



Game-Based Relaxation Training

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Effects Of Game-Based Relaxation Training On Attention Problems In Anxious Children

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Abstract

Results of recent research have suggested that game-based, biofeedback relaxation training may reduce symptoms of both Attention-Deficit/Hyperactivity Disorder (ADHD) and anxiety in children and youths. Inattention and poor concentration are common features of these disorders. However, it has not yet been explicitly studied whether the problems of inattention and poor concentration that are characteristic of anxious youths may be lessened with game-based relaxation training. The present study examines the effects of an intervention combining game-based relaxation training and behavioral practice in a sample of twenty-three 9 to 17-year-old children. We hypothesized that intervention participants would show significant improvements in attention problems subscale of the Child Behavior Checklist – Parent Report Form relative to a waitlist control group. Results indicated significant improvements in posttest scores for the intervention group relative to the control group. The findings of this study suggest that game-based relaxation training may be beneficial for attention and anxiety problems in anxious children and adolescents.

Introduction

Anxiety is a common mental health problem in childhood and adolescence (C 2006; Shaffer, 1996). According to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV-TR), anxiety disorders are characterized by intense fear and or inappropriate (American Psychiatric Association, 2000). This intense fear or an anxiety-provoking stimulus or in situations that normally do not produce or lead to panic attacks which are severe incidences of fear that can cause shortness of breath, palpitations, chest pain/discomfort, choking or smothering feelings, and fear. Children and adolescents with anxiety also may experience restlessness, fatigue, tension, and sleep disturbance.

In addition to these symptoms, inattention and poor concentration are common in children and youths (American Academy of Child and Adolescent Psychiatry, 2009; Clikeman & Ellison, 2009). These problems appear to relate, at least in part, to a tendency for people to attend too much to potentially threatening or dangerous situations and to tend to selectively attend to what they perceive to be the more threatening aspects of the environment (e.g., Rapee & Clark, 1997; Field, 2006; Hadwin et al, 1997; Vasey et al 1995). Such tendencies may lead to be less attentive to the more important or relevant information in their environment. Children with anxiety are thought to have problems with “attentional allocation,” (Rappaport et al, 2006) where attention is focused on targets that may not be useful or appropriate for meeting their goals. Thus, these children, unlike children with Attention-Deficit/Hyperactivity Disorder, do not have impaired ability to concentrate or pay attention, but rather tend to focus on unhelpful features of their environments. For example, in cases of social phobia, children may be too intensely to bodily symptoms such as blushing, trembling or sweating (Bogels et al, 2006) and too little to relevant information in the environment. Intense self-focus may lead to these individuals to evidence poor concentration in academic and other settings. A program called Task Concentration Training (TCT) was developed to address this problem (Rappaport et al, 2006). During TCT, patients learn to direct their attention to the task at hand and away from anxiety symptoms. This technique has been shown to effectively alter the attentional focus, providing improvements beyond those offered by cognitive therapy and transdiaphragmatic relaxation (Bogels, 2006).

Treatment Of Attention Problems Through Relaxation Training

Research conducted over the past four decades has indicated that relaxation training leads to improvements in attention span for children and adolescents (Lupin et al, 1982; Howell, 1982; Denkowski et al, 1983; Chang, 1991).

In a study of the effects of meditation as a form of relaxation training, college students who participated in meditation sessions demonstrated significantly better scores on a test of attention (Lupin et al, 2007). Research also suggests that attention and impulsivity can be altered by

been taught traditional biofeedback techniques, such as relaxation training, progressive relaxation, or interactive metronome training (Weize, 2004). A study with ADHD was conducted using “coherence training” to alter aspects of cognition (Lloyd et al, 2010). Coherence training involves teaching the regulation of heart rhythm designed to shift attention, regulate breathing, and activate positive emotions. The goal is to achieve psychophysiological coherence, a highly efficient functional model of increased nervous system harmony, enhanced emotional stability, and improved performance (McCraty, 2005). Improvements in immediate and delayed working memory and secondary memory were evident in the treated participants following six weeks of training (Lloyd et al, 2010).

