Using Differential Reinforcement in the Presence of Stressors to Teach Self Calming

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Anxiety is a problem affecting 31% of Americans (NIMH, 2017), especially people diagnosed with Autism Spectrum Disorder. Some popular treatments have demonstrated at least moderate efficacy with various populations, though most require the learner to demonstrate significant verbal repertoires. The current study tested the efficacy of a selectionist intervention combining systematic desensitization, positive feedback, and temporary interruption of positive feedback contingent upon indices of stress for the treatment of two stressors for one student diagnosed with Severe (Level 1) Autism Spectrum Disorder, with minimal verbal skills. This treatment package has come to be known, colloquially, as "calm counts".

Keywords: anxiety, shaping, calming

Anxiety disorders are prevalent, especially in learners with Autism Spectrum Disorder (Van Steensel, Bogels, & Perrin, 2011), and particularly as learners age (Gillot & Standon, 2007). Van Steensel et al. (2011) estimated that 40% of people with Autism Spectrum Disorder suffer from an anxiety disorder, with specific phobias accounting for the largest percentage. Groundhuis and Aman (2012) noted that it is difficult to be sure of the actual prevalence rate, primarily due to overlap of symptoms.

Without effective treatment, anxiety can significantly impact quality of life (Barrera & Norton, 2009), in part via self-imposed limits on degrees of freedom. A learner who is currently afraid of an escalator, for example, can soon become afraid of a nearby mall that has an escalator, limiting his opportunity to enjoy the pretzel shop in the same mall. Without systematic plans in place, caretakers will tend to try a variety of interventions, such as coaxing, bribing, tricking, and shaming, that can worsen anxiety and related behaviors over time. One common reaction is to tell an upset learner to "calm down".

Treatments

Clinical experience suggests that most teachers and parents manage their learner's avoidance responses by: minimizing exposure to stressors[1]; attempting to prompt a relevant communicative response; talking with learners after inappropriate behaviors (e.g., social autopsies) (Myles, Adreon, & Stella, 2001); or by prompting engagement in sensory integration (e.g., Case-Smith & Bryon, 1999); or other potentially calming activities. Each of these strategies, though sometimes effective, can impede the development of a calming repertoire.

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[1] The term "stressor" is widely used to describe stimuli associated with escape or avoidance responses, including phobias, intolerances, and activities with which a student has a negative history, such as an academic task with which the student has experienced minimal success. In this paper, "stressor" narrowly describes stimuli of which a particular student is phobic.

Brief explanations of these impediments are described for each intervention below.

Management of stressors, by arranging for avoidance, when feasible, can be an effective way to help a learner participate in a variety of environments. Escalators can be avoided, and a learner can participate in a visit to the mall. But there is a natural limit to the number of stressors that can be avoided and excessive management of stressors can impede the development of a calming repertoire. One way management of stressors limits growth is by providing insufficient practice tolerating stressors. Avoidance of stressors can be especially problematic when stressors are consistently removed contingent upon avoidance behaviors, as this escape negatively reinforces avoidance behaviors. "Avoiders" tend to develop additional anxiety disorders (Craske, Miller, Rotunda, & Barlow, 1990).

While communicative responses may frequently be relevant in the presence of stressors, anxious learners also tend to be less capable of complex verbal behaviors (Padmala, Bauer, & Pessoa, 2011). If a simple mand (e.g., "stop") can be evoked and reinforced, anxiety is likely to subside, and the mand may be an appropriate target. But it is possible that no relevant communicative response is feasible over the long term (e.g., "I don't want to brush my teeth") or effective in reducing arousal (e.g., "I'm mad"). For learners able to emit functional communication resulting in escape or avoidance of stressors, continued growth is dependent upon skilled teachers gradually changing the criteria upon which escape, or avoidance is contingent (Hagopian et al., 1998).

Social autopsies (Myles et al., 2001) are sometimes implemented after problem behavior episodes and generally involve discussions about what happened and what could be done differently in the future. Social autopsies and sensory integration (Case-Smith & Bryon, 1999) both come with the risk of reinforcing attention maintained or escape/avoidance maintained behaviors. Each of these interventions results in teacher attention and each takes the learner out of the context that evokes the problem behavior. The efficacy of social autopsies depends both upon the identification of the function of a current problem behavior and upon consideration of whether skill-building is necessary. Talking about something coming up in the future is frequently insufficient, and repeated, supported exposure and practice with calming is frequently necessary.

