Using Game-Based Training to Reduce Media Induced Anxiety in Young Children – A Pilot Study on the Basis of a Game-Based app (MARTY)

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Abstract: Digital games have been successfully applied for the treatment mental health problems such as stress disorders, traumatic disorders, or hyperactivity syndromes. Specifically the treatment of anxiety traits and anxiety disorders such as phobias have been in the focus of game-based treatments in the past. A societal challenge that is increasing in recent times is media-induced fears in young children. While tailored game-based treatments existing for schoolchildren, tailored and theoretically sound solutions for children below the age of eight are sparse and so is the available body of empirical research in this direction. In this paper, we present a game-based training app (MARTY) for teaching young children to cope with their fears. The training is based on standard techniques for anxiety reduction such as breathing techniques and cognitive strategies. We investigated quantitative effects, measured by physiological values such as heart rate and skin resistance (EDA), and qualitative aspects of the MARTY app based on 17 four to six year olds. Overall, we found significant effects of the training on EDA values, as indicators for the arousal and anxiety level of children. No significant differences were found for heart rates. A key finding is that the training effects are positively correlated with the general anxiety level of children, as reported by their parents. The MARTY app may be a promising tool to guide and support parents and young children in reducing fears and anxieties.

Keywords: anxiety disorders, trait anxiety, game-based treatment, cognitive behavioral therapy, physiological measures

1. Introduction

The digital change has arrived in the kids' rooms, even those of the youngest. Different studies (MIKE study 2017; KIM study 2017; miniKIM study 2015; "From Zero to Eight") revealed that children use more and more time-consuming electronic media (Genner et al. 2017 Medienpädagogischer Forschungsverbund Südwest (mpfs), 2017; mpfs, 2015; Rideout, 2013). Under 2-year olds spend about 58 minutes per day on digital devices/media, 2-4 year olds about two hours, and 5-8 year olds approximately two and a half hours (Rideout, 2013). The BLIKK study (Büsching et al., 2017) shows that 70% preschoolers use a smartphone for more than half an hour daily and 90% of that time is uncontrolled by adults. The results are severe. Primarily, a high media consumption is considered related to physical inactivity, violence, speech and sleep disorders. A specific risk is the occurrence of media-related fears in children (Cantor, 1994; Holzwarth 2009; Schoneveld et al. 2016; Theunert et al., 1999). The study "Having and showing emotions" (Götz & Schwarz, 2014) demonstrates that every second child between the age of six and nine years is at least occasionally scared of television and a third frequently suffers of nightmares. Such anxiety disorders are the most commonly diagnosed mental health problem in children and the number of subclinical anxieties among children under the age of 15 is estimated at 40%. However, 80% of affected children do not receive psychological or medical assistance (Kataoka, Zhang & Wells 2002). Serious games might be an adequate and natural approach to support children in recovering from anxiety disorders. Fleming et al. (2017) describe the potential of serious games to treat anxiety disorders. Lau et al. (2017) discuss the treatment of depression, post-traumatic stress disorders, autism, attention deficit hyperactivity disorder, functional cognitive disorders, and alcoholism. Recently, a very popular example is the treatment of phobia by exposing patients in the virtual reality. Levy et al. (2016), present a study on the treatment of fear of falling utilizing the strengths of virtual reality. Given the rich potential of digital games for fighting anxiety, the design of anxiety games is an increasing topic in research (e.g., Dekker and Williams, 2017). Schoneveld et al. (2016) presented *Mindlight*, a neuro-feedback training game for anxiety treatment and prevention for children aged 8 to 16. In a randomized controlled trial study, playing the game significantly reduced the anxiety level. Wijnhoven et al. (2015), showed that the game can also significantly reduce anxiety in children with Autism Spectrum Disorder.

In summary, there is some evidence that digital serious games are an adequate measure to treat mental disorders in general and anxieties (i.e., clinical anxiety disorders as well as aggravating anxiety tendencies, which do not reach the clinical level) in particular. While such games are available for adults and children aged 8+, not targeted game treatments are available for younger children, for example at the kindergarten level. Specifically for this age group, appropriate and child-centered treatments would be of great relevance. In the context of this

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master thesis, we designed, developed, and evaluated an anxiety treatment game for kindergarten children. Based on the research desideratum shown, the article focuses on the following research questions:

1. How high is the children´s anxiety level?
2. Can an increase in the EDA value be achieved over the intervention period?
3. Can the HR value be reduced over the intervention period?

2. Study Design

As part of a mixed-methods design, the anxiety level of the children is to be reduced by means of an intervention as a methodical implementation using the MARTY approach (Medienbedingte Aengste Reduzieren mit TonY [Reducing media related fears with Tony); whereas Tony referred to the name of the main character of the game-based training app. In order to be able to make quantitative statements, a questionnaire was issued prior to the training to have a baseline regarding the anxiety level of each child and their use of digital devices at home. Also, physiological measurements were taken, using a biofeedback wristband. In order to be able to make qualitative statements regarding the motivation as well as the impressions of the children's emotional states and opinions about the app and the underlying coping strategies, we kept a detailed log.

