

Effective Interventions on Test Anxiety Reduction

A Meta-Analysis

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ABSTRACT This meta-analysis synthesized the results from test anxiety reduction programs. Analyses were based on 56 studies ($n = 2,482$); the overall mean effect size (ES) for test anxiety reduction programs was $E_{++} = 0.65$ (95 percent confidence intervals [CI] + 0.58 to 0.73). On measures of anxiety reduction, the average individual completing treatment is seen as better off than 74 percent of those individuals who did not receive treatment. The treatment of test anxiety has been quite successful in reducing the test anxiety level of clients. The most effective treatments appear to be those that combine skill-focussed approaches with behaviour or cognitive approaches. Individually conducted programs, along with programs that combined individual and group counselling formats, produced the greatest changes. There is a serious lack of research on test anxiety reduction programs for primary, secondary and high school students.

Test anxiety is a serious problem for many student populations. Test anxiety among students has been negatively associated with test performance, achievement of degrees and the selection of occupations (Topp, 1989). Students at all levels who suffer from test anxiety choose and pursue careers which involve infrequent evaluations and which, consequently, may not fully challenge their cognitive abilities (Krohne and Laux, 1982).

The term 'test anxiety' as a scientific construct, refers to the set of phenomenological, physiological and behavioural responses that accompany concern about possible negative consequences or failure of an exam or a similar evaluative situation (Sieber et al., 1977). A particularly

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low response threshold for anxiety in evaluative situations characterizes test anxious students. As a result, they tend to react with threat perceptions, reduced feelings of self-efficacy, self-derogatory conditions; anticipatory failure attributions and more intense emotional reactions and arousal at the very first sign of failure. Test-anxious behaviour is typically evoked when a person believes that her or his intellectual, motivational and social capabilities are affected by the test situation (Sarason and Sarason, 1990). In test anxiety literature Spielberger's (1972) test anxiety definition is widely accepted (test anxiety is an 'unpleasant state characterized by feelings of tension and apprehension, worrisome thoughts and the activation of the autonomic nervous system when an individual faces evaluative achievement-demanding situations'). Test anxiety is a significant issue for counselling as evidenced by its rapidly growing literature.

Based on a number of estimates of the prevalence rates of test anxiety in school and college age populations the phenomenon appears to be widespread. Hill and Wigfield (1984) projected that two or three students in a typical classroom are 'highly anxious', with as many as a total of ten million elementary and secondary school students under-performing due to their high test anxiety. Furthermore, a study of 1,648 Canadian elementary and high school students indicated that 22 percent of the students were significantly worried about schoolwork and this was the most prevalent stressor by grade 12 (McGuire et al., 1987). Researchers have estimated test anxiety prevalence rates of anywhere between 15–20 percent for college students (Hill and Wigfield, 1984).

Reduction of test anxiety levels has been one of the important concerns in test anxiety research. Just as there have been different ways of conceptualizing the problem of test anxiety, there have also been different ways of approaching its treatment. With the early understanding of test anxiety in terms of a physiological/emotional phenomenon, treatment efforts were directed toward reducing the physiological arousal through behavioural methods. Later, treatments moved more in the direction of cognitive and combined approaches. Various treatments have been developed or applied to test anxiety: (a) behavioural approaches including systematic desensitization, relaxation training, biofeedback, modelling, anxiety induction, anxiety management training and other behavioural techniques; (b) cognitive approaches including rational emotive therapy, cognitive restructuring and other cognitive techniques; (c) cognitive-behavioural approaches including cognitive-behavioural modification, stress-inoculation training and other cognitive behavioural techniques and (d) skill-deficit approaches including study skills training, test-taking skills training, other skill deficit approaches and cognitive behavioural and skill-focussed approaches combined (Beck et al., 1996; Jones and Petruzzi, 1995; Kondo and Gifu, 1997; Onwuegbuzie and

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Daley, 1996; Sanghvi, 1995; Sud and Prabha, 1996). Test anxiety reduction programs have gained widespread acceptance and are used as an intervention for students and persons in different stages of education.