Some recent research has demonstrated decreases in both inattention and anxiety in meditation. A study with combat veterans diagnosed with post-traumatic stress disorder (PTSD) and anxiety disorder suggested that biofeedback training may improve attention (Lloyd et al, 2010). A study using meditation training illustrated that undergraduate students in a mindfulness program performed significantly better on a test of attention and had significantly lower anxiety than the control group (Tang et al, 2007). In another study (Harrison et al, 2004), 26 children with ADHD were taught meditation. The participants in the study evidenced improved attention, as reported and parent-reported attention. Anxiety was also reduced over the course of the study. Grosswald et al, (2008) conducted a study using a type of concentration meditation. The study focused on attention and stress, and results suggested that ADHD symptoms could be lessened through meditation.

Treatments Utilizing Computer Technology To Aid In The Treatment Of Anxiety

Biofeedback has been utilized successfully to help individuals with a variety of anxiety disorders achieve a state of relaxation (Yucha et al, 2008). Biofeedback has the potential to enhance an individual's ability to control physiological processes. There are various types of biofeedback which address improved control over central nervous system activity (e.g., neurofeedback) and those that promote improved control over peripheral nervous system activity (e.g., heart rate variability biofeedback). Biofeedback allows the participant to view on a computer screen real-time information about physiological processes such as heart rate variability (HRV) and skin conductance level (SCL). HRV is a measure of the activity of the Autonomic Nervous System (ANS). An increase in ANS activity may indicate stress, while a decrease can indicate relaxation (McCraty & Tomasino, 2006). High variability in HRV (the time between heartbeats); low variability implies that the participant is stressed (McCraty & Tomasino, 2004). SCL is a measure of the action of the sweat glands in the fingers. High levels of perspiration suggests that the participant is experiencing excitement or anxiety, while low levels of perspiration suggests that the participant is experiencing relaxation. On the other hand, leads to low levels of perspiration. These real-time measures, HRV and SCL, are typically plotted on a graph or depicted in a variety of ways on a computer screen. Through biofeedback and relaxation training, the individual can learn to manipulate images on the screen based on changes in HRV and SCL (Culbert et al, 1996). This is achieved through practice and utilization of relaxation techniques, imagery, and muscle relaxation. The training also helps the participant to find a state of relaxation.

methods work best for him/her and helps him/her stay “on task” when intrusions appear (Banquet, 1973; Condrón et al, 2009; Lagopoulos et al, 2009).

A number of studies illustrate that, like adults, children and adolescents can regulate peripheral nervous system processes such as heart rate and electrodermal activity (Cobb, 1980; Cobb & Evans, 1981; Siniatchkin, 2000). In recent years, technology has made use of video-game-like technology and graphics which may significantly increase engagement in biofeedback, particularly among young people. In game-based biofeedback, when physiological coherence is achieved, the participant can make different actions through involvement in video-game-like activities.

Neurofeedback is a type of biofeedback which measures and provides the user with ratios of alpha and beta waves detected via electroencephalograph (EEG). It uses similar game-based formats to maintain interest and motivation. Neurofeedback has strong evidence in favor of its effectiveness as a treatment for ADHD. A recent meta-analysis by Ridder, Strehl, Breteler, & Coenen, (2009), for example, suggested that neurofeedback brought clinically meaningful improvements in symptoms of ADHD, in children and adolescents. Biofeedback of central nervous system activity is used in the treatment of ADHD to alter the activity in the prefrontal cortex. This approach is based on research indicating that children with ADHD have been shown to generate high levels of theta activity relative to beta activity in the prefrontal cortex (Hughes & John, 1999).

