functions, one of them is always preponderant, however the others will be present in a smaller degree. The semantic subject of the product relates to its language and the way its conformation communicates its function and which "clues" the

object offers during its use making the interaction user/object easier [69], [70, 71].⁴ The CASTA scissors designed by Nakagawa for the Japanese company Harac, recognized as an example of Good Design and in which the Universal Design concept is applied, features a high semantic level. Beyond the purpose of the functions and of the semantics of the product, the questions concerning style are important when the objective is to evoke emotions from the user of the product. In agreement with Baxter [72], the style of a product "(...) is the quality which elicits its visual attractiveness. Style depends, above all, on the user's perception and cognition given the fact that beauty is not only in the product, but also in the mind and perception of the observer and in the relationship between both of them. Other requirements that incorporate style such as the social, cultural and commercial elements besides the visual perception, influence the way people see the objects as well as the way they feel excited about them. Style does not act as make-up for the product and in this way, should not be inserted on a particular stage. It should be developed throughout the design process [72]. The same should be done to avoid the improvisations in the assistive field. It refers to the analysis of the subjects of style right from its conception, and not only after its materialization, as in a type of make-up that still guides the conception of many ATs. To make the assistive universe capable of evoking emotions from its user, its project should call the attention for being visually pleasant; also it should make it desirable and elicit the noticed feeling of being "irresistible" compelling the user towards it. That process goes necessarily through the planning stage during which the style will be researched and specified; the transformation stage of the objectives into visual concepts (conceptual project) and the stage in which the originated visual concepts will be transferred to physical models with the purpose of being tested. In this way, projecting to arise emotion from the user of the Assistive Technology requires the ability to empower that technology with a visual attractiveness, balanced and based on the users' needs along with an identity that makes it desirable and irresistible. This is not a simple task and involves some reflection with the assistance of appropriate tools. Two of them are the synchronic and the diachronic analysis. In reference to the design aspect of AT, both analysis are taken as approaches for the current products which help the identification of opportunities for innovation. Regarding the diachronic analysis, the focus is on the development of the object through time and on the synchronic analysis, for the same period of time, different brands and manufacturers present different formal resolutions [73,74].

6. Final Considerations

After enhancing the understanding of the elements proposed in the text, it is time to emphasize that, given the fact that the disability is an individual experience, the Assistive Technology projects should take into account the emotional dimension involved in the innovation process. In order to innovate AT projects in an appropriate and competitive way, the user should be heard considering the context of the use, task to be accomplished and cultural universe, expanding the understanding of the real human needs. Designing a project with the objective of providing experiences requires knowledge of the process in order to cause a positive effect on the quality of the user's life stimulating it as a product, as an agent or as a future promise of use of a technology. Pleasure and emotion support interaction and rehabilitation. To avoid improvisations and to validate the quality design requires sensibility to understand what Richard Driehaus [75] declares: "A good design is not costly. It is worthy". It is not a matter of giving the projects a false impression of beauty but, to provide them of aesthetic-formal quality and significance while considering in all cases the user's final experience. Safety, functionality, usability, pleasure and individualization configure some of the instruments with which the product's personality is obtained leading to the perfect synergy between the aesthetic, symbolic, practical and semantic functions. It relates to the desire of creating opportunities to the users of the Assistive Technology to enjoy the pleasure of an innovative product that doesn't dialogue with the stigmatization, but one which moves side by side with the beauty, function, safety and the usefulness that is pursued in order to value the social inclusion and the valorization of the human diversity. For the purpose of debating the innovation processes for the Assistive Technology a different perception is required together

⁴ Some authors deal with equal importance, referring to Semiotics issues. Why not treat yourself to the scope of this work it will not be addressed. For further deepening see: Queiroz et al, emotional and semiotics Design.: Paths for emotional responses of users. *Studies in Design*. vol.17 (1) 2009 PUC-Rio, Rio de Janeiro.

with a special attention to the user and his real needs, to the hedonomics in his dimensions of pleasure and emotion and its use through consistent positive experiences. With the objective of overcoming physical and attitudinal barriers a favorable atmosphere is necessary. As the objects used in the rehabilitation have been considered important elements of stigmatization, it is time to re-evaluate the formal results of the Assistive Technologies to establish a language for ATs with the purpose of informing, instead of deforming the image of the users, keeping in mind that beauty is not only in the object but in the relationship established between AT and its user.

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