2.1 Participants

In total 17 children from two different German day care centers participated in the study, of these 6 boys and 11 girls. On average, the children were 4.74 (SD = 0.87) years old. Location I was a Kindergarten in Munich; here 5 boys and 4 girls participated. The kindergarten is a private institution, the parents are very educated and have a high socioeconomic status. Media are commonplace at home and in the kindergarten. They use tablets, televisions and cameras. Location II was a kindergarten in Leutkirch; here 2 girls and 6 boys participated in the study. The kindergarten is a public institution. The children come from social disadvantaged families. In addition, most of the parents and children can hardly speak German. There is no media use in the kindergarten but TV, tablets and game consoles are often used at home as "babysitters" or to promote language.

2.2 Baseline questionnaire

To identify an initial baseline of the children's general anxiety level and in particular the intensity of media-related fears a questionnaire was used. The questionnaire was completed by the parents and kept relatively short and simple, so that it can also be filled out by the parents with little German language literacy. The questionnaire was based on the already existing questionnaire „Spence Children Anxiety Scale – The Preschool Anxiety-Scale (SCAS, Muris, Schmidt, & Merckelbach, 2000). *„[The scale can be] used for identification of children with elevated symptoms of anxiety and for whom further assessment is recommended to determine need for intervention. Similarly, it provides an indicator of response to treatment. It has also been used in several studies to identify children for whom early intervention or prevention is warranted on the basis of elevated anxiety symptoms being a risk factor for the development of future mental health problems*" (Barrett & Turner, 2001). The questionnaire was already used in the "MindLight" study by Granic et al. (2014) and is summed up for valid and reliable (Schoneveld et al., 2016). In addition, the questionnaires BAV:3-11 (Mackoviack & Lengning, 2002), DISYPS-III:FBB ANG (Döpfer & Götz-Dorten, 2008) und PHOKI (Döpfner, Schnabel, Goletz, & Ollendick, 2006) were used as basis. The questionnaire was divided into five chapters: (i) demographic information, (ii) health related aspects (from a health-related and ethical point of view, only children without psychiatric treatment, heart disease, and clinical anxiety disorders could take part in the study), (iii) media usage, (iv) media literacy), and (v) general anxiety and specific fears.

2.3 The Anxiety Treatment Game

2.3.1 Treatment approach

Different research in the field of cognitive behavioral therapy has shown that children are less responsive to questions and do not like discussions. They prefer to be active and want to play. Thus, it is not surprising, that computer-aided psychotherapy programs especially Internet therapy for anxious children, which are usually performed without therapist accompaniment, provide surprisingly good results. They have a success rate of up to 70%. (Scholz & Heinz, 2015). This result can be justified by the fact that play therapy is a suitable form, especially for younger children. According to Clemens (2019), children are more motivated and this increases the effectiveness of the therapy. It also makes clear that successful anxiety processing is only possible if children are allowed to participate constructively and if they experience demand, support and empowerment (Kahle, 2019). "M*uch more important in the context of learning-oriented apps is the mental involvement to*

demonstrably facilitate learning" (Mertes, 2017). Therefore, the game is particularly suitable, because playing helps to find solutions and supports the childish processing. Very suitable for this are stories (or fairy tales) as well as magical powers, which can be awarded as substitute elements. The study by Allensbach in 2003 discovered that the contents of fairy tales or stories are most effective if they were introduced in an animated situation (Mertes, 2017). Almost as in a lab situation, the child can try out how brave or anxious it is (for example by finding a treasure etc.). By stimulating the children's imagination and showing them various possible solutions and developmental stages, the child's flexibility increases with how to deal with fears and conflicts, thereby expanding their repertoire of possible approaches (Wilkes, 2018). The interactivity of the medium leads to a changed perception of one's own role. Because in these virtual worlds it is possible to take alternative roles and try them out. So it is no longer the main character, it is the players themselves, who significantly shape the plot (Scholz & Heinz, 2015). In addition, the tablet can be considered as a suitable instrument for performing for a media-induced therapy, since, as Mertes (2017) shows, that children have already learnt at the age of about 15 months how to use a tablet. At the same time, compared to television, children can control the processes themselves on the tablet, depending on their age (self-paced learning, repeated tasks and procedures; Mertes 2017).

2.3.2 Structure and content

Most serious games or therapeutic learning games are based on elements of *Cognitive Behavioral Therapy* (CBT; Kahle, 2019). Playful means in which the ungendered hero bravely uses CBT procedures without showing fear are the best choice. Often, popular heroes do not have a clear gender. The characters are not addressed as he or she within the series and have no gender-specific names or signs (Götz, 2017). In addition, this role model can only be effective if it speaks to the children (Wilkes, 2018). It is also crucial that the figure is not a glorious hero figure, but a person like you and me - who has fear, courage and is brave (Göhlen, 2015). In this app, therefore, plays the gender-neutral character "Tony" the lead role. Tony is a human-like character, because human protagonists show better the emotions and this helps children better to identify and deal with them (Vom Orde, 2014).