A variety of behavioral interventions have been used to treat anxiety and related behaviors, most notably including: Progressive Muscle Relaxation (Jacobson, 1938), Behavior Relaxation Training (BRT) (Schilling & Poppen, 1983), Systematic Desensitization (Wolpe, 1958), Acceptance and Commitment Therapy (ACT) (Hayes, Strosahl, & Wilson, 2011), and Zones of Regulation (Kuypers, 2011). Each of these is briefly reviewed below.

Progressive Muscle Relaxation (Jacobson, 1938) involves: deep breathing, paced with an instructor; practice tensing and relaxing various muscle groups; and verbal exercises describing how tension and relaxation feel in contrast with each other. The rationale supporting Progressive Muscle Relaxation is that learners will develop the capacity to spontaneously detect indices of tension and will engage in self-calming responses. Benefits depend, at least in part, upon a learner's capacity to describe internal events (e.g., "it feels tight"). For appropriate candidates, extensive practice is required, though evidence suggests that abbreviated versions (Bernstein & Borkovec, 1973) have sometimes been sufficient (King, 1980). It should be noted, however, that the articles reviewed in King (1980) involve multi-component interventions and, as such, it is difficult to determine the role played by abbreviated Progressive Muscle Relaxation.

Behavior Relaxation Training (BRT) (Schilling & Poppen, 1983) involves the use of behavior skills training to teach learners to demonstrate behaviors consistent with being "calm", specifically: breathing, quiet, body, head, eyes, mouth, throat, shoulders, hands, and feet. BRT has been demonstrated to be an effective means of teaching calming (e.g., Schilling & Poppen, 1983) and can be effective with learners with minimal verbal skills (Paclawskyj & Yoo, 2006). Though extensive verbal repertoires are not required, students do need to cooperate reasonably well with instructions and require either imitative repertoires, listening skills, or the capacity to learn by physical prompting and prompt fading.

Systematic Desensitization (Wolpe, 1958) involves the introduction of stimuli that evoke only moderate stress responses and the gradual increase in exposure to those stressors. At its origin, Systematic Desensitization involves hierarchical rankings of stressors by the learner, mastery of Progressive Muscle Relaxation, and the use of Progressive Muscle Relaxation strategies, initially in the presence of stimuli evoking the lowest levels of stress, followed by progression up the hierarchy of stimuli evoking stress. Though not explicitly prescribed, it has become customary for teachers using Systematic Desensitization to offer a learner distracting or competing stimuli, such as access to an iPad, during the introduction of stressors (Cavalari, DuBard, Luiselli, & Birtwell, 2013; Tyner et al., 2016). There is substantial evidence of the efficacy of Systematic Desensitization (e.g., Flood & Luiselli, 2016; Rothbaum et al., 2000).

Acceptance and Commitment Therapy (ACT) (Hayes, Strosahl, & Wilson, 2011) has been researched extensively over the past decade, including 216 studies from 2013 to 2015 (Powell, 2018). With clear parallels to Zen Buddhism (Hayes, 2002), ACT includes: diffusion; acceptance; contact with the present moment; the observing self; values; and, committed action. Some components of ACT, such as presence activities, can be practiced with learners with minimal verbal repertoires. Other components of ACT require extensive verbal repertoires.

Zones of Regulation (Kuypers, 2011) has become a popular intervention for teaching self-regulation. In the Zones of Regulation curriculum, learners are prompted to associate arousal levels with colors and to associate colors with appropriate activities. For example, severe agitation is "red" and red may be associated with moving to an isolated beanbag in the corner of the room. The Zones of Regulation curriculum is recommended for learners demonstrating at least the intellect of an average four-year-old.