An abundance of literature exists that describe the process and outcome of test anxiety reduction programs with students at different levels. The majority of this information is presented as descriptive or anecdotal reports. Controlled research does exist that provides evidence of the effectiveness of test anxiety reduction interventions. These interventions have been shown to be effective in modifying test anxiety levels of clients. The generalizability of this research has often been hampered by small samples, different research settings and conditions and conflicting results. A methodologically sound synthesis of the available controlled research is needed to answer broad questions about the effectiveness of test anxiety reduction programs and the impact of the moderating variables on their overall effectiveness. Meta-analysis can address these shortcomings by synthesizing the available research into one comprehensive study.

The purpose of this study was to determine the overall effectiveness of test anxiety reduction programs and to find out if effectiveness is related to particular interventions, studies and client characteristics. These potential moderators included characteristics of the intervention and the client, as well as design features of the studies themselves. The results of this meta-analysis should provide the information needed for test anxiety theorists and for practitioners regarding effective test anxiety reduction programs and conditions under which the benefits of intervention may be maximized.

Methods

This meta-analysis included published and unpublished studies on the effectiveness of test anxiety reduction programs. The following methods were used to locate studies for inclusion: (a) computerized search of PsycLIT (1974–1998), Educational Resources Information Center (ERIC; 1966–1998), Social Science Citation Index (SSCI; 1990–1998), PsycINFO (1967–1998), Medline (1985–1998) and Digital Dissertations Abstracts (1977–1998) databases using the keywords test anxiety, examination anxiety, test fear, reduction programs, treatment, intervention, psychotherapy, counseling and outcome; (b) manual search of *Journal of Counseling Psychology*, *Journal of Counseling and Development*, *Behavior Research and Therapy*, *Journal of Experimental Education*, *Journal of Consulting and Clinical Psychology*, *Behavior Therapy*, *Psychological Reports* and *Cognitive Therapy and Research*; (c) manual search of numerous review articles, chapters and books as well as the reference lists of all located studies and (d) non-published studies were

sought by contacting anxiety and test anxiety associations, training and treatment centres and posting messages to electronic newsgroups.

As a result of these search procedures, 286 studies were identified as possibly meeting the inclusion criteria. A number of the studies failed to meet at least one inclusion criteria such as a lack of a control group, no random assignment of clients or data that were non-susceptible to analysis. After reviewing these studies, 39 published (included 76 experiment groups) and 17 unpublished (included 38 experiment groups) were included in the meta-analysis. In the current meta-analysis 56 studies (114 effect sizes) were analysed.

Coding process. Coding procedures for translating critical study information into coded form amenable to computer processing were established after all studies were retrieved for meta-analysis. Three graduate students, trained in coding the variables included on the coding sheet, coded the articles. These trained coders used a coding manual, which was developed by the researcher. Coders attended a two-hour training session about the coding process. (Coding sheets and coding manual can be obtained from the author on request.)

Three coders independently coded all studies for eight potential moderator variables that were thought to be theoretically relevant to the outcome of test anxiety reduction programs. These moderators included characteristics of intervention, client and study; intervention approach (behavioural, cognitive, cognitive-behavioural, skill-focussed, behavioural and skill focussed combined, cognitive and skill focussed combined, cognitive and behavioural and skill focussed combined and other techniques); type of intervention technique (systematic desensitization, relaxation training, anxiety management training, hypnotherapy, other behavioural techniques, rational-emotive therapy, cognitive restructuring, other cognitive techniques, cognitive-behavioural modification, stress inoculation training, other cognitive-behavioural techniques, study-skills training, other skill focussed interventions, behavioural and skill-focussed approaches combined, cognitive and skill-focussed approaches combined, cognitive behavioural and skill-focussed combined, other interventions); intervention modality (group, individual, both); time in therapy in minutes (0–60, 61–200, 201–350, 351–500, 501–650, 651 or above); education level of clients (primary school, middle school, high school, college and university); publication status (published versus unpublished). Inter-rater reliability among the coders was calculated by using intraclass correlation and was calculated as 0.84. The coding process was considered reliable.

