Running Head: MOTHERS' WRITING INTERACTION WITH TWINS

Sensitivity and Consistency of Maternal Writing Mediation to Twin Kindergartners

Dorit Aram

Constantiner School of Education

Tel Aviv University

EARLY EDUCATION AND DEVELOPMENT

The study was supported by a grant from the Israel Foundations Trustees (Special Fund for Post-Doctoral Research Grants - No.5). Warm thanks are extended to Sagit Hoshmand for collecting the data and to Dee B. Ankonina for her editorial contribution.

Correspondence should be addressed to Dr. Dorit Aram, School of Education, Tel Aviv University, Israel 69978. Phone: 972-3-533-3779. Fax (home): 972-3-634-1318. Email: dorita@post.tau.ac.il

ABSTRACT

The study investigated whether mothers are responsive to their children's literacy level, thus employing different writing mediation styles with each twin according to the child's level, or whether they possess a consistent style employed with both twins. The sample included 28 sets of twin kindergartners (56 children, M= 68.89 months) and their mothers. Children's literacy underwent individual assessment in their kindergartens. During home visits, mother-child writing interactions with each twin were videotaped. Interactions underwent analysis for task-specific measures (grapho-phonemic mediation, printing mediation, demand for precision, reference to orthography) and for general measures (atmosphere, mutuality, reinforcements, task perception). Findings demonstrated that along with sensitivity to the child's level (mediating on a higher level to the higher achieving twin), mothers of twins possessed a consistent mediation style. Sensitivity to the differences in literacy between the twins was salient in the task-specific mediation measures, whereas the presence of a style appeared in all the mediation measures.

Sensitivity and Consistency of Maternal Writing Mediation to Twin Kindergartners

The essential role of parental mediation in child development is well established (e.g., Holden, 1997; Meadows, 1996; Rogoff, 1990). Parents interact daily with their young children, and these interactions contain elements of teaching that may provide a basis for later outcomes including school successes and failures (e.g., Kelly, Morisset, Barnard, Hammond, & Booth, 1996; Pratt, Kerig, Cowan, & Cowan, 1992). As a result, parenting research must deepen the understanding of parental teaching characteristics, as distinct from other social processes (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). While interacting with their children in the context of teaching, do parents moderate their children's development or do they react to their children's developmental level? Parent-child interaction is presumably a two-way street; yet, information is lacking on which features of the parent-child teaching interaction relate more to the child's developmental level and which depend more on maternal style. These important questions are methodologically challenging (Shonkoff & Phillips, 2002) because parent-child interactions comprise ongoing dyadic processes that are difficult to disentangle. The present study addressed this challenge by exploring mothers' level of sensitivity to their twin kindergartners' level of literacy development, during maternal word writing mediation, as well as the consistency of mothers' mediation style for the two children.

When exploring the sources of literacy, researchers focus on families as the setting where children learn the basic skills that establish the foundations for later literacy development (Wasik & Herrmann, 2004). Studies of the relationship between parent-child interactions and children's literacy have concentrated mainly on reading books to children (e.g., Bus, van IJzendoorn, & Pellegrini, 1995; Reese, Cox, Harte, & McAnally, 2003; Scarborough & Dobrich, 1994). When trying to quantify the benefits of storybook reading to early literacy development, researchers have disputed its meaningfulness. Bus et al. (1995)

concluded their meta-analysis with a firm statement that joint book reading is very productive, whereas Scarborough and Dobrich (1994), in their review, raised doubts as to its unique significance for early literacy. In the opening to their recent book, *On Reading Books to Children*, van Kleeck and Stahl (2003) wrote that storybook reading to children provides reliable benefits to early literacy but may be less effective in promoting alphabetic skills than expected in the past.

