

ACCEPTANCE AND COMMITMENT THERAPY (ACT) VS. SYSTEMATIC DESENSITIZATION IN TREATMENT OF MATHEMATICS ANXIETY

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College students ($N = 24$) experiencing math anxiety were treated individually for 6 weeks with either acceptance and commitment therapy (ACT) or systematic desensitization. Statistical analyses indicated significant, but equivalent, reductions in self-report measures of math and test anxiety that were maintained at 2-month follow-up. Both statistically and clinically significant decrements in trait anxiety were limited to participants treated with systematic desensitization. No improvement in mathematical skills was noted for either treatment. As expected, pretreatment levels of experiential avoidance were more strongly related to therapeutic change among participants receiving ACT, suggesting that the two interventions, although generally comparable in reducing math anxiety, may do so through different processes. Implications of the findings for further research on ACT more generally and treatment of math anxiety, in particular, are discussed.

Historically, behavioral approaches to psychotherapy, in general, and especially those dealing with anxiety disorders (e.g., Wolpe, 1958), have pursued a primary strategy of first-order change in treating clinical problems in which private events such as unwanted thoughts, feelings, impulses, memories, and bodily states are thought to be centrally involved (Hayes, 1987, 1994). A primary focus on seeking to alter private events is perhaps not surprising given that varying forms of psychopathology traditionally have been explicitly grouped together diagnostically depending upon the particular common private event(s) thought to typify each (e.g., "mood disorders," "anxiety disorders"). In some instances, the private events per se are viewed as problematic, such as the excessive worrying and increased bodily tension that characterize generalized anxiety disorder (American Psychiatric

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Association, 1994), and are accordingly targeted for elimination or reduction through the use of approaches such as relaxation training or stress management. For other disorders, similar primary changes in the frequency, intensity, or form of private events are sought because of their presumed role in controlling overt dysfunctional behavior, such as compulsions in obsessive-compulsive disorder or escape/avoidance behavior in phobias.

Within the past decade, however, a number of empirically oriented clinicians from varying theoretical perspectives have questioned the utility of attempting to directly alter private events in suggesting second-order change strategies as viable alternatives for a wide range of presenting problems (Hayes, Jacobson, Follette, & Dougher, 1994). In general, acceptance-based approaches, such as certain forms of humanistic/experiential therapy (Greenberg, 1994), dialectical behavior therapy (Linehan, 1993), and integrative behavioral couple therapy (Wheeler, Christensen, & Jacobson, 2001), seek to facilitate therapeutic change by altering the context within which private events function rather than the content of private events through reducing, eliminating, or replacing unwanted thoughts and feelings. From a radical behavioral perspective, private events such as anxious thoughts and feelings are not viewed as causes for other behaviors (Zettle, 1990) and, consequently, do not have to be eliminated to effect a change in overt behavior. For example, it may be unnecessary to first reduce the anxiety of a phobic client in order to eliminate associated avoidance of the feared situation. Moreover, a growing body of research documenting "rebound effects" when deliberate attempts are made to suppress unwanted thoughts and other private events suggests that first-order change strategies may be counterproductive (Wegner, 1994) rather than therapeutic.

Among existing second-order change approaches, acceptance and commitment therapy (ACT) has been most explicitly derived from a behavior analytic perspective on private events, verbal behavior, rule governance, stimulus equivalence, and related phenomena (Hayes, Strosahl, & Wilson, 1999). ACT is a verbal psychotherapy grounded philosophically in functional contextualism (Biglan & Hayes, 1996; Hayes, 1993; Hayes, Hayes, & Reese, 1988) that has the ongoing act-in-context as its core analytic unit (Pepper, 1942). One major contextual factor that supports abnormal behavior appears to be human language itself within which anxiety and related private events may be regarded as problematic because they are verbally evaluated as "bad" or "awful" (an example of what is known as "cognitive fusion"), can be justified through reasoning (Zettle & Hayes, 1986), and commonly are held as causes for overt dysfunctional behavior such as escape from and avoidance of anxiety-eliciting situations.