Computation of effect sizes and statistical analysis. Effect sizes and their variances were calculated using formulas derived by Hunter and Schmidt (1990) for post-test comparisons of control and treatment groups. The data were entered into MetaWin Statistical Program

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(Rosenberg et al., 1997) after effect size calculations. The combined effect sizes and mean effect size differences were analysed using this program. The meta-analysis was based on fixed-effect models (Rosenberg et al., 1997); in other words, it is assumed that a class of studies with similar characteristics shares a common true effect size. Differences among studies in the actual effect size measured are assumed to be due to sampling error.

In this analysis, the null hypothesis that all effect sizes are equal, versus the alternative hypothesis that at least one of the true effect sizes in a series of comparisons differs from the rest, is tested with the homogeneity statistic, Q , which has approximately a X^2 distribution with degrees of freedom equal to one less than the total number of studies. The greater the value of Q , the greater the heterogeneity in effect sizes among comparisons. The total homogeneity, Q_T , much as one can partition variance in an ANOVA. In the formulæ Q_B is homogeneity between groups and Q_W , homogeneity within groups.

$$Q_B + Q_W = Q_T$$

The statistical analysis results were presented on 'Q Tables' as Halvorsen (1994) and Light et al. (1994) suggested.

Results

Comprehensive review of test anxiety outcome research derived 114 effect sizes from 56 studies meeting inclusion criteria (a table listing the 56 studies with corresponding effect sizes is available from the author on request). Analysis of effect sizes for outliers did not reveal any extreme outliers (i.e. effect sizes 3 or more standard deviation units from aggregate effect size), so all effect sizes in aggregation are included. The mean number of clients per study was 45 ($n = 2,428$). The mean year for the included studies was 1986. Most of the studies were completed in 1980 (six studies), 1994 (six studies) and 1995 (five studies). The earliest study included in the meta-analysis was published in 1973 while the most recent one was presented in 1998. The mean age for the clients was 18.86 with a range of 10 to 32 years. Clients were mostly female (67.10 percent). The age range for clients in the experiment groups was 10–32 with a mean age of 19. Most of the students were enrolled in colleges and universities. In the experiment groups 64 percent of the clients were female. Seventeen percent of the clients in experiment groups dropped out before the program was completed.

Mean effect of treatment

The overall mean effect of test anxiety reduction programs was $E_{++} = 0.65$ (95 percent CI = 0.58 to 0.73), with $k = 113$ effect sizes included. This

effect size is moderate by Cohen's (1988) standards for research in the behavioural sciences. Translating standard scores to percentages, the average individual completing treatment is seen as better off than 74 percent of those individuals who did not receive treatment (a Z-score of 0.65 corresponds to the 74th percentile in a standardized normal distribution).

Moderator analyses

Results of analysis of all categorical moderators are presented in Table 1. These analyses were conducted according to procedures recommended by Hunter and Schmidt (1990) and Rosenthal (1991). A significant between-groups (Q_B) statistic indicates that grouping studies by levels of the moderator variable results in a significant reduction in heterogeneity among effect sizes – that is, the moderator explains at least some of the heterogeneity observed in the omnibus analysis. A significant within-groups (Q_W) statistic indicate that heterogeneity greater than expected by chance remains within studies at the designated level of moderator variable (suggesting that studies within this group did not derive from homogenous populations and further moderators may yet be found).

