In Body Experiences: Persuasion by Doing

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Abstract. In this paper we argue that in the multidisciplinary field related to behavior change support systems using a body-centric approach where *participants act* rather than *discuss and contemplate* is a worthwhile technique and should also be investigated more often. Especially now that technology better allows to respond to bodily actions in an appropriate and experiential engaging setting. To this end we will introduce and reflect on two recent case studies we performed: 1) an interactive projection game to trigger better self-management of children with asthma and 2) a Virtual Reality (VR) environment to be integrated in therapy sessions on substance abuse for people with intellectual disabilities (i.e. IQ 50-85 and limited adaptive skills). This resulted in a realistic and controlled environment where individuals with substance use disorder and intellectual disabilities are confronted with substances related to alcohol or cannabis in order to trigger application of strategies for self-control. Both cases included interviews with experts and several user confrontations. These confrontations showed possibilities of including such technologies for persuasive purposes. Furthermore, the responses of the users and experts included where quite positive. This is why we suggest this might be a fruitful direction to look into for other use cases regarding behavior change support systems.

Keywords: Behavior Change Support Systems, asthma, addiction, interactive playgrounds, Virtual Reality, therapy

1 Introduction

The experiential and body-centric role in learning by playing is a well known topic of cognitive developmental theories. To paraphrase one of Vygotsky's examples [1]: by moving with a stick, a child that does not yet know how to imagine a horse, can still contextualize and clarify his actions, the actions with the stick allow him to circumvent integration of more difficult symbolic skills. For HCI related implementations of embodied cognition it is important to go beyond technology-driven implementation and take into account the network of meanings and subsequently needed transformation of the embodied experiences

[2]. In this paper we will argue that using a body-centric approach where *people do* rather than *discuss and contemplate* is a worthwhile technique for persuasion and should be investigated more in a Persuasive Technology setting, especially now that technology better allows to respond to bodily actions in an appropriate and experiential engaging setting. To this end we will introduce and reflect on two recent case studies we performed: 1) an interactive projection game to trigger better self-management of children with Asthma and 2) a Virtual Reality (VR) environment to be integrated in therapy sessions on substance use disorder (SUD) treatment for people with mild to borderline intellectual disabilities (MBID, IQ 50-85).

More traditional psychological oriented studies have already shown that movements can impact attitudes or self-image and related this to a concept of *Embodied Persuasion*, see [3] and [4] for a set of examples from literature, such as writing with a non-dominant hand decreasing confidence, as well as theories on how affective movements (smiling and nodding) might produce an accompanying attitude towards products or experiences[4]. However, as Briñol also discusses it is not straightforward to let people act outside the experimental setting (i.e. in a natural setting) in similar ways (e.g. making people nod, smile, or write with their non-dominant hand). Therefore, it is important to realize that the cases we selected for this paper are in a training setting where people are willingly *doing* exercises in order to change or improve their behavior. We especially look at large movements and physically *doing* during exercises (cf. [2] as a type of *Embodied Persuasion*[5]. Furthermore, compared to previous studies we look in a more exploratory and holistic way on *doing*, more from a design process perspective sharing first insights than focusing on evaluating specific underlying psychological processes or finding effect study outcomes.

In the next sections we will first introduce the *asthma case*, the importance to address asthma, a view on where the opportunities for improvement lay, the resulting game, and the findings of the exploratory user evaluation. In the subsequent section we will introduce the SUD case for which we introduce a controlled VR environment. In the final section we will discuss how these cases might be related to theories, and are clearly related and inspired by the PSD-model [6].

2 Self-Management for Children with Asthma

Asthma is the most common chronic diseases in childhood that frequently starts at a young age. A recent estimate of the WHO is that worldwide there are 235 million people that suffer from asthma [6]. Cohort-based estimates of prevalence of

[4] The results regarding an induced smiling movement were questioned later on due to lack of support found in the replication studies `https://en.wikipedia.org/wiki/Facial_feedback_hypothesis`, last visited 21-2-2019

[5] Note that physically static experienced schema such as (dynamic) visuals, related to previous acquired embodied movement counterparts (up/down, avoidance/approach), might also be influential on their own and are also called *Embodied Persuasion*[5] but is outside the scope of this paper.

