

A PLATFORM TOY FOR CHILDREN WITH SPECIAL EDUCATIONAL NEEDS

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Abstract: In childhood, play is critical to the successful development of children, and it can be regarded as the most important activity in their daily life, allowing interaction and discovery of the world around them. Consequently, it is important to ensure that this birthright is protected and accessible to every child, including those with special needs. Professionals, such as therapists, are often in a position where they can take advantage of the inclusion of toys in their therapies with children. Although, toys are not alike, and they must be carefully thought to be able to fulfil the child's needs. This paper presents a proposal and the first validation of an inclusive toy, entitled "HugMe", developed and designed with special attention for children who have cognitive and motor impairments and continue to be appealing to all children.

Keywords: Industrial Design; Special needs; Adapted toy; Child; Inclusive Design.

Introduction

Play is the first way a child interacts with the environment. Playing has been increasingly explored and studied in the scientific field to be able to identify its benefits and clarify the connection between physical and cognitive development, intervening in the education and learning processes of the children. The play offers a basic structure to cope with a child's needs and awareness. It takes into account the actions in the imaginary world, the creation of voluntary intentions, constituting an intrinsic motivation and an opportunity to interact with others, in particular with other children and child's parents - these interactions will contribute to the child's development (Queiroz, Maciel, & Branco, 2006). Play allows children to use their creativity while developing their imagination, dexterity, physical skills, and cognitive and emotional strength (Ginsburg, 2007).

During a child's development, play goes through several changes since the nature of play depends on the understanding of the environment, the need to act, the accessible objects, and the need to relate to the adult's world. As a case study, Martinez (2007) states that play can also be established as a motivational strategy, becoming a way for the child to demonstrate its physical abilities voluntarily. The study observes this by noting the child's positive expression during play, thereby verifying elements of its personality when playing (Martinez, 2007).

All children play, and they enjoy being able to create, to imagine their games which makes them capable of developing healthily. Nevertheless, not all children hold the same physical and cognitive capacities, making it difficult to follow and play with some existing toys. A child with a disability, despite having special needs, is first and foremost a child (UNICEF, 1999).

Throughout the time, studies of the importance of play in children with disabilities have increasingly become a popular area of research, particularly how play can relate to later competences in social and academic skills. Children with certain disabilities exhibit the same development play

sequences but with some qualitative and quantitative differences (Azatyan & Asoyan, 2017).

In each impairment, physical, cognitive, or both, one can distinguish different degrees that can go from lighter to more severe, thus interfering with the child's ability to interact with the environment and others. If a lack of play occurs due to a child's physical disability (at the sensory and motor levels), he/she becomes inevitably deprived of the experience of playing with certain toys. As an example, children with a visual impairment will not be able to experience a toy with lights or colours, and for children with hearing impairment, a toy with voices or sounds is of no use. Then there is an obvious need for alternative toys (Missiuna & Pollock, 1991).

For all children to appreciate the play, becoming in that way a more inclusive play, we need to offer the opportunity to let them play what they like to, and there are prepared for. We should support them in the process by reaching the level of challenge that allows them to have fun and pleasure together or with their peers and with adults of their life environment (Besio et al., 2018).

Play in an inclusive context has more facility and opportunities to share context, intentions, rules, objects, test abilities, imitations, and even refuse to play. Children should have the opportunity to express themselves without judgment. Play can fully develop the children's sensory, motor, social, communicative, and cognitive skills. Any kind of impairment (intellectual, sensorial, motor or socio-communicative) may severely delay the social and cognitive development of a child (Besio et al., 2018).

The limitations on the opportunity to play should be considered as important as any barrier in the child's development, and play should be seen as a form of development. Children who have disabilities do not engage the same way in play activities as typically developing children do, they have fewer group interactions, and also they do not play with the same kind of materials (Azatyan & Asoyan, 2017). For children with special needs, the lack of materials according to their limitations increases the risks of their correct development (Ruffino, Mistrett, Tomita, Poonam, & Mistrett, 2006). This may disturb the social interaction of impaired children, increasing the risk of isolation (Missiuna & Pollock, 1991). So, there is a need for children to be able

to interact with other children in an environment where they feel comfortable. Here, it is crucial to the commitment of parents (first and foremost) and child therapists. Therapists can develop and maximize the opportunities of children with special needs in playing in different contexts, being aware of and understanding the child's disability and thus, being able to help (Missiuna & Pollock, 1991).

With the increase of studies with children with disabilities, niche projects have risen, like social robotics for autistic children, adapted toys for children with cognitive and motor disabilities and accessible playground areas. This causes awareness of the importance of giving children the opportunity to play despite the disabilities they may have, putting play at the centre of multidisciplinary research and innovation concerning children with disabilities (Barron et al., 2017).