Nonetheless, these basic alphabetic skills hold significant implications for the acquisition of reading and writing (e.g., Adams, 1991; Muter, Hulme, Snowling, & Taylor, 1997; Naslund & Schneider, 1996; Shatil, Share, & Levin, 2000). Researchers have investigated other joint literacy related activities that may promote such skills among young children. For example, Sénéchal, LeFevre, Thomas, and Daley (1998) examined the effects on kindergartners' literacy of storybook reading compared to parental report of teaching reading and writing. Storybook reading was found to predict oral language, whereas parental teaching predicted written language skills such as letter naming and word writing. In the same vein, Aram and Levin (2002) compared the nature of maternal mediation in joint writing to storybook reading in terms of their relations with early literacy among kindergartners. Their findings revealed that maternal writing mediation explained added variance of alphabetic skills, after partialling out home environment measures and the nature of storybook reading. Storybook reading explained added variance of verbal ability, beyond home environment and maternal writing mediation. The researchers concluded that mediation in joint writing is prominently linked to reading and writing acquisition, and that joint storybook reading is mainly related to verbal abilities.

Preschoolers' experience with writing is important for cultivating literacy. Durkin (1966), who observed precocious readers, found that for many of them writing came before reading. She suggested that reading seemed almost a by-product of writing. When children

write, they ask questions about the relationship between speech and print that can help them construct their knowledge about the written system. Observations in homes have shown that children pretend to write, invent spellings, and question their parents on what they write, and that parents utilize these opportunities to explain the spelling of words (Baker, Fernandez-Fein, Scher, & Williams, 1998; Bissex, 1980; Burns & Casbergue, 1992; Gundlach, McLane, Stott, & McNamee, 1985; Hall, 2000; Teale, 1986; Tudge & Putnam, 1997). Writing interaction comprises not only cultural communication (writing letters, notes, and the like) but can also potentially encourage reference to the basic skills of letter knowledge and grapheme-phoneme mapping (e.g., Adams, 1991; Berninger et al., 1992; Muter et al., 1997; Naslund & Schneider, 1996; Shatil et al., 2000). Writing interactions between parents and their kindergartners offer a productive context for studying the complexity and features of parental mediation because such interactions pose a challenge for both parents and children. Writing constitutes a complicated activity that requires understanding of the grapho-phonemic code and the rules of orthography. Kindergartners cannot usually spell new dictated words autonomously (Aram & Levin, 2001; DeBaryshe, Buell, & Bender, 1996). When writing a new word, the child must segment the word into its sounds, retrieve the right letters, and produce them on the paper. The young child needs an expert's support to perform these tasks adequately.

To shed light on the contribution of mother-child joint writing to kindergartners' early literacy, Aram and Levin (2001) utilized a correlational study to reveal the separate contributions of diverse family environmental variables including SES, maternal literacy, literacy tools at home, and maternal writing mediation. They found that measures of maternal writing mediation on the one hand, which reflected the mother’s attention to the components of the grapho-phonemic relations and her references to orthographic rules in Hebrew, and measures of printing mediation on the other hand, which reflected the

autonomy allowed by the mother and accepted or assumed by the child in printing the letters, both correlated robustly with early literacy measures related to word reading and word writing (r = .74 to r = .82, p < .000).

The researchers explained this strong link by suggesting that mothers in general were sensitive to their children's literacy abilities and adjusted their mediation accordingly. However, the researchers illustrated via qualitative protocols that mothers differed in the extent to which they adjusted mediation to their child's literacy level. Some mothers seemed to be unaware of their children's literacy level and cognitive abilities, underestimating them and therefore making demands below the child's actual level. Aram and Levin (2001) declared that mothers carry the major role in the interaction and that their mediation style is crucial for their child's literacy development, but these researchers had no support for their claim beyond qualitative illustrations. In a follow-up study, Aram and Levin (2004) attempted to further explore the role of maternal writing mediation in children's literacy development by assessing the participants 2½ years later. They found that maternal writing mediation as measured earlier in kindergarten now predicted these second graders' spelling, reading comprehension, and language, beyond the predictive capacity of SES and of early literacy measures assessed in kindergarten. These results strengthened the important role of maternal mediation but did not yet provide answers regarding its sources.