[6] `http://www.who.int/mediacentre/factsheets/fs307/en/`, accessed 21-2-2019

asthma for children at 8 years old (or 10) depending on country of origin/cohort roughly range between 9-15 % [7][7]. Symptoms of an asthma attack include coughing, wheezing, shortness of breath, and chest tightness, difficulty talking, turning pale, excessive face sweating, and lips or fingernails turning blue [8]. There are different types of triggers that can cause an asthma attack, frequently this is induced by an hypersensitivity to certain triggers, such as allergens, viral infection, or exercise. Children with asthma are at risk of a low quality of life [9], they might get bullied, perceive limitations in the activities they can engage in, and often experience limitation related to environmental cigarette smoke [10]. However, with excellent treatment including proper self-management and medication intake it seems attainable to live a normal life, free of frequently reoccurring severe symptoms and without missing any school or work.

2.1 Goal and Approach for Design of the Asthma Game

The ultimate goal of our envisioned intervention was to improve the physical condition of children with asthma. In this case study we included educational elements by over-simplified cause-effect relations in an entertaining way to improve self-management skills while physically moving, as a step towards this overarching goal.

Previously Klaassen et al. showed a Behavior Change Support System for children with asthma for which they proposed the combination of monitoring of physical activity goals with giving rewards in an interactive playground located in a waiting room of their local hospital [11]. Klaassen et al. also defined three main areas where technology could be used to improve the current management of asthma among children, (1) improving physical condition, (2) increase the adherence to medication and (3) support self-management of asthma which relates to social, emotional, and mental aspects.

In this study we again use our interactive playground [12] but now as a tool to learn with. We targeted children ranging from 7 to 10. In order to develop the game, we worked closely together with a medical doctor and a technical physician, this included several interviews and feedback moments. In later stages of the project we did various types of user confrontations with external people. We showcased a draft version at an e-health symposium to gather feedback from health managers, discussed with an elementary teacher on the suitability for the target age group, played the game with a commercial interactive playground expert to gather feedback on floor-specific suitability, and let 6 children with their parents play the final version in the hospital.

2.2 Context for Dealing with Asthma of a Child

An important conclusion regarding the overall therapy context of the interview with the Dutch pediatrician specialized in addressing asthma, is that without

[7] Although the also reported MAAS cohort from Manchester had a higher prevalence of 23% this cohort seems to originate from a pre-selected high risk group[8].

[8] `https://www.webmd.com/asthma/guide/asthma-attack#1-1`, accessed 21-2-2019

acceptance of the disease by parent and child, education or any other element of therapy is bound to fail sooner or later. During their first visit the child and parent(s) do not yet know much about the disease. The education of parent and child should be done carefully, without scaring them. For instance, a study of Dantas et al. among Brazilian mothers of asthmatic children showed that although physical activity is important for asthmatic children nonetheless a large percentage of mothers impose restrictions on physical activity partially because they are afraid their child would fall ill [13]. It is very important for the child and parent to learn how to manage the disease, understanding both the medication, the importance of physical activity, as well as how to monitor the child and learn to recognize signals from the child which indicate uncontrolled asthma. In current practice a personalized approach is used as they all differ on an emotional level and in what amount they should be alarmed or calmed down. Especially medication adherence is an issue for children which should be learned better, as well as getting a proper experience of what the medication can mean for them. Besides the knowledge transfer the child and parent will get a tailored action plan to take home.

The context of the visits and the waiting room with interactive playground is important to take into account into the design of the game. The average waiting time is about 15 to 30 minutes, there are about 5-10 children simultaneously in the waiting room, and in total about 50 children have an appointment in the morning. When the child is diagnosed they have at least 2 appointments over a period of 6 to 8 weeks. The frequency of visits after this period is very person depended, roughly a child with reasonably controlled asthma would visit the doctor about 3 times a year, whereas a child after exacerbation or even hospitalization would have recurrent appointments until it is under control.