Intervention approach. Among the study experiment groups, 42 reported using behavioural interventions, 17 used cognitive interventions, nine used cognitive-behavioural interventions, 16 used skill-focussed interventions, five used behavioural and skill focussed techniques, three used cognitive and skill-focussed treatment, three used cognitive, behavioural and skill-focussed combined techniques and seven used other techniques such as Gestalt techniques, meditation or physical exercise. Between class effect size ($Q_B(7) = 44.01, p < 0.01$) results indicated significant differences among the mean effect size of the groups. Test anxiety reduction programs which used cognitive and skill-focussed techniques produced greater effect size ($E_+ = 1.22$); other approaches which produced large effect sizes were behavioural and skill-focussed ($E_+ = 1.10$) and behavioural ($E_+ = 0.80$). Other techniques such as Gestalt therapy, meditation and physical exercise produced small effect sizes ($E_+ = 0.15$). Among these approaches, only behavioural and skill-focussed, cognitive and skill focussed and behavioural and skill-focussed approaches were homogenous in effect size results.

Type of intervention technique. The overall effect size of experiment groups was broken down by type of test anxiety reduction program or technique to determine whether certain test anxiety reduction programs produce larger effect sizes than others. Cognitive restructuring ($E_+ = 1.11$), combined behavioural and skill-focussed approaches ($E_+ = 1.10$), cognitive and skill focussed approaches combined ($E_+ = 1.07$), other behavioural techniques ($E_+ = 1.01$), anxiety management training

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Table 1 *Effect size differences according to different categorical variables*

<i>Variable</i>	<i>E₊</i>	<i>95 % CI</i>	<i>Q</i>	<i>df</i>
Intervention approach				
Within groups (Q _w)				
Behavioural	0.80	0.68, 0.92	108.35**	45
Cognitive	0.63	0.45, 0.81	39.50**	16
Cognitive-behavioural	0.36	0.09, 0.64	30.68**	8
Skill-focussed	0.42	0.23, 0.61	32.27**	15
Behavioural and skill-focussed	1.10	0.78, 1.43	4.99	4
Cognitive and skill-focussed	1.22	0.81, 1.63	3.24	2
Cognitive and behavioural and skill-focussed combined	0.72	0.28, 1.17	0.14	2
Other techniques	0.15	-0.18, 0.41	17.19**	6
Between groups (Q _B)			44.01**	7
Type of intervention technique				
Within groups (Q _w)				
Systematic desensitization	0.90	0.68, 1.13	53.95**	14
Relaxation training	0.52	0.27, 0.77	5.36	10
Anxiety management train.	0.97	0.29, 1.66	0.03	1
Hypnotherapy	0.50	0.22, 0.78	9.85*	4
Other behavioural techniques	1.01	0.81, 1.21	31.38**	17
Rational-emotive therapy	0.54	0.15, 0.92	12.87**	3
Cognitive restructuring	1.11	0.67, 1.56	7.68	3
Other cognitive techniques	0.48	0.08, 0.87	1.43	3
Cognitive-behavioural modif.	0.08	-0.31, 0.47	18.97**	4
Stress-inoculation training	0.53	0.25, 0.80	9.99**	2
Other cognitive-behavioural tech.	0.43	-0.19, 1.05	6.56*	1
Study-skills training	0.28	0.03, 0.52	10.64	9
Other skill-focussed inter-behavioural and skill-focus approaches combined	0.45	0.01, 0.90	8.43*	2
Cognitive and skill-focus approaches combined	1.10	0.78, 1.42	4.99	4
Cognitive behavioural and skill focussed combined	1.07	0.61, 1.52	1.09	1
Other interventions	0.94	0.54, 1.34	4.75	3
Between groups (Q _B)	0.07	-0.20, 0.34	8.40	5
			74.49**	16
Intervention modality				
Within groups (Q _w)				
Group	0.67	0.59, 0.76	235.40**	86
Individual	0.34	0.11, 0.57	17.75**	6
Both	0.84	0.58, 1.10	18.05	11
Between groups (Q _B)			9.16*	2
Time in therapy (minutes)				
Within groups (Q _w)				
0-60	0.34	0.05, 0.62	4.72	7
61-200	0.52	0.36, 0.69	40.03**	12