CBT relies on the cognitive model of the interactions between cognitive processes, emotional experience and behavior. Therefore, CBT therapy is usually divided into three phases: confrontation with a frightening element, relaxation and the application of problem-solving techniques.

2.3.3 Confrontation and problem-solving

Many studies showed that confrontation in children is the most important therapeutic component in the treatment of anxiety. Fear experts recommend the use of multiple confrontations. Therefore, the children are also offered several confrontations for this app. Since, according to the results of the questionnaire, the children are most afraid of witches, ghosts and snakes, these figures are used. In addition, the confrontation is embedded in a dream, as reflected in a survey of 3000 children. The influence of these contents, happening on the dream is clearly higher to develop fears than experienced on the day (Holler & Mueller, 2014). Therefore, 4 out of 10 children have nightmares from TV (Götz & Schwarz, 2014) and a quarter have nightmares every week or more often (Friecke-Oerkermann, 2014).

Because of that, patients should, as far as possible, engage in confrontation exercises as independently as possible and should be accompanied by therapists only when it is absolutely necessary. A fictional character (Tony in our case), who is exposed to confrontations and copes with them, gives anxiety patients a sense of security. The fictional character is intended to show the children different ways of dealing with confrontations, for example, by trivializing, zooming (e.g., shrinking a scary character), and transforming the scary character into a positive form.

2.3.4 Relaxation

Relaxation procedures provide the foundation of CBT. The abdominal breathing is the most used form. Younger children learn effortlessly when the exercise is incorporated into an exciting story. Most children choose 5-8 seconds per unit (Schmidt-Traub, 2017).

3. The App MARTY

The game features the gender-neutral character Tony (Figure 1). The game-based training approach is designed as an interactive story. Tony lies in bed and has a nightmare. The game has three variants: In the dream, Tony

faces either a witch, a snake, or a ghost (Figure 1, 2nd row). This scene serves the purpose of a confrontation with an anxiogenic stimulus. The intention is to provoke a raising anxiety level, associated with the stimulus. After the confrontation, children have to perform a deep breathing relaxation exercise together with Tony in order to reduce physiological anxiety symptoms again. In a next step, the children learn how to deal with the anxiogenic stimuli (witch, snake, ghost) in sense of CBT. To achieve that, children can, defeat the mean characters together with Tony applying three cognitive strategies, that is, shrinking the character, disembodying the character or doing another relaxation. Following this procedure, Tony wakes up and both Tony and the child are rewarded with a gemstone. The playing/training duration is about 10-15 minutes. The reason for this is that the children experience a loss of attention and difficulty concentrating over a longer period of time, which means that learning, is no longer possible (cf. Mertes, 2017).

The app was created with the Adobe Flash Professional CS5.5 program, Actionscript 3.0. For this, the vector files were called up for the individual scenes and each scene was programmed individually and saved as a swf file. Finally, the individual swf files were linked to codes so that they can be played one after the other. The app can be played on laptops and tablets. In this study, we used Windows-based tablets.

Figure 1: Scenes of the MARTY app (from top left): (1) introduction to the main character Tony, (2) Tony has a nightmare, (3) a ghost and a spider appearing in Tony's nightmare, (4) Tony can transform the ghost into a cute penguin, (5) Tony can select different tools and strategies from the chests to cope with fears, (6) in a tutorial animation the children can learn breathing techniques together with Tony.

3.1 Physiological measurements and evaluation

In order to measure the anxiety level of children while playing the game, we used a wearable (Figure 2), developed by HTW Berlin (http://tel.f4.htw-berlin.de/lisa). This device can measure skin temperature, skin conductance (EDA), heart rate (HR), pulse, as well as environmental factors such as air quality. Due to time constraints and reasons of technical implementation, no classical biofeedback training, in which the children received feedback about their biofeedback immediately, instead the training was realized by several training sessions. The obtained measures were used only for evaluation and subsequent analysis. For the app itself, log data were recorded.

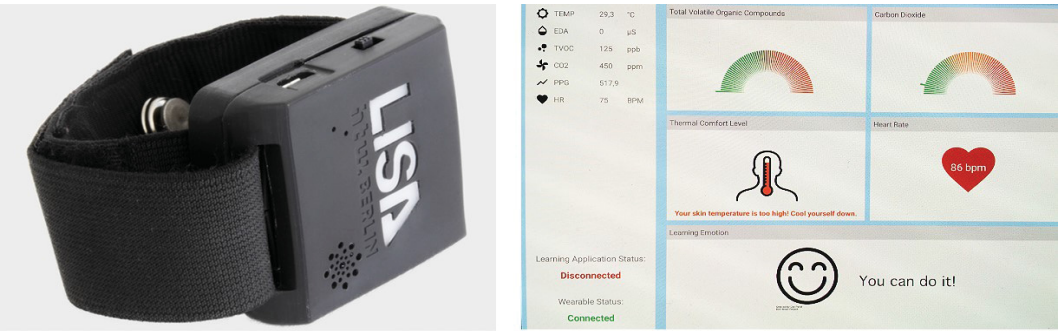

Figure 2: The left image shows the LISA wristband, the right image the SmartMonitor app that is connected to the wristband via Bluetooth and that records the physiological data during the training sessions.

