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Mediation Strategies and Cognitive Modifiability in Young Children as a Function of Peer Mediation With Young Children Program and Training in Analogies Versus Math Tasks

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The effects of a peer-mediation program and training in analogies *versus* math on mediation strategies, cognitive modifiability, and math were investigated with 78 tutor-tutee dyads. Experimental group tutors (EGT, $n = 39$) received the *Peer-Mediation for Young Children* program, whereas control group tutors (CGT, $n = 39$) received a substitute program. Grade 3 tutors taught kindergarten tutees analogies and math problems. Their interactions were videotaped and analyzed by the *Observation of Mediation Interaction* scale. Dynamic assessment measures were administered before and after the program. EGT showed higher levels of mediation strategies and cognitive modifiability than did CGT. EGT trained in teaching analogies showed higher mediation strategies and cognitive modifiability than did EGT trained in teaching math. EGT teaching math showed higher levels of mediation strategies than did EGT teaching analogies. EGT showed higher improvement in math than CGT. The findings are discussed in view of the mediated learning experience theory and transfer effects of intervention.

Keywords: mediated learning experience; dynamic assessment; peer mediation; transfer of learning; cognitive modifiability

Peer Mediation with Young Children [PMYC] (Shamir & Tzuriel, 2002; Shamir, Tzuriel, & Guy, 2007; Tzuriel & Shamir, 2007) is a relatively novel approach based on the sociocultural theory of Vygotsky (1929, 1962, 1978, 1981) and the *mediated learning experience (MLE)* theory of Feuerstein and colleagues (e.g., Feuerstein, Feuerstein, Falik, & Rand, 2002). According to Vygotsky, learning takes place by means of social adaptation, that is, through interaction between children and more competent persons, whether adults or peers. Thus, for learning to be efficient and for cognitive development to be realized, "tutors" should have more

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experience and better abilities than those of the tutees. In order to assist tutees in reaching higher cognitive levels, experienced tutors are required to organize, explain, synthesize, and apply the learned knowledge for the tutee. The inherently more experienced position of tutors is necessary to ascertain what the tutees know and to help advance the tutees at a pace commensurate with their capabilities.

Similarly, Feuerstein et al. (2002) conceived of parents and peers as active-modifying agents in directing and shaping children's development. MLE interactions are defined as a process in which parents or other adults interpose themselves between a set of stimuli and the learning person and modify the stimuli for that person (Tzuriel, 1999, 2001). MLE interactions are conceived as crucial for the child's cognitive modifiability. This refers to the child's ability to take advantage of principles, competencies, and patterns, learned in the past, for the purpose of adapting to new circumstances as well as the ability to "learn how to learn." Feuerstein et al. (2002) developed the MLE concept by suggesting an elaborated and specific list of MLE interactions that can be observed and applied in various developmental and educational settings, including a peer mediation context.

Previous research has shown the PMYC program to be effective in improving MLE strategies of young children (Shamir & Tzuriel, 2002, 2004; Shamir et al., 2007) as well as enhancing their *cognitive modifiability* (Tzuriel & Shamir, 2007) and math performance (Shamir, Tzuriel, & Rozen, 2006; Shamir & Lazerovitz, 2007). In earlier studies experimental children who participated in the PMYC program were compared with control children who were given a substitute program composed of the same amount of lessons focused on general conditions of peer interaction. In addition, all children were given a short training session in solving the specific problems that would be taught later to their younger peers. The trainers' interactions with the young peers were videotaped and analyzed using the *Observation of Mediation Interaction* (OMI; Klein, 1988) adapted for peer mediation (Shamir & Tzuriel, 2004). In all previous studies the peer interactions were carried out when the tutor was given either a thinking-type problem (e.g., a set of seriation tasks) or a typical subject matter (e.g., math) to teach the younger peer. The question remains, however, whether training to mediate in subject matter or in a thinking-type of problem is more effective for enhancement of mediation strategies and cognitive modifiability.

The findings of previous studies support the effectiveness of the PMYC program. Tutors in the experimental group have shown not only higher levels of mediation strategies than have control group tutors (Shamir & Tzuriel, 2004; Shamir, Tzuriel, & Rozen, 2006) but also higher cognitive modifiability in analogical reasoning tasks (Shamir et al., 2007; Shamir & Van der Aalsvoort, 2004; Tzuriel & Shamir, 2007) as well as in math (Shamir et al., 2006). Moreover, the findings indicate that tutees who themselves did not receive any training program but were taught by their peers trained in mediation showed also a higher level of mediation strategies (Shamir & Tzuriel, 2004) and a higher pre- to post-teaching improvement on seriation tasks (Shamir et al., 2007; Tzuriel & Shamir, 2007) and in math (Shamir et al., 2007) than did their peers who were taught by nonmediating tutors. The findings were explained by the fact that the experimental tutors used better strategies in teaching their peers than did the control tutors. The experimental tutors succeeded more than the control tutors in helping the tutees to use the mediation strategies, learn the rules of the cognitive tasks (seriation or math), and improve their performance in the post-teaching test.

These findings raise further questions that carry theoretical and practical implications regarding the transfer effects of training children in problem-solving tasks versus training them in content-oriented tasks. One should note that the PMYC program is not based on teaching a specific content but is rather *a process-oriented* program designed to teach children *how* to mediate effectively irrespective of the mediated content. The specific question is: Would children receiving the PMYC program (experimental condition) show higher levels of mediation strategies and cognitive modifiability when in addition they receive training to teach their peers a problem-solving type of task (e.g., analogical problems) versus training to teach their peers content-oriented tasks (e.g., math). In the current study we used a treatment (experimental/control) by training (analogies/math) experimental design (2 × 2). The question we asked was whether there is an interaction effect of the PMYC program, characterized by general mediation strategies, with the specific characteristics of the domain they are trained to teach. The interaction effects were investigated in relation to (a) the mediation strategies used by the tutors, (b) the cognitive modifiability as reflected in the problem-solving tasks, and (c) the content-oriented task as reflected in math. In the following section we present the PMYC program and the main hypotheses of this study.

THE PEER MEDIATION WITH YOUNG CHILDREN (PMYC) PROGRAM

Theoretical Aspects

The PMYC is based on the first five mediation criteria suggested by Feuerstein et al. (2002). These criteria have been operationalized for observation with mother-child and peer-mediation interactions (e.g., Klein, 1988, 1996; Shamir & Tzuriel, 2004; Tzuriel, 1999, 2001; Tzuriel & Shamir, 2007). Before discussing the PMYC program we describe first the five MLE criteria. Some of these principles are used in other programs under different terms and labels.

Intentionality and Reciprocity. This criterion refers to tutors' behavior that is aimed at focusing tutees' attention on the stimuli presented. Tutors must intend to use the interaction, verbally or nonverbally, with tutees as a means of producing cognitive change in the tutees. This can be done by changes in tone, facial expressions, and body language. The tutee must reciprocate intentionality in order to continue the chain of mediated interaction. This criterion is considered as a basic type of behavior that, combined with other criteria, makes the interaction powerful. Reciprocity can be conceived as intersubjectivity (Wertsch & Tulviste, 1992) where both tutor and tutee modify each other's behavior in the course of learning interactions.

Transcendence. Mediation for transcendence (i.e., expanding) refers to interactions in which the tutor goes beyond the immediate and/or concrete needs of the tutee and expands the information by teaching generalized principles, cognitive strategies, and rules that may be transferred to other situations. This expanding strategy may help children to use metacognitive processes, expand their cognitive awareness, promote transfer of learning and use of principles in other learning contexts, and actively search for solutions: characteristics considered essential for "learning how to learn" and cognitive modifiability.

Meaning. Mediation for meaning refers to interactions in which the tutor emphasizes the value-oriented characteristics of the stimuli and the affective-motivational aspects of the stimuli. It is done by expressing their importance, significance, and worth. Mediation for meaning can be conveyed nonverbally (i.e., facial expression, tone of voice) or verbally (i.e., labeling of an object or activity, illuminating a current event, or learned context, relating an event to past or current events and emphasizing its importance and value). In peer mediation, children express meaning by labeling of information and sometimes by interest and even excitement (Shamir & Tzuriel, 2004). Children who have experienced mediation of meaning are searching for meanings in their encounters with new information and actively attach meaning to new information rather than passively waiting for meaning to come.

