The Integration of the Computer-mediated Ludic Experience in Multisensory Environments

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ABSTRACT
Multisensory stimulation environments (MSE) have grown in popularity particularly among organizations dedicated to children with developmental disabilities. These artificial places are the stage for a custom-made intervention that relies on technological artifacts to induce a general feeling of relaxation and well-being, from which leisure, occupational or therapeutic objectives are pursued. Children with intellectual disability are a preferential group of clients in MSE for reasons related to the intervention on their personal development, taking into account the imperative of social inclusion and integration.

The computer-mediated ludic experience, provided by a computer game or a simulation, concentrates a stimulation potential that is similar to other traditional objects in MSE. In addition, the computer-mediated ludic experience can be designed and configured to work as a mediator to the objectives of the intervention being carried out.

The first objective of this work is to clarify which specific areas of the intervention based on the MSE for children with intellectual disability could benefit from the computer-mediated ludic experience. The challenge of contextual diversity is also meaningful for a second concern in this work, related to the elicitation of preferential characteristics of the computer game to be used in MSE, as a contribution to the definition of a set of design guidelines.

Author Keywords
Children with intellectual disability, Ludic experience, Multisensory Stimulation Environments.

INTRODUCTION
The intervention focused on persons with disabilities has historically been looking for innovative practices, involving skilled and varied technical resources to improve their general quality of life. Multisensory stimulation environments (MSE) are a popular space for intervention in the numerous forms of disability, with occupational, therapeutic or educational objectives. These spaces are a privileged opportunity to explore the potential of the Computer-Mediated Ludic Experience (CMLE), as consequence of the prolific set of sensory stimuli provided and the singular action-reaction cycles involved.

Whether resulting from a game or a simulation, the CMLE integrates a potential resembling other objects that traditionally are part of MSE. In addition it can be designed or adapted to produce results, compatible with the intervention carried out and context friendly.

Considering that possibility we face a problem defining the context of the practical use of the MSE, in which almost everything can change. The objectives of each intervention are contingent to the needs of the client and to the inspiring philosophy; the configuration of the objects in the environment are highly dependent on financial resources and staff creativity.

In this introductory work we start from the description of the multifaceted context of intervention in MSE. In the following exposition we mention the characteristics of the CMLE to propose some of the areas of intervention where it could be used, as a mediator tool to achieve the desired objectives. In fact, MSE are largely used with specific target-groups with disability, in special education, occupational therapy, or mental illness, whether with objectives related to personal development, therapy or mere relaxation.

Our argument of compatibility between MSE and the CMLE will be explained further ahead, centring our reflection on the game as object and on its shape, and also on the experience normally generated within those who play. Lastly, we suggest a set of guidelines expected to promote this integration, taking into account the option of design or the adoption of compatible games according to their characteristics.

1. THE CONTEXT OF THE INTERVENTION BASED ON MSE IN THE AREA OF DISABILITY
A simple way to explain the concept of a multisensory stimulation environment is to think about it as a stage in any theatre. The theatre stage is a space of action directed towards the public, where usually a set of colored lights, a sound system, and a scene build by objects that support the

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foreseen activities are found. This open configuration of versatility of the theatre stage also characterizes the multisensory stimulation environment: both are ready to receive different types of performances, prepared for audiences with different needs and therefore, with multiple categories of objectives in the agenda.

Multisensory environments can be found in organizations working in the area of disability or mental disease, in schools, hospitals and residential homes. Their inner configuration varies. Normally they are set in a specific room, prepared to deliver stimuli to the sensory system of the users. For visual stimuli artifacts like fluorescent lights, mirrored balls, shimmering fiber-optics, glowing figures, light colored projectors and interactive light devices are used. For olfactory stimuli a fragrance diffuser is used. For auditory stimuli the rooms are usually equipped with a sound speaker system. The tactile dimension is explored through vibrating pillows, touch-reaction light devices, puppets and dolls, comfortable sofas, cushions and colorful pillows.

