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Reducing Test Anxiety in School Settings: A Controlled Pilot Study Examining a Group Format Delivery of the Attention Training Technique Among Adolescent Students

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Researchers have called for the examination of test anxiety interventions that extend beyond the delivery of individual services by a trained professional. Following from conceptual models and research findings underscoring the importance of metacognitive beliefs to test anxiety, a controlled pilot study examined whether a group format delivery of the attention training technique (ATT) component of metacognitive therapy reduces test anxiety among eighth-grade students. Students completed baseline study measures and were allocated based upon class period to five sessions of ATT (n = 39) or a music listening control (n = 34) delivered within a group format during a school week. Students completed postintervention study measures on the final day of the intervention and completed follow-up study measures approximately 3 weeks following the intervention. As predicted, students receiving ATT reported less postintervention test anxiety than the control when they held stronger baseline metacognitive beliefs about worry. The patterns of findings held at the follow-up and when specifically examining the cognitive (i.e., worry) dimension of test anxiety. Study results suggest that ATT may be a viable test anxiety intervention for students holding heightened metacognitive beliefs about worry. Future directions are discussed.

Keywords: adolescence; attention training technique (ATT); metacognitive beliefs; school; test anxiety

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Test anxiety is a near-ubiquitous phenomenon that occurs when assessment performance is under evaluation (Zeidner, 2007). Test anxiety is associated with a number of adverse outcomes, including reduced performance on standardized tests, a lower grade point average, and greater general emotional instability (von der Embse, Jester, Roy, & Post, 2018). As increased anxiety symptom severity relates to greater negative emotionality across time (Leadbeater, Thompson, & Gruppuso, 2012), a broader reach of the impact of test anxiety may not yet be realized. Given the breadth of potential implications of test anxiety on academic performance and mental health, researchers have sought to develop conceptualizations of test anxiety to inform treatment efforts.

Conceptualizations of test anxiety emphasize three dimensions: cognitive, autonomic reactivity, and behavioral responses (Lowe et al., 2008; Wren & Benson, 2004; Zeidner, 2007). The cognitive dimension fundamentally is marked by worry about performance, autonomic reactivity reflects somatic anxiety, and behavioral responses generally relate to coping behavior. Although some researchers describe anticipatory and postevent processing associated with test anxiety (e.g., worry about performance before and after a test; Lowe et al., 2008), other researchers focus on experiences occurring specifically within a testing situation. For example, Wren and Benson conceptualize test anxiety as individual differences in worry (e.g., "I worry about failing"), somatic anxiety (e.g., "My heart beats fast"), and behavioral coping (e.g., "I tap my feet") during a test. As there is not yet consensus as to the breadth of the test anxiety construct (Zeidner, 2007), we used a long-standing conceptualization of test anxiety

focused on anxiety specifically during a testing situation (e.g., Spielberger, 1980).

The cognitive dimension of test anxiety has particularly deleterious effects, such as exacerbating threat perceptions and cognitive processing interference in the form of inefficient cue utilization (e.g., Cassady, 2004). Threat perceptions during a test often pertain to a sense of heightened test difficulty and related implications (e.g., level of readiness, performance) that detract from concentrating on test material and worsen negative emotionality, contributing to retrieval failures and reduced performance (Cassady, 2004). The cognitive dimension of test anxiety predicts worse test performance even when statistically controlling for prior performance (Cassady, 2004), while helping to account for relations between indices of negative emotionality and academic performance (Owens, Stevenson, Hadwin, & Norgate, 2012).

Following from the importance of the cognitive dimension of test anxiety, conceptual models emphasize the role of worry in the pathogenesis of test anxiety. Zeidner and Matthews's (2005) self-referent executive function model of test anxiety parallels Wells and Matthews's (1994) similarly named model of emotional disorders (i.e., self-regulatory executive function model). A central premise of those models is that self-knowledge guides nonadaptive self-regulatory efforts, such as worry, that maintain and worsen emotional distress (Wells & Matthews, 1994; Zeidner & Matthews, 2005). A central domain of self-knowledge in both models is metacognitive beliefs (i.e., beliefs about thinking), particularly metacognitive beliefs about worry. According to Zeidner and Matthews's model, a testing situation evokes a triggering cue (e.g., appraisal of failure) and worry is a central way individuals cope because metacognitive beliefs about the benefit of worry initiate worry about performance. As reviewed, that worry serves to increase threat perceptions, negative emotionality, and cognitive interference within the testing situation (Zeidner & Matthews, 2005).

Whereas Zeidner and Matthews's (2005) model broadly outlines potential metacognitive beliefs underlying worry (e.g., "It is important to monitor one's worry"), a separate model, based upon Wells and Matthews's (1994) self-regulatory executive function model, implicates two specific types of metacognitive beliefs in relation to worry: positive and negative (Wells, 1995). Wells's (1995) metacognitive model proposes that individuals initially worry because of positive beliefs about its benefit (e.g., "If I worry, I will be prepared"). The model further proposes that negative beliefs about the dangerousness and uncontrollability of worry (e.g., "No matter how hard I try, I cannot control worry") contribute to its maintenance, as those beliefs lead to ineffective coping that strengthen beliefs about the danger and uncontrollability of worry. As Wells and Matthews's self-regulatory executive function model is a transdiagnostic model for emotional disorders, conceptually, the role of positive metacognitive beliefs and negative metacognitive beliefs should extend from generalized worry to worry about assessment performance. Indeed, the extant literature indicates that metacognitive beliefs about worry, particularly negative metacognitive beliefs, positively relate to test anxiety (O'Carroll & Fisher, 2013; Spada & Moneta, 2014; Spada, Nikcevic, Moneta, & Ireson, 2006).

Reviewed conceptual models and research findings converge on the possibility that metacognitive-based intervention strategies seeking to reduce worry could be useful for reducing test anxiety. The attention training technique (ATT; Wells, 1990) is one component of metacognitive therapy (Wells, 2009), a form of cognitive-behavioral therapy emphasizing that emotional disorders originate because of nonadaptive coping responses to thoughts, feelings, and emotions (e.g., through the use of worry). Metacognitive therapy differs from other forms of cognitive-behavioral therapy because metacognitive beliefs underlying such processing are the target for intervention rather than challenging the accuracy of content-based beliefs, such as likelihood and cost estimates (Wells, 2009). ATT is an auditory listening technique developed to foster disengagement from worry. To accomplish this aim, ATT consists of differentially attending to non-self-relevant auditory stimuli for approximately 12 minutes, regardless of internal experiences that may become present. Auditory stimuli are embedded within an audio recording (e.g., speaker's voice, church bell, running water) and voice prompts provide directions as to how individuals should attend to the stimuli. Within a session of ATT, 5 minutes are spent on selective attention (i.e., instructed to listen to specific sounds while disregarding others), followed by 5 minutes on attention switching (i.e., instructed to rapidly switch focus of attention between sounds), and the final 2 minutes are spent on divided attention (i.e., instructed to focus on multiple sounds at once; Wells, 2009).

