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Measuring aggression-related emotion regulation in adolescents: Do computer games form a viable method?

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Abstract

How well children can regulate their emotions is an important indicator of how adaptive their development is. This study examined whether computer games form a viable method to induce frustration, with the goal of measuring aggression-related emotion regulation (ER) in adolescents, by looking at whether computer games are able to induce frustration as a research method, what type of computer game (cognitive vs. reaction-time) induces more frustration, whether there is a difference between boys and girls, and whether there is an effect of exposure. Participants (N=27), ranging between 13 and 17 years of age (M=14, SD=1), played two computer games steeply increasing in difficulty, where they were motivated to gain as many points as possible. Frustration levels were measured before and after gameplay with use of a self-report questionnaire. There was a two week period in between the two games, and participants were randomly divided into two groups deciding which game was played first. No statistically significant results were found, suggesting no frustration effect of this method, no statistically significant differences between game types, gender and levels of game experience, and no effect of previous exposure to the method. This study was the first to look into these particular subjects and its results are tentative. It does, however, provide several points of interest for further research aiming to examine this subject further.

Measuring aggression-related emotion regulation in adolescents: Do computer games form a viable method?

This study focusses on the ability called emotion regulation (ER), and specifically the measurement procedure of aggression-related ER. Regarding problems with aggression, the ability of ER is partly measured by inducing frustration, a methodologically difficult procedure. Current research shows that computer games can be utilized as an easier way to measure aggression-related ER, but various variables that affect this method have so far been overlooked. In order to assess whether computer games are indeed suitable as a method for measuring aggression-related ER, this research will examine the influence of game type, gender, and exposure.

All humans express emotions differently but how much we are able to control this expression is a crucial factor in our psychological well-being. Emotions play an important role in social interactions, decision making, and responses to various situations in daily life (Appelhans & Luecken, 2006). Therefore, it is important to properly use and regulate them. The regulation of the magnitude and/or duration of the emotional response in order to reach certain goals is called 'emotion regulation' (ER; Gross, 2013). Particularly in children and adolescents a maladaptive use of ER is often the main indicator of atypical development (Gross, 2013). More research into the workings of ER, and possible treatments to improve it, are still needed, especially in relation to problems with aggression (Weisz & Hawley, 2002). This is mainly because measuring aggression-related ER is a complicated task (Hubbard, 2005). Having little control over one's anger expresses itself in being more easily frustrated compared to those who control their feelings of anger well. Therefore, part of measuring ER with respect to aggression is done through inducing frustration in the research participants and measuring the responses. This is a difficult and complicated procedure because this frustration needs to be induced in a controlled and standardised manner. Due to additional ethical constraints this becomes even more complicated when children or adolescents are involved (Hubbard, 2005).

The procedure of inducing frustration in order to measure aggression-related ER is often conducted by using verbal insults, physical threats, the prevention of obtaining a defined goal, and/or a rigged form of competition (Hubbard, 2005; Stadler, Rohrmann, Steuber, & Poustka, 2006). Particularly in studies with children such experimental manipulations carry many ethical constraints, as they involve knowingly causing negative affect, which might

influence the participants' mental state (Hubbard, 2005). Additionally, such research can be complicated because the procedure needs to be both standardised and effective (Hubbard 2005; Stadler et al., 2006). Further complication can arise if a repeated measure is needed, as the participants will be aware of the intent to arouse frustration, likely negating the effects of the experimental manipulations. Cumulatively, these factors explain why there is a shortage of viable research in this area, particularly regarding children and adolescents (Weisz & Hawley, 2002). With the technologies available today, however, this procedure no longer needs to be as complicated, and may be applied more easily to children and adolescents. One such technology that may be used in these settings and that is almost ubiquitous among this population, is computer games. Computer games can replace the previously used procedures, and allow the researcher more control within a standardised design. Computer games can make use of competitive situations, which have been shown to work well in inducing frustration (Stadler et al., 2006; Waschbusch et al., 2002), and can use several difficulty levels. As such, methods can be readily adapted to offset the negative affect of the experiment (Hubbard, 2005) by ending on a lower difficulty session where the child is able to achieve the goals that were set. Thus, computer games may form a viable way to help measure aggression-related ER.