3.2 Electrodermal activity (EDA)

The one physiological measure recorded for this study was electro dermal activity (EDA), which is a sensitive indicator for changes in autonomic sympathetic arousal that are integrated with emotional and cognitive states. It is measured by skin conductance and is one of the most accurate methods for measuring human reactions. The EDA is controlled by the autonomic nervous system, which cannot be controlled intentionally. So the EDA value gives answers that cannot be influenced directly. For this study we had a closer look to the phasic EDA, which shows how quickly a child can recover from a stressor. The LISA wristband measures EDA in Ohm (i.e., skin resistance). A higher value indicates a higher relaxation. Although there is a lack of accuracy of EDA measurement using small wristband sensors with a comparably short measurement distance, results provide sufficiently reliable indicators for the children's arousal.

3.3 Heart rate

The second physiological measure recorded was the heart rate, which indicates the heart beats per minute and is a partial aspect of the pulse, which describes the pulse from beat to beat. Children have pronounced heart rate variability that decreases with age (Rauscher and Neuffer, 2016). Typically, heart rate and heart rate variability should decrease during a relaxed activity, such as breathing exercises or while sleeping. On the other hand, the heart rate increases in stressful situations when the body tries to cope with the demands. The heart rate level is individual for each person and therefore changes from day to day, depending on the activity level and amount of stress (Hoffmann, 2016).

4. The experimental study

4.1 Procedures

The questionnaires has been completed in April 2019. The actual training sessions took place in May 2019. The respective children were visited once a week for a total of 3 weeks. In total, each child participated in 3 sessions. In each session, a different scary character (i.e., ghost, snake and witch) appeared in the app. We ensured prior to each session, that children voluntarily participated in the intervention in order to obtain reliable measurements on the one hand and on the other hand not to cause negative effects that could affect the child´s state of health. Another factor in generating valid and reliable measurements was that all children completed their sessions under same conditions. Therefore, the sessions took place in a quiet room at the day care centers after breaks or relaxed phases of the kindergarten routines. In addition, the sound volume of the respective game was always equal, in order to achieve the same effects, especially with regard to the confrontations.

During each visit the children played one-"game session"; either ghost, snake or witch. The order of scary characters the children were confronted with was chosen randomly. All sessions were monitored by a kindergarten teacher. The children put on the wearable LISA and started to play the respective game themselves. The wearable recorded the physiological measures. During the intervention, the children were accompanied by a test administrator to help with technical problems; in order to avoid influences of the administrator, during the sessions the children were given no feedback, praise or calming words. After each session, the children had the opportunity to talk about the game. These statements as well as the statements while playing the game were documented.
To investigate the effects of playing the Tony app and to clarify the initially formulated research questions, we focused on the analysis of physiological measurements and qualitative data obtained from the children. In

addition, the results of the questionnaire were compared with the physiological measurements during the intervention to elucidate certain relationships.

5. Results

Prior to the training sessions with the *Tony* app, we issued a background survey asking for the children's media consumption and their general level of anxiousness. The answers were given by the parents.

The parents reported media consumption on a scale from 0 to 5, where 0 means a low consumption (0-15 minutes per day) and 5 a high consumption (more than 120 minutes per day). The most frequent medium consumed by the children of our sample, with an age range between 3.1 and 6.4 years, was television (mean = 2.40, SD = 1.24), which means up to 90 minutes per day. This corresponds to the consumption of books (mean = 2.40, SD = 0.91). Furthermore, the parents reported an average consumption of tablets of about 45 minutes per day (mean = 1.40, SD = 1.14), of Smartphones of about 35 minutes (mean = 1.14, SD = 0.69), of Laptop Computers of about 30 minutes per day (mean = 1.00, SD = 0.71), and of digital games of about 10 minutes per day (mean = 0.75, SD = 0.50). These values are average values and the consumption of different media does not sum up. We also asked the parents as to what extend they are aware of their children's media consumption (on a 5-point scale from never to always). The parents reported that the children on average use typical apps rarely (mean = 0.63, SD = 0.62) and also reported a low extent to which the children observe others (e.g., their older siblings) consuming media or playing games (mean = 1.50, SD = 1.21). The parents, in turn, reported that they have a medium level of knowledge about what media contents their children consume (mean = 3.00, SD = 1.65) and that they monitor their children's media consumption on a medium level (mean = 3.21, SD = 1.31). Overall, the extent of children's media consumption is in line with our expectations, whereas the parental supervision is lower than expected, given the young age of the children of our sample. The following table (Table 1) indicates the anxiety and stress related responses of parents. Overall, we found a very low level of general anxiety, the scale revealed a total average score of 0.796 (SD = 0.945; on a scale from 0 to 4).