Table 1 continued

<i>Variable</i>	E_+	95 % CI	<i>Q</i>	<i>df</i>
201–350	0.91	0.75, 1.08	48.07**	25
351–500	0.79	0.64, 0.95	70.24**	35
501–650	0.51	0.30, 0.72	20.54*	11
651 and more	0.43	0.19, 0.67	63.53**	5
Between groups (Q_B)			25.10**	5
Education level of clients				
Within groups (Q_W)				
Primary school	0.27	-0.06, 0.60	14.12**	4
Middle school	0.59	0.27, 0.91	2.38	4
High school	0.25	-0.13, 0.63	21.08**	4
College and university	0.68	0.59, 0.77	214.62**	76
Between groups (Q_B)			9.70*	3
Publication status				
Within group (Q_W)				
Published	0.46	0.33, 0.59	138.1**	38
Unpublished	0.64	0.48, 0.81	39.5**	16
Between group (Q_B)			2.94	1

Note: Column entries with different subscripts differ at $p < 0.001$; E_+ = Fixed effect meta analysis group effect size; CI = confidence interval; Q = heterogeneity test statistic; df = degrees of freedom. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

($E_+ = 0.97$), cognitive-behavioural and skill-focussed techniques combined ($E_+ = 0.94$) and systematic desensitization ($E_+ = 0.90$) had high effect sizes, whereas cognitive behavioural modification ($E_+ = 0.08$), study-skills training ($E_+ = 0.28$) and other interventions like physical exercise, gestalt therapy and meditation produced small effect sizes. The interventions which produced medium effect sizes were relaxation training ($E_+ = 0.52$), hypnotherapy ($E_+ = 0.50$), rational-emotive therapy ($E_+ = 0.53$), stress inoculation training ($E_+ = 0.43$) and other skill-focussed interventions ($E_+ = 0.45$). Between class effect ($Q_B(16) = 74.50, p < 0.01$) indicated that there was a significant difference in mean effect sizes among test anxiety reduction programs. As Table 1 indicates, combined test anxiety reduction programs produced bigger effect sizes. The results must be interpreted with caution because most of the groups failed to be homogeneous; therefore, a significant amount of variance in those groups remains unexplained

Intervention modality. The interventions which used both individual and group formats produced a large effect size ($E_+ = 0.84$) and the group format produced a moderate effect size ($E_+ = 0.67$), whereas the individual therapy format had a small effect size ($E_+ = 0.34$). Between classes effect ($Q_B(2) = 9.16, p < 0.05$) was significant, which indicates there are mean effect size differences among groups. Among the within class effects of

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groups, only the both individual-group format was homogenous, the both individual-group format and individual format had a significant amount of variance left unexplained.

Time in therapy. The overall effect size of test anxiety reduction programs were broken down into the time spent by clients in minutes in actual treatment. The clients who spent 201–350 minutes in treatment produced large effect sizes ($E_+ = 0.91$). The effect sizes of other groups were 351–500 minutes ($E_+ = 0.71$), 61–200 minutes ($E_+ = 0.52$), 501–650 minutes ($E_+ = 0.51$), 651 and more ($E_+ = 0.43$) and single session 0–60 minute therapies (0.34). Between class effect ($Q_B(6) = 25.10, p < 0.01$) indicated significant mean effect size differences among groups. Among these groups, only the 0–60 minutes therapy group was homogeneous. In interpreting results, caution should be given. Other groups were not homogenous, which means a significant amount of variance remains unexplained.

Education level of the clients. The mean effect sizes differ in magnitudes; the studies produced moderate effect sizes with college and university students ($E_+ = 0.68$) and middle school students ($E_+ = 0.59$). On the other hand, studies done with primary school students ($E_+ = 0.27$) and high school students ($E_+ = 0.25$) produced small effects. The between class effect ($Q_B(3) = 9.70, p < 0.05$) indicated that there are differences among the mean effect sizes of the four classes. Among the four classes only the mean effect size of test anxiety reduction programs for the middle school students group were found homogenous. The other three groups had significant amounts of variance left unexplained. Most of the test anxiety reduction programs ($n = 77$) were completed with college and university students. These results must be interpreted with caution. There are a limited number of studies with important study characteristics such as control groups and random assignments, which have been done with primary, middle and high school students.