Although neurofeedback appears a promising treatment for children and youth with ADHD, it may not be the treatment of choice for the poor concentration that characterizes ADHD. For individuals with anxiety, biofeedback may appear to have problems with inattention that occur directly linked to the central nervous system, promoting improved attention. For individuals with anxiety, biofeedback may involve different approaches. As reviewed above, such individuals may learn to redirect focus away from anxiety-promoting stimuli and to prevent overactivity of peripheral nervous system activity. Additionally, while neurofeedback may be expensive for some individuals (Anglada & Hakala, 2008) biofeedback technology for peripheral nervous system activity can be relatively less expensive because it can be completed using fewer expensive equipment (Schwartz & Andrasik, 2003).

To date, very little research has been conducted on the effectiveness of game-based relaxation training. Although there is not yet ample empirical evidence demonstrating the effectiveness of these new programs, it stands to reason that such technology may be useful for children and youths, in part because children and adolescents in the United States are heavily involved in videogames (Gentile & Walsh, 2002; Gentile et al, 2004). Research by Pop-Jordan et al (2008) on the use of HRV biofeedback training for the treatment of anxiety, conducted with 10-12 year old children. Results after 15 sessions of training showed that children from all groups showed significant improvements in HRV measures.

results were obtained for children with conduct and anxiety disorders. Another study found the efficacy of this approach with 24 children diagnosed with ADHD (Amon & Cauffman, 2004). Children learned to manipulate their heart rate using breathing techniques. The experimental group showed significant reductions in parent-reported ADHD symptoms. Researchers also noted that children took great interest in the study and were highly motivated by the use of technology and video game format. These results suggest that game-based treatments may be an enjoyable and motivating medium for treatment of children and adolescents. Results of a pilot study indicated that 14 to 35 percent of high-achieving children performed higher on standardized tests in reading and math after biofeedback training (Tomasino, 2004). This result was hypothesized to occur because participants learned to enter high-performance states by learning to better manage test anxiety and promote focus (McCraty & Tomasino, 2004).

The present study examines symptoms of inattention in a sample of 9 to 17 year olds. A game-based relaxation training combined with psychoeducation and behavior management intervention was found in previous research to result in significant improvements in attention and depression (Knox et al, manuscript under review). It is posited that anxious children who receive this intervention will demonstrate improvements in attention. There is a hypothesis that intervention participants will show significant improvements on the attention subscale of the Child Behavior Checklist – Parent Report Form relative to participants in the waitlist control group.

Methods

Participants

Thirty-one participants consented to take part in the study. However, eight participants (three females and six males) failed to complete the study, leaving a final sample of 23 children (10 females and 14 males). The portion of the sample who dropped out did not differ significantly in terms of demographics (age, gender, or SES) or in pretest scores [scores on the attention subscale for the Child Behavior Checklist (CBCL)]. The final sample of 23 participants ranged from 9 to 17 years ($M = 12.7$, $SD = 2.38$). Each participant had clinically significant anxiety, either a clinical disorder or problems such as excessive worry or fear. Participants were referred by pediatricians, nurse practitioners, and other mental health providers. The majority of participants were receiving traditional mental health treatment for anxiety or attention problems prior to and during the study (medication, therapy or both). None of the participants started medication during the course of the study. Twelve participants were assigned to the intervention group and the next 11 were assigned to the waitlist control group. Participants were assigned sequentially to groups, starting with the intervention group, because of the beginning of the study if there would be enough referrals to enroll a control group.

Independent sample t-tests and chi-square analysis were conducted to examine the groups. The intervention and control groups did not differ on age, gender, or socioeconomic status (SES).

Apparatus

Two biofeedback programs were utilized in this study. In the Freeze Frame program, when the player relaxes, he/she can color and add characters to a meadow, make a rain cloud, and blow up a balloon (Institute of HeartMath, 2010). In the other program (The Wild Divine Project, 2009) the participant achieves goals (e.g., making a fire, building a wall, shooting a bow and arrow) in a fantasy game. This game also uses images and sound to aid in rhythmic breathing and coherence.