Table 1: Children's level of general anxiety on a scale from 0 (never) to 4 (very often).

my child …	Mean	SD
… has difficulties in coping with sorrows / worries	1.333	0.900
… is reluctant to ask adults for help	0.625	0.885
… verifies actions to assure everything is in order	1.125	1.147
… is reluctant to sleep at friends' places	1.800	1.699
… is crying after having seen negative/inappropriate contents on TV/tablet	0.750	1.183
… is anxious and tense	1.063	0.998
… is afraid of meeting unknown people	0.875	0.885
… has to follow exact procedures to assure everything is in order	0.563	1.031
… is afraid that something negative may happen to parents	0.813	1.328
… is nervous after having seen negative/inappropriate contents on TV/tablet	0.313	0.793
… carries worries and sorrows	0.500	0.516
… is afraid of speaking to unknown people	0.875	1.147
… has frequently occurring negative thoughts and imaginations	0.563	0.892
… is afraid that something negative may happen to herself	0.563	0.814
… reports sickness or stomachache after having seen negative/inappropriate contents on TV/tablet	0.000	0.000
… wakes up at night after having had a bad dream	0.813	0.750
… has sleeping problems due to re-occurring worries	0.250	0.577
… mimics characters seen in movies	1.500	1.461

In addition, we asked parents about how different characters or events, as shown in Table 2, scare their children. Again, the data revealed a very low level of anxiousness (on average 0.919, SD = 1.153).

Table 2: Level of fear of different characters or events on a scale from 0 (very low) to 4 (very high).

Darkness	1.500	1.549
Loud noises	1.438	1.365
Ghosts	1.333	1.175
Blood / injuries	1.063	0.998
Witches	1.000	1.095
Snakes	1.000	1.155
Spiders	0.938	1.181
Fire	0.933	1.163
Insects	0.750	1.183
Dead people	0.636	1.120
Guns	0.615	1.044
Height	0.563	1.094
Dogs	0.563	0.964
Bomb attacks	0.538	1.050

Part of the quantitative analyses was to look into the physiological effects exhibited by the children, measured by the LISA wristband sensors. First, we analyzed the phasic (i.e., short term) electro-dermal activity (EDA), the skin resistance, over time. We could show that EDA values, on average, increased by repeated exposure to the Tony app. Figure 3a shows the mean EDA values for the baseline measurement prior to starting the app-based training. For the first session the mean was 12.86 (SD = 11.52), for the second session 30.92 (SD = 42.78), and for the third session the mean was 44.11 (SD=51.62). The broad variability (i.e., high standard deviations) are explained by large individual differences between children. As Figure 3b shows, the entire EDA activation increased with repeated exposure. For the first session the mean was 12.14 (SD = 1.26), for the second session 34.63 (SD = 2.99), and for the third session the mean was 42.21 (SD=6.04). A univariate ANOVA reported a significant difference across time [$F(2, 1350) = 7062$; $p < .001$]. Scheffé post-hoc tests reported that there was a significant increase between each session ($p < .001$ in all cases). The average EDA activation over time in each of the sessions revealed only small changes; yet, the different parts of the app (i.e., dream, breathing exercise, cognitive strategy, reward) can be identified (Figure 4). Since the children took differently long for the various parts, the curves do not overly exactly. The distinct amplitude spikes at the end of each session indicate a significant physiological reaction by finalizing the app-based training (i.e., reward part), including the happy ending of the narrative. An interesting effect is that in session 2 this spike has a different direction than those of sessions 1 and 3. We do not have a plausible explanation for this effect, though.

(a) (b)

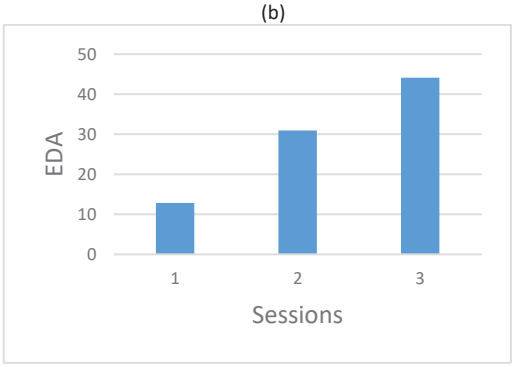

Figure 3: EDA activation for each of the three sessions. Panel (a) shows the initial baseline values, panel (b) shows the means for the full session durations.