Parallel evidence suggests that parental mediation affects children's development and, at the same time, that children's characteristics affect their parents' mediation (Bornstein, 2001; Maccoby, 2000). Parents reveal sensitivity to their children, attuning responses to the child's needs and developmental level along different interactions within the child's zone of proximal development (Vygotsky, 1978). For example, Damast, Tamis-LeMonda, and Bornstein (1996) found that mothers adjusted their play to their toddler's play level by responding with play that was either at the same level or at a higher level than their

children's play. In the context of shared book reading with second graders, Evans, Moretti, Shaw, and Fox (2003) reported that parents provided more feedback clues when their child was unsuccessful in rereading a word after initial feedback, causing children's success levels to rise. Children with weaker word recognition skills were offered more elaborate feedback. DeBaryshe et al. (1996) studied kindergartners attempting to write a letter alone and with their mothers' assistance. Analyzing the relationship between children's independent level of writing and maternal mediation, the researchers reported that despite the fact that the mothers directed their children to use conventional spelling, the mothers attuned their mediation to their children's ability.

In sum, the complexity of parent-child teaching interactions has yet to be unraveled. How responsive are parents to their child's knowledge, and how consistently do they act across children? The current study videotaped mother's writing interactions with each of her twins and assessed the twin's literacy level. Studying twins offers a fruitful method for exploring parenting qualities because it reveals how the mother interacts with two same-age children within the same familial context who nevertheless possess different literacy levels.

Parents develop unique and special relationships with each of their offspring, and siblings experience childrearing efforts differently because of each child's distinctive characteristics such as temperament, personality, gender, and age. Effective parents take these characteristics into account in adapting their general childrearing practices to their specific encounters with each child (Shonkoff & Phillips, 2002). Mothers have acknowledged that they treat their twins (both monozygotic and dizygotic) dissimilarly, and have attributed such differential treatment to the children's distinct needs and personalities. Typically, parents see one child as needing more attention or warmth, or as more mischievous, less easygoing, and less docile than the other (Lytton & Gallagher, 2002).

Studies on parenting of twins have focused mainly on the emotional atmosphere of the home and parental characteristics (Deater-Deckard, 2000), particularly warmth, control, mutuality, cooperation, and emotional reciprocity (Kochanska, 1997). Deater-Deckard and O'Connor (2000) found that overall mutuality was predictable from one parent-twin dyad to the other parent-twin dyad within the same family. Other studies reported less stability, showing that mothers treated their identical twins differently in terms of warmth, positive and negative control, and responsiveness (Deater-Deckard et al., 2001). In families of twins, a higher level of conduct problems covaried with higher levels of maternal negative affect and control and lower levels of maternal positive affect (Deater-Dckard, 2000). To the best of my knowledge, no research thus far has examined teaching aspects of parenting to twins in general or on writing interactions in particular.

The Current Study Questions and Design

The present study on mother-child teaching interactions with twin kindergartners outlined three questions:

1. During writing mediation, are mothers sensitive to their children's developmental level of literacy and as a result do they mediate on a higher level to their higher achieving twin?
2. Do mothers demonstrate a consistent mediation style that they employ on both twins regardless of the twins' literacy development levels?
3. Do the sensitivity and the consistency of maternal writing mediation to their twins depend on various aspects of the mediation? Writing interactions, like other challenging interactions, include mediation features that are specific to the writing task such as teaching the grapho-phonemic code or printing the letters, as well as general mediation features such as atmosphere or reinforcements (Aram, 2002). Will mothers show more sensitivity to their children in the task-specific mediation measures (e.g., in printing mediation, a mother may give more autonomy in writing to her twin who prints letters

well and less autonomy to her twin who has difficulty printing letters)? Likewise, will mothers display greater consistency in the more general mediation measures like atmosphere (e.g., a mother who creates a better atmosphere with one of her twins will create a better atmosphere with her other twin as well)?