ATT putatively exerts therapeutic benefit by strengthening attentional control, thereby facilitating disengagement from nonadaptive forms of self-referential processing (e.g., worry; Wells, 2000). Through the strengthening of attentional control and reduced worry-based processing, individuals receive disconfirming evidence surrounding existing self-knowledge for coping, such as metacognitive beliefs (Wells, 2000). There is empirical support for ATT reducing anxiety, such as generalized anxiety, health anxiety, posttraumatic stress, and social anxiety

among adults (see Fergus & Bardeen, 2016; Knowles, Foden, El-Deredy, & Wells, 2016, for reviews). As discussed in those reviews, ATT evidences moderate-to-large anxiety reduction across case studies, single-case experimental studies, and randomized controlled trials. Effects have been found among unselected samples and samples selected based upon elevated symptom severity (i.e., symptom self-report cutoff or diagnostic criteria). Pursuant to the present research, preliminary studies suggest that the benefits of ATT may extend to children and adolescents. For example, two studies have found that ATT strengthens self-control, as assessed using behavioral delay of gratification tasks among students as young as 5–6 years of age (Murray, Scott, Connolly, & Wells, 2018; Murray, Theakston, & Wells, 2016). Despite the potential promise surrounding ATT in relation to anxiety reduction, the application of ATT to test anxiety remains unexamined.

Whether ATT reduces test anxiety among adolescent students may merit particular attention, as test anxiety interventions with adolescent students remain understudied (von der Embse, Barterian, & Segool, 2013). Putwain, Chamberlain, Daly, and Sadreddini (2014) noted that interventions involving service delivery other than the delivery of individual services by a trained professional warrant specific consideration in the treatment of test anxiety in schools. The reason is that novel methods of service delivery for test anxiety can reduce the burden of service delivery and broaden the reach of the respective intervention within schools. Pursuant to this point, two studies found that ATT can be delivered to primary school students in a group format through a recording that has a voice-over narrator directing them how to engage their attention with presented auditory stimuli (Murray et al., 2016, 2018). Following the successful implementation of ATT using that format, a group format delivery of ATT could be useful when seeking to reduce test anxiety among adolescent students.

The purpose of the present study was to complete a controlled pilot study examining whether a group format delivery of ATT reduces test anxiety among eighth-grade students relative to a music-listening control. Eighth-grade students were selected for the present study since those students fall in an age range susceptible to experiencing particularly heightened levels of test anxiety (von der Embse et al., 2018). There are no established recommendations for control interventions within pilot intervention work (Rounsaville, Carroll, & Onken, 2001). A music-listening control was chosen because music listening is an auditory listening technique that can be matched for the length of ATT. Music listening has been found to evidence small reductions in anxiety (Panteleeva, Ceschi, Glowinski, Courvoisier, & Grandjean, 2018) and, thus, could be conceived as an active control. However, preliminary effects specifically examining the impact of music listening on worry—a defining feature of test anxiety—appear lower than for other indices of anxiety (Panteleeva et al., 2018) and the effects of music listening on test anxiety may be limited (Goldenberg, Floyd, & Moyer, 2013; Lilley, Oberle, & Thompson Jr., 2014). A music-listening control thus served as a comparison implemented using a parallel, time-matched procedure and with expected small, at best, effects on test anxiety.

Other methodological decisions merit attention. For example, we did not select students based upon test anxiety severity because test anxiety is most commonly viewed dimensionally (Zeidner, 2014) and prior applications of ATT in school settings used samples unselected based upon trait or ability (Murray et al., 2016, 2018). Nonetheless, Putwain, Chamberlain, Daly, and Sadreddini (2014) found that a test anxiety intervention given to all adolescent students, irrespective of test anxiety severity, evidenced only conditional effects. Conditional effects reflect a treatment being particularly effective under certain conditions (Hayes, 2018). Putwain et al. noted that individuals prone to certain dimensions of test anxiety (e.g., worry) may respond best to specific intervention strategies (e.g., cognitive). As reviewed, metacognitive beliefs underlie worry and test anxiety, with ATT developed to reduce worry for individuals prone to such self-referential processing (e.g., individuals with strong metacognitive beliefs). For those reasons, we expected that ATT would exert a conditional effect on test anxiety reduction based upon the strength of baseline metacognitive beliefs. It is important to note that the predicted conditional effect of ATT is an empirical question that has yet to be investigated. Thus, we examined the conditional effect in the present study rather than making study decisions based upon assumptions that the effect exists. More precisely, we used baseline metacognitive beliefs as a treatment moderator rather than including only participants with relatively strong endorsed beliefs at baseline. Following evidence that metacognitive beliefs are dimensional, rather than categorical (e.g., Olatunji, Williams, Haslam, Abramowitz, & Tolin, 2008), the beliefs were used as continuous moderators to maximize statistical power and minimize information loss.

Study predictions were that ATT, versus the control, would yield greater test anxiety reduction at postintervention among students who had stronger baseline metacognitive beliefs about the benefits of worry (positive metacognitive beliefs) and negative consequences of worry (negative metacognitive

beliefs). These two specific metacognitive beliefs were chosen because of theoretical models positing the specific importance of positive metacognitive beliefs and negative metacognitive beliefs to worry (Wells, 1995). A 3-week follow-up after the intervention examined the stability of the predicted conditional intervention effects. Exploratory analyses were completed to examine two additional study aims. The first exploratory aim examined the conditional effect of ATT on the cognitive dimension of test anxiety. The specific focus on the cognitive dimension of test anxiety is because ATT was developed to facilitate disengagement from worry and worry is the cardinal feature of cognitive test anxiety. As such, it would be informative to examine the effects of ATT specifically on that dimension of test anxiety. The second exploratory aim examined two other metacognitive beliefs—superstitious, punishment, and responsibility beliefs, and cognitive monitoring (Cartwright-Hatton, Mather, Illingworth, Harrington, & Wells, 2004)—as possible treatment moderators. This exploratory aim allowed for an examination as to whether metacognitive beliefs broadly related to emotional distress serve as treatment moderators as well or whether the predicted moderating effect is relatively specific to metacognitive beliefs directly implicated in relevant conceptual models of worry.