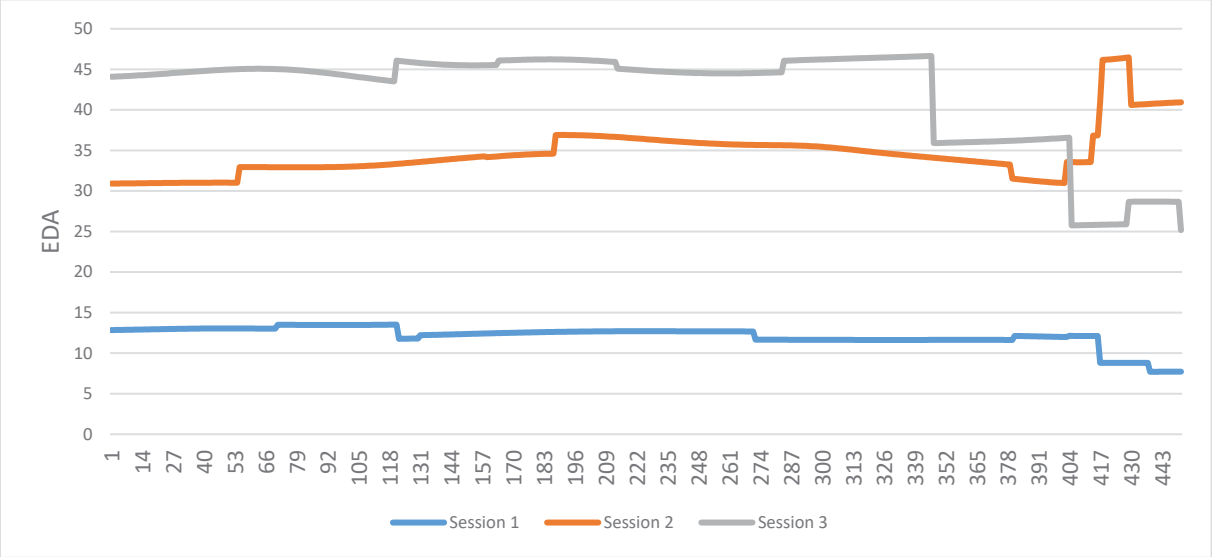

Figure 4: EDA activation over time for the three sessions.

Second, we analyzed the heart rate during and over the sessions. The mean heart rate in session 1 was 91.06(SD = 7.36), in session 2 90.85 (SD = 6.65), and in session 3 90.24 (SD = 6.88). Interestingly, a clear decrease in the baseline measurement was not found; the mean in session 1 was 52.39 (SD=24.95), the mean for session 2 was 61.87 (SD = 17.37), and for session 3 60.57 (SD = 20.79). As opposed to EDA activation, we found a clear difference in baseline measures and the measures during the app-based training. This is an indicator that children were clearly more excited during using the app, as opposed to their resting heart rate. A univariate ANOVA reported a non-significant effect of sessions [F(2, 1311) = 1693; p = .184]. Figure 5 illustrate these results.

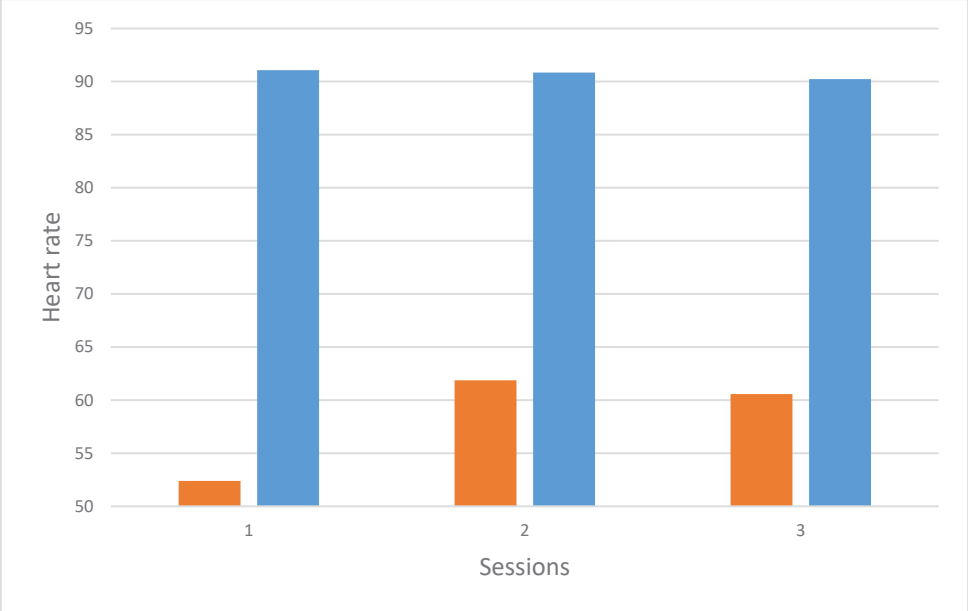

Figure 5: Heart rate of baseline (orange) and app-based training (blue) over the three sessions.

Finally, we were interested in the effects of the training in dependence to the initial – parent reported – general anxiety level. We correlated the change in EDA over the sessions with the initial anxiety score of the individual children. We found a moderate but noteworthy positive relationship between the changes in EDA values with the anxiety level; the correlation of the change in EDA from session 1 to 2 correlates with r = .320, the change from session 2 to 3 with r = .319, and the change from 1 to 3 with r = .353. These results indicate that the higher the initial anxiety level of children the more reduction of anxiety (as operationalized in form of arousal measured by EDA skin resistance) could be achieved by the app-based training. The change in heart rate was not as clear. The change from session 1 to 2 correlates with the anxiety level with r = .228, the change from session 2 to 3 with r = -.161, and the change from session 1 to 3 with r = .298. This indicates, overall, that the higher the initial

anxiety level the stronger the change in heart rate. As illustrated in Figure 6, the anxiety level, measured by EDA and HR, could be reduced.