To address these questions, I first assessed the teaching interactions of each mother separately with each her two biological twins and also measured each of the twins' early literacy. I then reorganized the twins' literacy data to create two groups of matched non-sibling pairs for comparison of maternal mediation: (a) divergence-matched pairs and (b) literacy-matched pairs. To create the sample of divergence-matched pairs, I matched each twin to a non-sibling who demonstrated the same literacy level as his/her own twin sibling. Thus, the twin sets' comparison with the divergence-matched pairs enabled the examination of whether a mother of twins would show more sensitivity and/or consistency in mediation style across her twins than would be shown between two different mothers of children who exhibited the same literacy gap as the twins. To create the sample of literacy-matched pairs, I matched each twin to a non-sibling who demonstrated a similar early literacy score. Thus, the twin sets' comparison with the literacy-matched pairs enabled the examination of whether a mother of twins would show more sensitivity and/or consistency in mediation style across her twins (who differed in literacy levels) than would be shown between two different mothers whose children shared the same literacy level**.**

METHOD

Participants

The sample included 28 sets of Israeli kindergarten-aged twins (N = 56) and their mothers (N = 28) recruited from 15 kindergartens in the city of Tel Aviv in central Israel. The 32 boys and 24 girls ranged in age from 55 to 76 months (M = 68.89 months, SD = 4.70). Out of the 28 twin sets, mothers reported that 5 were identical twins (3 male sets and 2

female sets), and 23 were fraternal sets, of whom 11 were same-sex sets (7 male sets and 4 female sets). The twins were born between the 35th and 40th weeks of pregnancy (*M* = 37.48 weeks, *SD* = 1.31). Note that only one set of twins was born in the 35th week of the pregnancy, and only 7 infants were hospitalized in the premature infant care unit (between 1-5 weeks). The time difference between the birth of the first and second twin was 1-20 minutes (*M* = 6.14 minutes, *SD* = 5.51). Weight at birth ranged from 1370 to 3250 grams (*M* = 2346.53 grams, *SD* = 402.70) for the firstborn and from 1370 to 2900 grams (*M* = 2296.53 grams, *SD* = 391.39) for the secondborn. Number of siblings other than the twin ranged from 0-7 (*M* = 0.96, *SD* = 1.36). Sixteen sets (57.14%) were the eldest in their family, 9 sets (32.14%) were born second, and 3 sets (10.71%) were born third or fourth.

The experimenter invited mothers or fathers to participate in the study, but only mothers volunteered. Mothers' age ranged from 28 to 48 years (*M* = 38.61; *SD* = 4.31). The majority of the mothers were born in Israel (78.57%), 18.85% were either born in the USA or in Europe, and one mother (3.57%) was born in Africa. Hebrew is the first and main language in 89.28% of the families; two families (7.14%) also speak English, and one family (3.57%) also speaks Spanish. Most of the families were 2-parent families (85.20%); 2 mothers were divorced (7.40%), one mother was a widow (3.57%), and one was a single mother (3.57%). The majority of the families were secular (82.14%) and the remainder were religiously observant. Maternal education ranged from a high school diploma to a masters' degree: 33.33% of the mothers had finished high school; 48.20% had a B.A. university degree, and 18.50% had an M.A.

Measures

Children's Early Literacy Measures

The children individually completed three early literacy tasks in their kindergartens: word writing, letter knowledge, and phonological awareness.

Word writing. To assess word writing**,** the experimenter asked each child to write four word pairs presented both orally and visually in a random order across the children. Children received four cards, each of which displayed identifying drawings of two nouns (e.g., *iparon – et*, 'pencil – pen'). The oral instructions for each card were straightforward; for example: "Write pencil and then pen." The eight nouns are all frequently used in discourse with children; thus, participants were expected to be familiar with their oral usage. Children were given a pencil to write with and four sheets of white paper (size A5), one for each card. The experimenter scored each written word on a 15-point scale adapted from Levin, Share, and Shatil (1996) and Levin and Bus (2003) ranging from pseudo letters through random letters, basic consonantal spellings, partial consonantal spellings, to formal writing. The mean score across the eight words served as the *word writing* score. The reliability of the scale was α = .98.

Letter naming. To assess letter naming, the experimenter asked the children to name the 27 letters in the Hebrew alphabet, presented randomly in black print letters on 27 cards sized 5.5 X 4cm. For each card, the experimenter asked, "Which letter is this?" Hebrew contains 22 letters, 5 of which have two forms, one used in medial and the other in final position**,** thus adding up to a 27-letter alphabet. The final form is used only at the end of words, whereas the medial form is used in all other word positions. The sum of correct letter names determined the *letter naming* score (α = .94).