Materials

The Attention Problems subscale for the Child Behavior Checklist (CBCL) was used. The CBCL is a questionnaire completed by parents of primary caregivers that assesses the youth's emotional and behavioral symptoms. The CBCL is very well established and reported to have high test-retest reliability, internal consistency, and discriminant validity (Achenbach & Edelbrock, 1983). Socioeconomic Status was evaluated using the Hollaender Prestige and Socioeconomic Scores (Nakao & Treas, 1994).

Procedure

The study was approved by the University Institutional Review Board. Participants completed informed assent forms, and their parents/caregivers completed informed consent forms for their participation in the study. Parents completed the CBCL upon enrollment into the study (pre-test). The game-based relaxation biofeedback (intervention) was implemented using a session-by-session protocol combining relaxation training and practice with education about how stress can affect people, how relaxation can relieve or prevent stress, and relaxation techniques in real life. Participants were also helped to identify significant stressors, events and thoughts that trigger anxiety. Participants were assigned behavioral strategies designed to help them most effectively incorporate the use of relaxation into their daily lives. Appendix 1 shows the session-by-session protocol that was used. Each session lasted for one hour. The control group was waitlisted, and offered game-based relaxation biofeedback at the completion of the study. At the completion of the study, parents completed a post-test CBCL.

Results

The intervention group's mean T-score on the CBCL Attention Problems sub

65.25 (SD=12.57) at pretest. This score falls in the “borderline” range of the CI group’s posttest mean T-score was 61.08 (SD=10.69), a score which falls in the waitlist control group’s mean T-score on the CBCL Attention Problems subscale at pretest, and 61.27 (SD=9.52) at posttest. Both scores fell in the “normal” range with condition (intervention or control) as the fixed factor. The dependent variable was CBCL Attention Problems subscale T-scores. The covariate was pre-test CBCL Attention Problems subscale T-scores. This analysis revealed significant differences between the groups at post-test ($F(2,22)=6.31, p=.008$; partial $\eta^2=0.39$) favoring the intervention group. Test analyses revealed that the intervention group’s scores reduced significantly ($t(11)=3.12; p=.01$), but the control group’s scores did not.

Discussion

The present study examines the efficacy of game-based biofeedback relaxation combined with psychoeducation and behavioral practice as a treatment for anxious youths. Children and youths who completed the intervention showed improvement in parent-reported attention compared with the wait-list control group. The waitlist control group showed no improvement on the attention problems subscale, while the intervention group scores improved significantly, suggesting that this intervention may be beneficial for attention problems experienced by anxious children.

Whether this intervention improves on existing treatments such as neurofeedback is possible however, that biofeedback and neurofeedback achieve similar outcomes. Previous research have correlated increased Alpha brain wave activity with meditative states. Alpha waves recorded at a slower and very regular 8 Hz frequency and Beta waves at quick transitions on EEGs. The link between HRV, SCL, and brain wave activity are correlations that occur concurrently. One does not cause the other. When a person is more relaxed, heart rate variability is rhythmically varied, sweat gland activity is decreased and Alpha brain wave activity increases. These are “end measures/results” of the mental meditation efforts. People who practice breathing, peaceful imagery, or positive memories help them produce decreased sympathetic nervous system arousal, as measured by the above outputs. Thus, both methods may be effective. There are a number of limitations to the current study. The relatively small sample size may limit the generalizability of the findings. Attrition was also an issue; of the original sample of 28, eight participants dropped out of the study. Although there were no identifiable differences between those who dropped out and those who remained in the study, it is possible that this was a threat to the internal and external validity of the study.

Assignment to condition was sequential rather than random. Future studies should use random assignment in order to better ensure the validity of the research. Also, the large majority of participants in the study were undergoing treatment at the start of and during the study. Some included medication, therapy, or both. Subsequent research should involve collecting detailed information about medications and other medical or mental health

allow for more precise conclusions about the implications of the findings.