Vygotsky (2000) exposes that whenever there is a play, there are rules - not rules formulated to achieve a goal, but rules that are happening in the course of the play. Unguided playing without any restriction is the first approach to playing with the toy, to begin to explore by themselves their skills, experience objects, make decisions, understand cause-effect, apprehend, and understand adjacent consequences, all in an unguided toy approach. If children with special needs are not free to play without guidance, there may be an increased dependence on others and a decreased motivation (Missiuna & Pollock, 1991). It is also used as a booster, referring to the work of Brodin (1999), which writes that playing comes before toys and that children do not play because they have toys; toys are just a tool to facilitate playing (Brodin, 1999). With advancing age, there is an underlying change in the motivation and interests of the child, showing that its centre of interests will modify (Vygotsky, 2000), regardless of being children with or without special needs, thus the toy must also be adapted to the children age.

From the research undertaken, children with special needs should have toys that fit their needs so that they can play. Taking this into consideration, this paper presents a proposal for an inclusive toy designed from scratch entitled "HugMe", aimed at different activities, with adapted accessibility that enhances play for all children and covering different forms of play.

The paper is organized into eight sections. The section Participatory Research, presents the research among professionals and therapists to understand the necessities and difficulties for children with special needs in a play scenario. The collected interviews present important information about the playing, in children with motor limitations who became the focus of the whole project. Section Theoretical Assumptions presents the standard anthropomorphic measurements considered in this study for 3 to 6 years old children. The toy proposal is detailed in section 4, showing the elements that will be part of the toy, as well as the surrounding technology - an explanatory table to facilitate the acquisition of the product and an image with a drawing of the toy is also presented. Section 5 presents HugMe, the proposed toy prototype. Usability tests are detailed, followed by “HugMe” improvements. Finally, section 8 concludes with the final remarks.

Participatory research

To better understand the importance of playing in children with special needs, a survey (in the form of interviews) was conducted among professionals to understand how they act in their therapies and what are the needs and difficulties of children at playing. Furthermore, it allowed us to explore the need to create a toy for children with special needs and understand how important an adapted toy is.

Occupational and speech therapists and psychologists were interviewed, as they are the most frequent health professionals in child's interventions in institutions, schools, or even at home. Some parents were approached to be part of the questionnaire, but they did not feel comfortable answering the questions after the first attempt to speak with them. Due to the children ages that the toy is directed to and their disabilities, the children could not express themselves what they need and feel. Only people who were close to them could, particularly therapists and medical professionals. The professionals who participated in this interview volunteered after contacting with the institutions. The professionals work in different associations with the main purpose of enabling the rehabilitation of children/adolescents. The Portuguese associations that participated in the study were: APAC (Association

of Parents and Friends of Children, in Portuguese “Associação de Pais e Amigos de Crianças”); APACI (Association of Parents and Friends of Handicapped Children, in Portuguese “Associação de Pais e Amigos de Crianças Inadaptadas”); SalusLive; APPCDM (Portuguese Association of Parents and Friends of the Mental Impaired Citizen, in Portuguese “Associação Portuguesa de Pais e Amigos do Cidadão Deficiente Mental”); and APPC (Porto Association of Cerebral Palsy, in Portuguese “Associação do Porto de Paralisia Cerebral”).

The interview was done with 4 psychologists, 6 occupational therapists and 4 speech therapists with around 6 years of work experience. All the professionals gave their consent to participate in the study.

The structure of the interview had 3 parts:

- Play, to understand how children play and how the professionals direct the children in play;
- Stimulus, to indicate the most used stimulus on children and if and how the parents are included in the therapy;
- Toy, which materials they use and if they have to access to toys specially designed for children with disabilities and the needs for a new toy.

In short, from the interviews, it was possible to realize that therapists are focused primarily on helping the child to increase the use of the function of playing, with toys or without them.

One of the first pieces of information that can be seen is that there are two ways to approach playing, one in which playing is unguided, playful; and the second in which playing focuses on reaching a goal, where the latter is the one most used in a therapy context. It is said that if playing is inserted more playfully there is no need to establish strict rules, thus, there is no need for children to reach a goal.

Referring now to play in the therapy context, all professionals reported that the toy for children to play is always an auxiliary instrument, never an end by itself but help to an end. In some cases, professionals use the toy to achieve a goal to increase children’s motivation in the activity, always following the

development milestones, the level where they are, their needs, and the intended goals. It is worth noting that the goals are established by therapists and the family.

The participants referred to an interesting example that reinforces the fact that the toy is an important auxiliary tool. In some cases, for the therapy to be effective, there is a need to place the child in an upright position. For a child who has limited mobility and its natural position is seated, this can put the child in discomfort or even in pain. By bringing in a toy or object that might be of its interest, it can help the child to 'forget' this uncomfortable situation. One may get the impression that the children go to the treatments only to play, but that is a wrong judgment; they do activities with toys because they feel motivated to do so, and they are seduced towards a goal. With this, activity in therapy context differs from a playful activity as long as we want to achieve a result. The main goal then is empowering the children or rehabilitating them according to the therapeutic strategies and adjust them according to what they want to do but giving a lighter disposition, making therapy recreational as well as useful.