Method

PARTICIPANTS

We followed published guidelines for pilot intervention work (Rounsaville et al., 2001) and sought to have at least 30 participants per intervention group, a sample size consistent with prior studies examining ATT in school settings (e.g., Murray et al., 2018). The total sample consisted of 74 eighth graders at a middle school in the southern United States who were part of health classes across four class periods. One student in the control condition did not provide any study information and was excluded from the onset, resulting in a sample of 73 participants. To be eligible to participate, students needed a completed adolescent assent and parent permission form and be English literate. Students receiving special education services were not eligible. Students were assigned to an intervention group based upon the period their health class met to facilitate study completion in group format and ensure similar numbers of participants in each group. Students in Periods 1, 2, and 4 received ATT with all the other students in the respective period, with group sizes ranging from 8 to 16 students. Results were pooled across the three groups for analysis. The 34 students in the third period received the music-listening control. Because of the differing class sizes, block randomization was not used. The decision to allocate the three classes to ATT was done to allow those group sizes to parallel the average group size receiving ATT in prior studies in school settings (Murray et al., 2018). Sociodemographic information for ATT and the control group is presented in Table 1.

MEASURES

Children's Test Anxiety Scale (CTAS)

The CTAS (Wren & Benson, 2004) is a 30-item self-report measure that assesses severity of the already introduced dimensions of test anxiety: cognitive (e.g., "I worry about failing"), autonomic

Table 1
Intervention Group Characteristics at Baseline

Variable	ATT (n = 39)		Control (n = 34)		Difference
	%		%		
Gender					$X^2_{(1)} = 0.66$, $p = .416$
Female	61.5%		70.6%		
Male	38.5%		29.4%		
Ethnoracial					$X^2_{(4)} = 5.12$, $p = .275$
White	61.5%		61.8%		
Latino	20.5%		17.7%		
Black	5.1%		14.7%		
Asian	12.9%		2.9%		
Other	0.0%		2.9%		
	Mean	*SD*	*Mean*	*SD*	
Age	13.82	(0.51)	13.78	(0.69)	$t_{(71)} = 0.19$, $p = .851$
CTAS total	60.95	(17.96)	61.26	(16.67)	$t_{(71)} = 0.08$, $p = .940$
MCQ-C-Positive	9.84	(4.01)	9.91	(3.16)	$t_{(71)} = 0.09$, $p = .932$
MCQ-C-Negative	13.16	(4.01)	13.32	(3.99)	$t_{(71)} = 0.17$, $p = .869$

Note. CTAS = Children's Test Anxiety Scale; MCQ-C = Metacognitions Questionnaire for Children.

reactions (e.g., "My heart beats fast"), and behavioral responses (e.g., "I look around the room"). The CTAS was developed for respondents between 8 and 12 years of age, with subsequent studies using the CTAS among adolescents (e.g., Owens et al., 2012). A total scale score is derived by summing all item responses. The 13-item cognitive scale from the CTAS was used within exploratory analyses to examine treatment effects specifically among cognitive test anxiety. Each CTAS item is responded to considering the stem "While I am taking tests . . ." and item responses are provided using a 4-point ordered-category scale. Participants were asked to report on their test anxiety over the past week. Higher scores reflect greater test anxiety severity. There are no established cutoff scores on the CTAS. Researchers have used a score of 1 standard deviation above (i.e., 78.46) and below (i.e., 45.48) Wren and Benson's mean score to classify students as experiencing high and low test anxiety severity, respectively, with moderate test anxiety severity scores falling between those two values (Segool, Carlson, Goforth, von der Embse, & Barterian, 2013). The CTAS total score (Cronbach's α = .92) and cognitive score (α = .89) have both evidenced good internal consistency in prior research (Wren & Benson, 2004). The CTAS cognitive scale shares a moderate negative association with academic performance (r = –.42), supporting the criterion-related validity of that specific scale (Owens et al., 2012). The CTAS total score showed good internal consistency—baseline (α = .94), postintervention (α = .95), and follow-up (α = .95)—as did the CTAS cognitive score—baseline (α = .85), postintervention (α = .87), and follow-up (α = .90).

Metacognitions Questionnaire for Children (MCQ-C)

The MCQ-C (Bacow, Pincus, Ehrenreich, & Brody, 2009) is a 24-item adaptation of the 30-item adolescent version of the Metacognitions Questionnaire (MCQ-A; Cartwright-Hatton et al., 2004) for respondents ranging from 7 to 17 years of age, with the adaptation seeking to improve the readability of item content. The MCQ-C assesses four metacognitive beliefs, including metacognitive beliefs about the benefit of worry (positive: e.g., "If I worry about things now, I will have fewer problems in the future") and beliefs about the negative consequences of worry (negative: e.g., "It is not a good idea to worry because worrying is bad for me"). The MCQ-C assesses superstitious, punishment, and responsibility beliefs (e.g., "If I did not get a worry thought out of my head and then something bad happened, it would be my fault"), and cognitive monitoring (e.g., "I often notice the thoughts that I have in my head") as well. Each scale consists of six items and item responses are provided using a 4-point ordered-category scale. Higher scores reflect greater metacognitive beliefs. The positive (α = .86), negative (α = .75), and cognitive monitoring (α = .75) scale scores have evidenced good internal consistency in prior research, whereas the superstitious, punishment, and responsibility (α = .64) scale score evidenced internal consistency below conventional guidelines (Bacow et al., 2009). Bacow et al. found small-to-moderate correlations between the MCQ-C scales and an index of generalized worry severity (rs ranging from .21 to .55), supporting the criterion-related validity of the scales. The positive (α = .78), superstitious, punishment, and responsibility (α = .75), and cognitive monitoring (α = .78) scale scores showed good internal consistency in the present research, whereas the negative scale score evidenced an internal consistency estimate slightly below conventional guidelines (α = .68). However, the items of the negative scale evidenced an average interitem correlation (r = .26) within an acceptable range (i.e., .15–.50; Clark & Watson, 1995).

PROCEDURE

The local Institutional Review Board approved the study protocol. Recruitment started in spring 2018 with packets sent home to students in health classes and their parents. The packets included an informational letter about the study and adolescent assent/parent permission forms. The informational letter indicated that through this research project students would have the opportunity to participate in a group format intervention aimed at reducing test anxiety. The middle school provided a lounge space where the intervention was administered and self-report measures completed. A laptop computer and speakers used to deliver the intervention recordings were positioned in the center of the lounge to help ensure all students could hear. The lounge contained tables and chairs where students sat to complete study materials.

Students with signed assent and parent permission forms were sent to the lounge by their health teacher to participate in the completion of baseline measures. Approximately 30% of the total number of students across the four class periods participated. Students were given a packet that contained the baseline study measures. A research assistant provided instructions for completing the self-report measures and was available to answer any questions or provide assistance as needed. Upon completing the baseline measures, students were told the research assistant would be back the following Monday to administer a

recording in a group format. Research assistants and students were blind to study predictions.