2.3 Educational Goals Asthma Game

Education is important in a way that it improves the ability of the patient to control their asthma. A few of the most important topics of asthma control following from the semi-structured interview and several scientific studies are explained below:

- Having an active lifestyle, and in particular playing sports regularly. Unfortunately, physical activity can also be a trigger for an asthma attack, thus it is not surprising that people with asthma often tend to quit sports or at least reduce their physical activity drastically due to their asthma. It could be helpful for the patients to be aware of the importance of physical activity, despite their fear for a possible attack when combined with poor asthma control, and especially what can be done to cope with asthma when playing sports. A broad common consideration is to keep in mind the length and intensity of the activity and proper medication intake to prevent severe symptoms of asthma during physical exercise. Furthermore, Thomas & Bruton [14] suggest that for asthma patients it can be beneficial to perform breathing training programs including potential benefits of reducing

the chance of asthma symptoms by breathing through their nose to filter, warm, and humidify, inspired air. Although, other review studies mentioned a lack of conclusive evidence for breathing programs due to a lack of enough comparable studies especially regarding children [15, 14]. Another suggestion is to prevent sudden physiological changes by performing a proper warming up.
- Avoiding triggers, patients should know which triggers to remove, reduce and avoid. Avoiding asthma triggers can be a massive aspect of asthma control. For a comprehensive overview of self-reported triggers we refer the reader to [16]. Mentioned and known possible asthma triggers in order of reported frequency include: plants and pollen, animals, dust (mites), change of seasons, (tobacco) smoke (also see [13]), mold, acute illness, chemicals/odors, food, activity, and air quality (including smog).
- Dealing with asthma attacks, another crucial element to learn is knowing what to do when the patient is having an asthma attack. It is important to stay calm, to take the medication and take them again in twenty minutes if this does not work. Taking the right medication and knowing when and how to take it is essential for this.
- Acceptation, as pointed out by our expert: *'The first thing I think that we need to get across is that they accept the diagnosis. It is just the first hurdle to take, they have to really accept, both parent and child, that they have it.'*
- Proper nutrition, eating healthy is important for everybody. However, following a healthy diet might reduce asthma symptoms and is therefore especially important for children with asthma. Losing weight after being overweight might reduce asthma symptoms and improve everyday life, taking into account the association (not claiming causation) between (measures of) fatness and asthma symptoms [17]. To our knowledge there is no clear specific diet an asthma client should follow, there are various foods which should be avoided (related to allergies and BMI), thus we suggest to follow general guidelines for eating healthy.

2.4 Design of Eldub's Asthma Adventure Game

The designed simple game consists of a central figure, called 'Eldub', that needs to be protected from incoming elements, see Figure 1. Eldub shows its physical health both with a health bar and its representation at the centre, ranging from green and happy to red with a few tears. The player can physically walk around in the interactive space, where a circle is projected automatically around the player, see Figure 2. When the circle hits an incoming trigger it is dissolved preventing it from reaching Eldub. The actions are accompanied with simple sounds, such as a cough when a trigger impacts Eldub, spoken instruction texts made high pitched and filtered to give a 'alien' impression. The game is intended for a single player but can be played with up to four players playing together.

The most frequent triggers are included, (cf 2.3), with exception of mold, food, and smog. In discussions with the research team, and also following from