The stimulation activities can be managed individually or in a transdisciplinary team, by occupational therapists, psychomotricity therapists, physiotherapists, speech therapists, special education teachers, psychologists, and other technical staff operating in the adaptation and production of objects to be used in the space.

The original concept behind the emergence of multisensory environments as intervention in the area of disability is called “Snoezelen”. It was created in The Netherlands, in the late 70’s by Jan Hulsege and Ad Verheul, as a therapy delivering moments of sensory stimulation and relaxation in a non-directive form to severely disabled individuals, making use of several technological devices in the process. The word “Snoezelen” combines two Dutch words “Snufflen” and “Doezelen”, meaning to sniff and to doze.

Originally, Snoezelen was conceived with no educational or development objectives, mainly used to build relations and trust between caregiver and the person with disability. Its success over the last twenty years has been granted due to the emergence of the idea that it is a very humane approach and a space of well-being in the socio-emotional perspective of interaction between therapist and client [14]. From our point of view a factor of innovation and technological novelty must also be considered. In our days multisensory environments have become an open stage for several interventions dedicated to different target-groups in the area of disability, with different objectives. In spite of the shortage of consistent data about their efficacy and efficiency, they are the base for therapeutic, occupational or educational objectives.

Pagliano [24] captured this widespread use of MSE by defining it as an open-minded space, “where stimulation can be controlled, manipulated, intensified, reduced, presented in isolation or combination, packaged for active or passive interaction, and temporarily matched to fit the perceived motivation, interests, leisure, relaxation, therapeutic and/or educational needs of the user. It can take a variety of physical, psychological and sociological forms”.

Three major categories of objectives of the intervention in MSE are perceptible in this definition: recreational, therapeutic and educational. However, they must be understood as closely linked and with fuzzy bordered categories; most likely they could be observable in any intervention program, whether within the scope of special education or health care therapy.

One example of activities related to motivation is the free use of the multisensory environment to play, explore and interact with objects. Therapeutic activities, for example, might include objectives of relaxation or physical mobility. Examples of educational needs are the learning and training of cognitive competences, or the development of communication and language skills.

In short, the intervention based in MSE is generally about proposing interaction in an artificial world, in which a close involvement between therapist and client is required, while enabling the progress of choices of action or following a pre-determined program.

In any case, the activities carried out are based on sensory stimulation as mediators to achieve the desired objectives, frequently inducing feelings of enjoyment and relaxation, enhancing sensation and emotion. To better understand the potential use of the computer mediated ludic experience in MSE we must be aware of the heterogeneous set of therapeutic, educational and recreational activities taking place. On the other hand, it is also important to know the way how they in which are carried out, in particular how they configure the participatory context for the client.

1.1. Target-groups for MSE

All the contextual diversity previously described is translated directly into the amount of intervention approaches within the area of disability that use the multisensory stimulation environment. The most significant are dedicated to children and adults with specific types of disabilities, adults with mental disease in psychiatric treatment, people recovering from brain injuries, and elderly persons.

The world of disability is a very complex field, with numerous dimensions and causes. Disability is presently defined as a dysfunction in the biological structures of the human being; however, it is understood by the World Health Organization as a universal human experience. Any negative change in a person’s health ends in a limitation of her activity and social participation, i.e. a form of disability.

The way disability is understood as a concept, and managed, in terms of intervention has been changing in recent years, much due to the empowerment and self-determination movements, the emphasis on personal rights

and achievements of people with disabilities, and also the understanding about the effects of discrimination. A historical review of the intervention in disability demonstrates an evolution from a paradigm of segregation, stemming from the perspectives of philanthropy and charity, evolving to a medical model, promoting models of institutionalization and assistance, into the ideal of inclusion, recognizing fundamental rights, equal opportunities and the right to integration in society.

The ideal of inclusion builds on the fight for human rights and the struggle for non-institutionalization of people with disabilities or mental disease. In the social perspective, inclusion means to attend to fundamental rights of education, health care, work and active citizenship. While this old paradigm of segregation is still perceptible in some organizations dealing with disabled persons, the contemporary political articulation of intervention in disability places an emphasis on the idea of inclusion.