The general goal of ACT is to simultaneously promote psychological acceptance and discourage experiential avoidance, or deliberate attempts like thought suppression to change the content of private events, by altering the normal social-verbal contexts, such as reasoning, that support dysfunctional control by private events. A detailed

discussion of some of the more specific goals and related strategies of ACT is beyond the scope of this paper and will only be summarized here. Interested readers are advised to consult Hayes et al. (1999) for a more in-depth treatment of them. Briefly, ACT may be viewed as attempting to strengthen the following client behaviors: (a) clarifying life values and identifying barriers to realizing related goals, (b) committing to actions necessary to attain such goals, (c) evaluating private events based upon the degree to which they are useful in goal attainment, and (d) experiencing private events without engaging in counterproductive avoidance behavior (psychological acceptance). Alternatively, ACT simultaneously seeks to weaken experiential avoidance and the degree to which clients respond to thoughts as if they are literally true (what is referred to as "deliteralization") and engage in reason-giving that supports dysfunctional behavior (e.g., "I skipped my math test because I was too anxious."). ACT strategically attempts to create a special verbal/social community within therapy in order to undermine experiential avoidance, reason-giving, cognitive fusion, and other verbal contexts and constructions that support dysfunctional behavior. It does so through the frequent use of metaphors, paradox, and experiential exercises to address the impact of language and private events upon broader behavioral problems.

While ACT has by now attained a certain degree of prominence, it has also recently been criticized as generally lacking in empirical support for its efficacy (Corrigan, 2001). Two randomized controlled trials (Zettle & Hayes, 1986; Zettle & Rains, 1989) have found ACT to compare favorably to cognitive therapy (Beck, Rush, Shaw, & Emery, 1979) in treatment of outpatient depression. Although there also have been several reports of successfully applying ACT to anxiety disorders, particularly obsessive-compulsive disorder and agoraphobia, (Hayes, 1987; Hayes, Afari, McCurry, & Wilson, 1990; Lopez, 1999), there have been no published clinical outcome studies to date evaluating ACT against a well-established therapy for anxiety disorders. One of the primary purposes of this study was to begin to address this empirical gap by comparing ACT versus systematic desensitization in alleviating math anxiety among college students. A second primary purpose was to investigate the degree to which the two treatments may facilitate therapeutic change through differential mechanisms by determining if reductions in anxiety attained by each were related to a process measure of experiential avoidance.

Mathematics anxiety experienced by college students was chosen as the focus of this study because of its prevalence at my institution (Wichita State University), where successful completion of college algebra is a general education requirement for all undergraduate majors, and because of the avoidance behavior that it frequently engenders. A majority of students enrolled in college algebra and courses preparatory to it here regard themselves as math anxious, with a significantly higher proportion of women (60%) than men (44%) reporting elevated levels of

math anxiety (Zettle & Raines, 2000). Math anxiety often has been cited as a factor limiting the educational and career choices of college students, particularly women (Betz, 1978; Chipman, Krantz, & Silver, 1992; Resnick, Viehe, & Segal, 1982; Singer & Stake, 1986). Students who are severely math anxious may opt for academic majors within the fine arts, humanities, or social sciences that enable them to avoid all but minimal coursework in mathematics (Chipman et al.). To the extent that mathematics anxiety is further characterized by a "marked and persistent fear of clearly discernible, circumscribed objects or situations" (American Psychiatric Association, 1994, p. 405), it seems meaningful to regard it as a specific phobia.

Systematic desensitization was selected as the standard against which to evaluate the relative efficacy of ACT for several reasons. Perhaps most important, systematic desensitization has been empirically supported as a well-established efficacious intervention for treatment of diverse forms of specific phobia ("Task Force on Psychological Procedures," 1995), thus providing a fairly stringent "benchmark" against which to evaluate the impact of ACT. Given the clinical status of mathematics anxiety as a type of specific phobia, it is not surprising that systematic desensitization, or variations of it, also has been shown to be one of the most efficacious treatments for math anxiety (Foss & Hadfield, 1993; Hembree, 1990; Schneider & Nevid, 1993; Suinn, Edie, & Spinelli, 1970; Wadlington, Austin, & Bitner, 1992). Finally, systematic desensitization was deliberately designed by Wolpe (1954, 1958) to be a first-order change strategy in which conditioned anxiety is thought to be reciprocally inhibited by a state of induced progressive muscle relaxation. Comparing systematic desensitization and ACT in the treatment of math anxiety consequently also provided a broader opportunity to evaluate differential outcome and therapeutic processes associated with first-order vs. second-order behavioral change strategies. It was generally expected that the two interventions would be comparable in their efficacy, but that pretreatment levels of experiential avoidance would be more closely related to therapeutic change induced by ACT than systematic desensitization.