Several studies have already used computer games as a method to measure aggression-related ER. Two studies specifically used video games as a way to measure aggression-related ER in adolescents and young adults. Both did this by making the goal of the game impossible for the participant to reach (Ajaya, Peckham & Johnson, 2016; Vara et al., 2016). Another study utilized games in order to measure hostile attribution bias in children by using staged peer interaction (Yaros et al., 2014). In each of these studies computer games were assumed to work as a valid method. Further studies support this use. In an examination of physiological responses to games, Ballard, Hamby, Pancee and Nivens (2006) found a significant increase in heart rate (HR; a standard physiological sign of stress) when participants were forced to stop playing. When this occurred, participants were generally trying to achieve a goal in the game. This concurs with the methods employed by Ajaya, Peckham and Johnson (2016) and Vara et al. (2016). A thorough meta-analysis of the various methods employed to induce frustration also found that games are capable of inducing both a physiological and psychological stress response (Van der Vijgh et al, 2015). In short, previous research clearly indicates that computer games work well as a method to measure aggression-

related ER. However, very little attention has been paid to the specifics of this method. Before bringing it into full use several confounding variables need to be considered.

First, "computer games" is a very wide category, that includes many different types, genres, difficulty levels, and presentation forms. As of yet no research has investigated the differential abilities of these various types and genres as frustration inducers. In an attempt to fill this knowledge gap, this research will distinguish between two main types; cognitive games and reaction-time based games (Amory, Naicker, Vincent & Adams, 1999), and assess how viable they are as frustration inducting methods. Cognitive games are defined as games that, as their main mechanism, make use of cognitive problem-solving capabilities. These are mostly known as puzzle games. Reaction-time based games are games where the main mechanism lies in quickly reacting to situations or events by pushing the right buttons. Most larger games have elements of both these types, making people solve problems but also demanding that they react as quickly as possible in certain situations. But many smaller, simpler games, are easily distinguished as belonging to one of these types. This study utilizes these simpler games to determine which type of computer game is more effective as a method to measure aggression-related ER.

Second, a measure of emotion regulation used in research would have to be used on a participant several times, in order to assess differences in ER over time and possible improvements in ER due to treatment. The previously mentioned study that measured physiological reactions to gameplay, found that physiological responses decreased across a 3-week period of repeated gaming (Ballad, Hamby, Pancee & Nivens, 2006), indicating a decrease in the frustration response. However, there has been no evidence that several short exposures over a longer period of time would have a similar effect. This study thus examines whether the effect of computer games as frustration inducers stays stable over multiple measures. Furthermore, it is possible that repeated exposure could increase the skillset of the participant at a particular game (Dye & Bavelier, 2010), thus potentially leading to a reduction in the amount of frustration induced. Similarly, participants' individual gaming history could affect their reaction to the game and their level of frustration.

Lastly, gender may present a possible confounding variable to the effect of games as frustration inducers. Overall, more men than women play computer games (Ballad, Hamby, Pancee & Nivens, 2006; Bartholow & Anderson, 2002; Blumberg & Sokol, 2004). If individual gaming history and skillset are indeed confounders, then then using computer

games to induce frustration would also skew the results found between men and women. Furthermore, men have consistently outperformed women on the skillsets that are necessary to play reaction-time based games (Cherney & Poss, 2008; Neubauer, Bergner & Schatz, 2010; Sanders & Sinclair, 2011), which may affect the frustration elicited by this method.

It is clear that the efficacy of computer games as a method to measure aggression-related ER must be better defined. In order to do this, this study looks at different types of games, and various variables that could affect the use of this method. The main question this research aims to answer is whether computer games are a viable method for measuring aggression-related ER. To answer this, we consider the following research questions: (1) Can computer games succeed in inducing frustration in adolescents (12-18 years of age) in a research setting? (2) Which type of computer game, cognitive or reaction-time based, induces more frustration in adolescents (12-18) in a research setting? (3) To what extent is the ability of computer games to induce frustration in adolescents (12-18) different for men and women? (4) Does repeated-measurement play a role in the effect of frustration inducement in this method? (5) Does game-play in daily life influence the effectiveness of this method? The goal of this study is to determine if and how computer games can be used to measure emotion regulation, and consequently whether they can be used to facilitate studies about effective treatments for aggression. Based on previous research it is expected that both types of games are effective in inducing frustration (Ajaya, Peckham & Johnson, 2016; Van der Vijgh et al., 2015; Vara et al., 2016; Yaros et al., 2014). However, there is no previous research into different types of games, and thus no basis on which to predict which type will perform better. It is expected that this method will induce more frustration in women than in men, based on different amounts of real-life exposure and skill levels. Exposure to the method itself is not predicted to have an effect since the sessions are short and spread over a longer period of time.