Another objective was to understand whether there was any difference in motivation by varying the kind of toys that children with special needs play with, considering their age and knowing that children of the same age can be at different stages of development compared with the others. For example, if an eight-year-old child with special needs likes a toy target for four years old typically developing child, one should always follow the interests of the child. If children are not cognitively affected, their motivation will be the same as all children of the same age. However, this does not mean the child is physically able to play with the toy. When developing inclusive toys, one must consider the point of development where the child stands and the potential that the child must develop.

From the reviews collected, the feedback has been very positive, which gave importance to the possibility of a toy designed entirely dedicated to children with special needs. This toy is beneficial to these children as it can improve their abilities and social interaction. Besides that, some suggestions were presented to improve the toy's content based on their know-how on the

everyday life of children with difficulties and their impairments. As there are few works in the literature related to the importance of adapting toys, the interviews with therapists about children's difficulties when playing were of utmost importance.

Theoretical assumptions

When designing a product, in this case, a toy for children with special needs, it is essential to ensure safety and reduce risks. In the project development, it is of utmost importance to perform an ergonomic design study and a survey on the anthropometric measures to achieve a product that balances all the needs (Saptari, Kiat Ng, & Mukyi, 2013). It was, therefore, necessary to survey the anthropometric measurements of 3 to 6 years old children, having as reference the body segments involved in the various tasks (Dreyfuss, Tilley, & Wilcox, 2002) and also the support products that can be used (ex. wheelchair). This survey of the measures adopted for the evaluation of the toy has the effect of defining an adequate proportion concerning the children's anatomy.

The measures that have been considered, represented in Figures 1 and 2, were wide waist and hip with the distance between the waist down to the knee, the total length of the arm, and the length of the elbow to hand.

Figure 1. Anthropometric measurements of 3 years old children. Source: adapted from (Dreyfuss, Tilley, & Wilcox, 2002).

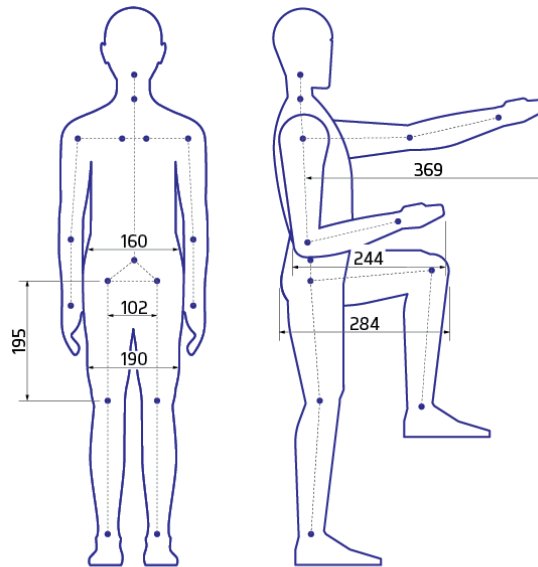
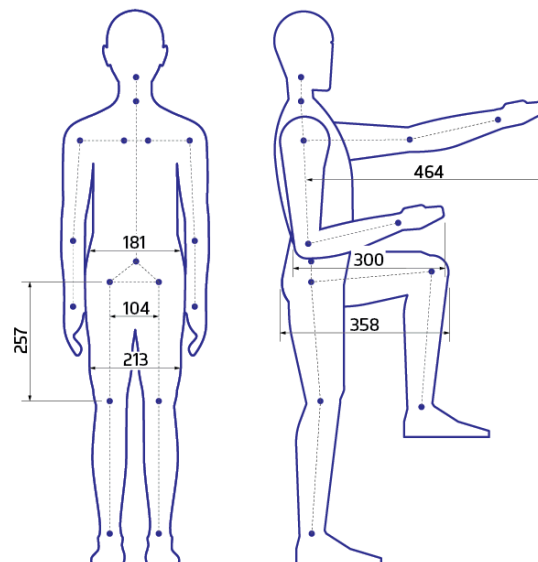


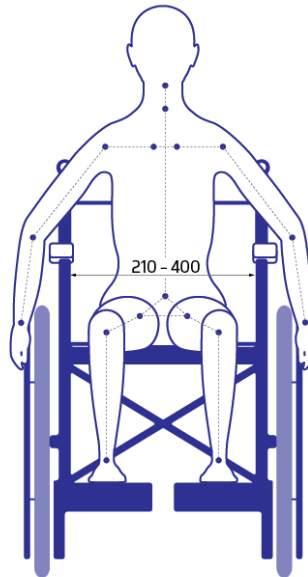
Figure 2. Anthropometric measurements of 6 years old children. Source: adapted from (Dreyfuss, Tilley, & Wilcox, 2002).