Shalock [28] summarized this emerging model of intervention in the area of disability, here understood as a condition that mixes functional limitations with the product of the interactions between the individual and the surrounding environment. The practical implications of this paradigm for the intervention are set in a new way to think and act about a person with disability, in four fundamental areas:

- The functional limitations of the person
- The person well-being
- The individualized supports needed
- The personal competence and adaptation

Therefore, the objectives of intervention are contingent upon the personal needs of the client. The contribution of MSE in the intervention must be clearly understood in this frame of reference.

Multisensory stimulation environments are promoted without a firm research, mostly based on unproven claims of beneficial outcomes, mainly caused by the dissemination of positive aspects of trust, relationship building, fun and enjoyment for users [31].

According to Lancioni [21] the evidence about positive effects of Snoezelen practice for people with disabilities and dementia is still preliminary and circumscribed. The scientific methodology followed in research projects relies predominantly on qualitative and unstructured data, and also on base-line control conditions. Yet, some positive within-session effects are mentioned in stereotypes and in social/ emotional behaviours. Another interesting fact is the increase of these within-session effects by a stimulus preference selection, and also that this may be the key factor for increasing a post session beneficial impact.

Most of the studies found in our literature review focus on three main variable categories: related to the person interacting in locus, related to the staff enabling that interaction, and related to environment settings. Most of the studies published about the effects of Snoezelen practice are still bounded to particular populations and contexts. Some examples are adults with mental illness and mental retardation [29], developmental disabilities [5, 17], children with Rett disorder [23], children recovering from severe brain injury [16] or residents of nursing homes with dementia [35]. Some notorious key variables influencing clients' behaviours in the multi-sensory therapy could be related to the relationship with the caregiver, the constant environment, relaxation and freedom from demands rather than sensory input [5]. In the area of mental health, Baillon [2] compared the effects of Snoezelen and reminiscence therapy and concluded that both interventions had a positive effect on agitated behaviour of people with dementia. Ball & Haight [3] consider it an innovative form to meet the social and recreational needs of the same population. On the other hand Chung et al. [6] considered that there is no evidence of the efficacy of Snoezelen in people with dementia.

1.3. Key thoughts

We now compile some decisive ideas to support our argument, emerging from this preliminary description of the intervention based on MSE and their target-groups in disability.

The first one is related to the consensual need for more scientific research in the area [7, 14, 31] there is still a lot remaining undisclosed about the effectiveness and efficiency of multisensory environments as a practice and about how better they could, or should be used.

A second thought is about objects in the multisensory environment space and their nature as mediators to achieve the designated objectives. Regardless of the philosophy of intervention, or the specialized area in the background, the activities go through a process of socialization and interaction with sensory stimuli, in a set of multidimensional and eventual cycles of action-reaction, involving the sensory perception system of those involved.

The last of these key thoughts refers to children with developmental disabilities as a preferential target-group in MSE intervention, mainly by reasons related to the potential results of obtained.

Developmental disability refers to a diverse set of mental or physical impairments diagnosed before the age of 18, and usually characterized by a subnormal intellectual functioning [1]. Therefore, the developmental disability becomes predictable through certain biological conditions (such as Down syndrome, Asperger Syndrome, Autism Disorder, etc) and visible by assessing the individuals' low performance in a test (e.g. the Wechsler scales, Griffiths scales), comparing results with the average score for the age. This is a condition also known as mental retardation, developmental delay, or intellectual disability.

The practical implications of a developmental disability are expected within the scope of several limitations, related to independent living (e.g. like job support, money management, personal grooming and health), mobility and safety (e.g. space orientation, use of services), language and learning. Thus, the consensual idea is to start oriented intervention as soon as possible to attenuate these potential problems by training cognitive and adaptive behaviour skills. At the ages between 5 and 12, play and exploration have a special value.

If we think of other target-groups (e.g. persons with mental illness, elderly persons), the multisensory environment is not offering much more beyond relaxation and leisure moments. In fact, MSE will not sustain the efficacy and efficiency of other educational/ training strategies, and therapies, geared towards the development of social skills, or functional skills, essential for integration in society. If we add to this fact the appealing potential of play in a sensory challenging environment for a child, we find a preferential target-group for development opportunities available in MSE.