Beginning the Monday after administration of the baseline measures, the research assistant pulled students from their health classes and brought them to the lounge to administer the intervention recording in a group format. The research assistant instructed students in both conditions to listen to the recording carefully, but did not specifically communicate information about learning strategies for reducing worry or test anxiety. The research assistant was present in the lounge during administration of the intervention and students were not permitted to have books, computers, or other belongings out. The ATT recording was from the developer of the technique, with the music-listening control recording matched for length (approximately 12 minutes in duration) and included music by Beethoven and Mozart. The group delivery format occurred Monday–Friday at the same time daily for five sessions. The decision to administer five sessions of ATT was based on studies by Murray and colleagues (Murray et al., 2016, 2018) that found as little as three sessions of ATT administered in a group format resulted in intervention effects and logistical considerations, such as the typical school week comprises 5 consecutive days students attend classes.

Attendance was not taken at the sessions and students were sent back to their health class each day upon completion of the recording, except for Friday, when they were administered the postintervention measures directly after completion of the final recording. The research assistant returned to the school approximately 3 weeks (i.e., 20 days) postintervention to collect follow-up data. Upon completion of the follow-up self-report measures, students were thanked for their participation and returned to class. Students were not provided financial compensation or extra credit for participation in the study. Participation was completely voluntary and students were told they could withdraw from the study at any time.

DATA ANALYTIC STRATEGY

Preliminary analyses examined the degree of missing data and whether data were missing at random. If so, missing data were imputed using expectation maximization (EM). Preliminary analyses also compared test anxiety severity on the CTAS in the present sample relative to other large samples of students who completed the study measure. Independent samples *t* tests examined the equivalency between the intervention groups on age and study variable scores at baseline. Chi-square tests examined sex and ethnoracial group differences, as well as differences in the distribution of test anxiety severity across groups.

Hayes's (2018) PROCESS macro was used for main study analyses to examine the moderating effect of baseline metacognitive beliefs on test anxiety reduction. Positive and negative metacognitive beliefs were examined as moderating variables in separate regression analyses. The intervention group variable was dummy coded (D1: control = 0, ATT = 1) and the moderator was mean centered. The interactive effect was calculated as the product of the dummy-coded group variable and the mean-centered moderator variable. To examine regressed change, baseline test anxiety was included as a covariate in all regression analyses (Cohen, Cohen, West, & Aiken, 2003). Postintervention test anxiety was the criterion variable in regression analyses to examine severity reduction immediately following the interventions (i.e., postintervention) and follow-up test anxiety was the criterion variable in separate regression analyses to examine the stability of severity reduction (i.e., follow-up).

The increased possibility of Type I error with completing four planned regression analyses was addressed using the false discovery rate (FDR; Benjamini & Hochberg, 1995). FDR indicated that a family-wise alpha of .050 (two-tailed) should be used when evaluating the interactive effects. The PROCESS macro involved running regression analyses with 1,000 bootstrapped samples. A 95% confidence interval (CI) not containing zero is indicative of a significant effect (Hayes, 2018). Simple effects for interactive effects were examined at ± 1 *SD* from the mean metacognitive belief score. Effect sizes for standardized conditional between-group effects were calculated following Bodner's (2017) recommendations and using values from PROCESS. Effect sizes for conditional within-group effects were calculated using Cohen's *d*, while using conditional means and conditional standard deviations from PROCESS.

Results

PRELIMINARY ANALYSES

A study flowchart is presented in Figure 1. Missing data ranged from 0 to 2.7% of data points at baseline and postintervention. At follow-up, missing data ranged from 9.6 to 12.3% of data points. Little's test indicated that the data points were missing at random: $\chi^2_{(1,500)} = 281.41$, $p = .999$. Missing data points were imputed using EM prior to analysis, a form of maximum likelihood estimation that performs similarly to other principled methods for handling missing data when missingness is < 20% (Dong & Peng, 2013).

Comparisons between baseline CTAS scores in the present sample to Wren and Benson's (2004)

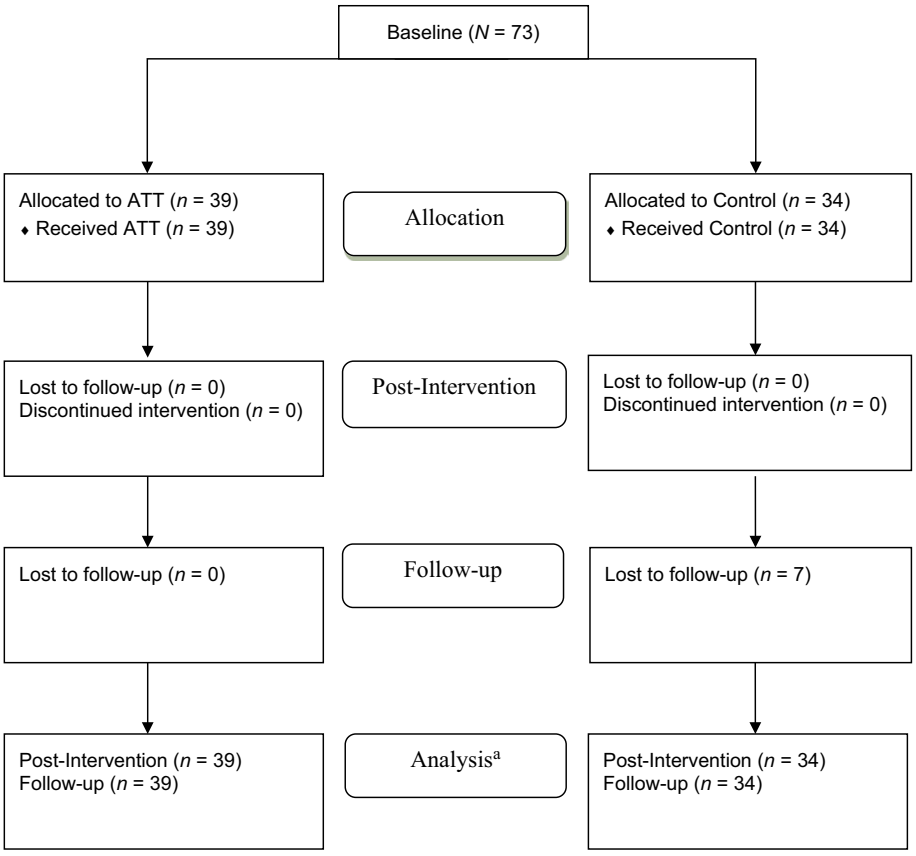

FIGURE 1 Study flow diagram. ATT = attention training technique. [a] Missing data points addressed using expectation maximization.

mean CTAS score indicated the present sample scored within 0.25 *SD* of the mean score of that prior sample (i.e., *T* score = 49.5, with *T* scores having a mean of 50 and an *SD* of 10). As such, baseline test anxiety in the present sample was comparable to other similar samples. The majority of students fell in the moderate range of test anxiety severity (60%) following Segool et al.'s (2013) CTAS cutoff scores, with 21% endorsing high test anxiety severity and 19% endorsing low test anxiety severity at baseline. The distribution of test anxiety severity did not differ between the ATT and control group: $\chi^2_{(2)} = 0.87$, $p = .647$. Table 1 shows group characteristics on sociodemographic and mean baseline study variable scores across the ATT and control group. The two groups did not significantly differ on any of those variables.