Another problem encountered during the study was that the finger electrode children and as a result were quite large. Consequently, they did not collect E consistently so that data could not be used (data was not collected about 20% physiological data could not be provided. The use of child-sized hardware w clinical use and research involving this intervention.

Because anxiety is known to affect cognitive performance (Derakshan & Eyse 2009), further research is indicated to examine whether the improvements in enhancements in cognitive performance. This should be taken a step further improvements lead to improved academic achievement. Because anxiety is c problems afflicting the school age population, such research could have impo the school-age population. Future research also is recommended to examine this intervention as compared to medication and therapy for anxiety and atte children and youths. If replicated, these findings may provide important info caregivers considering options for treatment.

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Appendix 1

Game-Based Relaxation Training Study Protocol: Intervention Condition

Session #1

Pre-test measures

Rate Anxiety on 1-10 Visual Analogue Scale (VAS)

Feelings that get in my way; What it means to feel “upset.”

Feelings are OK We need a healthy way to deal with them.

How the brain affects the body (favorite food example).

When we are frustrated, scared, worried, angry or upset, our heart rhythms are affected.

Activity: How stress gets in my way.

List: Things and situations that make me feel anxious or stressed.

List/Draw: Where I notice tension in my body.

What will be better in my life when stress is no longer getting in my way.

Teach Relaxation

Introduce Freeze Frame and Wild Divine.

Rate Anxiety on VAS

Session #2

Rate Anxiety on VAS

REVIEW:

Feelings are OK

Need a healthy way to deal with them

REVIEW:

How to relax

REVIEW:

How the brain affects the body (favorite food example).

When we are frustrated, scared, worried, angry or upset, our heart rhythms are affected.

REVIEW:

Where I notice tension in my body.

TEACH AND IDENTIFY:

Triggers of fear, worry, and insecurity.

Examples of thought triggers:

I'll never pass the test

I'm so stupid/ugly/fat/clumsy/unpopular....

I'll never get all this done

I can't believe I said that. I am so

I know I'll screw this up

I can't...

Everybody thinks I'm....

Continue with Freeze Framer and Wild Divine.

Rate Anxiety on VAS

PLAN: When I will relax this week

Session #3

Rate Anxiety on VAS

REVIEW:

How did relaxation at home go?

How to relax

Modify relaxation plan if needed

Continue with Freeze Framer and Wild Divine.

Rate Anxiety on VAS

PLAN: When I will relax this week

Session #4

Rate Anxiety on VAS

REVIEW:

How did relaxation at home go?

Modify relaxation plan if needed

Continue with Freeze Framer and Wild Divine.

Rate Anxiety on VAS

PLAN: When I will relax this week

Session #5

Rate Anxiety on VAS

REVIEW:

How did relaxation at home go?

Modify relaxation plan if needed

Continue with Freeze Framer and Wild Divine

Rate Anxiety on VAS

PLAN: When I will relax this week

Session #6

Rate Anxiety on VAS

REVIEW:

How did relaxation at home go?

Modify relaxation plan if needed

Continue with Freeze Framer and Wild Divine.

Rate Anxiety on VAS

PLAN: When I will relax this week

Session #7

Rate Anxiety on VAS

REVIEW:

How did relaxation at home go?

Modify relaxation plan if needed

Continue with Freeze Framer and Wild Divine.

Rate Anxiety on VAS

Identifying additional triggers, plan for in-vivo use

PLAN: When I will relax this week

Session #8

Rate Anxiety on VAS

REVIEW:

How did relaxation at home go?

Modify relaxation plan if needed

Continue with Freeze Framer and Wild Divine.

Rate Anxiety on VAS

Review triggers to stress, more plans for in-vivo use

PLAN: When I will relax this week

Post-test measures

Referral if needed