The distance between the child and the toy is one of the main focuses of the project, hence the importance of arm's length, since in the majority of adapted toys, the interaction is made through buttons and not with the toy itself. The reduction of the distance between the toy and the child is important for those who suffer from posture control problems and those who have a slow or too rapid coordination of the upper limbs (Abreu, Arezes, Silva,

& Santos, 2015; Heide, Fock, Otten, & Stremmelaar, 2005). Also, the dimensions of the seat of a wheelchair were taken into consideration, as children's posture and ease of access to the surroundings is decisive for their comfort and concentration on the task, Figure 3.

Figure 3. Anthropometric measures of a wheelchair seat. Source: adapted from (Dreyfuss, Tilley, & Wilcox, 2002).



Toy Proposal

The toys available and thought for children with special needs are, in most cases, specially designed or adapted with a switch. Some of them are outdated and the modern ones are too expensive. To overcome this gap, it is proposed in this paper an inclusive toy for children with special needs, to support and train their abilities to increase their skills, motor, social or cognitive (Brodin, 1999), to be used either for therapeutic purposes or as a simple toy.

The possibility of having a toy that is useful in training the different stages of learning while having fun, taking into account that it will require guidance when inserted into an educational activity, is of utmost importance (Brodin, 1999). The toy thus becomes a reflection, understanding the place of the children in society and showing how the child interacts (Brougère, 2004). So, one should always put the interests and motivations of the child first to be

able to develop a toy according to the limitations and within the focus of interest of the child.

Therefore, solutions must be found for children to rediscover how to play and with what toys, instead of being deprived of play. In this context, the assisted technology arises, which has the potential to open different options in toys and games (Lane & Mistrett, 1996). Assisted technology improves the development of children by providing them with a means to be able to play, communicate, move and control their world, including adapted toys, mechanical and electrical tools, and computers (Isabelle et al., 2003).

The aim is then to design an appealing toy (various colours, textures, sizes, and sounds); easy and intuitive to play with; to be used in different positions; with adjustable height, volume, and degree of difficulty (with a variety of different actions); suitable for different ages and levels of development - a toy with a universal design and at an affordable price (Ruffino et al., 2006).

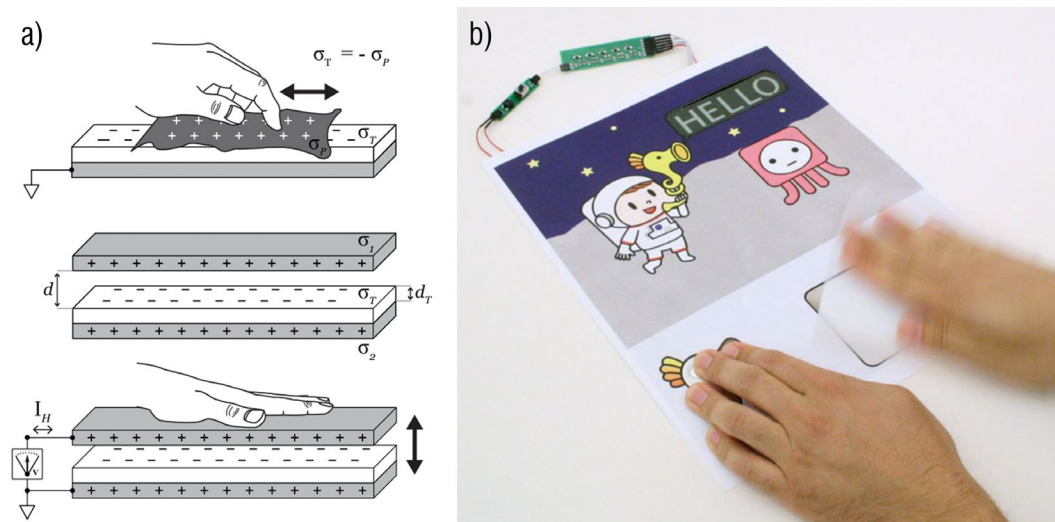
According to the professionals interviewed, table 1 summarizes the most common deficiencies in children and the associated impaired characteristics. The pathologies are related to the corresponding difficulties/disabilities, focusing particularly on generic ones. This table aims to summarize the most common impairment that may serve to identify the requirements for the proposed toy. It should be noted that all children are different from each other; two children who have the same diagnosis may not be treated the same way, they will need different approaches. Therapists/institutions are more susceptible to information about the difficulties/disabilities for which the toy is most suitable. On the other hand, for the family, and to facilitate the acquisition of the toy, the name of the impairment should be included in the toy. So, it is important to include both information in the designed toy.

Table 1. Most common impairments in children and their characteristics.