MAIN ANALYSES

Postintervention Test Anxiety

The omnibus regression analysis predicting postintervention test anxiety was significant for models with positive metacognitive beliefs, $F_{(4, 68)} = 62.32$, $p < .001$, and negative metacognitive beliefs, $F_{(4, 68)} = 59.93$, $p < .001$. The interactive effects between intervention group and metacognitive beliefs predicting postintervention test anxiety were significant (positive: B = –1.81, $p = .004$, 95% CI [–3.00, –0.62]; negative: B = –1.81, $p = .001$, 95% CI [–2.88, –0.74]). Simple effect regression results are presented in Table 2 and conditional means are graphically presented in panels (a) and (b) of Figure 2.

Simple effects indicated that postintervention test anxiety was significantly lower following ATT than the control at high positive metacognitive beliefs, but not low positive metacognitive beliefs, and the standardized mean difference at high positive metacognitive beliefs was large in magnitude ($\delta Y|Mi = 1.00$). Similarly, at postintervention, test anxiety was significantly lower following ATT than the control at high negative metacognitive beliefs, but not low negative metacognitive beliefs, and the standardized mean difference at high negative metacognitive beliefs was large in magnitude ($\delta Y|Mi = 1.05$). Within-group conditional mean differences in the ATT group indicated moderate reductions in test anxiety from baseline to postintervention at high positive metacognitive beliefs ($Mean_D = 8.11$, $SD_P = 13.53$, $d = 0.60$) and large reductions in test anxiety from baseline to postintervention at high negative

Table 2
Simple Effects of Between-Group Conditional Mean Differences in Test Anxiety

Outcome	Level of the moderator	B	*p*	95% CI
Postintervention total	High positive metacognitive beliefs	-8.75	.004	[-14.69, -2.82]
	Low positive metacognitive beliefs	4.34	.151	[-1.62, 10.29]
	High negative metacognitive beliefs	-9.36	.003	[-15.31, -3.41]
	Low negative metacognitive beliefs	5.02	.098	[-0.94, 10.98]
Follow-up total	High positive metacognitive beliefs	-12.39	.004	[-20.76, -4.02]
	Low positive metacognitive beliefs	10.29	.017	[1.88, 18.69]
	High negative metacognitive beliefs	-8.93	.049	[-17.82, -0.04]
	Low negative metacognitive beliefs	6.86	.129	[-2.05, 15.77]
Postintervention cognitive	High positive metacognitive beliefs	-4.70	.004	[-7.83, -1.58]
	Low positive metacognitive beliefs	1.07	.496	[-2.06, 4.21]
	High negative metacognitive beliefs	-6.20	< .001	[-9.11, -3.29]
	Low negative metacognitive beliefs	2.67	.071	[-0.23, 5.57]
Follow-up cognitive	High positive metacognitive beliefs	-5.73	.004	[-9.57, -1.89]
	Low positive metacognitive beliefs	4.74	.017	[0.89, 8.60]
	High negative metacognitive beliefs	-4.26	.039	[-8.32, -0.20]
	Low negative metacognitive beliefs	3.31	.107	[-0.73, 7.36]

Note. A negative beta weight indicates greater test anxiety reduction in the ATT group and a positive beta weight indicates greater test anxiety reduction in the control group. High values of the moderator at +1 *SD* from the respective mean score and low values of the moderator at –1 *SD* from the respective mean score.

metacognitive beliefs ($Mean_D$ = 16.76, SD_P = 11.58, d = 1.45). Within-group conditional mean differences in the control group indicated relative stability in test anxiety from baseline to postintervention at high positive metacognitive beliefs ($Mean_D$ = 0.08, SD_P = 13.50, d = 0.01) and high negative metacognitive beliefs ($Mean_D$ = 1.94, SD_P = 11.56, d = 0.17).

Follow-Up Test Anxiety

The omnibus regression analysis predicting follow-up test anxiety was significant for models with positive metacognitive beliefs, $F_{(4, 68)} = 30.68$, $p < .001$, and negative metacognitive beliefs, $F_{(4, 68)} = 24.21$, $p < .001$. The interactive effects between intervention group and metacognitive beliefs predicting follow-up test anxiety were significant (positive: B = –3.14, $p < .001$, 95% CI [–4.82, –1.45]; negative: B = –1.98, $p = .016$, 95% CI [–3.59, –0.38]). Simple effect regression results for the conditional effects at positive metacognitive beliefs are presented in Table 2 and conditional means are graphically presented in panels (c) and (d) of Figure 2.

Simple effects indicated that follow-up test anxiety was significantly lower following ATT than the control at high positive metacognitive beliefs and the standardized mean difference was large in magnitude (δY|Mi = 1.00). Unexpectedly, at follow-up, test anxiety was significantly lower following the control than ATT at low positive metacognitive beliefs and the standardized mean difference was large in magnitude (δY|Mi = 0.84). At follow-up, test anxiety was significantly lower following ATT than the control at high negative metacognitive beliefs, but not low negative metacognitive beliefs, and the standardized mean difference at high negative metacognitive beliefs was moderate in magnitude (δY|Mi = 0.67).

Within-group conditional mean differences in the ATT group indicated moderate reductions in test anxiety from baseline to follow-up at high positive metacognitive beliefs ($Mean_D$ = 10.74, SD_P = 14.83, d = 0.72) and large reductions in test anxiety from baseline to follow-up at high negative metacognitive beliefs ($Mean_D$ = 18.08, SD_P = 13.47, d = 1.34). Within-group conditional mean changes in the control group indicated relative stability in test anxiety from baseline to follow-up at high positive metacognitive beliefs ($Mean_D$ = –0.92, SD_P = 14.80, d = 0.06) and small decreases from baseline to follow-up at high negative metacognitive beliefs ($Mean_D$ = 3.69, SD_P = 13.44, d = 0.27). Within-group conditional mean differences indicated relative stability in test anxiety from baseline to follow-up at low positive metacognitive beliefs within the control group ($Mean_D$ = 0.82, SD_P = 14.80, d = 0.06), but moderate increases in test anxiety from baseline to follow-up at low positive metacognitive beliefs in the ATT group ($Mean_D$ = -9.22, SD_P = 14.83, d = 0.62). As such, the between-group conditional mean difference at follow-up between ATT and the control group at low positive metacognitive beliefs appears to be the result of individuals with low positive metacognitive beliefs reporting a worsening of test anxiety in the ATT group from baseline to follow-up than test anxiety reductions occurring in the control group.