Over-application of the Zones of Regulation curriculum may suffer the same problems as over-application of social autopsies, in that the intervention may serve as inadvertent reinforcement of escape/avoidance behavior or of attention-maintained behavior. The Zones of Regulation curriculum also relies upon a learner's capacity to tact internal states, his tendency to do so honestly, and his responsiveness to prompts to engage in selected activities deemed appropriate to a level of arousal. Many learners with special needs lack the prerequisites needed to benefit from the Zones of Regulation curriculum.

The interventions described in the paragraphs above, to varying degrees, rely upon verbal mediation. Learners may assist in the development of the intervention by ranking the relative stress evoked by various stimuli. Some of these interventions rely upon a learner's capacity to accurately describe internal states and upon his tendency to honestly describe the behaviors of himself and others.

A selectionist (Skinner, 1981) account of behavior allows for the development of a streamlined approach to calming, one that does not rely upon advanced verbal repertoires. A learner can be exposed to stimuli typically resulting in stress responses, and self-calming can be differentially reinforced.

Differential reinforcement is most effective when consequences immediately follow relevant responses. If a learner works with his teacher for three minutes and receives access to a highly preferred activity because his participation in the session is deemed to be of higher quality than usual, this is unlikely to have a robust effect upon the qualities of participation in future sessions. But, if tokens are earned throughout the session, and if each token immediately follows a high quality response, and those tokens are exchanged for backup reinforcers the moment the last token is earned, there is an improved likelihood that those tokens will effectively select high quality responses.

Analogously, "calm counts" establish a forum in which each number counted by the teacher soon comes to function as a conditioned reinforcer for the calming response it follows. Contrasting this with typical application of systematic desensitization, a feedback system is formally designed to select calming responses as they occur throughout the period of exposure to a stressor. Any session of calm counts or of systematic desensitization concludes with removal of the aversive stimulus. On the vast majority of sessions, calm counts and systematic desensitization conclude following a "success", a few moments of relative calm. Only calm counts specifically arrange for an emphasis on reinforcing calming responses, selecting them, and for de-emphasis on prompting calming responses.

A "calm count" establishes a condition relevant to calming by exposing a learner to stimuli typically resulting in modest indices of stress, such as raised eyebrows, pursed lips, or shallow breathing. As the learner remains calm, the teacher counts out loud and lifts her fingers in a corresponding fashion, praising intermittently. When the teacher reaches "10", the stressor is removed and preferred stimuli are added. During the count, when the learner demonstrates indices of stress, the teacher temporarily pauses counting and looks away, resuming the count the moment the learner appears calm.

Though the teacher models an exaggerated calm demeanor, including audible deep breathing, verbal prompts for calming responses are rarely provided. Calm counts rely primarily upon consequences to shape calm and rely minimally upon prompts to calm. Depending upon the stressor chosen, calming tends to be primarily a function of the learner's motivation to escape the relevant stressor, conditioning a return from teacher silence to teacher counting as a form of reinforcement. It is noteworthy that, in sharp contrast to most interventions, support is available contingent upon self-calming and is removed contingent upon indices of stress. Withdrawal of support establishes the return of support as a form of reinforcement.

Methods

This study combined a multiple baseline across stressors design with a changing criterion within stressors design. The author, and later the parents, first used calm counts to improve tolerance of tooth brushing, and then used calm counts to improve tolerance of a bike helmet.

Participant

"Gerard" was a 9-year-old male diagnosed with Severe (Level 1) Autism Spectrum Disorder. He hit others an average of four times per week, outside of the contexts of brushing teeth and donning a bike helmet, and he usually hit at least twice when his parents attempted to brush his teeth or put on his bike helmet. In most contexts, redirections and corrections tended to evoke screaming and sometimes evoked hitting. Gerard demonstrated a very limited communication repertoire, usually saying a generic "ba" for any preferred item or event and only approaching others for items or activities an average of four times per hour outside of structured

mand training sessions. He was usually able to follow directions to "clap hands" or "touch head" but demonstrated no other consistent listening skills. He was able to imitate five different gross motor actions with 90% accuracy and spent most of his downtime engaged in self-stimulatory behavior.