2. MINING FOR MEANING IN THE COMPUTER-MEDIATED LUDIC EXPERIENCE

The computer-mediated ludic experience results from a decision of engagement in an activity in which the user in control searches for meaning. This experience is constituted by a visible dimension that normally concerns the efforts for control by game designers. However an individual dimension built by variables blended exclusively in the individual playing the game must also be considered. The structural model proposed by Fernandez [9] identifies and describes several of these elements able to influence the ludic experience enabled by digital games: the age of the player, his/her game preferences or his/her education, all apply their influence clearly on the individual context of the player, ensuring that the ludic experience may be comparable, but also personal.

However, this is not a barrier for an interpretation of the ludic experience in a social perspective [8], as catalyst for interaction and communication between players. The CMLE must not be considered only in the duality player/game because it can be shared in communication acts of observation, participation or description.

Another important aspect to point out in clarifying the concept of the CMLE relates to the different emotional states that could be generated in the player, in such a way that it promotes his/her total involvement and commitment with the game. This idea is close to the concept of immersion, as a perceptual and cognitive condition that pulls away the player from the real environment, while enabling the construction of mental representations of the game [33].

Clearly, the ludic experience generates emotional states. These are also frequently understood in the relation between challenge and competence. According to the model proposed by Csikszentmihalyi [7], the bigger the challenge, and the greater complexity of the competences required in its resolution, the more concentrated and fascinated is the individual, in a state he called Flow.

Some researchers recognize that games with different characteristics elicit different emotional response patterns [27], so it is possible to consider the idea that some computer games are capable of inducing specific emotional states. There is also some evidence, although unclear, that an emotional state of happiness is possible to be elicited by games [37].

The positive generation of emotions through computer games was already used as a theme for research. A group of students recently used a design-research method to produce a specific game, exploring new emotional territories [11]. The resulting “Cloud” game aims for the creation of a tranquil, relaxing and joyful emotional experience, proposing the dream metaphor of a flying child in a sky full of clouds. Vala, Paiva and Prada [34] actually explored the player’s emotional influence in a game. In their proposal, the player would express appropriate gestures with a doll (a wireless tangible interface) to represent in the game one of six emotions: anger, fear, surprise, gloat, sadness and happiness.

Emotion generation in videogames, as proposed by Zagalo, Branco & Barker [38] can be explained trough a set of specific elements that emerge from “in-game” resolution moments, or catharsis: the game environment (music, perspective), the characters (interaction matrix, the facial expressions and voice) and the decision ability. These can be roughly understood as responsible for moments of revelation in the game narrative disclosure process or moments when objectives are achieved.

The last of these elements, the decision ability, brings us to the explanation of an essential part of the computer mediated ludic experience: user control. This apparently trivial aspect assumes greater importance for a child with developmental disabilities, who misses it in various aspects of his daily life. Therefore, the generation of positive emotional states is a central point in the concept of the CMLE we wish to explore. Its use involving children with developmental disabilities in the context of MSE may be a valid contribution for their personal development.

3. THE BRIDGE BETWEEN CMLE AND MSE

The core value of multi-sensory stimulation environments emerges from the artificial atmosphere created, i.e., sensory stimuli towards relaxation or arousal, concentrated experiences of interaction and from a specific sort of object-human and human-human socialization. The multi-sensory environment has all these ingredients presented in a very attractive form, all compatible with the experience of play. Play is the bridge for integration of the CMLE in MSE.

As human activity, play is a very prolific ground for research. Most of it insists on the function of play for child

development. Play is our most natural form of interaction and relationship, as an action free from demands, exploratory, safe and situated in a context. How is play recognized? It relies on a rather strange duality because it is easily acknowledged in the subjective experience of play and hardly through objective analysis. This means that you learn more about play in play itself. Play is a moment to moment creation: in a continuous involvement, play is a process of active maintenance of a context [13].