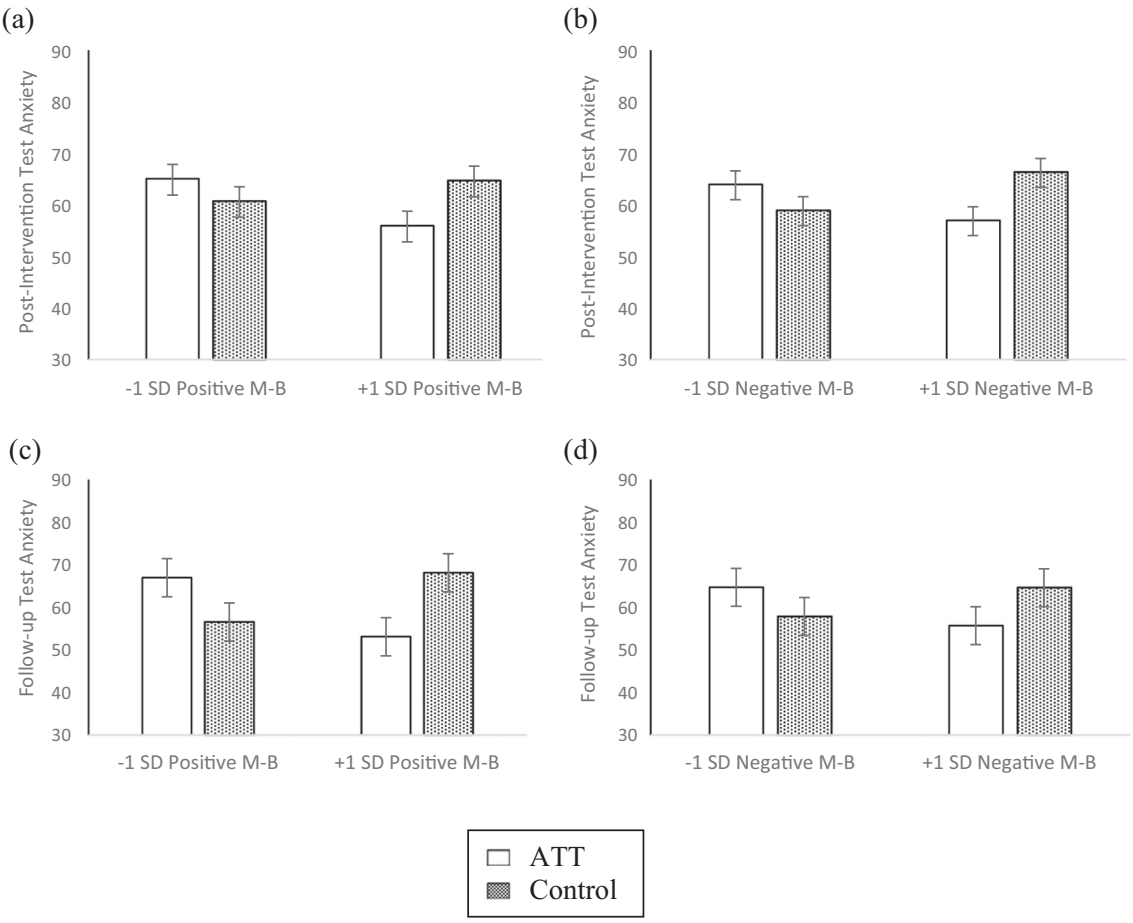

FIGURE 2 Simple effects examining mean differences in total test anxiety severity across interventions based upon strength of baseline metacognitive beliefs (M-B) with standard error bars presented. Panels (a) and (b) depict postintervention test anxiety severity, whereas panels (c) and (d) depict follow-up test anxiety severity. ATT = attention training technique.

EXPLORATORY ANALYSES

Postintervention Cognitive Test Anxiety

Exploratory analyses examined the conditional effect of ATT on cognitive test anxiety using the cognitive scale from the CTAS as the criterion variable. These analyses mirrored the main study analyses and included baseline cognitive test anxiety as a covariate. The omnibus regression analysis predicting postintervention cognitive test anxiety was significant for models with positive metacognitive beliefs, $F_{(4,\ 68)} = 39.62$, $p < .001$, and negative metacognitive beliefs, $F_{(4,\ 68)} = 46.76$, $p < .001$. The interactive effects between intervention group and metacognitive beliefs predicting postintervention cognitive test anxiety were significant (positive: B = –0.80, $p = .013$, 95% CI [–1.42, –0.17]; negative: B = –1.12, $p < .001$, 95% CI [–1.64, –0.59]). Simple effect regression results are presented in Table 2 and conditional means are graphically presented in panels (a) and (b) of Figure 3. The pattern of simple effects mirrored the simple effects in the main analyses, as did the pattern and magnitude of conditional mean differences.

Follow-Up Cognitive Test Anxiety

The omnibus regression analysis predicting follow-up cognitive test anxiety was significant for models with positive metacognitive beliefs, $F_{(4,\ 68)} = 27.38$, $p < .001$, and negative metacognitive beliefs, $F_{(4,\ 68)} = 21.96$, $p < .001$. The interactive effects between intervention group and metacognitive beliefs were significant (positive: B = –1.45, $p < .001$, 95% CI [–2.22, –0.68]; negative: B = –0.95, $p = .011$, 95% CI [–1.68, –0.22]). Simple effect regression results are presented in Table 2 and conditional means are graphically presented in panels (c) and (d) of Figure 3. The pattern of simple effects mirrored the simple effects in the main analyses, as did the pattern and magnitude of conditional mean differences.