Feelings of Competence. Mediation for feelings of competence refers to interactions in which a tutor provides positive feedback, rewards for successes, and arranges the environment so that the tutee perceives himself or herself as capable of functioning successfully and independently. The tutor not only provides opportunities for success but also rewards the tutee for attempts to master the situation, to cope effectively with and organize the environment. It also may be expressed by positive interpretation to the tutee of his or her own behavior and by clear specification of the correct or incorrect aspects of the tutee's behavior. The interpretation of behavior may be considered as a metacognitive component, which enhances reflective thinking.

Regulation of Behavior. This criterion refers to tutors' management of the tutees' behavior before, during, and after task performance. Regulation of behavior is carried out by inhibiting tutees' tendency to react impulsively to a stimulus by sequencing components of information, systematically exploring tasks, and reviewing performance after completing the task. In some cases regulation of behavior requires accelerating the behavior, depending on the child's reactive style and the task demands. Regulation of behavior can be mediated in various ways, such as inhibition (e.g., "stop and think before you act"), arousing awareness of task characteristics and analysis of task components, verbal anticipation of answer before acting, modeling of self-control, and eliciting metacognitive strategies after performance.

These criteria, with some adaptations, were the basis for the development of the PMYC model and training lessons with children between 6 and 8 years of age. They were also used to observe and analyze the children's mediating skills as a function of participating in the program (Shamir & Tzuriel, 2004; Tzuriel & Shamir, 2007).

Objectives

The PYMC, which is a relatively novel cognitive intervention program for young children, has three main objectives: (a) to enhance a *mediating teaching style,* (b) cognitive modifiability of tutors, and (c) to facilitate performance and learning skills of young children who are mediated by their experienced tutor peers. The principal assumption is that teaching for peer-mediation will both elicit better mediating skills from the tutors and improve cognitive skills in both tutees and tutors. The mediation skills acquired and internalized as a result of the intervention will enable children to apply them in future learning contexts, whether when teaching peers or being exposed to new learning experiences. The PMYC includes also the basic conditions for teaching such as providing "personal space," empathy with and respect for the tutee.

Components and Principles

The peer-mediation model and the specific strategies are characterized by four main components: (a) A comprehensive theoretical model, which combines cognitive and emotional components; both are entailed in the concept of MLE; (b) Mediation strategies and a teaching style that go beyond content domains and contexts of learning and can be applied with problem solving tasks as well as with school subjects or behavior management techniques; (c) The mediation strategies contain creative, flexible, and open ways for tutor-tutee mutuality, although they are based on theoretically guided and structured principles. The tutor is asked to modify his or her mediation as a response to changes in the tutee's behavior; (d) The status of the tutor, as a more experienced individual, is clearly higher than that of the tutee; the tutor, who learned how to mediate, has an active-modifying role in the interaction. Thus, the peer mediation model has the advantage of both the experience of an older mediating peer and the collaboration of a cross-age peer who participates in the teaching interaction.

The program focuses on five MLE principles adapted to the age level of young children; that is, each MLE principle has its own visual symbol and slogan explaining its meaning. Children learn that these principles assist them in helping peers to solve tasks by themselves and how to "bridge" the mediation principles to different situations of learning with a peer. During the intervention program, children are exposed to the ideas and strategies of MLE. They learn the basic MLE principles and how to apply them with young children in a variety of tasks irrespective of the specific task domain.

Phases

The PMYC is composed of three phases: (a) *teaching* young children the basic MLE principles, (b) *observation* and discussion of a didactic movie that demonstrates mediation processes with young children in an actual learning event, and (c) *practicing* of the MLE principles with peers using a multimedia program as well as with conventional materials. The PMYC program consists of seven lessons given over a period of 3 weeks, each lesson for 90 min. The lessons include processes of presentation of the mediation principles, understanding their significance in general and in a peer-mediation situation in particular, and practicing and applying the principles in a variety of learning situations. The phases of the program are constructed so as to enhance internalization of each mediation principle.

MAIN GOALS AND EXPECTATIONS

The main goals of this study were: (a) to investigate the interactive effects of the PMYC program with training of analogies versus math on mediation strategies and cognitive modifiability of young children, (b) to replicate earlier studies showing the efficacy of the PMYC in improving mediation strategies and inducing cognitive modifiability.

In general, beyond our expectation to replicate earlier findings, we expected that experimental children who learned how to mediate to their peers and in addition were trained in teaching analogical reasoning (representing a general problem-solving domain) to show better mediation strategies than experimental children trained in teaching math tasks (representing content-related domain). No such distinction was expected among control children who were trained to teach analogies as compared with children trained to teach math. The first two expectations are related to the unique contribution of the current study.

1. Experimental tutors (e.g., receiving the PMYC program) trained in relatively content-free tasks such as analogies problem-solving would show a higher level of mediation strategies during interaction with their peers than their experimental counterparts trained in content-related tasks such as math.
2. Experimental tutors trained in relatively content-free tasks such as analogies would show a higher level of cognitive modifiability than would their experimental counterparts who had been trained in content- related tasks such as math. This expectation was based on the assumption that training of mediation strategies by using a

content-related task such as math (e.g., number-quantity correspondence and verbal math problems) might interfere with the mediation principles. Training in general problem- solving tasks, on the other hand, paves the way for clarification of the mediation principles and enhances their internalization in the absence of a "need" to deal with and excel in math contents.

3. Tutees who are taught by experimental analogy-trained tutors (A-tutors) would show a higher level of cognitive modifiability than would tutees taught by experimental math-trained tutors (M-tutors). The rationale for this expectation is related to two interrelated factors. The first factor is that A-tutors use more effectively the mediation strategies acquired in the intervention than M-tutors (as explained above in the second expectation). The second factor is the similarity between the training task (analogies) and the test used to tap the tutees' cognitive modifiability (analogies).
4. Experimental group tutors and tutees would show greater improvement in math scores from pre- to post-intervention than would control group children.

The next two expectations are aimed at replication of previous research findings:

5. Experimental children would show a higher level of mediation strategies than would control children.
6. Experimental children would a show higher level of cognitive modifiability than would control children.

METHODS

Sample

The sample consisted of 78 tutor-tutee dyads of children. The tutors were randomly selected from three Grade 3 classes and the tutees from three kindergarten classes. All children came from families of average socioeconomic status, as defined by the Israeli Ministry of Education. Children with special needs were not included in the sample. The tutors were randomly assigned to experimental (n = 39) and control (n = 39) groups; in each group children were randomly assigned to subgroups trained in teaching problem-solving versus math (see Design of the Study). The tutors sample was composed of 38 boys (48.7%) and 40 girls (51.3%) and the tutees group was composed of 42 boys (53.8%) and 36 girls (46.2%). Dyads of tutor—tutee were matched based on gender using a counterbalanced design in each of the experimental and control groups. Frequency analysis of Treatment × Gender showed no significant difference, $\chi^2_{(3)} = .38$, *ns*. The tutors' and tutees' mean age (in months) were 102.26 (SD = 3.28) and 77.89 (SD = 4.34), respectively. No significant age differences were found between children in the experimental and control groups, either among the tutors, $t_{(38)} = 1.10$, *ns*, or among the tutees, $t_{(38)} = 1.60$, *ns*. Comparison of the experimental and control tutors on sociodemographic variables showed that in the tutors group 48.6% of control group fathers and 48.7% of control group mothers had academic education as compared to 31.6% of experimental group fathers and 38.4% of experimental group mothers. The differences between parents of tutors in the experimental and control groups were: $\chi^2_{(4)} = 9.28$, $p < .05$ for mothers and $\chi^2_{(4)} = 9.95$, $p < .05$ for fathers.

A similar comparison in the tutees group showed that 30.3% of the control group fathers and 28.2% of the control group mothers had academic education as compared with 35.9%

of experimental group fathers and 46.1% of experimental group mothers. The differences between parents of tutees in the experimental and control groups were: $\chi^2_{(4)} = 9.02$, $p < .05$, for mothers and $\chi^2_{(4)} = 3.25$, $p = ns$, for fathers.