Publication status. The effect sizes for published and unpublished studies are ($E_+ = 0.46$) and ($E_+ = 0.64$), respectively. Between-class effect is nonsignificant, $Q_B(1) = 2.94, p > 0.05$ which indicates that there is no variation between these two groups. However, in both published and unpublished study groups, a significant amount of variance was left unexplained. The current findings indicate that there was no publication bias in test anxiety literature in terms of published and unpublished studies with reference to effect size.

Discussion

The calculated overall effect size of this study was $E_{++} = 0.65$ (95 percent CI 0.58 to 0.73) This effect size is considered medium to large according to Cohen's (1977) interpretations of effect sizes. This results was similar

to the Hembree's (1998) estimate of effect size for test anxiety reduction ($E_+ = 0.72$) and Gambles (1994) latest meta-analysis effect size ($E_+ = 0.73$). Effect sizes for test anxiety interventions in previous studies (DiTomasso, 1980; O'Bryan, 1986; Thompson, 1987) were found to be larger, $E_+ = 1.16$, $E_+ = 1.07$ and $E_+ = 0.95$ respectively, than the effect size of this study. The mean effect sizes of the studies included here decreased with each more recent year. This might be the result of utilizing better statistical techniques or having more studies which have better research designs.

Intervention approach. For a better understanding of which approaches were more effective, test anxiety reduction groups were categorized into eight different intervention approaches: behavioural, cognitive, cognitive behavioural, skill-focussed, behavioural and skill-focussed, cognitive and skill focussed, cognitive, behavioural and skill focussed combined and other techniques. The observed differences among these interventions were significant. This indicates that type of intervention was related to the effectiveness of the intervention.

Behavioural and cognitive approaches were effective in reducing test anxiety. They produced $E_+ = 0.80$ and $E_+ = 0.63$ effect sizes. Using skill focussed approaches alone produced a small effect size ($d = 0.42$). These findings are consistent with previous studies (O'Bryan, 1986; Hembree, 1988; Gambles, 1994). One contradictory finding with previous studies was that the cognitive-behavioural approach had a small effect size. This might be due to the heterogeneity of variances in that group.

One of the significant findings was the high effectiveness of combined therapies with skill focussed approaches. Behavioural and skill focussed combined; cognitive and skill focussed combined; and cognitive, behavioural and skill focussed combined approaches produced high effect sizes of $E_+ = 1.10$, $E_+ = 1.22$ and $E_+ = 0.72$ respectively. Other techniques like meditation, physical exercise alone, Gestalt therapy and humanistic counseling produced small effect sizes ($d = 0.15$).

Type of intervention technique. Test anxiety reduction groups was categorized into 21 different interventions. The observed differences among these interventions were significant. Type of the intervention was related to the effectiveness of the intervention. Behavioural treatments included systematic desensitization, relaxation training, anxiety management training, hypnosis and other behavioural treatments such as modelling and extinction. Systematic desensitization and other behavioural techniques were found to be effective, $E_+ = 0.90$ and $E_+ = 1.01$ respectively. Relaxation training alone and hypnotherapy were moderately effective, $E_+ = 0.50$ and $E_+ = 0.52$ respectively. Although Hembree's (1988) meta-analytic study supported the effectiveness of relaxation training, this finding has been contradicted in the literature.

Among cognitive therapies, cognitive restructuring produced the largest effect size ($E_+ = 1.11$). However, rational-emotive therapy and

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other cognitive techniques produced moderate effect sizes, $E_+ = 0.54$ and $E_+ = 0.48$ respectively. These findings are also consistent with previous studies (DiTomasso, 1980; O'Bryan, 1986; Thompson, 1987). These interventions may be effective on the emotionality and 'worry' components of the test anxiety construct as proposed by Spielberger and Vagg (1995). The result of this meta-analysis indicate that effectiveness of cognitive therapies increased when they were combined with skill-focussed techniques. This finding is consistent with O'Bryan's (1986) meta-analytic study. Clients may increase their sense of readiness and their confidence level by learning different study and test taking skills. Cognitive behavioural interventions were found to be small to moderately effective in reducing test anxiety. This contradicts the findings of the studies conducted by DiTomasso (1980) and Gambles (1994).