Other Metacognitive Beliefs

Exploratory analyses examined the conditional effect of ATT on test anxiety based upon two other metacognitive beliefs: (a) superstitious, punishment, and responsibility, and (b) cognitive monitoring. When examining postintervention test anxiety, the

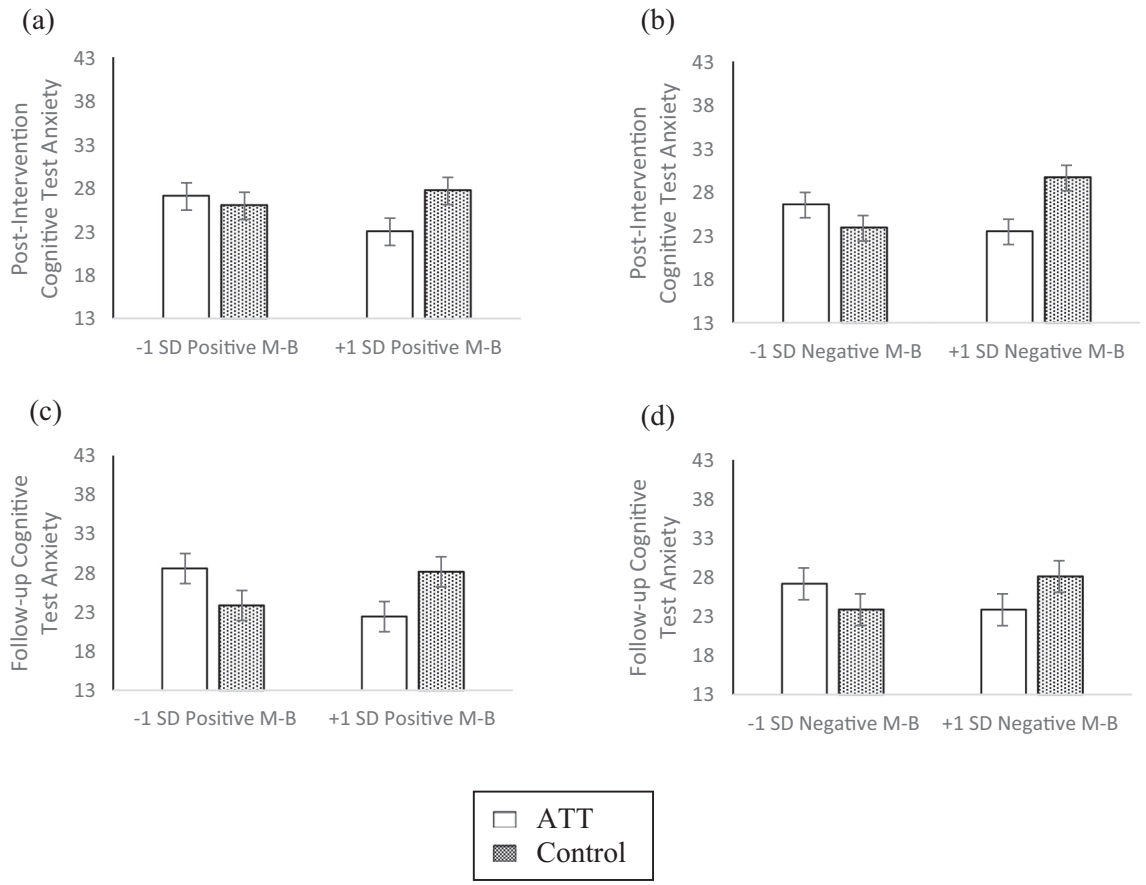

FIGURE 3 Simple effects examining mean differences in cognitive test anxiety severity across interventions based upon strength of baseline metacognitive beliefs (M-B) with standard error bars presented. Panels (a) and (b) depict postintervention cognitive test anxiety severity, whereas panels (c) and (d) depict follow-up cognitive test anxiety severity. ATT = attention training technique.

results mirrored the results found using positive metacognitive and negative metacognitive beliefs. More precisely, the interactive effects between intervention group and metacognitive beliefs were significant (superstitious, punishment, and responsibility: B = –1.19, p = .037, 95% CI [–2.31, –0.08]; cognitive monitoring: B = –1.40, p = .012, 95% CI [–2.49, –0.32]). Simple conditional effects indicated that test anxiety was significantly lower at postintervention following ATT than the control at high metacognitive beliefs (superstitious, punishment, and responsibility: B = –7.05, p = .029, 95% CI [–13.36, –0.74]; cognitive monitoring: B = –8.20, p = .009, 95% CI [–14.26, –2.14]). No group differences were seen at low metacognitive beliefs (superstitious, punishment, and responsibility: B = 2.73, p = .390, 95% CI [–3.58, 9.04]; cognitive monitoring: B = 3.19, p = .315, 95% CI [–3.11, 9.49]). However, neither of the interactive effects held at follow-up (superstitious, punishment, and responsibility: B = –1.55, p = .061, 95% CI [–3.17, 0.08]; cognitive monitoring: B = –1.14, p = .166, 95% CI [–2.77, 0.49]). Notably, a worsening in test anxiety was not seen at follow-up among individuals low in either set of these metacognitive beliefs. A similar pattern of results emerged when examining the conditional effects with these two metacognitive beliefs with cognitive test anxiety as the outcome variable.

Discussion

Results from this controlled pilot study offer support for ATT as a potential test anxiety intervention for adolescent students with stronger metacognitive beliefs about the benefits and consequences of worry. ATT yielded greater test anxiety reductions than a control for those students at postintervention, with effects remaining at a 3-week follow-up. The conditional mean differences in test anxiety across the ATT versus control group were nearly all large in magnitude. Within-group effects indicated moderate-to-large reductions in test anxiety for students with relatively stronger metacognitive beliefs following ATT and no substantive

reductions in test anxiety for students with relatively stronger metacognitive beliefs following the control. The effects of ATT extended to the cognitive dimension of test anxiety, with the pattern of results and effect size estimates paralleling the main analyses.

The pattern of conditional effects was in the expected direction, as group differences in test anxiety were seen at high, but not low, metacognitive beliefs with one exception. At follow-up, students with weaker baseline positive metacognitive beliefs evidenced lower test anxiety following the control versus ATT. Within-group effects suggested this pattern of results was due to worsening test anxiety from baseline to follow-up among students with weaker baseline positive metacognitive beliefs in the ATT group rather than such students achieving notable benefit from the control. Differences in test anxiety at postintervention versus follow-up could be the result of greater testing situations during the period between postintervention and follow-up (i.e., 3 weeks) compared to baseline and follow-up (i.e., 1 week). Students who believe that worry is not a beneficial coping strategy (i.e., endorsing low positive metacognitive beliefs) may not be expected to evidence benefit from an intervention designed to mitigate worry. However, it is not conceptually clear why ATT would contribute to worsened test anxiety from baseline to follow-up for those students and not for students with either relatively low negative metacognitive beliefs about worry or relatively low related metacognitive beliefs (cognitive monitoring or superstitious, punishment, and responsibility). The lack of generality across the metacognitive beliefs suggests that caution should be drawn in regard to conclusions that ATT in fact contributes to a worsening of test anxiety for students with relatively low metacognitive beliefs. The overall pattern of results indicates that, as expected, students with stronger metacognitive beliefs about worry evidenced the greatest benefit from ATT.