Method

Participants

Participants were recruited through flyers posted in math classrooms and on nearby bulletin boards and through announcements in a campus newspaper about a program to assist students in "coping with math anxiety." Potential participants were 37 students (30 women and 7 men, mean age = 30.9 years) who, following a pretreatment evaluation, were assigned randomly via a coin toss to receive either systematic desensitization or ACT. It should be noted that the age of participants reflects the substantial proportion (55%) of older, nontraditional students enrolled at this university. Four students failed to attend a single treatment session and 9 others (7 assigned to systematic desensitization and 2 to

ACT) dropped out before completing all six sessions. Participants who failed to complete the program did not differ from the 24 who did in their levels of math anxiety, age, gender, or any other demographic variables. Similarly, there were no significant pretreatment differences on any demographic variables between students in the two treatment conditions ($n = 12$ in each) who attended all six sessions (see Table 1). No students were paid for their participation nor were they charged for the services they received. All participants were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association, 1992).

Table 1

Characteristics of Participants		
Characteristic	ACT ($n = 12$)	Systematic desensitization ($n = 12$)
Gender		
Male	2	2
Female	10	10
Mean age in years	30.2	30.8
Race/Ethnicity		
White	9	7
Black	2	3
Hispanic	1	2
Class standing		
Freshman	7	6
Sophomore	1	3
Junior	3	1
Senior	1	2
Currently enrolled in math		
Yes	6	5
No	6	7

Outcome Measures

Because math anxiety is associated with high rates of comorbid test and trait anxiety (Zettle & Raines, 2000), measures of all three were obtained at pretreatment, posttreatment, and at 2-month follow-up. Participants at pretreatment and posttreatment also completed an assessment of their mathematical skills. All outcome measures were administered by myself and were completed by participants individually in my absence.

Mathematics Anxiety Rating Scale. The Mathematics Anxiety Rating Scale (MARS; Suinn, 1972) was used to assess levels of math anxiety. The MARS contains 98 items depicting various life ("being treasurer for a club") and academic ("signing up for a math class") activities and situations involving mathematics. Participants rate each item on a 5-point scale, yielding total scores of 98-490. The MARS has been widely used in other research of math anxiety in college student populations and appears to possess adequate psychometric properties. Acceptable test-

retest reliability coefficients ranging up to .85 after 7 weeks (Richardson & Suinn, 1972) have been reported. The internal consistency of the MARS also appears to be acceptable with an alpha reliability coefficient of .97 (Richardson & Suinn). The construct validity of the MARS has been supported by two sets of findings. First, college students have produced significantly reduced MARS scores after receiving treatment for math anxiety (Suinn et al., 1970; Suinn & Richardson, 1971). Second, scores on the MARS have been found to be significantly, but inversely, related to the performance of college students on a test of mathematical ability (Dew, Galassi, & Galassi, 1984).

Test Anxiety Inventory. Spielberger's (1977) Test Anxiety Inventory (TAI) was used as an index of test anxiety. The TAI consists of 20 self-descriptive statements rated by participants on a 1-4 scale, producing total scores of 20-80. The TAI has consistently displayed sound psychometric properties when used with college student populations. Test-retest reliability coefficients range from .80 at 2 weeks to .62 at 6 months. Correlation coefficients of .82 and .83 for men and women, respectively, between the TAI and Sarason's (1979) Test Anxiety Scale provide evidence of its concurrent validity.

Trait Anxiety Inventory. The trait portion of the State-Trait Anxiety Inventory, Form Y (STAI; Spielberger, Gorsuch, & Lushene, 1970) was used to measure levels of trait anxiety. Like the TAI, the STAI also consists of 20 self-statements such as "I feel calm" to which participants respond on a 1-4 scale based upon how they generally feel, yielding total scores of 20-80. The psychometric properties of the trait portion of the STAI appear to be quite sound. Dreger (1978) reported alpha reliability coefficients for populations of high school juniors, college freshmen, and introductory psychology students of .86 to .92. Additionally, Katkin (1976) obtained test-retest reliability coefficients for college men and women of .73 and .77, respectively, at 6 months. Concurrent validity of the trait portion of the STAI has been supported by its relationship with the IPAT Anxiety Scale (Krug, Scheier, & Cattell, 1976), Manifest Anxiety Scale (Taylor, 1953), and the Affect Adjective Check List (Zuckerman & Lubin, 1965). Correlation coefficients for 126 college women were .75, .80, and .52, respectively.

Wide Range Achievement Test. The arithmetic subtest of the third edition of the Wide Range Achievement Test (WRAT3; Wilkinson, 1993) was used to evaluate the mathematical skills of participants. Two alternate forms of the WRAT3 (Blue and Tan) are available, with the former administered at pretreatment and the latter at posttreatment. On both forms, participants are given 15 minutes to solve a series of 40 increasingly more difficult mathematical problems without the use of a calculator. Participants older than age 8 are given 15 points credit for oral problems that are not administered and earn 1 point for each of the written problems solved correctly, yielding a maximum score of 55. Both forms of the arithmetic subtest appear to be internally consistent and to be equivalent psychometrically. Coefficient alphas for the age range of

participants in this study are reported to be .85 or higher and alternate forms reliabilities are at least .86. Test-retest reliability coefficients are .87 and .84 for the two forms at 37 days. A significant relationship ($r = .66$) between combined scores from the two forms of the arithmetic subtest and the arithmetic subtest of the Wechsler Intelligence Scale for Children - Third Edition (WISC-III; Wechsler, 1989) supports the concurrent and construct validity of the WRAT3.