This study aims to answer these proposed research questions with a between and within-subjects study. It will make use of a cognitive game and a reaction-time-based game to represent the two game types. Self-report data will be collected at several points to measure experienced levels of frustration. This is expected to be a favourable set-up based on methods of previous studies using computer games (Ajaya, Peckham & Johnson, 2016; Vara et al., 2016; Yaros et al., 2014).

Method

Participants

The participants were 27 adolescents (81,5% men and 18,5% women) between 13 and 17 years of age (M = 14.3, SD = 1.1), 22 of whom participated in the repeated measure (84,6% men and 18,5% women). The division of the participants over the game conditions for both the first measure (T1) and the repeated measure (T2) can be seen in Table 1 and Table 2. All participating adolescents were from special education schools. This type of school was chosen due to the number of children with aggression problems being higher compared to other schools. This sample thus guaranteed the highest likelihood of participants with problems with emotion regulation, helping to ascertain whether this tool forms an adequate way of measuring such problems. Participants education levels ranged from VMBO-P to VMBO-T.

TABLE 1. Division of Participants over Variables and Conditions for T1.

Variable	N	Range	Mean ± SD
Game Experience	27		
Age	27	13 – 17	14.3 ± 1.1
Variable	N		Percentage
Game Type			
Cognitive	14		51.9
Reaction	13		48.1
Variable	N		Percentage
Gender			
Female	5		18.5
Male	22		81.5

TABLE 2. Division of Participants over Variables and Conditions for T2.

Variable	N	Range	Mean ± SD
Game Experience	22		
Age	22	13-16	14.1 ± 1.0
Variable	N		Percentage
Game Type			
Cognitive	10		45.4
Reaction	12		54.6
Variable	N		Percentage
Gender			
Female	3		13.6
Male	19		86.4

The medical ethical testing commission of the Utrecht Medical Centre (UMC) gave permission for the execution of this research. Both the participants and their parents were fully informed about the procedures and gave active informed consent. This information was sent to the parents by letter. Children were briefed by their teachers in class and again at the beginning of the first session (both verbally and by letter).

Design

The study design consisted of a 2 X 2 mixed repeated measures design with the condition (cognitive game first vs. reaction-time based game first) serving as the between-subjects factor and assessment phase (baseline measure, post-game measure) serving as the repeated measures factor. The participants were randomly assigned to two groups of equal

size using block randomization, and, in accordance with their group, presented with the games in this order:

1. Cognitive game – Reaction-time based game
2. Reaction-time based game – Cognitive game

Procedure

The experimental sessions were carried out in a quiet room on the school grounds. In each session, the participants were first asked to fill in several questionnaires. In the first session (T1), this also included a questionnaire about game experience in everyday life. Afterwards, participants were asked to watch a relaxing video. The video used in this research was a YouTube video called "Coral Sea Dreaming" (https://www.youtube.com/watch?v=JzA00afbUkU). After the video, the participants filled in a self-report questionnaire measuring anger expression and control.

Two games were used in this study to represent the two game types. Puzzle Cube, a 3D puzzling game, was used a cognitive game, and Existence Speed, a reactionary game that increases in speed, as a reaction-time based game. The participants were presented with three game levels or gameplay sequences (depending on the game), each with a time limit of 3 minutes. The first was easy, the second had a significantly increased difficulty level, and the last was easy again. Participants were asked to fill in the self-report questionnaire again after the second gameplay sequence, this was the post-game measure. Throughout these levels participants gain points. They are told that the point will be tallied, and that they might be able to make the high score. After the first level, they were told that they needed to gain as least as many points in the next level to get into the top ten of the school. Due to the second level having an increased difficulty, they did not achieve this goal, but subsequently earned more points in the last and easier level.