Exploratory findings highlighted a potential degree of specificity of the conditional effects in regard to positive metacognitive beliefs and negative metacognitive beliefs. More precisely, conditional effects of superstitious, punishment, and responsibility beliefs or cognitive monitoring beliefs were not supported at follow-up for test anxiety. That pattern of findings converges with conceptual models underscoring the particular importance of positive metacognitive beliefs and negative metacognitive beliefs to worry (Wells, 1995). Moreover, ATT was developed to facilitate disengagement from the use of worry and individuals with stronger metacognitive beliefs (positive and negative) are more likely to engage in worry as a self-regulatory strategy (Wells, 2000, 2009). Wells (2000) notes that behavioral avoidance strategies often may be the result of worry, such that individuals use those strategies as a way to terminate the worry process or to stop the initiation of worry altogether. Wells (2000) further notes that worry and metacognitive beliefs, particularly negative metacognitive beliefs, can worsen somatic anxiety, such that individuals interpret somatic anxiety as a sign of losing control or a negative effect of worry. Following from Wells (2000), an intervention putatively directly targeting cognitive test anxiety (i.e., worry) would be expected to broadly influence overall test anxiety, and the present results in regard to ATT support that notion.

The examined and supported conditional effects have potential implications for prevention and intervention efforts. For example, schools may seek to screen students for heightened metacognitive beliefs about worry using brief screening tools to identify students at risk for potentially experiencing test anxiety and who may benefit most from certain cost-effective intervention strategies, such as ATT. Unfortunately, there is lack of a consensus about a preferred measure of metacognitive beliefs among children and adolescents. A commonly used child and adolescent version of the MCQ developed by Bacow et al. (2009) was included in the present study—however, White and Hudson (2016) questioned the readability of Bacow et al.'s item pool and developed a revised version. The factorial validity of White and Hudson's revised item pool did not receive uniform support, as correlated error variances for several items were needed to reach minimally adequate model fit in structural analyses. Another MCQ version to consider for future use is Esbjørn et al.'s (2013) MCQ for children and adolescents, although White and Hudson noted that not all of the scales of Esbjørn et al.'s version might be suitable for younger children. Future research is needed to identify potentially preferred self-report measures of metacognitive beliefs among children and adolescents.

Study limitations warrant consideration. Participants represented only the portion of students in the respective health classes who had signed assent and parent permission forms. It is possible that students who returned the forms differ in unknown ways from students who did not assent or receive parental permission that make them more likely to respond well to interventions. Participants were drawn from differing class periods and it is possible that the time of day impacted participation rates. It is important to note that students and parents were blind to condition enrollment, suggesting that participation rate would not have been impacted by one intervention being perceived as more desirable. Further, both groups

received what could have been considered an active intervention. Individual students were not randomized to an intervention, but rather entire class periods received an intervention following prior studies (Murray et al., 2016, 2018). Block randomization was not completed given the divergence in class sizes participating in the present study.

To allow for consistency with the group sizes of students receiving ATT in prior research (e.g., Murray et al., 2018), class periods consisting of smaller groups of students received ATT. There were larger numbers of students who participated in the study in the third and fourth periods of recruited classes, likely because of more classes being available to recruit from during those periods. The larger number of students in the control condition may have attenuated the benefit of that specific intervention strategy, as students may have felt more comfortable in smaller group sizes. The optimal delivery format of ATT remains unclear, with the bulk of existing studies using an individual format delivery of ATT (see Fergus & Bardeen, 2016; Knowles et al., 2016). Both the present results and prior findings (Murray et al., 2016, 2018) offer preliminary support for benefit following group delivery of ATT. Future research should have intervention groups drawn from same-timed class periods, intervention groups that are equally sized, and examine whether the effectiveness of ATT differs based upon individual versus group delivery format.

An additional study limitation is that student attendance was not taken at the five intervention sessions. As such, it is unknown how much each student practiced the respective intervention. It is possible that students with relatively stronger metacognitive beliefs were more motivated to attend the ATT sessions and practice the intervention, influencing our study findings that these individuals benefited most from the ATT intervention. Those particular students may have been more motivated to attend the sessions to practice the intervention, in part because of parental investment stemming from the informational letter sent home. It is worth noting, though, that the informational letter was sent home to all participants irrespective of intervention group, as well as that both students and parents were blind to condition enrollment. It remains unclear what is the optimal dosage of ATT (Knowles et al., 2016) and the present results are unable to speak to whether practice frequency correlated with test anxiety reductions. Future research should take attendance to examine the effects of practice frequency. We did not assess whether students had specific tests during the assessment periods. Concerns that test anxiety reductions may not be in relation to testing situations that occurred following the intervention are mitigated by the inclusion of a 3-week follow-up. Nonetheless, it would be informative to complete ATT before known testing situations and to assess test anxiety immediately following those situations.

There is great heterogeneity in how researchers make qualitative distinctions as to what constitutes severe test anxiety, with test anxiety examined as a continuous individual difference in the present study following the general precedence of that approach in the extant literature (Zeidner, 2014). The majority of students who participated in the present study had moderate levels of test anxiety at baseline, with severity levels not differing between the two intervention groups. Future research may seek to examine the effects of ATT exclusively among students who endorse test anxiety severity at a determined severe level to help support the generality of the present findings. Although the effects of ATT were stable at a nearly 3-week follow-up, future research should examine longer follow-up periods to examine the stability of test anxiety reductions (e.g., across academic semesters).

Despite offering promising preliminary results in relation to test anxiety reduction, other potentially relevant outcomes were unexamined in the present study. For example, future research could examine whether students receiving ATT show academic achievement improvements and, if so, whether test anxiety reductions help account for those improvements in achievement. Other outcomes that could warrant examination in future research include self-regulation (Murray et al., 2016, 2018), approaches to studying (e.g., surface vs. strategic; Spada & Moneta, 2014), and the tendency to withstand examination pressures (Putwain et al., 2014). Such variables have been linked to academic outcomes in prior research (Richardson, Abraham, & Bond, 2012) and could be important for understanding the benefit of ATT on test anxiety.

Limitations notwithstanding, the present results offer preliminary support for ATT as a potential intervention for reducing test anxiety among adolescent students. There are practical advantages to the use of ATT, including the ability to deliver ATT in a group format within school settings by a nontrained professional. The use of ATT could reduce the need for certain students to receive individual services from a trained professional for test anxiety. Pursuant to that point, the present results indicate that adolescent students with stronger metacognitive beliefs about worry are most likely to see test anxiety reduction following

ATT. Brief assessment screenings of those metacognitive beliefs within school settings could be used to identify students who are most likely to benefit from ATT.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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