Impairment	Cerebral Palsy	Down Syndrome	Autism Spectrum Disorder	Muscular Dystrophy	Mental impairment (light)	Asperger Syndrome
Visual impairment	Apply	Apply	Does not apply	Does not apply	Does not apply	Does not apply
Hearing impairment	Apply	Apply	Does not apply	Does not apply	Does not apply	Does not apply
Communication impairment	Apply	Apply	Apply	Does not apply	Does not apply	Apply
Learning impairment	Apply	Apply	Apply	Does not apply	Apply	Does not apply
Socialization impairment	Apply	Apply	Does not apply	Does not apply	Does not apply	Apply
Upper limbs inability	Apply	Apply	Does not apply	Apply	Apply	Apply
Lower limbs inability	Apply	Apply	Does not apply	Apply	Does not apply	Apply
Manual dexterity inability	Apply	Apply	Does not apply	Apply	Does not apply	Apply
Cognitive delay	Apply	Apply	Apply	Does not apply	Apply	Does not apply

In order to improve the interaction with the toy, electronic adaptations may be included to improve the degree of interest in the toy when compared to other more classic tools as puzzles, toys with *velcro* straps, or with large buttons (Hsieh, 2008). Considering the integration of technology into the toy, Karagozler et al. (2013) presented a new technology that captures energy from the user's interaction with materials, like paper (Karagozler, Poupyrev, Fedder, & Suzuki, 2013). This phenomenon is due to the energy field (semi-permanent charge) obtained on the surface of a thin and flexible sheet of PTFE (polytetrafluoroethylene), commonly known by its trademark - Teflon. When this sheet is rubbed with paper, the charges with opposite polarity σ_P and σ_T accumulate in the paper and PTFE surfaces due to the triboelectric effect, Figure 4.

Figure 4. New technology that captures energy from the user's interaction with materials, (a) Technological principle; (b) Toy. Source: (Karagozler et al., 2013).



Paper generator technology collects electricity just by applying touch (touch and/or rub). Users interact with the toy, triggering some electrical component connected to it, a LED (light-emitting diode) for example. The paper generator technology is simple to reproduce, and it is considered low-tech, offering a variety of options with the possibility to adapt the toy according to the child's interest. This technology and the use of low-cost materials bring several advantages: different forms of interaction are possible, an affordable and competitive price toy on the market, and the possibility of adaptation (Lane & Mistrett, 1996). The integration of technology in some play activities like board games, books, or puzzles for children with special needs strengthens and motivates the experience of having toys tailored to the children's needs, which contains various interactivities and allows them a first approach to the technology.

The application of the technology proposed by Karagozler et al. (2013) can offer a wider variety of activities and interactivities making the act of playing more appealing, hence it provides a higher level of involvement.

The toy is intended for 3 to 6 years old children since it is in this period that changes in children are more significant and that they begin to learn from models that surround them, to imitate adult behaviour, creating the need to relate to the world through the act of playing. The children who will be able

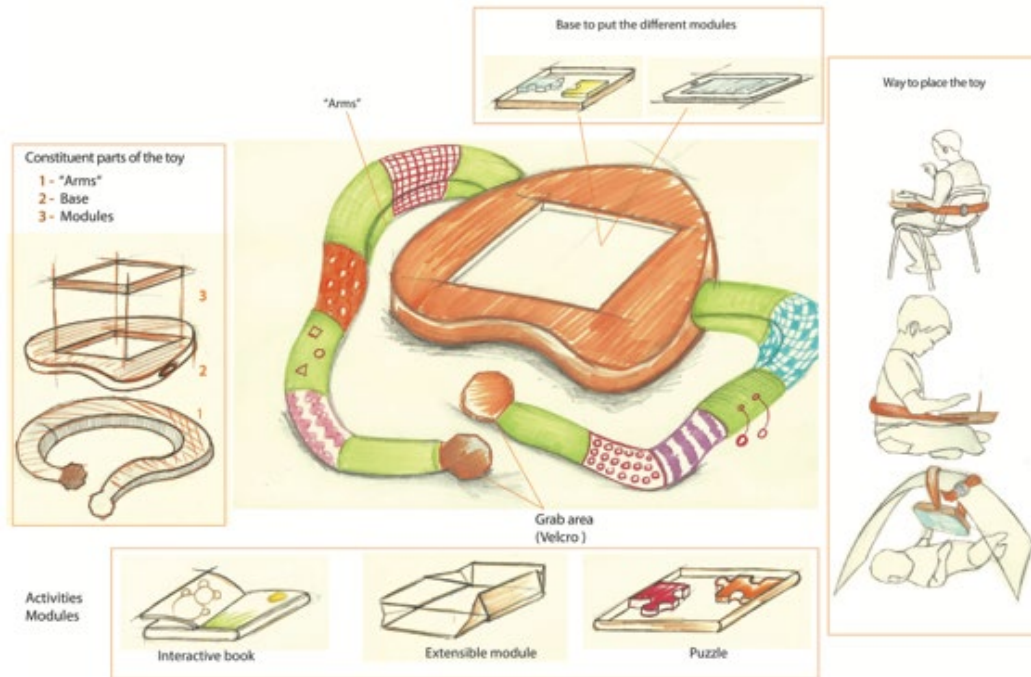
to enjoy and play with the toy are all children with no severe motor and cognitive disabilities. Children who have physical disabilities such as little mobility on upper members, with small or no mobility on lower members, blind and deaf will be able to play with the toy. And those who have cognitive and social disabilities, not severe, also will enjoy the toy - as the objective of the toy is to develop different games that will have a focus on specific disabilities and have different levels going against the necessities of a child in the same base.