Phonological awareness. This study measured phonological awareness using two tests, each pertaining to a separate list of 15 monosyllabic words. One test referred to the initial phonemes and the other to the final phonemes. On the initial phoneme test, the experimenter asked children to derive the opening phoneme of each word, for example, "What is the opening sound of *kor* [coldness]?" On the final phoneme test, the experimenter asked the same question with reference to the final phonemes. In each session, before testing,

the child received an explanation of the task and a demonstration using the child's own name, followed by three additional items that did not appear on the word lists. Responses to both tests received scores along a 4-point scale: (1) no answer or incorrect answer; (2) partial answer comprising the retrieval of a subsyllable (e.g., "*bor* starts with *bo*"); (3) retrieval of the correct initial phoneme pronounced with a vowel ("*bor* starts with *ba*") or retrieval of the correct letter name "*bor* starts with a *bɛit*;" (4) correct phoneme retrieval ("*bor* starts with /b/"). The mean score in each test determined the score on initial phoneme and final phoneme. The mean score across the two tests served as the *phonological awareness* measure (α = .98).

Maternal Writing Mediation

To tap the mother's writing mediation to her twins, the experimenter videotaped one mother-child writing interaction for each twin at home on a separate afternoon. The mother and the child were presented with four cards (23 x 17 cm.), each of which displayed identifying drawings of two nouns (9 x 9 cm.). The card presentation was in random sequence. Four blank cards (17 x10 cm.) were given to the child who was then asked to write the name of each object pair pictured on a separate card. The mother was asked to help her child and no further instructions were given. If a mother asked for the experimenter's instructions or clarifications, such as "Can I do it this way?" the reply was: "You can do whatever you think is right, in whatever way you feel is appropriate."

The word pairs used for the mother-child writing interactions at home differed from the pairs the children wrote when tested on their own in kindergarten; the word pairs also differed for each twin sibling. The videotapes' analyses yielded four task-specific mediation measures: grapho-phonemic mediation, printing mediation, demand for precision, and reference to orthography. The analyses also yielded four general mediation measures: atmosphere, cooperation, task perception, and reinforcements (Aram, 2002). Inter-judge

reliability of two independent judges was computed on the scoring of all the measures on eight randomly selected children (four boys and four girls), resulting in a highly significant Kappa of .91.

Task-Specific Mediation Measures

Grapho-phonemic mediation. This scale reflected how the mother mediated the child's segmentation of a word into its sounds and the child's retrieval of the required letter for each sound when attempting to represent an oral word in writing (Aram & Levin, 2001, 2002). Mediation of each letter ($N \simeq 30$) received a separate score because mothers used different strategies for different letters in the same word. An 8-point scale emerged: (1) Mother refers to the word as a whole, saying the word and then either writing it down herself or writing a model and letting the child copy it; (2) Mother refers to the word as a sequence of sounds, uttering the sequence (e.g., mɛ-la-fɛ-fo-n, 'cucumber') and then writing the whole word down herself or writing a model and letting the child copy it; (3) Mother refers to the word as a sequence of letters, uttering the letter names while writing the whole word down herself or writing a model for the child to copy; (4) Mother dictates a letter name (e.g., the mother says: "Write dalɛt," the letter D); (5) Mother retrieves a phonological unit (syllable, subsyllable, or phoneme) and immediately dictates the required letter name; (6) Mother retrieves a phonological unit and encourages/helps the child to link this unit with a letter name; (7) Mother encourages/helps the child to retrieve a phonological unit and to link it with a letter name; and (8) Mother encourages the child to go through the whole process independently while supporting the child along the steps. Thus, the encoding process included segmenting the word into its sounds, isolating a sound, and connecting a segmented sound with a letter. The average across all the letters for the eight words served as the *grapho-phonemic mediation* score. Higher scores indicated a higher level of maternal

mediation, meaning that the mother supported her child's a more complete encoding process for the retrieval of more letters (α = .97).