Process Measures

Two process measures were obtained in order to explore the degree to which the two interventions might facilitate therapeutic change through differing mechanisms. To assess the presence of any potential therapist bias or other nonspecific effects that might favor one intervention over the other, a brief questionnaire was completed by all participants at the end of each treatment session. Participants also completed at pretreatment, posttreatment, and follow-up a second process measure designed to assess experiential avoidance.

Nonspecific effects. At the end of each session, participants were asked to rate their own therapeutic progress and their evaluation of that session in response to two items taken from a questionnaire developed by Orlinsky and Howard (1966). Specifically, participants on the postsession questionnaire were asked to evaluate the overall quality of the session just completed according to a 7-point scale (1 = "perfect," 7 = "very poor") and how much progress they felt they made during it according to a 6-point scale (1 = "a great deal of progress," 6 = "in some ways, my problems seem to have gotten worse this session").

Experiential avoidance. The Acceptance and Action Questionnaire (AAQ) recently has been explicitly developed by Hayes and his colleagues (2002) to measure the processes of experiential avoidance and psychological acceptance thought to be impacted by ACT. The version of the AAQ that was administered asks participants to use a 7-point scale to rate "the truth . . . as it applies to you" of nine statements designed to evaluate aspects of psychological acceptance vs. experiential avoidance. Individual items relate to offering private events as reasons for dysfunctional behavior ("When I feel depressed or anxious, I am unable to take care of my responsibilities"), deliteralization ("When I evaluate something negatively, I usually recognize that this is just a reaction, not an objective fact"), and cognitive fusion ("Anxiety is bad"). Total scores on the AAQ range from 9-63, with higher scores reflecting greater levels of experiential avoidance. A series of studies on the psychometric properties of the AAQ suggest that it possesses satisfactory levels of reliability and validity to be used for research purposes as a process measure of experiential avoidance. Hayes et al. found the internal consistency of the AAQ (Cronbach alpha = .70) to be adequate for a scale in development (Nunnally, 1978). Support for the concurrent validity of the AAQ has been provided by its relationship with measures of general psychological dysfunction such as the Brief Symptom Inventory (Derogatis, 1992) as well as more specific forms of

psychopathology including the Beck Depression Inventory (Beck, Steer, & Brown, 1996) and Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988). Significant correlations between the AAQ and other measures of experiential avoidance such as the Dissociative Experiences Scale (Bernstein & Putnam, 1986) and White Bear Suppression Inventory (Wegner & Zanakos, 1994) may be viewed as evidence for its convergent and construct validity.

Treatment Conditions

I served as the therapist in both treatment conditions that consisted of six weekly sessions of approximately 1 hour each. All sessions for both conditions were designed to be progressive and were conducted individually with participants according to treatment manuals.¹ The general format for each session included reviewing any relevant experiences of math anxiety/avoidance since the previous session and assigned homework, presentation and discussion of new treatment material, and assignment of new homework. As previously mentioned, participants at the end of each session were asked to rate their own therapeutic progress and evaluation of that session.

ACT. I followed guidelines detailed by Hayes et al. (1999) to adapt ACT as an intervention for math anxiety. The first two sessions primarily were devoted to inducing a state of “creative hopelessness” in participants through the use of metaphors that emphasized the futility of deliberate efforts to control, reduce, or eliminate unwanted levels of math anxiety and related private events. For example, concentrated attempts by participants to avoid or suppress math anxiety were likened to the futility of trying to dig oneself out of a hole by presenting the “man in the hole metaphor” (Hayes et al., pp. 101-102). The middle two sessions introduced willingness and psychological acceptance as alternative ways of responding to math anxiety, while simultaneously weakening literalization, cognitive fusion, reason-giving, and other related contexts that support experiential avoidance. In particular, “the chessboard metaphor” (in which private events are likened to pieces on a chessboard) and “the observer exercise” (in which changes in private events are experienced from the context of an invariant sense of self) were presented to assist participants in making a distinction between private events related to math anxiety and what is referred to in ACT as “the observing self” (Hayes et al., pp. 190-195). The final two sessions clarified how successfully completing college algebra related to larger goals and values in the lives of the participants (e.g., completing a degree and obtaining a better job, being a better parent, improving oneself, etc.) and what behavioral process participants would have to commit themselves to in order realize these goals and values (i.e., “Are you willing to do what needs to be done to complete college algebra and experience math anxiety, along with whatever other feelings and thoughts - such as feeling stupid or thinking that you’re incompetent - you may not like as well, as part of that process?”).