The activities present in the proposed toy have different levels of difficulty to cover in full the age groups, designing different forms of interaction and always trying to arouse interest in the child and promote a progressive development. The different levels will be presented with a difficulty grade. The levels, for example, can start with simple geometric figures fitting, followed by an association of primary colours, and may end with the activity of a word association with their respective images. The toy presents the possibilities of different activities, using various multi-sensory resources (lights, sounds, movement, different colours, contrasts, and textures) activated by the child. The ability to continuously create a changing toy-child interaction allows the toy to captivate the child's attention and allows the child to be constantly interacting through the choices he/she makes.

One of the problems observed and reported in the interview context - the inability of children with mobility restrictions to handle the toys - justified the need to develop a way to grab the toy in different situations. As a solution, it was developed a handle, Figure 5, ("arms") to be able to fix it and hold to different places (tables, car front seat, the child's own body), which may also be removed when this is not accepted by the child, when the child has finished playing or if it is not necessary. With this fixing element, it is possible to have a close relationship between the child and the toy, taking advantage of all that the toy may offer without interruptions in playing or limitations in positions that could exist. There is also the possibility/need to have removable parts in the toy, so they can be washed. As an example, the handle is in contact with various surfaces, Figure 5. With the presence of different activities, the child is the active participant, and it is also encouraged by the toy to interact with other children to get the full enjoyment of an activity in

which is included to acquire social skills. The toy can also be used in the context of therapy, combined with the therapist's wants to establish the child's interaction with the toy and the chosen activity.

Figure 5. Proposed Toy handle. Source:(Ferreira, Matos, Soares, & Carvalho, 2017).



With the purpose that the toy can reach a higher number of children, depending on their impairment, and considering the interviews, it was decided to make the toy modular, including different activities characterized by the table, which fit into the base structure of the toy. So, the toy will have several activities suitable for different deficits and stimulations. The toy can thus provide the child to play alone, as well as in a social and cooperative approach. When the toy is inserted in the context of therapy, predefined parameters must be defined and registered to compare the evolution of the child from the first interaction with the toy to the following interventions.

It is worth highlighting the need for usability testing with children accompanied by their therapists and/or parents to validate the concept and the proposed toy. The tests will be more of notetaking and questions to the persons accompanying the children.

Toy Prototype

The proposed toy for children with disabilities, “HugMe” first prototype, shown in Figure 6, tries to respect the main requirements a toy must have: to be appealing, with different colours, with different textures, to be intuitive, to be used in different positions and environments, adjustable both in volume and in the difficulty level of activities, to be used in different ages and/or with different levels of cognitive development, and with an affordable value comparing to other toys (Directiva 2009/48/CE, 2009).

Figure 6. “HugMe” first prototype.



Throughout the toy development, the professionals who answered the questionnaire had always been present and indicated their point of view, also giving some improvement suggestions. They gave pieces of advice about the shape, the dimensions, the materials that could be used to stimulate the children, among others. “HugMe” toy has a 3-part structure, in which each component has a specific function. The “base” (Figure 7) is the main structure and the piece which supports the other two. Its components are a pillowed body with an inclination necessary for the child to remain in the most correct posture. It considers the possible motor difficulties of the child, being possible

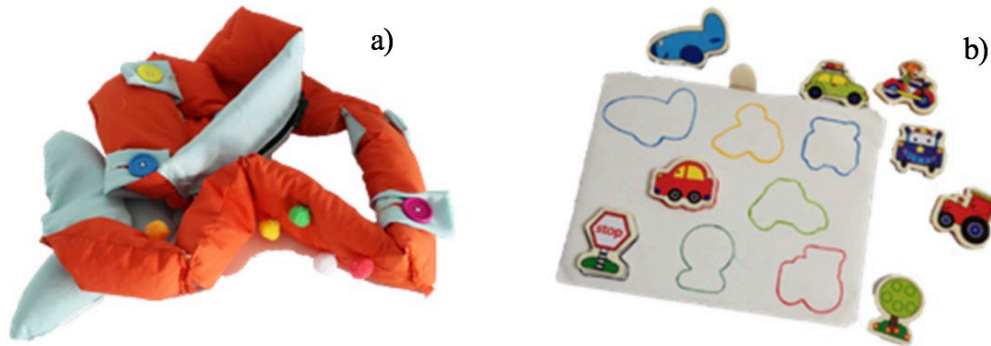
to place the toy in different configurations: on a chair, on a table, or on the floor. It is in this “base” that the activities and/or the tablet will be fitted.