Printing mediation. This measure assessed the autonomy allowed or encouraged by the mother and accepted or assumed by the child in producing the written letters. The printed production of each letter (N ~ 30) received a separate score along the following 6-point scale: (0) No production of a conventional letter; (1) Mother writes the letter on her own; (2) Mother holds the child's hand and produces the letter together with the child; (3) Mother writes and the child copies the letter; (4) Mother scaffolds the child in writing the letter; (5) Child writes the letter on his/her own, usually encouraged by mother (Aram & Levin, 2001). The average across letters for the eight words served as the *Printing Mediation* score, with higher scores indicating more autonomy encouraged by the mother and accepted by the child in producing the written letters (α = .96).

Demand for precision. This measure assessed the amount of precision the mother demanded from the child in shaping the letters, spacing between them, and writing the words horizontally and approximately in the same size. The demand for precision was assessed for each of the eight words along a 4-point scale: (1) low demand, where the mother hardly refers to the outcome, letting the child write freely and accepting the product even if unconventional; (2) moderate demand, where the mother tries to make the child produce the proper letter in the proper position but compromises when the child shows difficulties, accepting a less conventional product; (3) higher demand, where the mother asks that the letters and the words be written accurately and requires some corrections if any product is unsatisfactory; and (4) full demand, where mother insists that words be written absolutely conventionally. The average score across the eight words served as the *demand of precision* score (α = .85).

Reference to orthography. This measure included maternal references to two aspects of Hebrew orthography: morpho-phonology and medial/final letters. Maternal mediation on morpho-phonology was scored for each word that allowed reference to the number-gender structure, which is highly salient in Hebrew morphology and already emerges in the invented spellings of advanced kindergartners (Levin & Korat, 1993). Maternal mediation on medial/final letters was scored on each word that required a final letter form. Five Hebrew letters have two written forms, medial and final, the latter used only in the last position of a word. The same 3-point scale was used for morpho-phonology and for medial/final letters: (0) no reference; (1) reference without explanation; and (2) reference with explanation. The mean score across those words that allowed reference to orthography rules served as the *reference to orthography* score.

General Mediation Measures

Atmosphere. Atmosphere within the dyad while writing the words was scored on a 3-point scale for each word as follows: (1) negative ambiance between the mother and the child (e.g., the mother may show disappointment from her child's performance); (2) neutral ambiance, where the observer received the impression that mother and child felt that a task required completion and should be performed; and (3) warm, contented ambiance, where mother and child were obviously enjoying their dyadic activity. Each word was scored, and the average across the eight words served as the *atmosphere* measure, where higher scores indicated a more positive atmosphere (α = .92).

Mutuality. The mother's ability to keep her child working on-task and willing to accept her suggestions, instructions, and directions while writing the words was scored on a 4-point scale for each word as follows: (1) The child shows clear objection or ignores the mother’s suggestion; (2) The child may argue with the mother but eventually the mother makes him/her partially accept her suggestion; (3) Negotiation ensues between the child and

the mother, and the child accepts the mother's suggestion; (4) the mother suggests, and the child simply accepts the mother's suggestion or direction. Each word was scored, and the average across the eight words served as the *mutuality* measure (α = .95).

Reinforcements. All maternal reinforcements like "Good," "Very nice," and "You wrote this letter beautifully" were counted throughout the eight words.

Task perception. Mothers' perception of the task was coded as separate (scored 1) or as joint (scored 2). Perception of the task was coded as separate when the mother either viewed the task as her own, and thus was very involved and left a very small space for the child to contribute, or else she saw the task as the child's and thus left the child to perform the task with hardly any help from her. Perception of the task was coded as joint when the mother collaborated with the child and gave the impression that the task was a joint task. Each word was scored, and the average across the eight words served as the *task perception* score, where higher scores indicated perceptions of more reciprocality (α = .91).

General Information Regarding the Family and the Twins' History

The experimenter interviewed the mothers in their homes regarding family demographic variables (e.g., parents' age and education, number and ages of children, marital status, level of the family's religiosity) and the twins' history (e.g., week of pregnancy at delivery, fraternal versus identical twins, firstborn versus secondborn, time gap between firstborn and secondborn, weight at birth, prematurity, length of stay in premature infant care unit, if any).