Dependent Measures

Partial interval data on whining and physical aggression were gathered in four-second intervals. All sessions were videotaped, and data were recorded by viewing these video clips, allowing researchers to pause the video every four seconds and score whether whining or physical aggression had been demonstrated during the preceding interval. This permitted a high percentage of agreement. Though not formally documented, in the interest of simplifying operational definitions of dependent measures, other relevant responses included shallow breathing, furrowed brow, moving body slightly away from relevant materials, yelling, pushing materials away, and running from materials.

Baseline data were collected in the form of the participant's parents attempting to brush the learner's teeth and to put a bike helmet on his head, a manner that they had employed for the previous three months. In baseline, parents repeated verbal instructions every five seconds, physically blocked escape, and reminded the participant of potential reinforcers. Baseline evidence showed that the participant's parents were not able to brush the participants' teeth or get the helmet on his head. Parents ended baseline sessions in an average of 46 seconds, with a range from 18 seconds to 86 seconds.

Interobserver Agreement

Agreement was calculated by scoring the number of four-second intervals of agreement and dividing the number of intervals of agreement by the total number of intervals recorded and multiplying by 100. Agreement was calculated for 40% of sessions and agreement was 100%. Gerard's parents alternately served as the second observer and this process functioned as a method of training them to discriminate between small stress responses, such as shallow breathing, and calm tolerance.

Treatment

In treatment, the researcher presented an aversive stimulus (e.g., a toothbrush within three inches of the participant's mouth) and utilized the following steps: began counting at a moderate pace (approximately one second per number), both vocally and with fingers; modeled an exaggerated calm affect; periodically praised "calm" waiting; after reaching "10", removed the stressor and delivered praise and a token. Throughout the counting time, the teacher attended carefully to any signs of tension.

When signs of tension were observed, the teacher paused and looked slightly away from the learner, continuing to hold up the fingers that had already been counted. The teacher waited and carefully observed the learner peripherally, resuming counting, without starting over at "one", the moment the learner calmed.

Criteria for counting, especially for relatively novice learners, are flexible. The teacher shapes calming by sometimes continuing to count despite modest signs of tension and by sometimes resuming counting after an agitated learner has only partially deescalated. Experienced teachers, as necessary, raise their criteria throughout a single calm count.

As with systematic desensitization, stressors are gradually and systematically increased following successful calm counts. For Gerard, the following phases were used for tooth brushing: (1) An empty toothbrush was held three inches from his mouth (implemented by author); (2) a wet toothbrush touched his lip;

(3) a wet toothbrush touched his teeth (implemented by Mom); (4) a wet toothbrush scrubbed his front teeth; (5) a toothbrush with toothpaste scrubbed his front teeth; (6) a toothbrush with toothpaste scrubbed all of his teeth (implemented by Mom or Dad); (7) full tooth brushing with no counting out loud.

A similar treatment protocol was used to teach Gerard to don a bike helmet: (1) A helmet was held six inches from his head (implemented by author); (2) a helmet touched his head (implemented by Mom); (3) a helmet rested on his head; (4) a helmet rested on his head and one teacher hand touched the chin strap; (5) a helmet rested on his head and a teacher touched both chin straps (Mom or Dad); (6) a teacher clipped the chin strap; (7) the student clipped his own strap.

Results

The combined multiple baseline and changing criterion designs used in the current study demonstrate a clear functional relation between the use of differential reinforcement in the presence of a stressor and calming. These data contribute to the extensive body of research supporting systematic desensitization (Wolpe, 1958) and provide initial support for the use of sensitive and immediate differential reinforcement of calming responses.

Gerard's tolerance of tooth brushing and of donning a bike helmet both improved to the point that either parent was able to brush his teeth and put his bike helmet on without counting and without signs of tension. Tooth brushing and donning a bike helmet were mastered within 28 and 22 training sessions, respectively. All sessions occurred over the course of eight calendar days.

Baseline performance for donning a bike helmet improved slightly following the introduction of calm counts for tooth brushing. This suggests some generalization and slightly weakens the functional relation demonstrated between the use of calm counts and improved tolerance of stressors. But, following the introduction of calm counts, tolerance of the bike helmet improved significantly. And, both tooth brushing and the bike helmet had, according to parent reports, been very challenging for several months before intervention.