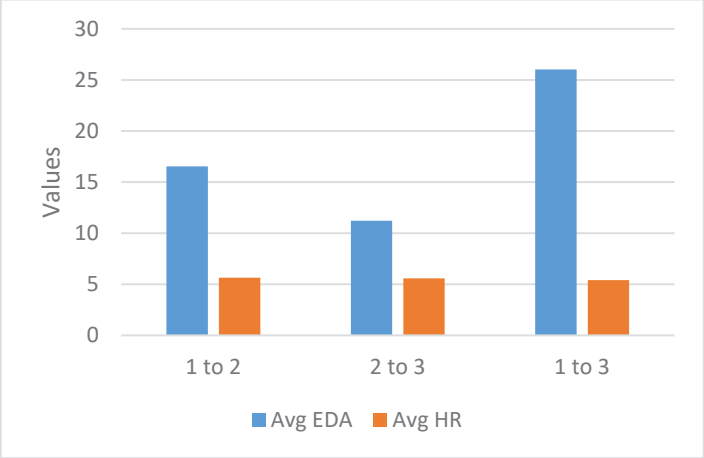

Figure 6: Changes in skin resistance (EDA) and heart rate (HR) over the three sessions. Please note that an increasing skin conductance (blue bars) indicates higher relaxation.

In order to obtain qualitative statements regarding the motivation as well as children's impressions and opinions we kept a protocol about all statements or the children. These protocols were in turn related to the measurements in order to be able to make statements about the agreement of the qualitative and quantitative results.

Child number 16 (female, 4 years, location I) showed one of the highest EDA levels during all 3 sessions (Figure 7), although according to the questionnaire, the child had a general anxiety level of 1.6 (scale from 0=low level to 4= high level) and has therefore surprisingly one of the highest anxiety-level values of the children. Asking the child for her reasons for selecting certain coping strategies in the game, she stated:

> *"The card with the breathing exercises is like what my mom always does at home. Like yoga. I always do that with her. And sometimes when I have to cry, I do it with her. Then I often feel better again."*
>
> *"I think the wand is cool, too. It´s like the one that Bibi Blocksberg has. It can always enchant everything and then it can always help everyone. Then people are better off. And if I take the magic wand, I can do that, too. Then I can help, too. And I enjoy that. That pleases me."*
>
> *"The potion is for boys. That´s why I used once to see what happens."*

It turned out that the child relates different everyday experiences to the strategies. It can identify with them and thus seems to have a positive effect on the child´s wellbeing.

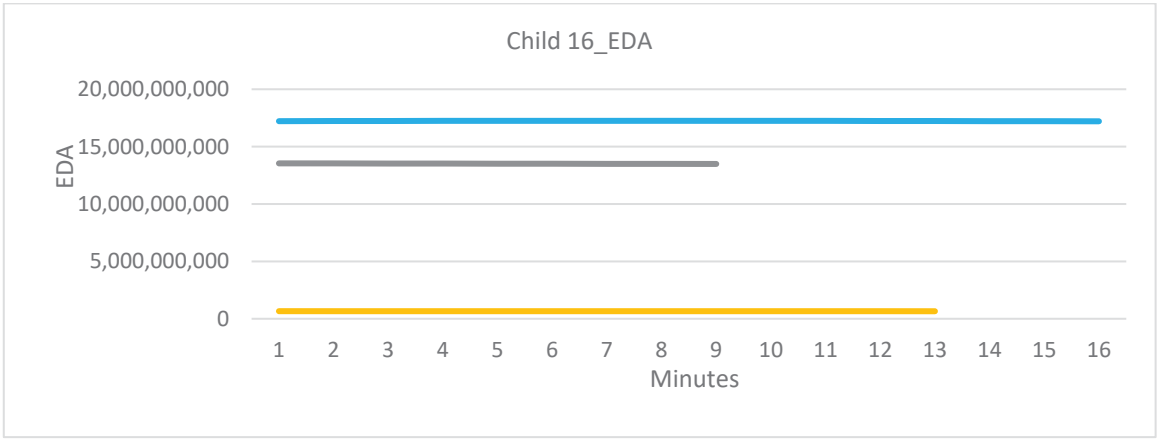

Figure 7: EDA values of child 16 for session 1 (blue, snake), session 2 (orange, ghost), and session 3 (grey, witch).

Another example is child number 3 (male, 5.4 years, location I), which has an anxiety level of 0.8. This child (Figure 8) also shows high EDA values and it seems to become more relaxed from session to session. The child stated
After session 1:

> *"I like that I can choose all the things myself and can do as often as I want. I particularly like the card. If I close my eyes and then breathe in and out, I just focus on it. Then I don´t have to think about the bad witch or the bad snake anymore."*

After session 2:

> *"Yesterday I saw something bad on TV. Then I did that with breathing at home."*
> *"My mum said that I should always do this before going to sleep because I always wake up and have trouble falling asleep. […]. I always think that a bad man comes in the door and wants to eat me at night. Now my mum has put a potion next to my bed. And when someone comes, I can drink it quickly and the bad man can´t do anything anymore. Then I can transform it."*

Before session 3:

> *"Look here. I have now built a magic sword. Now I can always take it to bed and then make someone small. Like Tony. Cool, isn´t it?"*

Even if, according to the results of the parent questionnaire, the child has a relatively low level of anxiety, it seems that the child is still dealing intensively with the topic and has a high level of speaking about what happens at home and what he can learn from Tony and how he can use the strategies he learned to use.