Procedure

The education department of the Tel Aviv municipality provided a list of surnames and kindergartens for 35 sets of twins living in Tel Aviv. Through the kindergarten teacher, families were contacted by a letter explaining the nature of the present research, and 30 families returned the form indicating that they agreed to participate in the study. Two

families dropped out during the videotaping process, due to illness in their families; thus, our study comprised 28 sets of twins.

All the data was collected by an MA student in early counseling. She assessed the children's early literacy individually in a quiet room inside the kindergartens, in one session that lasted approximately 30 minutes. The tests followed the same order: phonological awareness (first phoneme), letter naming, phonological awareness (last phoneme), and word writing.

The words for the word writing task in the kindergartens and for the mother-child writing interaction at home were drawn from a pool of 16 word pairs. In each family, each twin’s word writing underwent assessment individually on four different word pairs in the kindergartens. The mother mediated writing via four different word pairs to each child. Thus, each family used all 16 word pairs, 8 for each twin.

The experimenter visited the twins’ homes for two sessions on separate days within the same week as each other and also within the same week as the session in the kindergartens. In the first home session, the experimenter first interviewed the mother for demographic variables on the family and twins' history. A randomly selected half of the mothers mediated writing to their firstborn twin in the first session and then to their secondborn twin in the second session, and the other half mediated writing to their twins in the opposite order. For each interaction, the experimenter posted the tripod and the camera, explained the task to the mother and the child, operated the camera, saw that the mother and the child had begun the task, and left the room. During the interaction, the mother and one of her twins were alone in the room; the other twin was in another room; and the experimenter was outside the room.

Matching Procedure for Data Analysis

The paradigm of this study, comprising 28 sets of twins and their mothers, enabled further investigation of maternal mediation style. To that end, as described above, the original sample of 28 biological twin sets underwent two different matching procedures. I first transformed the three early literacy measures (word writing, letter naming, and phonological awareness) into Z scores and then averaged them (reliability of $\alpha = .76$) to form a combined early literacy variable.

In the first matching procedure, to determine if a mother of twins would mediate more similarly to her twins than would two different mothers with children who revealed the same gap in literacy level as shown between the twins, I created 27 divergence-matched pairs of non-biologically related children. I matched each twin to a non-sibling who demonstrated the same combined literacy level as his/her own twin sibling (except 2 children who could not be matched). For example, Participant #1 scored .48 on literacy and his twin brother, Participant #2, scored .20; therefore, I matched Participant #1 with Participant #21 whose literacy score was .22, and they became a divergence-matched pair. At the same time, I matched his brother (Participant # 2) with Participant #17 whose literacy score was .48, and they also became a divergence-matched pair.

In the second matching procedure, I created 28 literacy-matched pairs of non-biologically related children to determine if a mother of twins would mediate more similarly to her twins (who always differed on literacy level), in comparison to two different mothers' similarity of mediation to their children who shared a comparable literacy level. In this procedure, I matched each twin to a non-sibling who demonstrated a similar combined early literacy score. For example, both Participant # 13 and Participant #42 scored .78 on the combined early literacy measure and thus became a literacy-matched pair. See below for the three groups' descriptive statistics.

RESULTS

The results will be presented in two parts. The first part refers to the sample of 56 children as a whole and the second part focuses on the children's twinship.

Total Sample Analysis

Descriptive Statistics

Table 1 presents the ranges, means, and standard deviations of all the study measures. The results on Table 1 indicate sufficient variance in all the measures used in this study. Children's early literacy measures demonstrated that, on average, the kindergartners in this study used some consonantal spelling in their writing; they knew on average 17 out of the 27 Hebrew letters; and they often did not refer to phonemes but rather to subsyllables when asked to retrieve a phoneme.