With tooth brushing, physical aggression reduced to zero immediately upon introduction of calm counts and remained at zero through the remainder of the study. Whining also reduced to 20% of intervals upon introduction of calm counts, subsequently reaching a maximum of 30% during the first calm count conducted by the learner's mother. A similar increase in whining was observed during the first calm count conducted by the learner's father and, in both cases, whining quickly subsided.

With the bike helmet, both physical aggression and whining reduced immediately following introduction of calm counts and physical aggression reduced to zero by the fifth treatment session. Again, whining temporarily increased when the learner's mother began to implement treatment and again when the learner's father began to implement treatment, subsiding quickly in both cases.
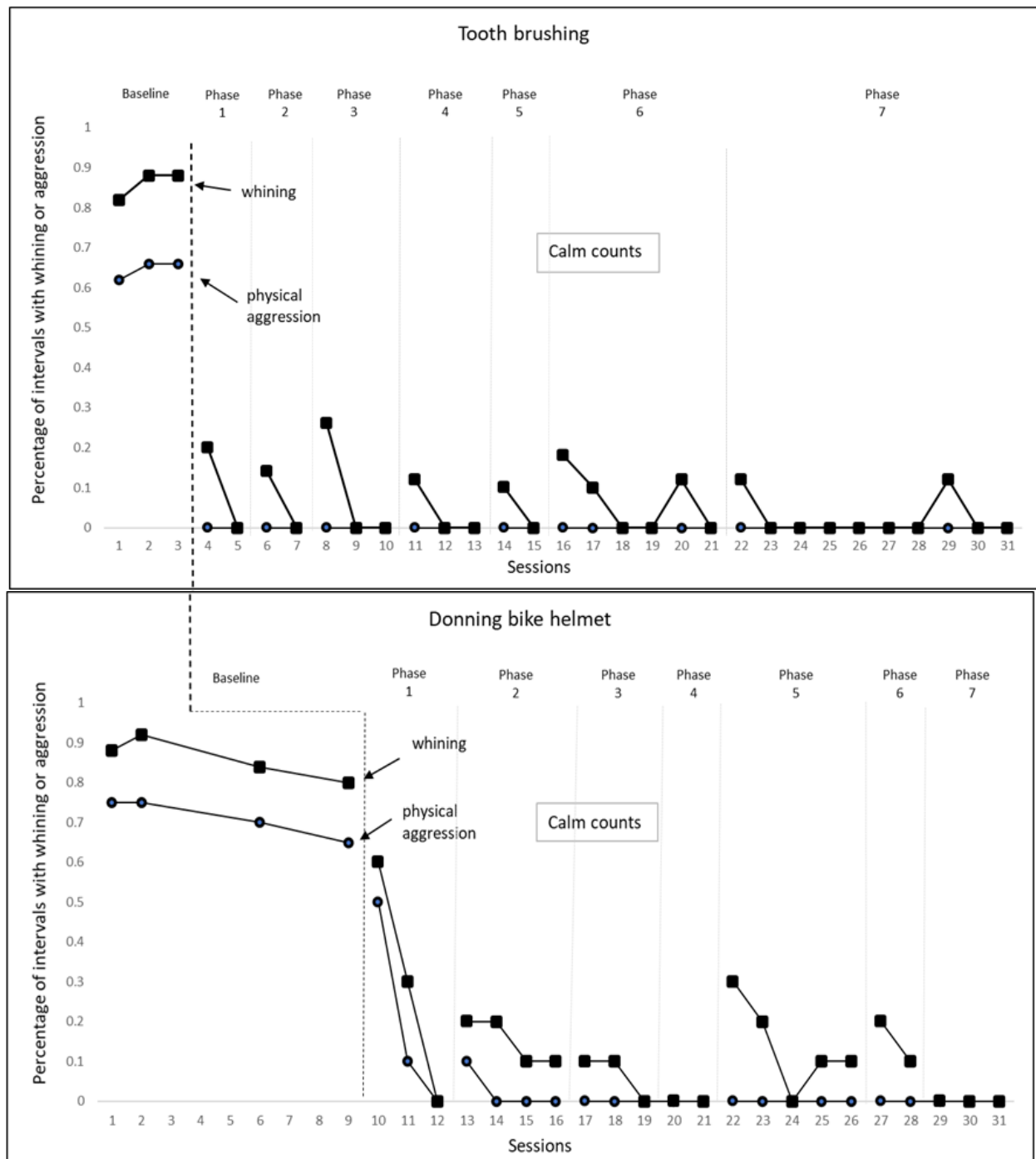
Figure 1. Whining and aggression during exposure sessions.