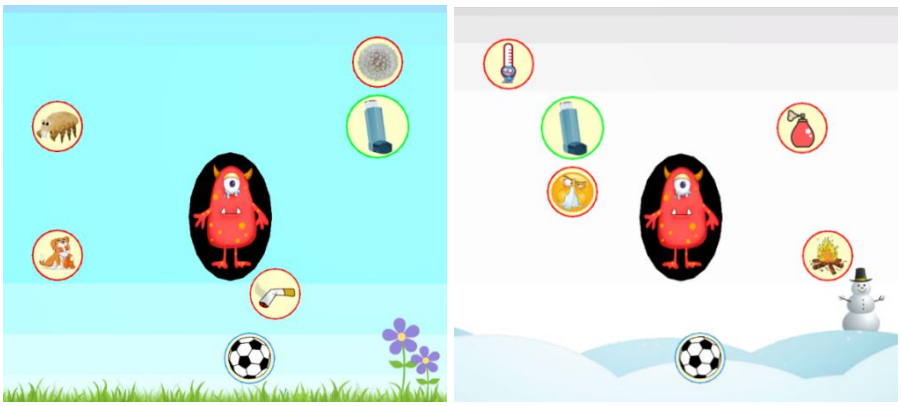

Fig. 1. The two implemented environments showing the various triggers and features. The first level (left) represents the spring day environment, the second harder level (right) is the cold environment.

alternative game concepts, it was decided that appropriate nutrition would be harder to include, and that preventing contact with mold would be more targeted at the parents than children (primarily) playing the game. The games consists of multiple levels, reaching the next level when Eldub has enough health when the timer reaches zero, and each level incoming triggers speeding up throughout the level. Two levels were implemented. The first level is a spring day environment (150 seconds) which includes various (seasonal) triggers: pollen, dust mites, cigarettes, and animals (dogs & cats). The second level is harder and lasts 200 seconds, it represents a cold environment, the cold itself affects the health of Eldub negatively constantly. Additional triggers in this environment include smoke (using a camp fire icon), strong odors, having a cold, and a temperature drop.

Two special features are included: sports (ball icon) and medicine intake (inhaler icon). The first feature simulates a real life interaction of physical activity: doing sport is positive for the general health (a green circle around the icon) unless the health is already too weakened due to other triggers (then shown with a red circle). The medication intake is introduced with a small pause in the game with an overlay with written and spoken text that explains that taking the medication can make 'Eldub' feel much better even when it does not seem to be really necessary. This object should not be touched by the player's circle, and when it reaches Eldbub it is protected from incoming triggers during 7 seconds which is accompanied with a short happy samba-like music clip.

In this way the game contains information about self-management including watching out for and learning of certain triggers, the importance of medication, and benefits of physical activity. As some children might not be able or willing to read well the texts are also presented in spoken instructions with a visualization.

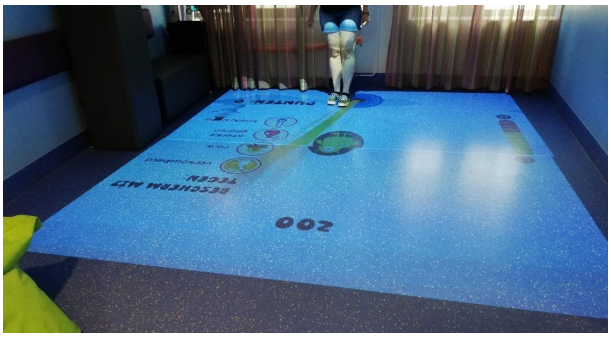

Fig. 2. The game being played at the hospital setting, Eldub is in the centre on the left (upside-down) instructions are showed, the right shows the current health status, and the top the current score. The circle projected underneath the player can be used to prevent negative elements from reaching the central character called 'Eldub'.

2.5 Persuasive Systems Design

We were inspired by the Persuasive System Design framework [6] during the design of the game. Linked to *Simulation* from the primary task support category we embedded the cause-effect relation of sports and current health status, furthermore, the sports feature in itself also functions as a *Reminder* of the target behavior. Linked to *Liking* from the Dialogue Support category, the visuals are clearly chosen to be child friendly. Other principles such as *Reduction* (and recognized after implementation: *Tunneling*) from the primary task support category can also be seen in the game, as the games pauses and is split in two environments with different simplified triggers.