Figure 7. “HugMe” “base”.



The arm, Figure 8.a is attached to the rear part of the “base” and has different textures and fine movement activities along its body. It is an extra element for stimuli. Consequently, the toy is always closer to the child, which is not the case with most adapted toys. The “arms” are fitted simply, their extremities are made of *velcro* and their length is malleable, making them easy to fit. The activities piece Figure 8.b are a key piece that has the possibility of fitting different modules with diverse activities designed for the different needs of the children. Also, it allows the simple exchange between activities. It also has a design that enables the fitting of a tablet, which increases the number of activities and interaction potential the child may have with the toy.

Figure 8. HugMe (a) Arms; (b) Activity. Source: authors' photograph.



“HugMe” can be used in different positions adapted to the child’s daily posture, both in the most comfortable or in any posture correction context in a therapy session. Thus, it can be used on the floor, on a table, or in the wheelchair due to the malleable “arm” that is adaptable to multiple scenarios and can be easily removed, if necessary.

The toy hygiene requirements were also considered, which is why all the toy parts that the child can touch can be washed and disinfected. This allows for the use of the toy by different children, in an institution, for example. The choice of the materials and colours used for the prototype were chosen to be appealing to the children in the usability tests. One of the objectives of the toy is to be inclusive and personalized where the user can choose the colours, the activities, and the stimulus.

Usability tests

HugMe prototype was tested to validate the conceptual idea of the toy as well as the proposed functions and their effectiveness. The therapists carried out the usability tests in three different associations: APAC (in Portuguese “Associação de Pais e Amigos de Crianças”), APPC (in Portuguese “Associação do Porto de Paralisia Cerebral”) and 7SENSES, Figure 9, in the context of therapy sessions. The informed consents, from the therapists and the parents of the children, were obtained prior to the tests.

Figure 9. HugMe prototype usability tests.



Some guidelines to test “HugMe” functionalities were introduced:

- To leave the child interact freely with the toy; to register the first impact;
- To leave the child interact with the activity:
 - Game;
 - Tablet;
- To place the grasped toy;
 - To the body of the child;
 - To the chair/table.

Twenty-five tests were carried out in children between 3 and 6 years of age, with 4 elements that do not fit the stipulated age group, to study the possible needs of widening the age group for the toy. The child’s impairments were autism, cerebral paralysis (affected motor part), DiGeorge syndrome, left hemiparesis, global development delay and sensorial integration dysfunction.

While performing the tests, there was not any distinction, neither on gender nor in the child's impairment.

After the test, the therapist of the children fulfilled a questionnaire. The questionnaire's objective was to collect information at the level of effectiveness, efficiency, and satisfaction within the presented toy to the children and their careers (therapeutic, parents). A Likert scale: Full agree-5; Agree-4; Neutral-3; Disagree-2; Full disagree-1 was considered for the analysis.

The results obtained indicate that 68% fully agree that the children felt comfortable with the toy and only 4% of the children did not feel comfortable. Regarding the proposed children's age the toy should be applied, 84% considered that the toy applies properly to different age groups. Moreover, the need to understand if the toy has some level of complexity was also considered, where 52% consider that it has no complexity, against 8% who consider that it has. It was also verified if the toy frightened the children, where 76% considered that it does not and only 8% agreed that the children were scared. In a more structural aspect of the toy, it was verified if the dimensions are the most appropriate, especially considering that the toy encloses different age groups consisting of different sizes of children. Regarding the size of the toy base, 44% fully agreed and 28% agreed that the dimension is well adjusted.

In the activity of placing a tablet in the toy, 64% fully agreed and 16% agreed that it is an asset. Comparing the interest between the tablet and the traditional game, 36% maintained their neutral response as the interest paid by the children with the tablet, while the traditional game received more interest, getting 44% and 20%, respectively, to fully agree.