¹Copies of treatment manuals may be obtained from the author.

Systematic desensitization. Imaginal systematic desensitization was implemented according to guidelines presented by Wolpe (1973). During the first session, participants were presented with a rationale for treatment and a demonstration of progressive muscle relaxation. Participants were given an audiotape of the exercise and asked to practice relaxation on a daily basis for homework. Subsequently, the relaxation induction procedure was modified to also include relaxation by recall and cued relaxation. By the end of the third session, an 11-item anxiety hierarchy was constructed individually for each participant, consisting of a range of situations that elicited math anxiety (e.g., "being called upon by my math instructor to solve a problem at the blackboard," "encountering a word problem I don't know how to solve on the final," etc.). The final several sessions were spent progressively presenting items in imagination from the hierarchy while participants were relaxed. Items higher on the hierarchy were not presented until participants indicated they could successfully imagine lower items with minimal anxiety. All participants completed their hierarchies by the end of Session 6.

Results

Means and standard deviations for the outcome measures and AAQ for both treatment conditions at each assessment occasion are presented in Table 2. There were no significant differences between the two treatment conditions on any of the measures at pretreatment: (a) MARS,

Table 2

Means and Standard Deviations of Outcome Measures and AAQ

Measure	ACT (<i>n</i> = 12)		Systematic desensitization (<i>n</i> = 12)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Mathematics Anxiety Rating Scale (MARS)				
Pretreatment	290.92	55.21	308.42	54.98
Posttreatment	191.92	46.22	167.25	43.75
Follow-up	173.67	52.03	168.00	39.79
Test Anxiety Inventory (TAI)				
Pretreatment	55.83	15.76	58.00	14.32
Posttreatment	42.17	10.08	37.50	9.33
Follow-up	38.78	9.65	33.89	9.93
Trait Anxiety Inventory (STAI)				
Pretreatment	40.67	11.60	45.42	9.21
Posttreatment	37.08	9.69	35.75	9.07
Follow-up	35.22	6.59	33.00	6.75
Wide Range Achievement Test (WRAT3^a)				
Pretreatment	39.33	4.67	40.75	5.51
Posttreatment	39.00	3.22	40.50	5.79
Acceptance and Action Questionnaire (AAQ)				
Pretreatment	35.83	8.27	34.67	6.24
Posttreatment	30.33	7.57	27.67	4.81
Follow-up	31.11	4.51	26.44	5.15

Note. *n* = 9 for both treatment conditions at follow-up. ^aThere was no administration of the WRAT3 at follow-up.

$t(22) = .78, p = .44$; (b) TAI, $t(22) = .35, p = .73$; (c) STAI, $t(22) = 1.11, p = .28$; (d) WRAT3, $t(22) = .68, p = .50$; and (e) AAQ, $t(22) = .62, p = .54$. Changes from pretreatment to posttreatment were evaluated with 2 (treatment condition) \times 2 (assessment occasion) ANOVAs. Because 3 participants in each treatment condition failed to complete the follow-up assessment, data from follow-up were analyzed separately.

Outcome Measures

Main effects for assessment occasion alone were obtained on the MARS, $F(1, 22) = 72.37, p < .001$, and TAI, $F(1, 22) = 48.31, p < .001$, reflecting significant, but equivalent, reductions in math and test anxiety from pretreatment to posttreatment for both treatment conditions. A significant main effect for assessment occasion was obtained on the STAI, $F(1, 22) = 25.93, p < .001$, as well as a significant treatment condition \times assessment occasion interaction, $F(1, 22) = 5.47, p = .03$. Only participants who received systematic desensitization reported significant decrements in their levels of trait anxiety over the course of treatment, $t(11) = 4.91, p < .001$. Pretreatment to posttreatment reductions in trait anxiety for participants receiving ACT fell just short of that required for statistical significance, $t(11) = 2.10, p = .06$. The relative superiority of systematic desensitization in reducing levels of trait anxiety was underscored further by an analysis of pretreatment to posttreatment change scores between the two treatment conditions. Significantly greater change scores were associated with systematic desensitization, $t(22) = 2.34, p = .03$. No significant findings were obtained on the WRAT3.