2.6 Exploratory Evaluations

Multiple evaluations were performed of the game as explained above in various stages. The tests were following ethical guidelines of our department, written consent was given by the parents and information was anonymized, the tests were deemed standard non-medical research, and approval from the University's ethics committee was given. Different type of users were asked a few questions and were observed playing the game: a primary school teacher, students, e-health professionals, the involved health experts, and finally some of the children from the hospital. Observations included signs regarding the level of understanding (frown/pause/explanations), observable signs of emotions (joy/frustration/indifference), usability issues, level of activity and interaction, and motivation. Questions differed on whom was asked but included their opinion of the game, positive/negative feedback, the liking of the overall design, the understanding of the aim of the game and related to this the provided information, and for the health experts the correctness of the represented information.

During a university e-health external matchmaking event with about 60 participants from regional health care organization only 4 of those participants

choose to go to the playground (it was in an accompanying room). On the other hand 21 students were interested in the game during two sessions at the university. The students were able to play the game, although this depended heavily on whether they understood enough Dutch to know the (spoken) instructional texts. Although the explanation was a bit hard due to the reflecting light, the used sound filters and sound system at the DesignLab (our university location of the playground). Remarkably, it was quite difficult to understand for the (student) players that the physical exercise feature could both function as a positive and negative trigger. The overall impression was positive, it was even suggested to start a spin-off surrounding the game. Most players found Eldub to be cute, only one student instead saw it as a monster that had to be killed.

The elementary teacher that played the game suggested to include more feedback. The commercial playground expert suggested that the projection itself could be improved and discussed the importance of a good mix between education and fun for such games.

The health experts mentioned that it was important that many of the triggers were included in the game and that the medical content was correct. They imagined it would be suitable for a wide range of age groups. The were concerned whether the children would understand and recognize the triggers and especially the way the physical activity feature worked.

User Test with Children at the Hospital Although the original target group was 7 to 10 years old, for practical reasons in the user test the six participating children ranged from 3 to 9 years old (three were 6 years or older) and their parents often participated as well. Children were asked to play but parents were not discouraged from joining and could tag along. Especially for the younger children this made for a more representative setting of actual use, and would also fit well with the importance of including parents in the process towards acceptance of the disease. Sessions were done on two consecutive days in a time span of about 3 hours in total, including the semi-structured interviews each individual session took about 10 to 15 minutes.Small breaks were included directly after the session to write down important observations, feedback, suggestions, problems, and ideas.

The children responded very positively, the most common answer when asked what they liked was: *'Everything!'*. Two of the six children were unaware of all the triggers and personalized the game by responding that they were allergic to ... as well. Three children stated they loved the physical activity performed during the game. Four of the children played together with their parent, most because they were a bit shy (possibly also due to having an audience), and one child played with his parent because he wanted to win the game and could not manage to do that alone. The number of children playing with their parents was unexpected when designing the game but as explained this might be positive in itself. Many of the children were too shy to truly answer all the indicated questions, the observations provided a better representation. Two of the children did indicate

they were introduced to new triggers to consider, some other educational aspects did not come across as planned for other children.

Even the most shy children started to play enthusiastically after about a minute. The difficulty seemed to be alright and did result in some children some acceptable level and mix of frustration and fun while playing the game. One of the children managed to survive the first level on its own. The children really cared about their scores and were still very excited, even if they lost, when they noticed the high number shown on the floor (e.g. 600 points). The younger children were more guided by their parents to play the game together. Some children would first hold hands. The children above 6 were more excited and less shy when playing the game. One eight-year-old child even nearly begged the parent to continue playing until they won the game, which they unfortunately did not manage to do. The children above 6 also even understood the game without additional explanation, including the distinction between the orange border of triggers, and a green border of the medication intake. However, the game was not clear enough from the beginning, and the physical exercise feature was only interpreted as a positive item throughout the game.

It takes quite some time until the first triggers enter the screen, especially in the second level, up to 15 seconds, which seemed to be way too long, and this required to mention that the children had to wait for a bit during the user tests. The symbols used for the triggers were not clear for at least two of the children and they indicated they had a problem with this. For instance, one child recognized a sock in both the inhaler and the cigarette butt. As some of the children were fairly small, the tracking system was not yet set to recognize them accurately enough which frustrated the children. Another technical issue to be fixed is that the game becomes unresponsive after around 15 minutes of playing.