Measures

Observation of Mediation Interaction (OMI). The *OMI* (Klein, 1988, 1996) was originally developed for observation of parent-child mediated learning interactions with infants and toddlers and was later adapted for observation of kindergarten children (e.g., Isman & Tzuriel, 2008; Tzuriel, 1999; Tzuriel & Ernst, 1990; Tzuriel & Weiss, 1998), teacher–child interactions (Tzuriel, Kaniel, Zeliger, Friedman, & Haywood, 1998) and for peer–mediation interactions (e.g., Shamir & Tzuriel, 2002, 2004; Shamir et al., 2006, 2007; Tzuriel & Shamir, 2007). The OMI is based on five behavioral categories that represent the five MLE criteria: intentionality and reciprocity (focusing), meaning (affecting), transcendence (expanding), feelings of competence (rewarding), and regulation of behavior. Each mediation category had been operationalized in terms of mutually exclusive specific behaviors. Behaviors of tutors and tutees were coded in relation to the other's behaviors and the meaning conveyed through these behaviors. This observation method is based on a macroanalytic (molar) rather than a microanalytic sequential observation procedure (e.g., Ramey, Farran, & Campbell, 1979) because the latter usually results in an unwieldy number of detailed behavior codes, thus demanding data reduction for manageability and interpretation.

For the purpose of use with the present sample, the OMI was adapted by changing the type of stimuli presented and prolonging the interaction time to allow for improved sampling of interaction. All peer–mediation interactions were videotaped for a period of 20 min. The inter-rater reliability coefficients for mother-child mediation with kindergarten and school age children ranged between .54 and .95 (Tzuriel, 1999; Tzuriel & Ernst, 1990; Tzuriel & Weiss, 1998). Shamir and Tzuriel (2004) reported reliability coefficients ranging between .85 and .95 for the different criteria of peer mediation.

Children's Conceptual and Perceptual Analogies Modifiability (CCPAM) Test

CCPAM Closed Analogies Version. The CCPAM (Tzuriel, 2006; Tzuriel & Galinka, 2000) test was constructed on the theoretical basis of Vygotsky's (1978) zone of proximal development concept and Feuerstein's theory of mediated learning experience (Feuerstein et al., 2002). The CCPAM items represent classical analogies in a pictorial modality divided into two types of pictorial analogies: Conceptual and Perceptual. Following Goswami's (1991) and others' suggestion, all items were composed of meaningful pictures. The conceptual analogies subtest is composed of pre- and post-teaching phases, each containing 20 items. The *Closed Perceptual Analogies Subtest* is composed of pre- and post-teaching phases, each containing 16 items. Each problem is formatted in a 2 × 2 matrix (A : B :: C : D) and presented in a pictorial colored modality at the top of the page. At the bottom there are four alternative answers, of which three are distracters and one is the correct choice. The child is required to think about the relationship between the first pair of pictures in the problem, apply it to the second pair, and choose the right answer from the four given alternatives. Each problem in the pre-teaching phase parallels a problem in the post-teaching phase in terms of the relation expressed in the analogy. For example, the conceptual pre-teaching analogy *Bird: Nest :: Dog :: Doghouse* parallels the post-teaching analogy *Bee: Beehive :: Parrot : Cage*; both represent the same relationship, that is, the first lives in the second. Unlike the perceptual items, the relations between pairs of pictures in the analogy (i.e., "lives in") are not contained in the perceptual stimuli and must be inferred from the pictures. For each subtest there are two more analogies used for instruction before administration of the test. The conceptual closed analogies are composed of three types according to the relationship expressed in the analogy: *functional* relation (i.e., A lives in B), *part-whole* relation, and *categorical* relation. The four alternative answers are divided into four categories based on Goswami and Brown's (1989) suggestion: semantic association to the C term of the analogy, different semantic category, categorical relation, and part-whole relation. For example, in the functional analogy *Dog : Bone :: Girl : ?* the correct answer is *Sandwich*. The other alternatives are *House* (semantic relation), *Man* (categorical relation), and *Head of a Girl* (part-whole relation). Systematic construction of the answers allows analysis of mistakes before and after the teaching phase.

The tasks of the *Closed Perceptual Analogies Subtest* are based on an adaptation of Goswami (1992), but instead of using geometric shapes the analogies are based on familiar objects. In each analogy the relation between terms in the analogy was one of three types: (a) *difference* (change of color, position, number, or type of object), (b) *existence* (an object appears or disappears), and (c) *opposite* (e.g., object is above the chair changes to object under the chair). For example, the terms A and B of the first problem are similar in the color of the object (Box) but differ in position of another object (Cat inside and Cat outside the Box). Terms A and C are similar in terms of position of the object (Cat inside the Box) but differ in color (purple Box changes to green Box). In order to solve the analogy the child has to pay attention to both task components (position and color), and use both of them to find the correct solution. Each problem contains three alternative diversions: a picture identical to the term B, a picture identical to term C, and a random picture that relates to an irrelevant part of the objects presented in the problem (e.g., the Cat is in front of a purple Box).

The CCPAM is scored by giving each correctly solved analogy a score of 1. The maximal score for the conceptual subtest is 20 and for the perceptual subtest 16. The total score of subtests was weighted to allow comparison of performance in the conceptual versus perceptual subtests. Cronbach-alpha reliability coefficients were calculated in different samples of kindergarten children between the ages of 4 and 8 years (Tzuriel, 2000b, 2006; Tzuriel & Galinka, 2000; Tzuriel & George, 2009). Cronbach-alpha reliability coefficients, based on the present sample, were as follows: Conceptual Analogies subtest: .72 and .83 for the pre- and post-teaching phases, respectively; Perceptual Analogies subtest: .82 and .89 for the pre- and post-teaching phases, respectively. The results of a series of pilot studies on the current sample of kindergarten children provided validation data on the utility of the CCPAM (Closed Analogies version) in predicting various cognitive variables (expressive language processing, readiness for math, auditory associations, and emergent literacy). For example, Tzuriel and Zilber (2001) showed (n = 31, mean age = 69) that *readiness for math* correlated .79 ($p < .0001$) and .61 ($p < .0001$) with post-teaching phases of conceptual and perceptual analogies, respectively. Tzuriel (2001) demonstrated ($n = 195$, mean age = 70 months) that *expressive language processing* and *auditory associations* (subtests of the Illinois Test of Psycholinguistic Abilities–ITPA) were significantly predicted by conceptual and perceptual analogies. For expressive language processing, in the group that received conceptual analogies training the variable that emerged as a significant predictor was post-teaching Perceptual Analogies

(R^2 = .31, $p < .001$) whereas in the group that received Perceptual Analogies training the variable that emerged as a significant predictor was post-teaching Conceptual Analogies (R^2 = .37, $p < .001$). No significant prediction was found in the control group. For auditory associations, post-teaching Conceptual Analogies has emerged as a significant predictor in both the conceptual training group (R^2 = .20, $p < .001$) and in the perceptual training group (R^2 = .15, $p < .001$). In the control group auditory associations were predicted by a combination of post-teaching Conceptual Analogies and pre-teaching Perceptual (R^2 = .43, $p < .001$) Analogies. When training in Perceptual Analogies was compared to training in conceptual analogies among kindergarten children it was found that perceptual training was limited to gains in perceptual analogies whereas conceptual training was effective in improving both conceptual and perceptual analogies (Tzuriel, 2006).

CCPAM Construction Analogies Version. The construction analogies (Tzuriel, 2000b) were used in this study as a training instrument. Tutors were trained how to teach their younger peers to solve classical-type analogies. The construction analogies are composed of two sets of problems, conceptual and perceptual, each set containing nine problems. In each problem the child is presented with 6 cards, in a mixed order, and is asked to construct an analogy with only 4 cards formatted in a 2 × 2 pattern, sorting out 2 distractive cards.

The Cognitive Modifiability Battery (CMB): Analogies Subtest. The CMB (Tzuriel, 1995, 2000a; Tzuriel & George, 2009; Tzuriel & Shamir, 2007) is a dynamic assessment instrument designed for kindergartners to fourth graders. It is composed of seven subtests, each addressed to a different area of cognitive functioning. Only the Analogies subtest was used in the current study. The Analogies subtest includes two main levels of difficulty: easy and difficult. Each level of difficulty is composed of three sets of problems, designed for pre-teaching, teaching, and post-teaching phases. It should be noted that we used the measurement/research version of administration (Tzuriel, 2001) according to which teaching is given between pre- and post-intervention phases. The Analogies subtest includes a preliminary-baseline phase in which the examiner familiarizes the child with the main dimensions of the test and explains the basic rules of solving analogies (i.e., A:B :: C:D). The Analogies subtest is constructed of a plate with four wooden squares arranged in a 2 × 2 pattern, a set of colored blocks, and a series of problems for each of the test's phases. The examiner places blocks in three of the open "Windows" on the plate and asks the child to complete the analogy in the last open "Window," which always is to the "bottom right" from the child's perspective.