Each participant took part in two sessions with a two week period in between. The second session (T2) was identical to the first, except that the participant played a different game the second time.

Measures

The construct was measured using the State-Anger scale of the State-Trait Anger Expression Inventory for children and adolescents (STAXI-CA) questionnaire. This questionnaire was specifically designed to measure the current emotional state of children (STAXI-CA; del Barrio, Aluja & Spielberger, 2004). This scale of the STAXI-CA intends to

measure state anger. The scale has 12 items, in the form of statements (i.e., "I am irritated), rated on a 4-point scale (1= *almost never*, 4 = *a lot*) about how participants feel at that moment. Chronbach's α ranged from 0.76 to 0.95 across measurement times.

To check for possible influence from game experience in everyday life, participants filled in another questionnaire during the first session. This short questionnaire was designed for this study and consisted of 3 items. The first item was a yes or no question of whether the participant plays video games in daily life. If the participant answers 'no' their score is '0'. If the participant answered 'yes', their score was decided by the next two items. These items both had a 5 point scale and asked them to rank how much they play and how many hours they play per week. These two items were averaged to achieve the score for daily game experience. This use of two separate items that were averaged was done in an attempt to decrease the effect of the estimations of the participants being off. The results were then clustered as follows: scores '1' and '2' become the score '1'; score '3' becomes the score '2'; and score '4'and '5' become score '3', so as to create a categorical variable of four categories: none (0), little (1), moderate (2), and a lot (3).

Data analysis

Data analysis was conducted using the statistical programme Statistical Package for the Social Sciences (SPSS; IBM, 2012). For each participant both the baseline and post-game measure were used. For each of the five research questions a 2 X 2 mixed methods ANOVA was used to analyse the effects and interactions between the different variables. In each analysis 'time' formed the within subjects factor (baseline measure vs. post-game measure). The between subjects factors were, respectively: (1&2) Game condition (cognitive game vs. reaction-time based game); (3) Gender (female vs. male); (4) Exposure (game played first vs. game played last); and (5) Game experience (no game experience vs. little game experience vs. moderate game experience vs. a lot of game experience).

Results

All participants were randomly divided over the two conditions per gender ($\chi^2 = 0.08$, df = 1, $p = .772$) and age ($\chi^2 = 1.81$, df = 3, $p = .614$). A summary of the results can be seen in Table 3.

TABLE 3. Means and Standard Deviations on Baseline and Post-Game Measurements of Frustration Levels for the First Measure and the Repeated Measure.

	T1				T2			
	T1 Baseline		T1 Post-Game		T2 Baseline		T2 Post-Game	
Game Type	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Cognitive Game	1.29	0.15	1.38	0.15	1.36	0.11	1.26	0.13
Reaction Game	1.38	0.17	1.17	0.16	1.37	0.13	1.16	0.10
Total	1.34	0.11	1.27	0.11	1.36	0.08	1.20	0.06

The Ability to Induce Frustration

The difference in frustration between the baseline measure and the post-game measures were examined with a 2 x 2 mixed ANOVA (T1 baseline frustration versus T1 post-game frustration x cognitive game versus reaction-time based game). The results showed no significant main effect for time, $F(1,0) = 0.25$, $p = .623$. This means that frustration levels did not significantly increase after gameplay, which goes against expectations.

Game Type Differences

The relationship between the changes in frustration and the type of game played were examined with a 2 x 2 mixed ANOVA (T1 baseline frustration versus T1 post-game frustration x cognitive game versus reaction-time based game). The interaction effect of time and game types is non-significant, $F(1.0) = 1.41$, $p = .246$. This means that the type of game does not significantly influence the amount of frustration induced by this method.

Gender Effects

The relationship between the changes in frustration and the gender of the participant were examined with a 2 x 2 mixed design analysis of variance (T1 baseline frustration versus T1 post-game frustration x female versus male) showed no significant interaction effect for gender, $F(1.0)= .67$, $p = .420$. Contrary to our expectations, this means that this method does not affect women differently than men.