2.7 Suggested Improvements Based on Evaluations

To circumvent a bug in which the color of the physical activity feature would not match its effect (as Eldub's health might have changed), in the most recent implementation the color and its accompanying effect was decided upon when it spawned.

Several people, including the primary school teacher, noticed that there was a lack of feedback in the sessions, therefore thought bubbles and short spoken texts were added to indicate the current health of Eldub every 50 seconds (e.g. *'Wow! You are protecting me very well!*), or when it dropped below a certain threshold for the first time: *'I don't feel so well'*. Furthermore, some adjustments were made in the way the triggers were spawned at the start of the second level as this took a bit too long to notice.

Based on feedback of the health experts, a short tutorial of 10 to 15 seconds was included in which all the triggers were explained, which was implemented before the test with the children. In an improved version the triggers should also generalize more, they should not just be about cats and dogs, but about all pets. The game should put more emphasis on the hay-fever season, as depicted in

the environment, over a pollen trigger. Furthermore, the confusion and limited recognition of some of the triggers needs additional work, and perhaps going beyond the limited availability of the royalty free on-line resources but simply drawing or buying better depictions. Before the user tests it was suggested to stimulate more to move more, as children could also play with minimum effort standing near the centre. Instead, the game could also give scores if negative triggers would be dissolved quickly, enticing players to move more. However, the user tests showed that children would run around and none of the children stood still on top of Eldub to catch the triggers more easily.

Fitting the Persuasive Systems Design framework [6], a future version could be better tailored to younger children. It seems worthwhile to test a better and more fun explanation or collection-only variation (omitting the dodging of positive triggers), where the importance of medication intake and physical activity should be incorporated differently (e.g. as intermediate automated side-events). Alternatively, an entire different game might be created that also takes into account a more active role from a parent player perhaps increasing the impact on acceptance.

Interestingly, there are also two more contextual related suggestions. The first is to make the playground more recognizable with a white floor and physical sign indicating the playground area. The second is to make the game start automatically including explanation when a player enters after several minutes of inactivity, although sound levels and the repetitive sounds accompanying the explanation might annoy the people around which also need further investigation and work.

3 VR for Substance Use Disorder Treatment for Individuals with a Mild to Borderline Intellectual Disability

Individuals with MBID are a risk group for SUD [18, 19]. Treatment of SUD in this group is hindered by several factors related to the disabilities [20, 21]. These disabilities include both cognitive and adaptive functioning.

Because of these limitations, mainstream treatment protocols need to be adapted to better suit the needs of individuals with MBID (e.g. personalization in the form of use of language and content). Over the last few years, several interventions have been developed targeting individuals with SUD and MBID [22, 23]. These interventions are mainly based on motivational interviewing and cognitive behavioural therapy (CBT). These adapted interventions are promising with regard to their effectiveness, however, repeated training of new behaviors in a safe and controlled environment is missing in most of these interventions.

VR offers an attractive opportunity to treat SUD in a safe and personalized environment. It can be used to induce craving by introducing the participants to virtual risk situations. Also, participants learn to reduce craving, by applying self-control techniques, and learn which, factors induce and reduce their cravings.

3.1 Designing the prototypes

Qualitative interviews with treatment providers and a review of existing treatment protocols were used to define user and functional requirements for the VR environments. Based on these requirements, two prototypes of a virtual bar were designed and developed in an iterative process. Recurring themes within the interventions developed for this target group are self-control techniques. These techniques can be used by the clients when they find themselves in risky situation with high changes of SUD. The self-control techniques are called the six D's (Deals, Distance, Distraction, Declaring, Different thinking different acting, Doing great). The self-control techniques are implemented in two different VR environments where clients could interact with the environment and apply the learned self-control techniques. The prototypes are developed in Unity 3D and the HTC VIVE is used as VR headset. The first prototype was a bar environment designed for users with a substance use disorder related to alcohol. Based on the feedback on this environment a second prototype was developed for users with a SUD related to cannabis use. Below we will introduces both environments.