No differences between the two treatment conditions were obtained at follow-up on any of the outcome measures: (a) MARS, $t(16) = .26, p = .80$; (b) TAI, $t(16) = 1.06, p = .30$; (c) STAI, $t(16) = .71, p = .49$; and (d) AAQ, $t(16) = 1.68, p = .11$. Analyses within treatment conditions revealed that participants who received ACT maintained their levels of test and trait anxiety from posttreatment and showed further reductions in math anxiety during the follow-up period, $t(8) = 2.95, p = .02$. By contrast, participants treated with systematic desensitization reported further reductions in test anxiety, $t(8) = 2.72, p = .03$, and continued maintenance of their posttreatment levels of math and trait anxiety.

Clinical Significance

The relative efficacy of ACT and systematic desensitization also was evaluated by comparing the clinical status of participants at posttreatment and follow-up according to a twofold criterion of recovery and improvement proposed by Jacobson and Truax (1991). On each of the three measures of anxiety and separately at both posttreatment and follow-up, each participant was categorized as either recovered and/or improved. To be considered recovered, a participant's score had to be statistically more likely to be drawn from a functional than dysfunctional population. Local normative data on the MARS (Zettle & Raines, 2000) and descriptive statistics from the manuals of the TAI (Spielberger, 1977)

and STAI (Spielberger et al., 1970) were used in a formula provided by Jacobson and Truax to determine cutoff scores reflective of recovery for each of the three measures. Participants were then categorized separately at posttreatment and follow-up as recovered if their scores on the anxiety measures fell at or below the cutoffs determined for each.

To determine if individual improvement on the MARS, TAI, and STAI from pretreatment to posttreatment through follow-up exceeded that which could be attributed to limited instrument reliability, separate reliable change indices were calculated for each. Test-retest reliability coefficients reported by Richardson and Suinn (1972) for the MARS, Galassi (1985) for the TAI, and Dreger (1978) for the STAI were used in doing so. Participants were categorized separately at posttreatment and follow-up as improved if their reliable change index scores exceeded the cutoff of 1.96 recommended by Jacobson and Truax.

The clinical status of participants at posttreatment and follow-up is summarized in Table 3. At posttreatment, a majority of participants in

Table 3
Clinical Status of Participants at Posttreatment and Follow-up

Measure	ACT		Systematic desensitization	
	Post ^a	F-U ^b	Post	F-U
MARS				
Recovered ^c and improved	6	6	8	7
Recovered but not improved	1	0	0	0
Improved but not recovered	3	2	3	1
Neither	2	1	1	1
TAI				
Recovered ^d and improved	1	0	1	1
Recovered but not improved	1	2	1	3
Improved but not recovered	3	4	4	3
Neither	7	3	6	2
STAI				
Recovered ^e and improved	0	0	0	0
Recovered but not improved	1	0	0	1
Improved but not recovered	0	0	3	5
Neither	11	9	9	3

^a $n = 12$ for both conditions. ^b $n = 9$ for both conditions. ^cScore of ≤ 190 required. ^dScore of ≤ 29 required. ^eScore of ≤ 23 required.

each treatment condition displayed recovery and/or improvement from pretreatment in their levels of math anxiety. By contrast, most participants in each treatment conditions failed to show similar clinically significant reductions in their levels of test and trait anxiety, especially in the latter. The proportion of participants categorized as recovered or improved at posttreatment was not significantly different between the two treatment conditions on any of the measures. As indicated in Table 3, the clinically significant changes in math anxiety noted at posttreatment were maintained during the 2 months of follow-up. Also during follow-up,

further reductions occurred in test anxiety for both treatment conditions to where a majority of participants in each was now recovered and/or improved. At follow-up, two thirds (6 of 9) of the participants who received systematic desensitization could be categorized as recovered or improved based upon their levels of trait anxiety compared to none (0 of 9) of the participants treated with ACT, a proportional difference that is statistically significant, $p = .004$, according to Fisher's exact probability test (Siegel, 1956).

Process Measures

Responses on the postsession questionnaire from each treatment session may be viewed as an index of any nonspecific, but differential treatment effects. A series of Mann-Whitney tests on these data detected no differences between the two treatment conditions at any of the six sessions in how participants rated the quality of services they received or their therapeutic progress, suggesting that any treatment differences are unlikely attributable to therapist bias or other types of nonspecific variables.