Literature states that computer games can be produced with demonstrative and training functions, and they have been used with positive results in several contexts. Fisher [10] argued that computer games promote cognitive remediation in areas like concentration, perceptual disorders, memory and difficulty with language. Computer games have also been used for cognitive rehabilitation of attention, perceptual and spatial abilities, memory and reasoning with people with brain damage [30]. Another example is provided in the framework of physiotherapy, for the treatment of arm injuries [32] or improving hand strength [18]. The area of mental disability has also been visited by videogames, used to train scanning and selection responses [15], as these skills are essential for the utilization of alternative and augmentative communication devices.

Some inspiring examples of ludic systems suitable to use in multisensory environments could be elicited: the Personics System [26] and Gesturetek Health™ [12]. The Personics System is a modular and portable solution for training facilities meant for physical rehabilitation, and stimulation of handicapped persons. Alongside the modules of movement sensors, image projection and signal processing, several choices of games are available to join fun with therapeutic movement.

The GestureTek health systems are interactive technologies and virtual reality systems for therapy, rehabilitation and immersive play. In a recent experience with these technologies, researchers found a high level of interest during the twelve weeks of intervention, with clear motivation potential among young adults with intellectual and physical disabilities [36].

Both examples provide recognition of the great stimulation potential of the CMLE, all compatible with the intervention in MSE and their main target-groups. There is a set of cognitive, motor and sensorial structures at work in the individual while playing a computer game, enabling it as a preferential mediator tool for several interventions in MSE. Some examples can be elicited.

The computer game can be tested as a mediator tool for the development of the human sensory system, in particular the discrimination of visual and auditory stimuli, and the build-up of adequate responses. The CMLE calls first into action the competence of space visualization, the perception of objects in space, and the identification of figures, in a locus of control. This also involves the symbolic nature of represented objects, the ability to interpret and manipulate them as exterior and independent. On the other hand, the computer-mediated ludic experience demands coordinated and precise movements. The inspiring systems previously referred to, as other technological solutions able to liberate the ludic experience from the manipulation of peripheral devices might be adequate for the development of motor coordination and the sense of proprioception (i.e. individual stimuli that are produced inside one's organism, for example about the location of body parts in relation to each other and the surrounding environment).

The importance of encouraging physical movement relies both on placing value on the individual and his body. It is important to enhance the development of a self-awareness of one's own human body, as a way to experience positive emotions, exalting identity and existence through the ability to sense self-movement, orientation, position, and control. The contextual theme of the computer game is also a source for the acquisition of vocabulary and for the development of communication skills.

The examples mentioned above represent eventual needs for intervention with children with developmental disabilities, associated with areas like special education, psychology, occupational therapy, speech therapy or physiotherapy.

4. THE QUEST FOR GUIDELINES FOR DESIGN OR ADAPTATION

At this point, it is important to raise the question about the preferential characteristics of computer games to be used in a MSE. Whether we are considering design or adaptation, the criteria for selecting depends on financial resources. The major concern for any computer game design should be the generation of fun. Without this objective clearly matched, the final results of the intervention would be compromised.

Could we generally classify the type of games suitable for MSE? The necessity of a classification for different types of games comes from their considering them as a product and with the significance of order, especially if one is interested in the design of ludic experiences.

Lindley [22] considers games as ludic systems. This concept involves elements of story construction, game play and simulation, all contributing as different classes of semiotic systems, with principles and methods to inform the player's general experience. Callois [4] proposed a classification of games according to the range of determinacy of rules between free improvisation and lined conventions, and four major attitudes in play: competition, imitation, chance and vertigo. This matrix allows a clear classification of the game at stake and an easy perception of where the differences with others are.

Considering games as activity systems is a useful perspective to understand their architecture towards a design strategy. It allows a structural perception about the potential relations of the several dimensions involved in a game. Klabbers [19] argues that games are social systems

and models of social systems. His idea about the architecture of a game is a matrix combining both the social system (actor, rules, objects) and the linguistic approach (form, content and usage) to provide a singular description.