The bar environment In the bar environment users are confronted with substances (all related to alcohol) in order to apply the 6Ds, see Figure 3. User can be confronted with situations where someone will offer them a beer or where they have to order a drink at the bar. The 6D's were implemented as follows:

- Distance - The user can leave the bar by going out the door and entering an outside area.
- Deals - This is a response consequence and is not implemented.
- Distraction - The user can play a game of darts in the bar.
- Declaring - The user can pick up a mobile phone to make a phone call, see Figure 3.
- Different thinking different acting - The user can choose other drinks such as coffee and soda instead of alcoholic drinks.
- Doing great - Making it a pleasant experience in the virtual environment when the user makes the right choices.

When users enter the virtual environment all elements (other virtual characters, the 6D's and the full interior of the bar) are available. Users have to stand while being in this virtual environment. User can move through the environment by walking around and by using the controllers of the HTC VIVE.

The Coffeeshop environment In the coffeeshop[9] environment users are confronted with substances (all related to cannabis) in order to apply the 6Ds. User can be confronted with situations where someone will offer them a joint or where they can order all kinds of cannabis at a counter. The design of the coffeeshop

[9] A Coffeeshop is Dutch for a bar-like environment dedicated to legally tolerated cannabis use.

Fig. 3. The two implemented environments, a bar (left) and coffeeshop (right). Left, the implementation of one of the 6Ds: *Declare*–grabbing a phone to make a call in the virtual bar. Right, the therapist can alter the environment in a step-by-step way by using the 'show element', 'move to location', and 'start and stop the tutorial' buttons.

environment also included offering the user a joint at the table in the coffeeshop (exposure), and the 6D's were implemented in a similar fashion as the bar, with some changes: *Distraction* - The user can play a game of checkers in the coffeeshop. *Different thinking different acting* - The user can choose not to order or smoke a joint.

When users enter the virtual environment they enter an empty coffeeshop where only the wall, tables, chairs and the counter are visible. The virtual environment can be build up by a therapist who has control over all available elements via the therapist user interface (other virtual characters, the 6D's and the full interior of the bar), see Figure 3. This control by the therapist provides an important distinction to make, turning the application into a tool for the professional, rather than an unrealistic replacement approach, similar to what Schell addressed for what he considers to be Transformational Games [24].

3.2 User Confrontation

The two different prototype discussed above are designed and developed with seven patients at a clinic for individuals with SUD and ID. The prototypes are evaluated using the think aloud method, observation, and qualitative interviews. The first pilot revealed that individuals with SUD and ID were well capable to work with the VR equipment and interact with the virtual environment. However, the target group proved to be easily overwhelmed and distracted and therefore requires a VR product that can gradually increase in complexity. In addition, personalization of the VR environment (i.e. offering VR stimuli that are highly relevant for the patient, such as using their favorite beer brand), was suggested to be crucial. Therefore, the second prototype (the coffeeshop) included the option to start with a simple environment, with the option to increase complexity in both the realism of the virtual environment as well as the interaction with this environment. In this prototype patients could not freely navigate in the virtual space. Therapist had the control over the navigation

and the complexity of the environment. The option to personalize stimuli (i.e. choosing between a bar and a coffeeshop environment', using the patients favorite substances etc.) was also added in the second prototype. Patients rated these changes positively, and confirmed staff observations that cue exposure within the VR environment triggered craving, and that activities in the VR could be of assistance to reduce these cravings and train self-control techniques.