Discussion

The current study demonstrates that calm counts can be effective with students with very limited imitative, listening, or communicative repertoires. Unlike other calming procedures, students participating in calm counts generate their own calming responses, and the teacher's role changes from one of prompting calming responses to one of reinforcing self-calming responses.

Calm counts were developed for a particular student with minimal verbal repertoires, for whom more traditional versions of systematic desensitization yielded insufficient progress. The author successfully used systematic desensitization to decrease fear of new buildings, unfamiliar bathrooms, and small cars. But in the time it took to overcome those fears, the learner developed fears of baths, movie theatres, carnival rides, elevators, escalators, busy intersections, and Chic-fil-A (a restaurant). The author hypothesized that a more refined context, minimizing prompting and emphasizing indices of progress as a form of reinforcement, was required.

Whether explicitly programmed or not, indices of learner stress are usually followed by some form of attention. For example, a teacher might tell a student he is "in the red zone", ask him "what's wrong?", or encourage him to try a little bit longer. These imprecise consequences may result in counter-productive ambiguity, impeding the development of stimulus control for calming responses. For some learners, it may be necessary to view this contingency as upside down. Attention may need to be provided contingent upon calming and withdrawn contingent upon indices of stress. This reliance upon reinforcement is consistent with a selectionist approach (Skinner, 1981).

Like other relaxation training procedures, it is important for calm counts to be introduced proactively. Experience suggests that, throughout treatment, the vast majority of calm counts should be conducted proactively, rather than reactively.

Some teachers confuse calm counts with the familiar practice of requiring a student to count to 10. When practicing calm counts, ideally, the student does not count along. Some students choose to count along, and this is unproblematic providing the student is not pushing the rate of the calm count. If the teacher judges that a learner is counting along in an attempt to accelerate the count, the teacher pauses, resuming counting when the learner refrains from counting for at least one-two seconds.

Future research should record the emergence of repertoires not specifically targeted, such as improved rate of spontaneous imitation, social referencing, and sensitivity to verbal feedback as a form of reinforcement. The researcher anecdotally noted increases in each of these behaviors after calm counts were introduced. It is possible that the escape provided at the conclusion of each calm count established the value of the teacher's counting, that pauses in counting tended to result not only in self-calming but also in social referencing, and that a portion of the teacher's counts followed imitation of the calm behaviors the teacher was modeling, such as calm breathing.

References

Allen, K. D., & Matthews, J. R. (1998). Behavior management of recurrent pain in children. In *Handbook of child behavior therapy* (pp. 263-285). Boston, MA: Springer.

Barrera, T. L., & Norton, P. J. (2009). Quality of life impairment in generalized anxiety disorder, social phobia, and panic disorder. *Journal of Anxiety Disorders, 23*(8), 1086-1090.

Bernstein, D. A., & Borkovec, T. D. (1973). *Progressive relaxation training: A manual for the helping professions.* Champaign: Research Press.

Case-Smith, J., & Bryan, T. (1999). The effects of occupational therapy with sensory integration emphasis on preschool-age children with autism. *American Journal of Occupational Therapy, 53*(5), 489-497.

Cavalari, R. N., DuBard, M., Luiselli, J. K., & Birtwell, K. (2013). Teaching an adolescent with autism and intellectual disability to tolerate routine medical examination: Effects of a behavioral compliance training package. *Clinical Practice in Pediatric Psychology, 1*(2), 121.

Craske, M. G., Miller, P. P., Rotunda, R., & Barlow, D. H. (1990). A descriptive report of features of initial unexpected panic

attacks in minimal and extensive avoiders. *Behavior Research and Therapy, 28*(5), 395-400.

Flood, W. A., & Luiselli, J. K. (2016). Home-based in vivo desensitization treatment of bathroom avoidance in a child with autism spectrum disorder. *Clinical Case Studies, 15*(6), 476-483.