Study skills training alone had a small effect size ($E_+ = 0.28$). This indicates that test anxiety cannot be explained by a learning deficit model which indicates the lack of effective study skills and test taking skills. While cognitive and behavioural treatment techniques focus on relieving symptoms of test anxiety that interfere with an individual's ability to perform well or be comfortable in testing situations, other researchers have conceptualized test anxiety as a result of a deficit of knowledge, training, ability to study, or test-taking skills. These theorists suggest that improving an individual's skills in these areas will result in improved performance and comfort. Results of this meta-analysis indicate that this may not necessarily be the case. Study skills training when measured by test anxiety show only small and moderate effect sizes ($E_+ = 0.28$, $E_+ = 0.43$, $E_+ = 0.45$). These results indicate that subjects treated with study skills training have only moderate improvement when compared with individuals who receive no treatment. However, a trend is indicated for significant improvement when study skills training is combined with cognitive or behavioural interventions. One of the significant findings of this study is that effectiveness of behavioural or cognitive interventions is increased whenever they are combined with study skills training.

Although a number of interventions have been suggested and tested in test anxiety reduction, an integrated approach, utilizing various strategies in combination, is likely have special value. Such a combined program might include such components as: (1) applicable information about studying and test taking skills; (2) opportunity to observe someone take tests, or test-like problems; (3) increasing self-monitoring and practice self-control especially of behaviour and thought in test-taking situations; (4) practice in attending to the task in hand, attentional training and (5) learning how to relax under test specific conditions.

Modality. The test anxiety reduction programs which were done with groups and individuals together produced larger effect sizes ($E_+ = 0.84$);

second, the group format had an effect size of ($E_+ = 0.67$). The individual format had the smallest effect size ($E_+ = 0.34$). Most of the intervention programs (83 percent) were conducted in the group format. It is highly likely that clients in groups can get other students' perceptions and get alternative solutions to their problems. They may see that they are not the only person who has problems related to test anxiety; they may gain therapeutic benefit in group formats and easily transfer it into their daily lives.

Time in therapy. The length of treatment, as measured by the minutes a client spent in actual treatment, was related to treatment effectiveness at a statistically significant level. The length of treatment and effect sizes were not linearly related. Maximum effect sizes ($E_+ = 0.91$) associated with 201 to 350 minutes of treatment and decreasing effect sizes as the time of the therapy moved away from this range in either direction. Sixty minutes treatment produced a small effect size ($E_+ = 0.34$). Longer programs produced small effect size ($E_+ = 0.43$). These findings indicate that the benefits of test anxiety reduction programs may increase with the number of therapy sessions until approximately 201 to 350 minutes of treatment are completed. The benefits of intervention decreases as treatment length was extended to 351 minutes or more of therapy. It does seem reasonable to assume that the benefits of intervention decrease, or at least do not increase, after approximately six or seven sessions.

Education level of the clients. The education level of the clients in the studies were categorized into four groups: Primary school students, middle school students, high school students and college and university students. A significant difference was found among mean effect sizes. Test anxiety reduction programs had high effect sizes ($E_+ = 0.68$) with college and university students and moderate effect size ($E_+ = 0.59$) with middle school students. Whereas these programs produced small effect sizes with primary and high school students ($E_+ = 0.27$) and ($E_+ = 0.25$) respectively, there were a limited number of studies with primary, middle and high school students. There is a tendency to complete studies with college and university students in test anxiety literature. As Hembree (1988) indicated, test anxiety is starting to effect performance of primary school students from fourth grade, therefore developing programs for these grades is important for the academic and personal development of students. There is a good chance that the highly anxious primary, middle and high school students will experience difficulty in getting higher grades and being accepted in university programs. These students may already be dropped by educational institutions. It could be suggested that introducing test anxiety reduction programs or test anxiety prevention programs in lower grades would be most beneficial.