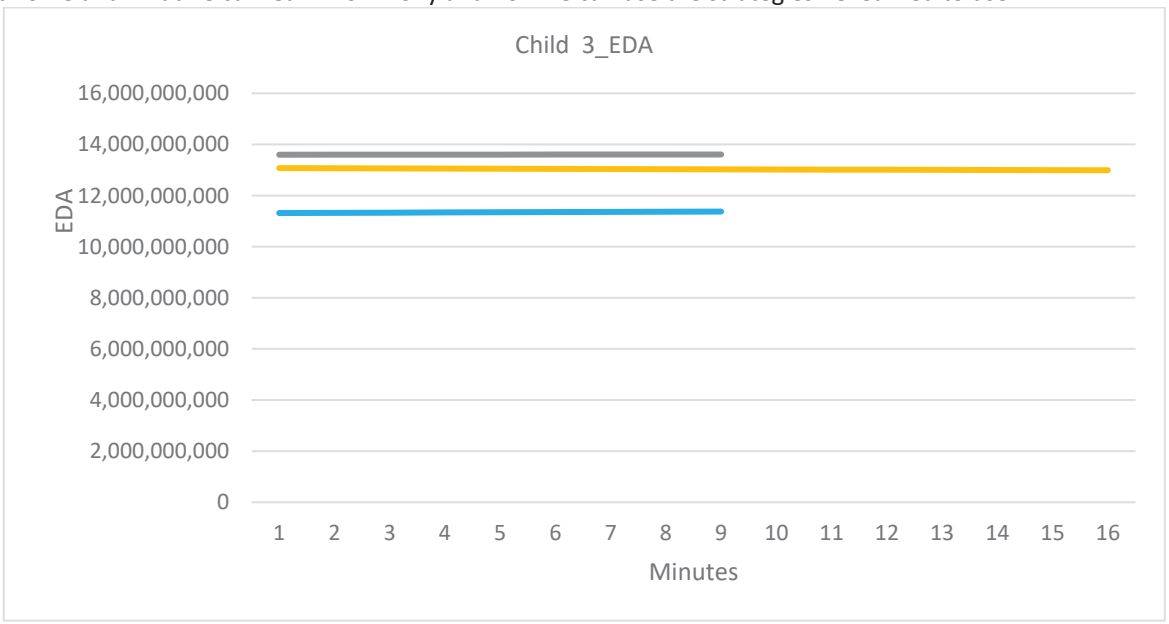

Figure 8: EDA values of child 3 for session 1 (blue, snake), session 2 (orange, snake), and session 3 (grey, ghost).

6. Discussion and Conclusion

In this paper, we presented a game-based training app (MARTY) for teaching young children to cope with their fears. The training is based on standard techniques for anxiety reduction such as breathing techniques and cognitive strategies. We argued that appropriate anxiety reduction strategies for preschoolers are rare and difficult to realize. However, given the increasing media consumption even of the youngest and the increasing frequency of media-induced fears in children, trainings tailored to young children are of high relevance. We conducted a first study to investigate the effects of the app with 17 kindergarten children from Germany.

Overall, the children´s anxiety level was on average 0.919, (SD = 1.153) with a maximum of 4.0. Compared to results from other studies (e.g. MIKE study 2017; KIM study 2017) this level is significantly lower. This could be

due to the parent´s social desires when filling out the questionnaire. We found significant effects of the training on EDA values, as indicators for the arousal and anxiety level of children. No significant differences were found for heart rates. A key finding is that the training effects are moderately positively correlated with the general anxiety level of children, as reported by their parents. This means that the more anxious children were, the higher was the training effect. The positive effect is emphasized by the qualitative statements of children. A limitation of the study is that no control group design could be realized. Thus, the effects, specifically in EDA, might be due to a general familiarization with the app over the three sessions. Counter arguments are that this effect has not be found for heart rate. This indicates that children still have the same high level of excitement and arousal (cf. Figure 5). Moreover, when looking at the changes in EDA within a specific session, we can identify the differences between the different parts of the game (e.g., intro vs confrontation). These changes are much smaller, though, than the changes between the sessions. This lets us conclude that the found effect is likely due to the theory-based training approach. At the same time, children exhibited a high motivation to use the app. The app is very easy to use. The children can start the respective games themselves and play them without help. There were sometimes technical problems recording the logging-timestamps. Sometimes the app did not save all logging-timestamps in the background. This data could not be used for the evaluation. A revision of this problem is necessary for further research.

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