The Effect of Repeated Measurement

The relationship between the changes in frustration and the sequence in which the games were played were examined with a 2 x 2 mixed design analysis of variance (frustration difference T1 versus frustration difference T2 x cognitive game versus reaction-time based game) showed non-significant main effect for game sequence, $F(1.0) = 0.04$, $p = .851$. This means that as we expected, exposure through repeated measurement has no effect on the ability of this method to induce frustration.

Effects of Real Life Game-Experience

The relationship between the changes in frustration and the amount of real life game experience of the participant were examined with a 2 x 2 mixed design analysis of variance (T1 baseline frustration versus T1 post-game frustration x game-experience) showed a non-significant interaction effect for game experience, $F(3.0) = 1.98$, $p = .146$. This means that, contrary to our expectations, daily life experience with games does not influence the ability of this method to induce frustration.

Discussion

The present study sought to take a closer look at whether computer games form a viable method for measuring aggression-related ER in adolescents. To our knowledge this is the first study to look in depth at the effect of different game types, gender, and exposure on this method. The results show no statistically significant results for the functioning of the method itself. This means that participants were not significantly more frustrated after playing the game, and the method did not succeed at inducing frustration. This stands in contrast to the meta-analysis of Van der Vijgh et al. (2015), that found games to be a very successful method of inducing frustration. This could be a result of the manner in which the sessions were conducted, the quality of the games used, or simply the small size of the research sample. Compared to the studies performed by Ajaya, Peckham and Johnson (2016) and Vara et al. (2016) that both used games successfully to induce frustration in adolescents, the current study used a set-up where participants were more likely to succeed at the game. Next to this the motive for succeeding at the game was less enforced in this study. Combined, these differences might explain why the set-up of the current study was not successful in inducing frustration. These differences were part of this being a small-scale study with limited resources, which meant that there was a reliance on existing games without specially designed mechanisms to stimulate goal-oriented behaviour and/or thwart the reaching of this goal. This result thus suggests that it may difficult to induce frustration in adolescents with existing games, and that for this purpose there is true merit to having games designed specifically. Another large difference between the current study and the studies performed by Ajaya, Peckham and Johnson (2016) and Vara et al. (2016) is sample size. Due to small sample size this study had less power to detect statistical differences (Cleophas & Zwinderman, 2012). This will be further discussed later in this section with regards to this studies shortcomings and points of reference for further research.

The results of this research suggest cognitive games and reaction-time based games do not differ in their capability to induce frustration. No statistically significant differences were found between the two games. This was the first study to examine the frustration-inducing effects of different game types, thus there are no expectations to compare this result to. It is possible that the two games employed in this study do not fully represent the different game types, and that a larger analysis of different types, possibly including larger, more complicated games and different genres (for example shooter, or thriller), would yield more results. Based on observations during data-collection, however, the effects of both types could also depend on the individual. Some participants appeared to become very frustrated by the cognitive game, but very much enjoyed the reaction-time based game, while others had the exact opposite reaction. This may be due to the type of games they were used to playing, or it may simply be a matter of personality. This was something the current study was not able to consider due to time constraints, but that is definitely a matter of interest for the future.

The results further suggest that there is no difference in how this method induces frustration in girls and boys. To our knowledge this was the first study to consider gender differences with regards to frustration-inducing effects of computer games. Still, these results contradict previous research showing large differences between men and women with regards to computer games (Cherney & Poss, 2008, Sanders & Sinclair, 2011, Neubauer, Bergner & Schatz, 2010). The question still remains, however, whether this is due to different levels of exposure or inherent differences in skill. It is also important to keep in mind that this study had only a small number of women in the data sample, which may have skewed the results as possible differing effects for girls might simply not have been visible in the data from this sample.

In this study, the results showed no significant effect of exposure on the amount of frustration induced by the method. This means that the repeated measure is just as reliable (or unreliable) as the initial measure. These results are in support of the hypothesis that exposure would not influence the results if it concerned two game play session with a two week period in between. Regarding the effects of game experience in daily life, no statistically significant results were found. This indicates that the amount of time participants spend on games in their day to day lives does not affect how they respond to this method.