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Publication status. Publication bias occurs when studies reporting statistically significant results are published and studies reporting less significant results are not. Rosenthal (1991) mentioned that these unpublished studies ended up in investigators' files and dubbed this phenomenon the file-drawer problem. At least two variations of this problem have been identified. One is reporting bias (Hedges and Olkin, 1985), which arises in published studies in which authors do not report results that are statistically nonsignificant or provide insufficient information about them. The other is retrieval bias (Rosenthal, 1991), which is due to the inability to retrieve all of the research, whether published or not.

Publication bias presents possibly the greatest methodological threat to the validity of a meta-analysis as it may lead to spurious conclusions.

Publication bias was assessed by checking effect size differences between published and unpublished studies. Hypothesis testing for this sample of studies did not indicate the presence of publication bias in test anxiety literature. It can be stated with confidence that the sample of studies used in this meta-analysis were representative of the population of studies relating to test anxiety literature. Both published and unpublished studies reported similar results in terms of the effectiveness of the test anxiety reduction programs. In previous meta-analytic studies, O'Bryan (1985) and Thompson (1986) also reported no publication bias.

Recommendations for future research

One recommendation for future researchers would be to start a study collection by looking at a directory called *Computer-Readable Databases: A Directory and Data Sourcebook*. The seventh edition is currently available and it is revised on a regular basis. It provides information on over 6,000 databases worldwide, including bibliographic, statistical and full-text document files. For reference databases, each entry includes information on its availability, years covered and document type coverage, search aids, costs and availability formats. It is a good source for locating and retrieving unpublished studies such as conference presentations, master's theses, dissertations and project reports. Most research does not contain enough data for making generalizations on the type of therapist characteristics including experience, sex and type of training that are effective in which circumstances. This topic has received little systematic attention within the test anxiety program literature. The results of this analysis suggest this may be a rich area for a more focussed research effort.

Regarding the educational level of the clients, there is a serious lack of research on test anxiety reduction programs for primary, middle and

secondary school students; however, the literature abounds with well-designed studies on college and university students. But, as Hembree (1988) indicated, test anxiety starts to affect students' performance from the fourth grade. Research investigating how and what types of interventions would be effective with primary, middle and high school students should be conducted as it would provide useful information for counsellors, psychologists and educators. Investigation of the time of therapy sessions which are most effective for the differing educational levels of clients would be a useful addition to the research. Again, since most of the research was completed on college and university students, there is a lack of information on effective program lengths for primary, middle, and secondary school students. In addition, more complete information is needed regarding the characteristics of the clients involved in test anxiety reduction programs. The question to be answered is which test anxiety reduction programs are effective with whom and why? In order to draw accurate conclusions regarding the factors of effective therapy outcomes, more detailed descriptions of clients need to be reported in test anxiety research.

Conclusion

In general, the psychological treatment of test anxiety has been quite successful in reducing the test anxiety level of clients. Even if some of the interventions tested in this meta-analysis turn out to be only palliative, they do focus attention on specific aspects of the problem and the possibilities for preventive, developmental and remedial action. The most effective treatments appear to be those that combine skill focussed approaches with behaviour or cognitive approaches. Individually conducted programs along with programs that combined individual and group formats produced the greatest changes. Programs that were somewhat brief in nature produce higher effect sizes. Most of the test anxiety reduction programs are developed for college and university students; there is an urgent need for the development of effective test anxiety reduction programs for primary, middle and high school students. No publication bias was observed in test anxiety literature.

Note

In memory of Dr Sally Navich from Ohio University, Athens, OH.

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* References marked with an asterisk indicate studies included in the meta-analysis.

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