All analogies are based on four dimensions: color, height, number, and position. The combination of some or all of these dimensions creates several levels of task difficulty. The pre-teaching phase serves as a baseline for the modifiability of the child's analogical thinking. In the teaching phase the child is taught strategies such as systematic search for relevant dimensions, understanding transformational rules of analogy, and applying efficient performance, reflected in recognition of a need for accuracy and the balance between accuracy and rapidity. The child's performance in the post-teaching phase indicates the extent to which the child benefited from the teaching given by the examiner and the level of cognitive modifiability. Scoring of the Analogies subtest was done by giving each correctly solved problem a score of 1; the maximal score for the easy and difficult problems were 14 and 6, respectively. Cronbach-alpha reliabilities reported by Tzuriel (2000a) were .80 and .85 for pre- and post-teaching phases, respectively. Cronbach's alpha reliability coefficients based on the current sample were .70 and .76 for the pre- and post-teaching phases, respectively. The CMB has been validated in several studies in England (e.g., Lauchlan & Elliott, 2001) and in Israel (e.g., Tzuriel, 2000a; Tzuriel & George, 2009; Tzuriel & Shamir, 2007).

Math Tests

Math Tests for Tutors. The tutors were given two math tests: *Math Achievement Test* and *Verbal Math Problems Test*.

The *Math Achievement Test* (MAT; Albert, 1997) is a standardized test of computation designed by the Weitzman Institute of Science that is used to map math knowledge of students at the start of the school year. The computation problems are based on addition and subtraction in the realm of 10s and 100s. We used parallel versions for the pre- and post-intervention tests (27 items each), except 8 more difficult items were added to the post-intervention version to avoid a ceiling effect. For each correct answer a score of 1 is given and final scores were transformed into percentages. Cronbach alpha reliability coefficients for the pre- and post-intervention scores were .77 and .82, respectively.

The *Verbal Math Problems Test* (Shamir et al., 2006) is composed of six verbal problems: two one-stage addition and subtraction computation problems, two problems requiring two-staged computation of addition and subtraction, one multiplication problem, and one division problem requiring a one-stage computation. Two versions of the test were designed; one for the pre-intervention phase and one for the post-intervention phase. Both versions were similar in terms of the number of problems and content domains but different in terms of difficulty, with the post-intervention versions more difficult than the pre-intervention versions. For each correctly solved problem a score of 2 was given and the maximal score was 12. The Cronbach alpha reliability coefficient based on the current sample was .65.

Math Tests for Tutees. Tutees' math achievement was assessed by the achievement test for preschool children's learning ability (Levy & Tzfati, 1997). The areas assessed were free counting, row counting, perception of quantity (1–5), number-quantity correspondence, number order, and verbal problem solving. The test is composed of eight items, each scored 1 for correct answer. The Cronbach alpha coefficient reported by the authors was .84.

The Study's Design

Separate designs were used for tutors (Figure 1) and for the tutees (Figure 2). The tutors were assigned randomly to one of four groups according to the variables of treatment (experimental versus control) and training (analogies versus verbal math problems) in a 2×2 design. Experimental tutors received, after participating in the PMYC program, training in teaching construction analogies (Experimental 1) or in teaching verbal math problems (Experimental 2). Similarly, control tutors received, after a substitute program, training in teaching construction analogies (Control 1) or in teaching verbal math problems (Control 2).

The PMYC program was then carried out during a 7-week period; one lesson of 90 min. for each week. The substitute program was composed of two lessons during 1 week in which the importance of peer assisted learning and detailed description about their role in the interaction was explained. Training in analogies included learning the principles of perceptual and conceptual construction analogies (from the CCPAM test) and how to teach them to younger peers. Training in verbal math problems included learning the principles of solving math problems and how to teach them to young peers. Each type of training was given in two consecutive lessons.

Each tutee in the kindergarten was assigned to a third grade tutor based on gender in a counterbalanced design (see Sample). Analyses of gender-heterogeneous *versus* gender-homogeneous group showed no significant differences on the pre-or post-intervention cognitive variables and no significant Treatment by Group interaction. It should be noted that the

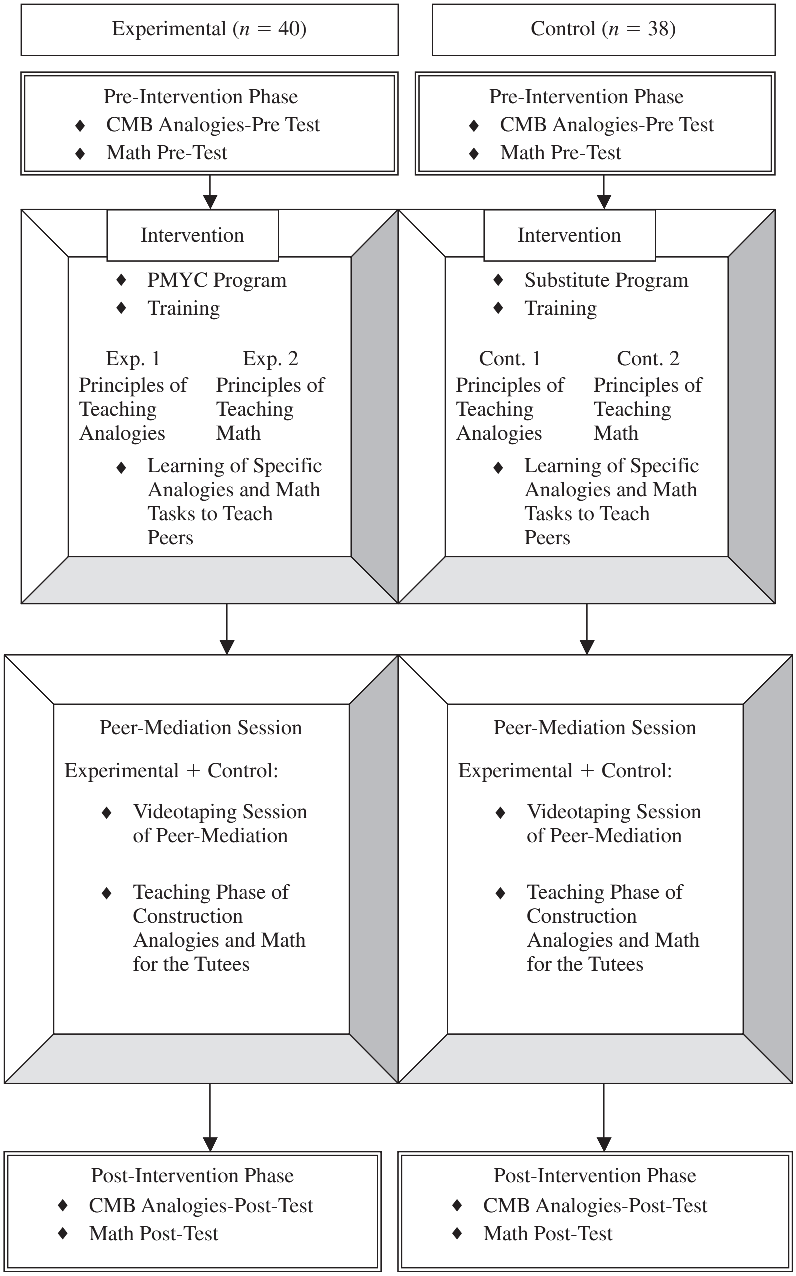

FIGURE 1. The study's design of the tutors.

tutees were labeled as experimental or control tutees because of being assigned to experimental or control tutors; they actually did not receive the PMYC or the substitute program.

Procedure

The procedure of the study was composed of five phases: Pre-Intervention, Intervention, Training, Videotaping of Peer Mediation, and Post-Intervention (see Figures 1 and 2).