Gillott, A., & Standen, P. J. (2007). Levels of anxiety and sources of stress in adults with autism. *Journal of Intellectual Disabilities, 11*(4), 359-370.

Grondhuis, S. N., & Aman, M. G. (2012). Assessment of anxiety in children and adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders, 6*(4), 1345-1365.

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31*(2), 211-235.

Hayes, S. C. (2002). Buddhism and acceptance and commitment therapy. *Cognitive and Behavioral Practice, 9*(1), 58-66.

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (2011). *Acceptance and commitment therapy: The process and practice of mindful change*. New York: Guilford Press.

Jacobson, E. (1938). *Progressive relaxation*. Chicago: University Chicago Press.

Jain, S., Shapiro, S. L., Swanick, S., Roesch, S. C., Mills, P. J., Bell, I., & Schwartz, G. E. (2007). A randomized controlled trial of mindfulness meditation versus relaxation training: Effects on distress, positive states of mind, rumination, and distraction. *Annals of Behavioral Medicine, 33*(1), 11-21.

King, N. J. (1980). Abbreviated progressive muscle relaxation. In M. Hersen, R. M. Eisler, and P. M. Miller (Eds.), *Progress in behavior modification* (pp. 147-182). San Diego, CA: Academic Press.

Kuypers, L. (2011). *The zones of regulation.* San Jose: Think Social Publishing.

Myles, B. S., Adreon, D., & Stella, J. (2001). *Asperger syndrome and adolescence: Practical solutions for school success*. Shawnee: AAPC Publishing.

Norton, M., Holm, J. E., & McSherry II, W. C. (1997). Behavioral assessment of relaxation: The validity of a behavioral rating scale. *Journal of Behavior Therapy and Experimental Psychiatry, 28*(2), 129-137.

Paclawskyj, T. R., & Yoo, J. H. (2006). Behavioral Relaxation Training (BRT): Facilitating acquisition in individuals with developmental disabilities. *NADD Bulletin, 9*, 18-13.

Padmala, S., Bauer, A., & Pessoa, L. (2011). Negative emotion impairs conflict-driven executive control. *Frontiers in Psychology, 2*, 192.

Poppen, R. (1988). *Behavioral relaxation training and assessment*. Oxford: Pergamon Press.

Poppen, R., & Maurer, J. P. (1982). Electromyographic analysis of relaxed postures. *Biofeedback and Self-Regulation, 7*(4), 491-498.

Powell, A. (2018). When science meets mindfulness. *The Harvard Gazette*.

Prakash, R. S., Hussain, M. A., & Schirda, B. (2015). The role of emotion regulation and cognitive control in the association between mindfulness disposition and stress. *Psychology and Aging, 30*(1), 160.

Qualls, P. J., & Sheehan, P. W. (1981). Electromyograph biofeedback as a relaxation technique: A critical appraisal and reassessment. *Psychological Bulletin, 90*(1), 21.

Rothbaum, B. O., Hodges, L., Smith, S., Lee, J. H., & Price, L. (2000). A controlled study of virtual reality exposure therapy for the fear of flying. *Journal of Consulting and Clinical Psychology, 68*, 1020.

Schilling, D. J., & Poppen, R. (1983). Behavioral relaxation training and assessment. *Journal of Behavior Therapy and Experimental Psychiatry, 14*(2), 99-107.

Skinner, B. F. (1981). Selection by consequences. *Science, New Series, 213*(4507), 501-504.

Tyner, S., Brewer, A., Helman, M., Leon, Y., Pritchard, J., & Schlund, M. (2016). Nice doggie! Contact desensitization plus positive reinforcement decreases dog phobias for children with autism. *Behavior Analysis in Practice, 9*, 54-57.

Van Steensel, F. J., Bögels, S. M., & Perrin, S. (2011). Anxiety disorders in children and adolescents with autistic spectrum disorders: A meta-analysis. *Clinical Child and Family Psychology Review, 14*(3), 302.

Wolpe, J. (1958). *Psychotherapy by reciprocal inhibition*. Stanford: Stanford University Press.