The following table shows a tentative exercise to describe one example of a game that could be adopted based on Klabbers' game architecture matrix:

	Syntax	**Semantics**	**Pragmatics**
Actors	Two Players (Therapist and Client)	Therapist orients the activity, stirring the engagement of the client	Hand-eye coordination (cognitive competence)
Rules	Open trials for object manipulation through hand movement in front of image projection of the game	Collaboration of the project team defining game regulations	The Therapist applies the rules
Resources	Dedicated area in multi-sensory stimulation environment	Space to observe the image projection	Video projector, signal processing unit, movement sensors

Table 1: Descriptive example of the architecture of a MSE activity based on the computer-mediated ludic experience

This game would be set in the multisensory room, standing by for user interaction. This would permit the client's choice, i.e. equal opportunity for interaction with other objects in the space. In this example two players could be engaged simultaneously in the game, to allow the control by responsible staff. The game objective would involve object manipulation, contributing for the practice of hand-eye coordination.

In this configuration we stress that there is no need for complex games to be used in MSE. For example, the games proposed in the Personics e GestureTek Health systems consist of the simulation of simple activities, like blasting balloons, defending a football goal, or balancing a tray with drinks on it. However, the technological apparatus is significant.

Considering the inspiring examples already identified, and the perspective of design or selection of a game for use in MSE, we will now propose a group of characteristics. These features will be useful as an orientation to produce, to test or to investigate future possibilities.

A pleasant context

A pleasant non-aggressive context is a central condition to integrate a computer game into a multi-sensory stimulation environment. Several emotions that computer games can trigger are completely undesirable, such as anger, frustration and rage. The MSE is tailored to deliver experiences that otherwise would not take place, but in a positive and safe way.

Explore interaction and interactivity

Interactivity is understood here as bidirectional communication in the triad responsible staff, client and game, implicating essentially visual and auditory stimuli. Interactivity will provide a shared ludic experience and the opportunity to build the relationship between therapist and client. The recent set of technologies available pushed by the market of video games brought a significant innovation into the way a game is played, exceeding the plain manipulation of peripherals. Mapping of the movement of the player through special technologies is possible: a body-driven multiplayer game, as proposed by Laakso [20].

Devices of augmentative and alternative communication may be necessary, like a switch, a trackball or a joystick, although they do limit player movement. The developmental disability is frequently associated to some kind of limitation in the individual general body coordination. These new technological possibilities have the great advantage of simplifying the engagement into the game experience. The Mediate Project is also an inspiring example in the area of disability: the researchers proposed a whole adaptive physical environment, allowing children with severe autism to interact with multimodal stimuli [25]. Several technological suggestions were proposed and developed by this project.

Recreational competition

Competition is inherent to any game, but in MSE it should be understood in a recreational perspective. The prosecution of the objectives of the game should be encouraged without any pressure in the obtained results. A less competitive and

more cooperative game experience, between therapist and client would be required.

CONCLUSION

In this introductory work we have presented a future contribution for the body of knowledge within the intervention directed for people with disabilities, gathering the fields of Ludology and MSE practices.

We have tried to illustrate the compatibility between the CMLE and the MSE. The idea that the CMLE can, in theory, be a mediator tool for the development of the sensory system was presented, in particular as contribution for the discrimination of auditory and visual stimuli, working also as catalyst for motivation and participation in MSE. The technological possibilities presented are also inspiring to open the intervention possibilities to the development of motor coordination, the proprioceptive system, or vocabulary skills.

For the group of professionals working in MSE within their specialized areas, the comprehensiveness of the suggested interventions should be translated into more concrete target competences and activities; however, always understanding that the developmental needs of their clients in the area of disability are individual and contingent. Children with developmental disability are a preferential group.

The design and selection of games to generate the desired ludic experience were also approached in this work. We have suggested a set of guidelines for integration in MSE, stressing the importance of support technologies and intervention strategies.

In future research we will focus on the design and test of the computer-mediated ludic experience, acting as mediator for the personal and social development of children with developmental disabilities in MSE. We intend to bring the CMLE into multi-sensory stimulation environments building a critic overview about practice and a compatible intervention model.

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