A 2 x 2 ANOVA on the AAQ found a main effect for assessment occasion alone, $F(1, 22) = 25.75$, $p < .001$, indicating significant, but equivalent, reductions in experiential avoidance for both treatment conditions from pretreatment to posttreatment. Additional separate analyses (t tests) indicated that increases in psychological acceptance were maintained for both interventions over the follow-up period. Because

Table 4

Correlations Between Pretreatment AAQ Scores and Anxiety Measure Change Scores				
Measure	ACT ($n = 12$)		Systematic desensitization ($n = 12$)	
	r	p	r	p
MARS	.641	.025	-.279	.379
TAI	.500	.098	-.189	.556
STAI	.740	.006	.572	.052

the absence of any difference between the two treatment conditions in enhancing psychological acceptance might obscure differential processes involving experiential avoidance occurring within them, an additional analysis of AAQ scores was undertaken. Specifically, the relationships between pretreatment levels of experiential avoidance as assessed by the AAQ and reductions in the three types of anxiety from pretreatment to posttreatment were compared for the two interventions. As mentioned previously, it was expected that pretreatment levels of experiential avoidance would be positively associated with therapeutic change for ACT alone. As can be seen in Table 4, this expectation was largely supported. Levels of experiential avoidance at pretreatment were significantly associated with reductions in math anxiety only for participants treated with ACT and the correlational coefficient ($r = .641$) differed significantly, $z = 2.22$,

$p = .03$, from that noted for systematic desensitization ($r = -.279$). There was also a significant correlation between experiential avoidance and change scores in trait anxiety for ACT, while that obtained for participants receiving systematic desensitization fell just short of the requirement for statistical significance ($p = .052$).

Discussion

One of the primary purposes of this study was to expand the comparative outcome literature on the efficacy of ACT as a second-order change strategy by evaluating it against systematic desensitization as a first-order approach in the treatment of math anxiety. Systematic desensitization as noted previously represented a fairly stringent "benchmark" against which to compare ACT, given its status as a well-established and efficacious therapy for specific phobia. While it is recommended that the results be viewed tentatively until replicated by other researchers, the overall findings of this study indicate that ACT compared quite favorably to systematic desensitization. Both interventions were associated with statistically equivalent and significant reductions in math anxiety that were also clinically significant. At posttreatment, a majority of participants (10 of 12 for ACT and 11 of 12 for systematic desensitization) displayed recovery or improvement in their levels of math anxiety, suggesting that the parity in statistical significance between the two treatments can not be attributed to each being equivalently ineffective. Furthermore, clinically significant reductions in math anxiety noted for both interventions at posttreatment were maintained during the 2 months of follow-up.

It should be noted that ACT and systematic desensitization were administered individually in this study and it seems advisable, consequently, to limit any tentative conclusions that might be drawn about the comparable efficacy of ACT to this treatment format. Systematic desensitization more broadly (Lazarus, 1961; Paul & Shannon, 1966) and as applied to math anxiety specifically (Suinn, 1968; Suinn et al., 1970), has been successfully adapted for use in groups. By contrast, there have been no reports of directly comparing ACT when administered individually versus in a group. An indirect comparison in treatment of depression suggested that the efficacy of ACT may be diminished when delivered in a group format (Zettle & Rains, 1989). Whether ACT is also comparable to systematic desensitization when both are offered in groups is an empirical question that is currently the focus of my further research in this area.

A secondary purpose of this study was to further compare ACT and systematic desensitization in reducing comorbid levels of test and trait anxiety. Both were associated with statistically significant reductions in test anxiety that, however, reflected only modest levels of clinical significance. That only roughly half of all participants (5 of 12 for ACT and 6 of 12 for systematic desensitization) could be categorized as recovered or improved at posttreatment does not seem surprising given that both interventions focused

on math anxiety and did not specifically target test anxiety. Additional comparative outcome research in which both ACT and systematic desensitization primarily focus upon test anxiety would provide a more rigorous evaluation of the relative efficacy of the two approaches in alleviating it.

The only comparison in which ACT fell somewhat short of matching systematic desensitization was in the latter's alleviation of trait anxiety. Statistically significant reductions in trait anxiety were only attained by systematic desensitization and, at follow-up, a significantly higher proportion of participants could be categorized as recovered or improved. Why the successful treatment of math anxiety generalized to trait anxiety for systematic desensitization but not for ACT is not at all clear. One possible explanation may be found in the differential emphases placed upon homework within each and in the differing nature of such assignments. Beginning at the end of the first session during which they were introduced to progressive muscle relaxation, participants receiving systematic desensitization were assigned weekly homework in which relaxation induction was an integral part of the assignments, either through participants practicing various relaxation techniques in earlier sessions or through imagining items from their hierarchies while relaxed as homework from later sessions. In doing so, participants presumably experienced states of relaxation in a number of diverse settings that may have helped alleviate more general levels of tension reflective of trait anxiety. Less of a reliance was placed upon homework in ACT and assignments tended to be more suggestive rather than prescriptive in nature (e.g., "maybe you'd like to think a little bit more about what we talked about today before our next session and, if so, we can talk more about it then."). Further research comparing ACT and systematic desensitization should perhaps consider controlling the level of homework in each to more systematically evaluate this possibility.