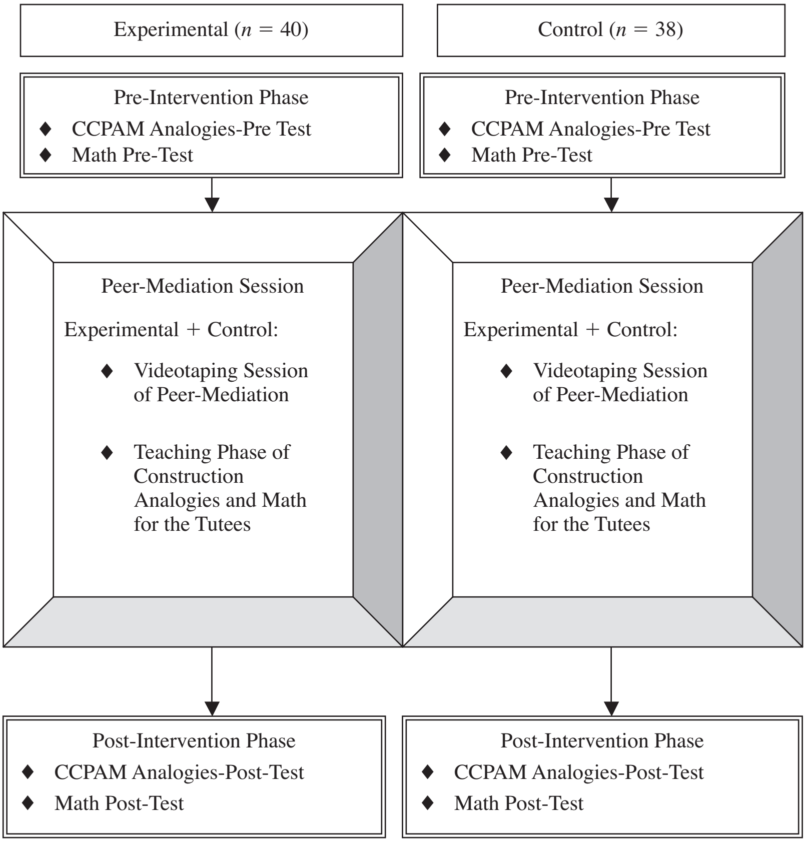

FIGURE 2. The study's design of the tutees.

Pre-Intervention. The tutors were administered two pre-intervention tests: Analogies subtest (Set A) of the Cognitive Modifiability Battery (CMB) and the Math test. The tutees were administered two pre-intervention tests: the CCPAM (Set A) and Math.

Intervention. The PMYC program was implemented with the experimental tutors and the substitute program with the control tutors (see description of intervention above).

Training. Following the PMYC program each of the experimental and control groups were randomly divided into two subgroups. The first subgroup received a 2-hr training in principles for solving construction analogies from the CCPAM (Experimental 1 and Control 1 subgroups), and the second group received a 2-hr training for solving math problems (Experimental 2 and Control 2 subgroups). The math training included two types of tasks: number-quantity correspondence and verbal math problems. The parallel experimental and control subgroups received the same training for teaching analogies or math. All children were told that they would have to teach their younger peers the problems they had been taught. The main difference between them was participation in the PMYC program.

Videotaping of Peer Mediation. Following the intervention and training phases all children were videotaped in a peer-mediation context. Tutors were asked to teach their peers to solve construction analogies and then to solve math problems in that order. The videotaping session was for 20 min; 10 min for each type of task. No guidance was given as to how to teach during the peer interactions. The peer mediation phase served actually two purposes: to provide tutors an actual teaching experience and to videotape the peer interaction. All interactions were analyzed later by the *Observation of Mediation Interaction* (OMI, see Measures). In this way we could study not only the main effects and interaction of treatment and training but also the degree to which training in one type of task transferred to another in terms of use of mediation strategies and the degree to which treatment and training main effects interacted with type of task used in the peer mediation session.

Post-Intervention. The tutors were given two post-intervention tests: A parallel set of the Analogies subtest (B) from the Cognitive Modifiability Battery (CMB) and a parallel math test. Similarly, the tutees were given two post-intervention tests: a parallel CCPAM test (Set B) and parallel math test.

RESULTS

In the following sections we present the effects of peer mediation program (experimental *versus* control), type of training (analogies *versus* math), and type of task (math *versus* analogies) in relation to three major dimensions: (a) MLE strategies, (b) analogical reasoning, and (c) math performance.

Tutors Group: The Effects of the Treatment, Type of Training, and Type of Task on MLE Strategies

A multivariate analysis of variance (MANOVA) of Treatment × Training × Type of Task (2 × 2 × 2) was carried out with the five MLE scores as dependent variables. The means and standard deviations are presented in Table 1 and the MANOVA findings are presented in Table 2. Since the main effects were modified by interactions and in order to simplify the presentation, we refer only to the interaction effects.

Post hoc analyses of the Treatment × Training interaction revealed that it derives mainly from mediation criteria of Transcendence, $F_{(1, 74)} = 8.96$, $p < .01$, $\eta^2_p = .11$, and Regulation of Behavior, $F_{(1, 74)} = 5.17$, $p < .05$, $\eta^2_p = .07$ (see Figure 3). Simple effects analysis revealed that when tutors were trained in teaching analogies the experimental group children scored significantly higher than did control group children on Transcendence, $F_{(1, 38)} = 16.61$, $p < .01$, $\eta^2_p = .30$ and Regulation of Behavior, $F_{(1, 38)} = 15.56$, $p < .01$, $\eta^2_p = .29$. When tutors were trained in teaching math, experimental group children scored higher than control group children only on mediation for Transcendence, $F_{(1, 36)} = 11.58$, $p < .01$, $\eta^2_p = .25$.

Post hoc analyses of the Treatment × Type of Task interaction revealed that it derives mainly from mediation criteria of Transcendence, $F_{(1, 74)} = 5.43$, $p < .05$, $\eta^2_p = .07$, and Feelings of Competence, $F_{(1, 74)} = 10.85$, $p < .01$, $\eta^2_p = .07$ (see Figure 4). Simple effects analysis revealed that the experimental group tutors showed significantly higher mediation for Transcendence than did control group tutors when teaching Math, $F_{(1, 76)} = 12.27$, $p < .001$, $\eta^2_p = .14$, but not when teaching Analogies, $F_{(1, 76)} = 5.97$, *ns*. The experimental group tutors showed also higher mediation of Feelings of Competence than did control group tutors in teaching both type of tasks, Analogies, $F_{(1, 76)} = 20.69$, $p < .001$, $\eta^2_p =.21$, and Math, $F_{(1, 76)} = 34.86$, $p < .001$, $\eta^2_p = .31$.

Tutors Group: Cognitive Modifiability as a Function of Treatment and Training

Cognitive modifiability was investigated in the tutors group by comparing the post-teaching to pre-teaching performance on CMB Analogies. The means and standard deviations

TABLE 1. Means and Standard Deviations of MLE Criteria of Tutors in the Experimental and Control Groups by Training (Analogies Versus Math)

MLE criteria	Training		Experimental	Control
INTN	Analogies	*M*	4.87	3.97
		SD	2.65	1.77
	Math	*M*	5.29	3.53
		SD	2.43	1.26
MEAN	Analogies	*M*	1.97	1.40
		SD	1.35	0.47
	Math	*M*	1.68	1.58
		SD	0.92	0.73
TRNS	Analogies	*M*	3.17	1.45
		SD	1.79	0.60
	Math	*M*	2.00	1.79
		SD	0.90	0.73
COMP	Analogies	*M*	5.50	2.52
		SD	2.79	1.31
	Math	*M*	4.50	1.84
		SD	2.32	0.90
SRGL	Analogies	*M*	2.60	1.15
		SD	1.61	1.03
	Math	*M*	1.55	1.02
		SD	0.66	0.11

INTN = Intentionality and Reciprocity, MEAN = Meaning, TRAN = Transcendence, COMP = Feelings of Competence, SRGL = Self-Regulation.

TABLE 2. MANOVA of MLE Criteria of Tutors by Treatment, Training, and Type of Task

Source of variation	*df*	*F*	η^2_p
Treatment (A)	5.70	9.44***	.40
Training (B)	5.70	2.04	.13
Type of Task (C)	5.70	17.52***	.56
A × B	5.70	3.48**	.20
A × C	5.70	3.06*	.18
B × C	5.70	1.10	.07
A × B × C	5.70	1.08	.07

*$p < .05$. **$p < .01$. ***$p < .001$.