Next to it being the first into this particular topic the current study was a small scale study, with a small sample size and limited time. The significance of these results is possibly

further undermined by the reliance on existing games and use of self-report data.[1] It also needs to be considered that perhaps the games and set-up of the games in this study simply did not work well enough to induce frustration. However small it was, this was still the first study to explore this matter, and it shows that there is likely something to explore within this subject.

Next to the methodological issues than have been discussed above, it is important to keep in mind that the results of this study are possibly further influenced by the sample. First, the sample of this study was small, which means that the power to demonstrate a difference if there was one is also very small (Cleophas & Zwinderman, 2012). In order for this study to have found significant effects with this sample size, there needed to be large differences between variables. This means that all results should be interpreted carefully and really the results of this study are tentative. Real conclusions on the discussed subjects can only be drawn after larger scale research. Second, the sample contained a disproportionate amount of boys. Considering the differences laid out in previous research between men and women when it comes to games (Ballad, Hamby, Pancee & Nivens, 2006; Bartholow & Anderson, 2002; Blumberg & Sokol, 2004; Cherney & Poss, 2008; Neubauer, Bergner & Schatz, 2010; Sanders & Sinclair, 2011), it is possible that the skewed sample could have influenced the results in some way. As no other research has been found into the relation between gender and the frustration effect, it is not sure what form this possible influence could have taken. But the differences in experience and skill between the genders that has been established in previous research could have come into play in how challenging the games were over all, and thus how well they induced frustration. Finally, it is important to consider that all participants came from a special education school. During data-collection we noticed multiple children with signs of attention-deficit disorders who seemed annoyed by sitting still and watching a video for 3 minutes. The intent of the video was to elicit a calm state for the baseline measure, but possibly this method is unsuited for children with attention-deficit disorders (especially since the same video is also used in the repeated measure). This could possibly help explain the overall decrease in frustration after playing the game, as the data shows.

Future research would be able to gain more information with a larger scale study. First, the use of objective physiological data, such as heart-rate variability (HRV), will likely

[1] It had been planned to use heart-rate variability (HRV) data in order to have an objective physiological measure of the stress response, but due to technical problems with the HR-monitors used it was not possible to interpret this data.

lead to more reliable results. Changes in HRV can be reliably associated with psychological phenomena, and it has been shown through both theory and research that the high frequency component indicates the capacity of a person's emotion regulation (Denson et al., 2011). In essence HRV reflects the interaction of autonomic, cognitive, and behavioural aspects of emotional expression and regulation (Appelhans & Luecken, 2006). Thus, using HRV data will lead to more reliable and more detailed results than if only self-report data is used. Second, a larger scale study would not have to rely on existing games and could have games developed specifically for its purpose. They could design games to only differ in the matters that they would want to investigate, and to employ mechanisms specifically designed to induce frustration (like annoying error sounds, or controls that purposefully do not work). This would lead to better standardization, and possibly a better effect.

In conclusion, taking the limitations of this study into consideration, it can best be stated that the current results are tentative, and that the efficacy of using computer games as a method to induce frustration in order to measure aggression related ER merits further research on a larger scale. When such further research takes place, the current study will be able to provide information about potential confounding variables, and which possible methodological issues to avoid.

References

Ajaya, Y., Peckham, A.D. & Johnson, S.L. (2016). Emotion regulation and mania risk: Differential responses to implicit and explicit cues to regulate. *Journal of Behavior Therapy and Experimental Psychiatry, 50,* 283-288.

Aldao, A., Gee, D.G., Los Reyes, A.D., Seager, I. (2016). Emotion regulation as a transdiagnostic factor in the development of internalizing and externalizing psychopathology: Current and future directions. *Development and Psychopathology, 28,* 927-946.

Appelhans, B.M. & Luecken, L.J. (2006). Heart rate variability as an index of regulated emotional responding. *Review of General Psychology, 10*(3), 239-240.

Amory, A., Naicker, K., Vincent, J. & Adams, A. (1999). The use of computer games as an educational tool: identification of appropriate game types and game elements. *British Journal of Educational Technology, 30*(4), 311-321.

Appelhans, B.M. & Luecken, L.J. (2006). Heart rate variability as an index of regulated emotional responding. Review of General Psychology, 10(3), 239-240.