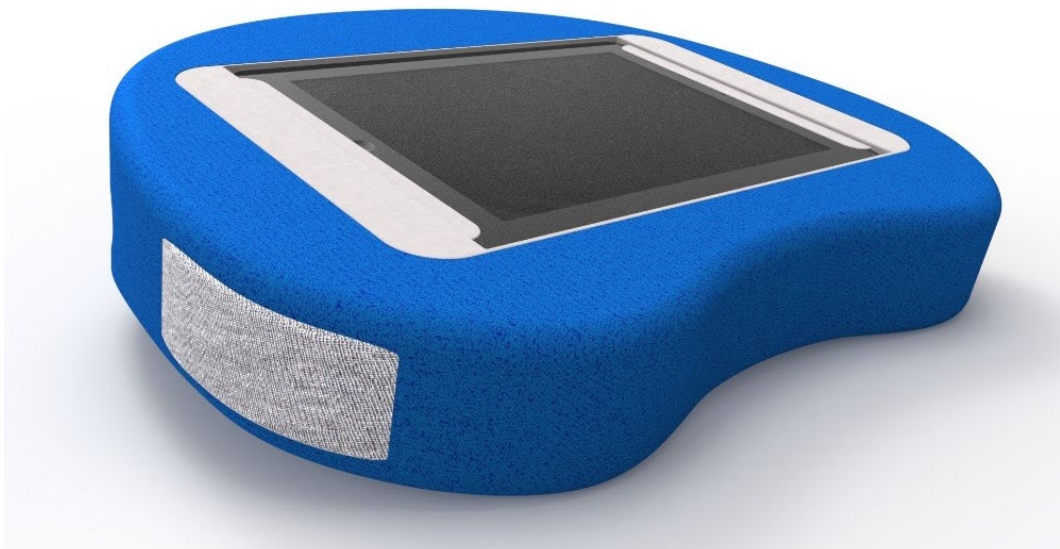
Finally, considering the length of "arms" of the toy, 46% agreed that it was appropriate. Furthermore, considering the textures of the "arms" of the toy, 46% disagreed that the children felt stimulated with textures. However, when questioned about if fixing the toy is simple, 52% fully agreed and 28% agreed regarding the easiness of fixing the toy. After a brief and preliminary analysis, one can see that some points should be improved and retested. At the moment, the textures along the arms are within the fabric which will be more

effective if placed on the outside. Moreover, it should be pursued to even get a more suitable size to the base of the toy so that it can adapt even better to all children.

“HugMe” improvements

As a result of the usability tests, some improvements were performed on “HugMe” toy. Thus the “base” (Figure 10) and some parts in the “base” were changed, in particular the way the arms were fixed and the system for placing the activities and/or tablet.

Figure 10. “HugMe” “base” improved prototype.



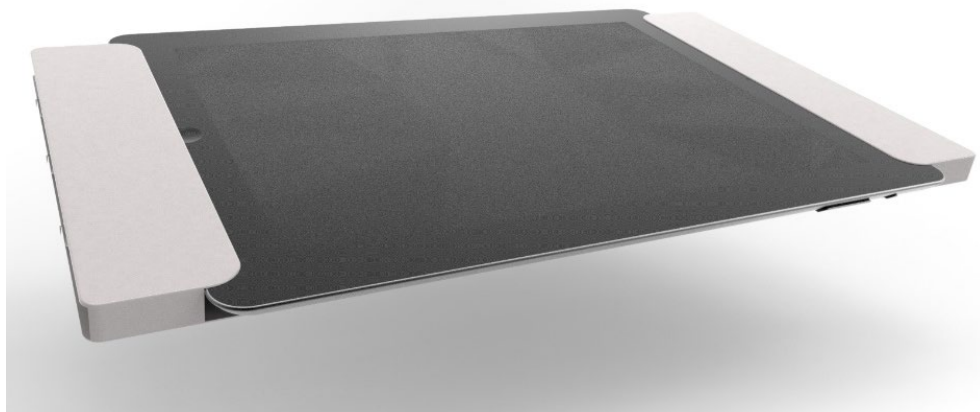
The changes made to the “arms” have to do with the fact that they are not well-positioned for the child's comfort when they were around. So, the arms started to be placed inside the base and the attachment also becomes the base itself if placed around the child, Figure 11.

Figure 11. “HugMe” “arms” - improved prototype.



The system for placing the activities or tablet had previously a fixed measure. It was reconsidered to offer more flexibility in the dimensional requirement of the equipment, allowing now to place tablets and activities with different sizes due to an integrated system of springs that adjust depending on the size of the activity and/or tablet (Figure 12).

Figure 12. HugMe System for tablet and activities - improved prototype.



Final remarks

Usually, impaired children may play with adapted toys which are not designed for them from scratch. Toys designed for typically developing children are adapted for children with disabilities, and sometimes at very high prices. We consider that there is a need for designing, developing, and constructing a toy that includes particular functionalities and stimulus, which may serve to several child impairments.

A proposal for an inclusive toy entitled “HugMe” was presented to simplify the act of playing for children with specific needs. The design makes it possible to achieve a change in the way children play without the common obstacles they usually feel, showing that they are equally capable and possess the same abilities and opportunities that other children have for granted. With these principles, it is possible to take different approaches, with projects mainly focused on increasing the accessibility of play for all children and in creating new opportunities for them. One can thus say that this toy distances from the toys available in the market, being an advantage and an asset. It was designed from the first stage thinking in the accessibility of children with special needs, making it an inclusive toy.

The goal of this study was to ascertain the relevance of the proposed inclusive toy “HugMe”. The results of the usability tests allowed us to conclude that the first version of the toy “HugMe” is worth considering, and some points for improvements were highlighted. At this stage, these improvements were performed only in 3D drawing, which will be needed to further the development of a new prototype. “HugMe” base and arms were improved accordingly to the therapists' and parents' suggestions. Further tests, in therapeutically and entertainment sessions, are needed to test the new prototype.

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