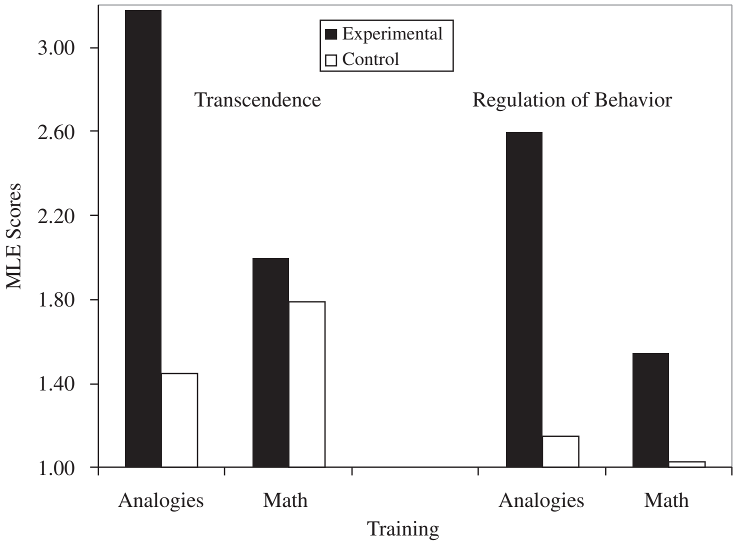

FIGURE 3. Mediation for transcendence and regulation of behavior of experimental and control children trained in analogies versus math.

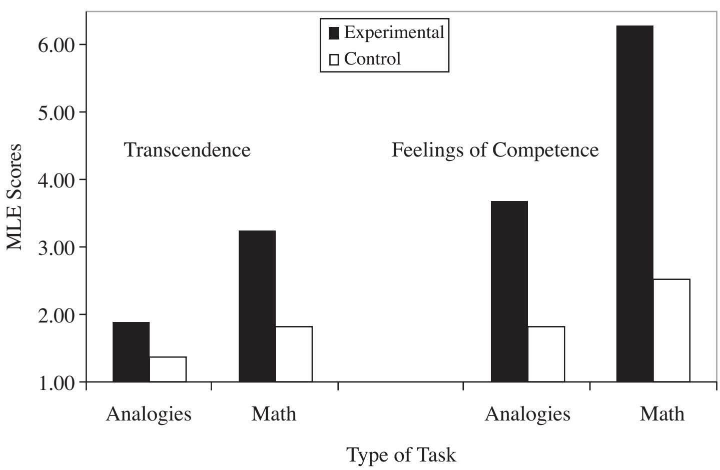

FIGURE 4. Mediation for transcendence and feelings of competence of experimental and control children in teaching analogies task versus teaching math tasks.

are presented in Table 3 and the MANOVA findings in Table 4. Performance on the CMB Analogies among tutors was analyzed by a repeated measures MANOVA of Treatment × Training × Time (2 × 2 × 2); the last variable was a within-subjects variable. The findings revealed higher scores for children trained in Analogies (i.e., construction analogies) than for children trained in Math, and higher scores in the post- than in the pre-intervention stage. However, these main effects were modified by interactions of Treatment × Time, Training × Time, and Treatment × Training × Time. In the following we focus only on the three-way interaction, which modifies the main effects and the two-way interactions.

TABLE 3. Means and Standard Deviations of CMB Analogies Among Experimental and Control Tutors Receiving Analogies Versus Math Training Before and After the PMYC Program

		Experimental		Control	
Training		Pre	Post	Pre	Post
Analogies	*M*	19.35	30.90	26.45	29.05
	SD	6.42	3.65	6.68	4.26
Math	*M*	20.67	24.10	21.79	23.47
	SD	6.49	6.79	6.37	5.98

TABLE 4. MANOVA of Tutors' CMB Analogies Score by Treatment, Training, and Time

Source of Variation	*df*	*MS*	*F*	η^2_p
Treatment (A)	1	2.52	0.91	.01
Training (B)	1	42.51	15.36***	.17
A × B	1	4.22	1.52	.02
Error	74	2.77		
Time (C)	1	195.47	59.21***	.44
A × C	1	77.85	23.58***	.24
B × C	1	42.85	12.98***	.15
A × B × C	1	21.54	6.52**	.08
Error	74	3.30		

**$p < .01$. ***$p < .001$.

The triadic interaction of Treatment × Training × Time shown in Figure 5 indicates that among children trained in analogies the experimental group showed a drastic pre to post improvement, $F_{(1, 19)} = 82.17$, $p < .001$, $\eta^2_p = .81$, as compared with the control group who showed a slight and insignificant improvement, $F_{(1, 19)} = 3.85$, *ns*. Also, among tutors trained in analogies the experimental subgroup scored much lower than the control group in the pre-intervention test, $F_{(1, 38)} = 13.65$, $p < .001$, $\eta^2_p = .26$, but on the post-intervention test the difference was no longer significant, $F_{(1, 38)} = 2.32$, *ns*. Among tutors trained in math neither the experimental, $F_{(1, 19)} = 3.84$, *ns*, nor the control children, $F_{(1, 18)} = .56$, *ns*, made significant improvement. The experimental and control groups scored about the same in the pre-intervention, $F_{(1, 36)} = .36$, *ns*, and post-intervention, $F_{(1, 36)} = .68$, *ns*, tests.

Tutees Group: Cognitive Modifiability as a Function of Treatment and Training

The tutees' cognitive modifiability was investigated by analyzing the pre- to post-teaching improvement on the Conceptual and Perceptual Analogies of the CCPAM test. We used a

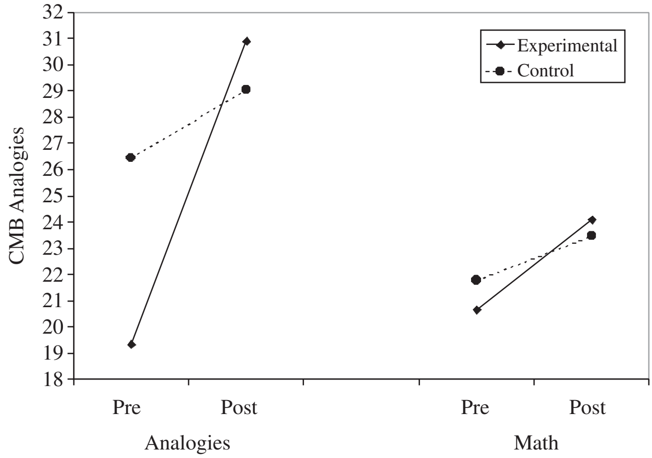

FIGURE 5. Pre- and post-intervention scores on CMB analogies among experimental and control tutors trained in analogies versus math tasks.

repeated measures MANOVA of Treatment × Training × Time (2 × 2 × 2), with the last variable being a within-subjects variable and the Conceptual and Perceptual analogies the dependent variables. It should be noted that the tutees did not receive any intervention program; they are labeled as experimental or control only because they were exposed for peer-interaction with their experimental or control peer tutors. For the sake of succinctness and clarity, tutees taught by tutors trained in analogies are labeled A-tutees whereas tutees taught by tutors trained in math are labeled M-tutees. The means and standard deviations are presented in Table 5 and the MANOVA findings are presented in Table 6.

The significant triadic interaction of Treatment × Training × Time is portrayed in Figure 6. Experimental tutees showed improvement from pre- to post-intervention, especially the experimental A-tutees, as compared with no improvement in the control group. Simple effects analysis showed that both experimental A-tutees, $F_{(1, 19)} = 34.88$, $p < .001$, $\eta^2_p = .65$, and experimental M-tutees, $F_{(1, 18)} = 12.32$, $p < .001$, $\eta^2 = .41$, showed significant improvement from pre- to post-intervention. It is interesting to note that the improvement was much greater (above 100%) among experimental A-tutees than among experimental M-tutees (50%). Neither experimental subgroup showed any significant differences in the pre-intervention test, $F_{(1, 37)} = .41$, *ns*, but on the post-intervention test the experimental A-tutees showed significantly higher scores than did the experimental M-tutees, $F_{(1, 37)} = 21.35$, $p < .001$, $\eta^2_p = .37$. The same analyses among control tutees showed no significant improvement either for A-tutees, $F_{(1, 37)} = 1.07$, *ns*, or M-tutees, $F_{(1, 37)} = 1.29$, *ns*.