Ballad, M.E., Hamby, R.H., Pancee, C.D. & Nivens, E.E. (2006). Repeated exposure to video game play results in decreased blood pressure responding. *Media Psychology, 8*(4), 323-341.

del Barrio, V., Aluja, A., & Spielberger, C. (2004). Anger assessment with the STAXI-CA: Psychometric properties of a new instrument for children and adolescents. *Personality and Individual Differences, 37*(2), 227-244.

Bartholow, B.D. & Anderson, C.A. (2002). Effects of violent video games on aggressive behavior: Potential sex differences. *Journal of Experimental Social Psychology, 38,* 283-290.

Blumberg, F.C. & Sokol, L.M. (2004). Boys' and girls' use of cognitive strategy when learning to play video games. *The Journal of General Psychology, 131*(2), 151-158.

Cherney, I.D. & Poss, J.L. (2008). Sex differences in Nintendo Wii™ performance as expected from hunter-gatherer selection. *Psychological reports, 102,* 745-754.

Cleophas, T.J. & Zwinderman, A.H. (2012). Statistical power and sample size. In *Statistics Applied to Clinical Studies*. Springer Science & Business Media.

Densen, T.F., Grishaw, J.R. & Moulds, M.L. (2011). Cognitive reappraisal increases heart rate variability in response to an anger provocation. *Motivation and Emotion*, 35, 14-22.

Dye, M.W.G. & Bavelier, D. (2010). Differential development of visual attention skills in school-age children. *Vision Research, 50,* 452-459.

Gross, J.J. (2013). Emotion regulation: Taking stock and moving forward. *Emotion, 13*(3), 359-365.

Hubbard, J.A. (2005). Eliciting and Measuring Children's Anger in the Context of Their Peer Interactions: Ethical Considerations and Practical Guidelines. *Ethics & Behavior, 15*(3), 247-258.

IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.

Neubauer, A.C., Bergner, S. & Schatz, M. (2010). Two- vs three-dimensional presentation of mental rotation tasks: Sex differences and effects of training on performance and brain activation. *Intelligence, 38,* 529-539.

Sanders, G. & Sinclair, K. (2011). Sex differences in accuracy and precision when judging time to arrival: Data from two internet studies. *Archives of Sexual Behavior, 40,* 1189-1198.

Scarpa, A., Fikretoglu, D. & Luscher, K. (2000). Community violence exposure in a young adult sample: Psychophysiology and aggressive behavior. *Journal of Community Psychology*, *28*(4), 417-425.

Stadler, C., Rohrmann, S., Steuber, S. & Poustka, F. (2006). Effects of provocation on emotions and aggression: An experimental study with aggressive children. *Swiss Journal of Psychology*, *65*(2), 117-124.

Van der Vijgh, B., Beun, R., Van Rood, M. & Werkhoven, P. (2015). Meta-analysis of digital game and study characteristics eliciting physiological stress responses. *Psychophysiology, 52,* 1080-1098.

Vara, M.D., Baños, R.M., Rasal, P., Rodríguez, A., Rey, B., Wrzesien, M. & Alcanñiz, M. (2016). A game for emotional regulation in adolescents: the (body) interface device matters. *Computers in Human Behavior, 57,* 26-273.

Weisz, J.R. & Hawley, K.M. (2002). Developmental factors in the treatments of adolescents. *Journal of Consulting and Clinical Psychology, 70*(1), 21-43.

Waschbusch, D.A., Pelham, W.E., Jennings, J.R., Greiner, A.R. Tarter, R.E. & Moss, H.B. (2002). Reactive aggression in boys with disruptive behavior disorders: behavior, physiology, and affect. *Journal of Abnormal Child Psychology*, *30*(6), 641-656.

Williams, D.P., Cash, C., Rankin, C., Bernadi, A., Koening, K. & Thayer, J.F. (2015). Resting heart rate variability predicts self-reported difficulties in emotion regulation: A focus on different facets of emotion regulation. *Frontiers in Psychology*, *6*(261), 1-8.

Yaros, A., Lochman, J.E., Rosenbaum, J. & Jimenez-Camargo, L.A. (2014). Real-time hostile attribution measurement and aggression in children. *Aggressive Behavior, 40*, 409-420.