The one outcome measure in which neither treatment fared well was in improving mathematical skills as assessed by the WRAT3. These results were somewhat surprising for several reasons. For one, although not all research in treatment of math anxiety has included a measure of mathematical skills as a dependent variable (Foss & Hadfield, 1993; Hendel & Davis, 1978; Wadlington et al., 1992), those studies that did have reported significant improvements in mathematical skills as a benefit of alleviating math anxiety (Schneider & Nevid, 1993; Suinn et al., 1970; Suinn & Richardson, 1971; Vance & Watson, 1994). Secondly, the mean pretreatment level of mathematical skills of participants fell within the low end of the average range (standard score = 93; 32nd percentile) according to norms of the WRAT3 (Wilkinson, 1993), precluding any ceiling effect. None of the studies cited above that reported increased mathematical skills as a consequence of reducing math anxiety used the WRAT3. Three used the Differential Aptitude Tests (Bennett, Seashore, & Wesman, 1981) and the other (Vance & Watson), a locally-constructed algebra exam. One possibility is that the arithmetic subtest of the WRAT3 lacks sufficient sensitivity as an outcome measure for use with participants with a limited range of mathematical skills.

A second primary purpose of this study was to evaluate whether two treatments that represent behavioral change strategies of differing orders may facilitate therapeutic change through dissimilar processes. The overall results suggest that they do. No differences between ACT and systematic desensitization were noted on the postsession questionnaire, at least suggesting that any nonspecific variables that may have been operative exerted an equivalent influence on each. However, differences in the relationship between pretreatment levels of experiential avoidance and pretreatment to posttreatment reductions in the three measures of anxiety suggest that the two treatments initiated therapeutic change through different processes. Participants who had higher levels of experiential avoidance, in general, benefitted the most from ACT, suggesting that, at least in this study, participants who were most lacking in psychological acceptance were the most responsive to a second-order approach that explicitly sought to enhance it by altering the contexts within which math anxiety is held. By contrast, the correlation between experiential avoidance and reductions in math anxiety, in particular, for participants who received systematic desensitization was negative, and although nonsignificant, differed significantly from that obtained for ACT. In short, levels of pretreatment experiential avoidance generally were not related to responsivity to systematic desensitization as a first-order change strategy that sought to substantially reduce math anxiety by inducing relaxation as an incompatible response. This occurred despite the finding that equivalent and significant reductions in experiential avoidance as assessed by the AAQ were obtained by both treatments. Further, differences in therapeutic process associated with the two were most pronounced in how they apparently impacted math anxiety as the primary clinical focus of this study. Additional research using the AAQ as a process measure in comparing ACT against other first-order change strategies in treatment of other clinical problems (e.g., versus cognitive therapy of depression) would help determine if the relationship between experiential avoidance and responsivity to ACT is limited to math anxiety.

Math anxiety in large measure served as a "disorder of convenience" in this study to provide a vehicle for addressing primary comparative outcome and process questions involving ACT and systematic desensitization. This admission should not be taken to diminish the clinical status of math anxiety as a specific phobia nor the emotional turmoil of math anxiety and the psychological obstacle it represents for many college students who experience it at severe levels. For example, I have encountered undergraduate psychology majors who have had to delay their graduation because they avoided taking college algebra, which, in turn, serves as a prerequisite for required courses in statistics and research methods within the major. In this regard, although the participants in this study could be regarded as legitimately math anxious, their level of "math avoidance" did not appear to be especially extreme. At pretreatment, 6 of the 12 participants and 5 of 12 participants assigned respectively to ACT and systematic desensitization were enrolled in math classes. Whether participants who

were not enrolled in a math class at the time of treatment did so the following semester was not systematically tracked, although several participants anecdotally reported that this occurred. A more stringent test for both ACT and systematic desensitization, but particularly the former, would be to compare them with students who have been continuing to avoid enrolling in math, with posttreatment enrollment serving as a primary outcome measure. As Tobias (1978) has emphasized, "The test of success for any math anxiety management scheme will be whether one bites the bullet and signs up for an appropriate course in math, sticks with it, and does well" (p. 249). As applied specifically to ACT, the "acid test" is whether it can induce students who have avoided math to do what they need to do (i.e., enroll in and successfully complete a course in math) *and* be anxious about doing so.

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