Effects of the Treatment and Training on Math Performance of Tutors and Tutees

Improvement in math performance was analyzed by repeated measures ANOVA of Treatment × Training × Time (2 × 2 × 2), the last variable being a within-subjects variable and math performance the dependent variable. Separate analyses were carried out for the tutors and tutees. The means and standard deviations are presented in Table 7.

TABLE 5. Means and Standard Deviations of CCPAM Scores Among Experimental and Control Tutees

Training		Experimental		Control	
		Pre	Post	Pre	Post
Conceptual analogies					
Analogies	*M*	8.45	10.70	9.10	10.30
	SD	1.85	2.34	2.12	2.39
Math	*M*	8.05	10.79	8.58	9.00
	SD	2.57	2.20	2.93	2.36
Perceptual analogies					
Analogies	*M*	4.65	9.60	5.80	5.90
	SD	2.66	2.37	3.02	2.38
Math	*M*	4.16	6.21	4.84	5.05
	SD	2.09	2.20	2.75	2.27

TABLE 6. MANOVA of CCPAM Test Scores of Conceptual and Perceptual Analogies of Tutees by Treatment, Training, and Time

Source of variation	Scale	*df*	*MS*	*F*	η^2_p
Treatment (A)	Conceptual	1	1.25	0.27	.00
	Perceptual	1	17.40	2.47	.03
Training (B)	Conceptual	1	5.52	1.21	.02
	Perceptual	1	61.54	8.75**	.11
A × B	Conceptual	1	2.79	0.61	.01
	Perceptual	1	8.20	1.17	.02
Error	Conceptual	74	4.54		
	Perceptual	74	7.03		
Time (C)	Conceptual	1	212.72	51.91***	.41
	Perceptual	1	407.12	38.34***	.34
A × C	Conceptual	1	55.19	13.47***	.15
	Perceptual	1	340.91	32.11***	.30
B × C	Conceptual	1	0.42	0.10	.00
	Perceptual	1	59.12	5.57*	.07
A × B × C	Conceptual	1	7.81	1.90	.02
	Perceptual	1	68.87	6.49**	.08
Error	Conceptual	74	4.09		
	Perceptual	74	10.62		

Tutors. A significant interaction of Treatment × Time, $F_{(1, 74)} = 7.85$, $p < .01$, $\eta^2_p = .10$, portrayed in Figure 7, indicates that although the control tutors scored higher than did the experimental tutors before the intervention, in the post-intervention stage both groups scored about the same. *Post hoc* analyses showed that in the pre-intervention stage the experimental tutors achieved significantly lower math scores than did control tutors, $F_{(1, 74)} = 10.87$, $p < .01$, $\eta^2_p = .13$, but in the post-intervention stage the experimental tutors closed the initial gap and showed about the same performance as the control tutors, $F_{(1, 74)} = 2.44$, *ns*. Significant pre- to post-intervention improvement was found for the experimental group tutors, $F_{(1, 38)} = 28.19$, $p < .001$, $\eta^2_p = .43$, and for the control group tutors, $F_{(1, 38)} = 9.40$, $p < .01$, $\eta^2_p = .20$.

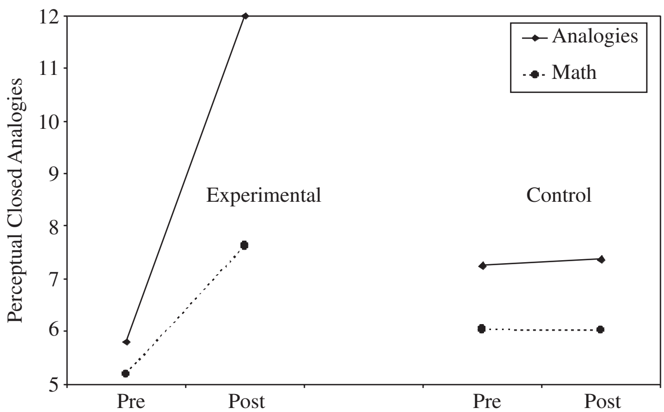

FIGURE 6. Pre- and post-intervention scores of perceptual analogies in the experimental and control tutees trained in analogies versus math tasks.

TABLE 7. Means and Standard Deviations of Math Scores (in percent) of the Tutees and Tutors in the Experimental and Control Groups Before and After the PMYC Program

		Experimental		Control	
Training		Pre	Post	Pre	Post
Tutees					
Analogies	*M*	71.14	96.06	83.41	93.89
	SD	3.81	2.58	3.81	2.58
Math	*M*	61.90	91.90	75.24	90.18
	SD	2.65	2.65	3.91	2.65
Tutors					
Analogies	*M*	77.24	87.57	89.56	92.92
	SD	3.44	3.02	3.44	3.02
Math	*M*	72.92	84.87	78.32	83.70
	SD	3.53	3.10	3.53	3.10

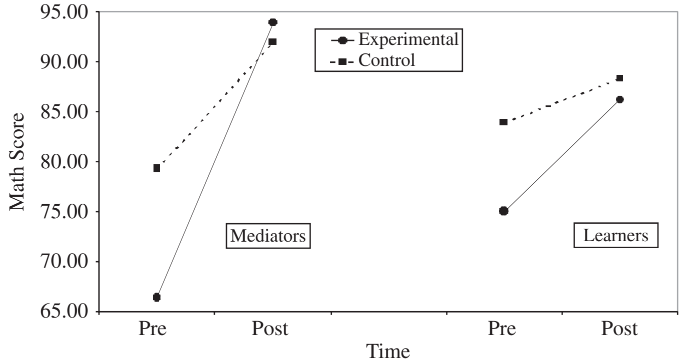

FIGURE 7. Pre- and post-intervention math scores (in percent) of tutors and tutees in the experimental and control groups.

Tutees. The findings for the tutees were very similar to those found for the tutors. A significant interaction of Treatment × Time, $F_{(1, 74)} = 32.50$, $p < .001$, $\eta^2_p = .30$, portrayed in Figure 7, indicates that while the control group tutees scored higher than the experimental group tutees before the intervention, in the post-intervention stage both groups scored about the same. *Post hoc* analyses showed that in the pre-intervention stage the experimental group tutees achieved significantly lower scores than did control group tutees, $F_{(1, 76)} = 10.80$, $p < .01$, $\eta^2_p = .12$, but in the post-intervention stage the experimental group tutees closed the initial gap and showed about the same performance as the control group tutees, $F_{(1, 76)} = .22$, *ns*. Significant improvement was found for the experimental group tutees, $F_{(1, 38)} = 132.83$, $p < .001$, $\eta^2_p = .78$, and for the control group tutees, $F_{(1, 38)} = 60.93$, $p < .001$, $\eta^2_p = .62$.

DISCUSSION

The data show clearly that tutors in the experimental group (i.e., children trained in the PMYC program) displayed a higher level of mediation in their interaction with their peers and a higher level of cognitive modifiability than did their control counterparts. These major findings replicate findings of earlier studies demonstrating the effectiveness of the PMYC in facilitating a mediational teaching style as well as the cognitive modifiability of young children (e.g., Shamir & Tzuriel, 2004; Shamir et al., 2006, 2007; Tzuriel & Shamir, 2007). The focus of the current study and therefore of our discussion, however, is mainly on the interactive effects of two variables: the peer-mediation program and training of tutors in teaching analogies versus teaching math. In addition we were interested in investigating the transfer of mediation strategies when tutors were actually engaged in teaching math problems as compared with teaching analogy problems. The literature on transfer is replete with evidence about the effectiveness of cognitive and metacognitive interventions on transfer of cognitive skills (e.g., Detterman & Sternberg, 1993; Kaniel, 2001; Salomon & Perkins, 1989) but not much is known on transfer of mediation strategies. The findings of the current study are the first known findings that focus on the interactive effects of intervention on how to mediate (PMYC program), type of training (how to teach analogies versus how to teach math), and type of task (actual teaching of analogies versus actual teaching of math).