4 Discussion

We showed two different ways, both regarding strategies and technical implementation, in which an embodied *persuasion-while-doing* approach was implemented. The last use case was a VR environment in which individuals with SUD and ID could be confronted with substance they crave in a realistic but safe environment. The user confrontations showed that VR offers opportunities in the treatment of individuals with ID and SUD. It has the potential to become an extension of current treatments as it provides more practical learning opportunities. It also offers clients to repeat exercises with the push of a button, in their own pace and time, which could improve the treatment satisfaction and adherence of patients. The first use case resulted in an embodied learning environment that included several elements important for improving self-management of asthma. Children liked to play in it and showed interest in the material to be learned while being entertained and physically moving. The user confrontations of both studies show opportunities to start changing behavior by using interactive embodied technologies, although both were done in a fairly exploratory way and do not provide conclusive evidence.

It is good to notice the success of application of Virtual Reality in the context of Exposure Therapy (VRET) for both PTSD and various anxiety disorders [25]. However, in our application for substance abuse therapy it is not based on the response extinction after the exposure to the substance related stimuli, but rather on training self control techniques to cope with substance use craving after such exposure.

Unlike these disorders, for that should play a central role, for obvious reasons related to negative effects on craving. The therapy is focused on training coping mechanisms and therefore care should be taken to find the right balance. There might also be elements where research findings can build on shared knowledge generation, for instance considering personalization and integration in a user friendly therapy setting. In the coming years we will continue to work on this interesting topic.

Although we started with some applied knowledge originating from the theoretical framework of embodied cognition in our mind, we also started from a technology-driven approach, where we knew the platform before implementation. As Malinverni, Ackerman, & Pares warned for, we primarily looked at online (constructing of knowledge while doing) and not yet specifically to the offline transformation of these experiences, nor the integration of the two. We also anticipated certain pre-conceived and planned outcomes, which shows a

rather reductionist approach, and calls for future research looking into relations of knowledge construction [2], as well in our cases to actual attitude and behavior change.

Another important aspect to address is to further accommodate different ways in how participants interact and make sense (cf. [2]), where we see the doing already as opening up alternatives more tailored to certain user groups such as children and people with cognitive abilities.

Furthermore, building on the argumentation of Briñol & Petty related to the Elaboration Likelihood Model, it might be that certain user groups that are a-priori less motivated or capable to think will experience a bigger effect of (affective) bodily responses [3]. Currently we have no evidence yet, but do foresee the possibility that guided through the peripheral route people will be able to contemplate (subsequently) over the more motivated cognitive route, about the behavior in their therapy setting. Instead, fitting the remarks regarding embodied learning of going beyond the 'dualistic' approach by Malinverni et al. [2], together with a teacher or parents using the applications as a tool (cf [24]), the end-users might be better able to go-back and forth between the more motivated cognitive route and the peripheral route related to the bodily responses.

Beyond the link to related theories our cases also showed the importance of unanticipated outcomes and interactions. We reported on several exploratory evaluations that focused on the interaction, and finding the meaning beyond actions and responses in order to improve the systems. This seems important especially for these specific user groups. For instance we saw the importance of details (e.g. the brand of the beer offered) and the subsequent possibilities, as well as the impact of testing in a realistic context (e.g. finding that the younger children actually start of playing with their parent). With these cases we show some of the possibilities of investigating a persuasion-while-doing approach.

Both cases also show a clear relation to implementation of the PSD framework (both include simulation, tunneling, and reminders to target behavior), one might recognize elements of self-monitoring, praise, suggestions, and see opportunities to future extensions of implementations (e.g. additional reward systems in the VR environment and increased tailoring regarding age or the social role of the parent in the Eldub game). Noteworthy is that the system credibility support of the system is not dealt with extensively, especially not in the implementation of the interactive system, but it is more linked to the entire context of use, perhaps while implementing the systems the developers were (unconsciously) expecting these features to be less effective for these target groups.

5 Conclusion

In this paper we suggested to apply a persuasion-by-doing approach for behavior change support systems. We showed two possible implementations, one focusing on improving self-management of asthma using an interactive playground, and the second focusing on therapy following substance abuse for people with with mild to borderline intellectual disabilities using a virtual reality environment that

can be controlled by a therapist. Both exploratory user confrontations showed positive responses that suggest this is a worthwhile direction to look into for the multidisciplinary field of behavior change support systems.

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