The analysis of mediation strategies showed an overall significant Treatment by Training interaction. This interaction was derived mainly from two mediation strategies: Transcendence (expanding) and Regulation of Behavior (see Figure 3). The experimental group tutors trained in teaching analogies showed much higher use of mediation for the expanding strategy than did their control counterparts. The expanding strategy is characterized by rule teaching, generalization, and emphasis on principles beyond the immediate context of the specific task. They also showed a higher level of mediation for self-regulation strategies, such as ordering, sequencing, organizing, and delaying impulsive behavior of their peers, than did the control group tutors. The differences between the experimental group and control group tutors trained in teaching math were much smaller and insignificant. These findings support our hypothesis that the combination of a program aimed at teaching mediation principles and specific training on how to tutor peers in analogy tasks is the most powerful in enhancing a mediation teaching style. One of the reasons for that might be related to the conceptual match between the mediation criteria of the PMYC, which relies on generalized strategies of mediation, and training in a domain such as analogies, which is focused on generalized principles and relatively content-free characteristics. This match might help tutors to apply better the internalized mediation tools (Vygotsky, 1978) and use them later in the peer teaching situation. These findings coincide with MLE theory (Feuerstein et al., 2002) according to which teaching generalized and relatively content-free tasks provides individuals with effective teaching strategies that can be applied later in different contexts. From a general cognitive education approach, we might say that it is relatively easy to obtain transfer of mediation strategies when teaching tasks similar to cognitive contents or components in which the tutors were trained earlier (analogy tasks) than when teaching tasks that are relatively unfamiliar (math tasks). In other words, teaching analogies requires much nearer transfer of the acquired mediation strategies than does teaching math.

The inclusion of Type of Task in the analysis adds a new dimension to our findings on mediation strategies. Unlike the training effects, which show superiority of training in analogies over training in math for enhancing children's mediation strategies, the actual tutoring of math tasks during the peer interaction was found to be more potent in eliciting higher levels of mediation strategies than when tutoring analogy tasks. As can be seen in Figure 4 the superiority of the experimental group tutors over their control group counterparts was more articulated when tutors tutored peers in math tasks than when tutoring them in analogies. This was most evident in the mediation strategies of Transcendence and Feelings of Competence. It seems that when tutors in the experimental group are asked to teach a math problem they are triggered to use more mediation for transcendence and provide more feelings of competence to their peers than when asked to teach their peers analogy tasks. A possible explanation for this finding is that the tutors perceive the math tasks as more relevant to school success than analogy problems. They therefore invest more efforts in mediating rules and principles and reward the tutees for their successes when teaching math than when teaching analogies. It is also possible that the tutors perceived a greater need for mediation in the tutees when working with them on math problems, or even a greater resistance. This possibility might indicate that the tutors have internalized the PMYC program principles focused on being sensitive to the need for mediation in the learners.

This finding, which was irrespective of the type of training, goes hand in hand with recent approaches according to which transfer of learning, and in our case transfer of mediation strategies, depends on the context of transfer (e.g., Gruber, Law, Mandl, & Renkl, 1999;

Kaniel, 2001; Sternberg & Wagner, 1994). The context of teaching math problems was probably perceived as more meaningful to the tutors than the context of teaching analogies, and therefore triggered more mediation efforts from the tutors.

Based on our findings we would expect that the most effective combination for transfer of mediation strategies for tutors taught how to mediate would be training on teaching analogies and actual tutoring of math tasks, though the triadic interaction of treatment by training by type of task was not found as significant. Because of the uniqueness of these findings and its pioneering nature more research is required to establish the complex interactive effects of type of training and type of task taught combined with the intervention for peer mediation effects.

The significant findings on the effects of the PMYC program on cognitive modifiability of the tutors replicate previous findings (Shamir et al., 2006; Shamir, Tzuriel, & Guy, 2007; Tzuriel & Shamir, 2007) and support our expectations that children who learn how to mediate will become not only better mediators (tutors) but also better learners, as reflected in their pre- to post-intervention improvement on the CMB Analogies (Figure 5). In Vygotsky's (1978) terms, the peer-mediation experience enabled the tutors to advance from a *lower* zone of proximal development (pre-intervention) to an *upper* zone of proximal development (post-intervention). It should be noted that the problems of the CMB Analogies were novel to all children, so the improvement cannot be attributed to a familiarity factor. Furthermore, the PMYC program and the analogies used in the training session and the peer mediation do not contain any components that are similar to the CMB Analogies used to assess the tutor's cognitive modifiability. The PMYC program was focused on teaching effective mediation strategies and in principle is content-free. More than that, the tutors trained in teaching analogies received pictorial analogies of the CCPAM that are different from the CMB Analogies in terms of modality (pictorial versus nonpictorial) and dimensions involved (see Measures). Thus, the improvement in analogy performance can be attributed to transfer of mediation skills acquired during the PMYC program to learning of the new tasks such as the CMB Analogies. The CMB Analogies require analyzing the relevant dimensions, systematically exploring the rules that are behind changes in the stimuli, integrating all information leading to the answer, choosing the correct number of block(s) from a pile of blocks (differentiated by color and height), and inserting the block(s) into the correct positions on the plate. This kind of task clearly taps level II thinking (i.e., requiring elaboration of an abstract nature) considered by Jensen (1980) to be essentially unmodifiable at the age of 8–9 years.

The significant interaction of Treatment × Training × Time on cognitive modifiability of tutors (see Figure 5) shows clearly that the experimental tutors trained in analogies showed the greatest improvement from pre- to post-intervention phases on the CMB Analogies. It is interesting to note that the control group tutors trained in teaching analogies scored higher than the experimental group tutors trained in math. This finding is reasonable due to the fact that the CMB Analogies are domain similar to the CCPAM analogies used for training (e.g., both require analogical reasoning). Thus, the most effective combination in terms of improvement of cognitive modifiability is intervention for peer mediation and training for teaching analogies. These findings support our approach, according to which cognitive modifiability is multiply determined by teaching children how to mediate to their peers and the type of training (analogies versus math).

The findings of the tutees' group are also intriguing as they show that the PMYC program had an effect on tutees who themselves did not participate in the intervention but were exposed shortly (for about 30 min) to the tutors teaching. The tutees received the CCPAM analogies using a DA procedure at the end on the intervention by trained adult examiners. The data revealed that tutees who were taught by their experimental peers showed a higher pre- to post-teaching improvement on the pictorial perceptual analogies of the CCPAM test than did their peers who were taught by control group tutors (see Figure 6). Furthermore, the significant interaction of Treatment × Training × Time indicates clearly that the combination of treatment and training was most effective in producing pre- to post-teaching change among the tutees. The experimental A-tutees (i.e., tutees who were taught by analogy-trained tutors) showed higher pre- to post-teaching improvement than experimental M-tutees (i.e., tutees taught by math-trained tutors). For tutees in the control group, performance in pre- and post-teaching was more or less the same. Also, comparison of the A-tutees to the M-tutees shows that the group differences were minor and insignificant.

These findings of the tutees are intriguing as they show that just half an hour of exposure to qualitative mediation strategies with experienced peers is effective in improving the cognitive modifiability of young children. In addition, these finding shed more light on the importance of considering the interactive effects of treatment and training not only as a determinant of cognitive modifiability of the tutors but also as an important factor in determining the cognitive modifiability of the tutees. The finding that A-tutees showed better improvement on the CCPAM perceptual analogies than M-tutees might be related to two interrelated factors: task similarity and quality of mediation of the analogy-trained tutors in the experimental group. For experimental A-tutees there was a match between the task taught and the criterion outcome variable; both are analogies. In addition, as discussed above, the experimental analogy-trained tutors showed a higher level of mediation than that of experimental math-trained tutors. The combination of both factors probably made it easier for the experimental A-tutees to benefit from teaching more than experimental M-tutees.

Finally, the effects of treatment were demonstrated when academic skills in math of both tutors and tutees were examined (see Figure 7). In both groups experimental group children showed significantly higher pre- to post-intervention improvement than did control group children. These findings replicate earlier findings showing that The PMYC improves academic performance of both young tutors and tutees (Shamir et al, 2006; Shamir et al., 2007). These findings clearly indicate transfer effects of mediation strategies to academic skills. It is impossible to make a distinction as to what portion of the improvement in math can be attributed to the PMYC program itself (treatment), the training activity, or the actual peer-mediation experience. Further studies with different age groups and different tasks are warranted.

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