As to maternal mediation measures, the descriptive statistics for the task-specific measures on Table 1 show that mothers, on average, related to phonological units (syllable, subsyllable, or phoneme) in their grapho-phonemic mediation and dictated or helped the child to retrieve the required letter name (M = 5.73). In the printing mediation measure, mothers afforded their children much independence (M = 4.37), and mothers also demanded a high level of precision *(*M = 3.42). Mothers referred to the Hebrew orthography but seldom gave explanations (M = 1.95). The descriptive statistics for the general mediation measures indicated that, on average, mothers perceived the task to be of a dyadic nature (M = 1.85); the mother-child atmosphere was positive (M = 2.82); mothers succeeded in achieving mutuality with their children (M = 3.08); and mothers gave an average of 7.03 reinforcements throughout the 8-word interaction.

Mother's Sensitivity to Her Child's Literacy Level

Table 2 presents the correlations between maternal mediation measures and the child's early literacy. As seen in the table, regarding the task-specific mediation measures, all

the correlations were significant (r = .23, p < .05 to r = .83, p < .001). This result was particularly notable for *grapho-phonemic mediation* and *printing mediation* as correlated with *word writing* and *letter naming*, ranging from r = .73 to r = .83, p < .0001. Compared to mothers of children who scored lower on literacy, mothers of children who showed higher literacy levels encouraged them to further segment the word and retrieve the letter name, gave them more independence in printing the letters, demanded a higher level of precision, and tended to refer the children more to orthographic rules. As for the more general mediation measures, they were not related to the child's literacy measures, with the exception of atmosphere that correlated moderately (r = .31, p < .01) with both *word writing* and *letter naming.*

Analyzing the Twins

Descriptive Statistics

Table 3 presents the means, standard deviations, *t*-tests, and correlations for the three early literacy measures (word writing, letter naming, and phonological awareness) for the group of biological twin sets and for the two comparison groups obtained via the matching procedure – the divergence-matched pairs and the literacy-matched pairs. Note that in the two groups where pair members differed from one another on literacy level (the biological twins group and the divergence-matched pairs group), the child who scored higher appears in the left column and the child who scored lower appears in the right column. Also note that the divergence-matched pairs and the literacy-matched pairs groups refer to pairs of children and their two mothers, whereas the biological twins refer to one mother and her two children.

As seen in the table, the matching procedure was effective: the biological twins and the divergence-matched pairs presented fairly similar outcomes regarding means, standard deviations, and gaps between the higher and lower scoring children. The literacy-matched

pairs revealed very similar statistics for the pair members on all literacy measures, thus validating their matching procedure.

Is Mothers' Mediation Sensitive to the Differences in Literacy Levels Between Children? Do Mothers Have a Consistent Mediation Style?

Table 4 focuses on maternal mediation measures. It presents the means, standard deviations, *t*-tests, and correlations for the biological twins, divergence-matched pairs, and literacy-matched pairs on all the mediation measures: the task-specific and the more general measures. The *t*-tests on this table show that when mediating writing, mothers were sensitive to differences and similarities in children's level of literacy, especially in the task-specific mediation measures. The mothers of biological twins mediated most of the task-specific measures at a significantly higher level for their higher scoring twin, with the exception of reference to orthography. Likewise, in the divergence-matched pairs, the mothers of children with higher literacy scores mediated the task-specific measures at a significantly higher level than did the mothers of children with lower literacy scores (again with the exception of reference to orthography). In contrast, for the literacy-matched pairs, no significant *t*-test emerged. When different mothers mediated writing to their children whose literacy scores were similar, the mothers did not differ in their task-specific mediation measures.

Regarding the more general mediation measures among the three groups, these measures did not appear to be sensitive to differences in children's literacy level (with the exception of *mutuality* in biological twins). The atmosphere of the interaction, the way mothers perceived the task as separate or joint, and the amount of reinforcements used by mothers did not differ if the children scored higher or lower on literacy.

Did mothers of biological twins evidence a style of mediation? The significant correlations on Table 4 suggest that indeed mothers of biological twins possessed a mediation style. Despite the differences in literacy level between twins, if a mother mediated

on a higher level to one twin, she mediated on a higher level to her second twin as well, even if the twins scored differently on literacy. This trend emerged across the board, with the task-specific as well as the general mediation measures. A different picture emerged when examining these correlations with regard to the divergence-matched pairs and the literacy-matched pairs. In the literacy-matched pairs, the two mothers in each pair mediated similarly to the two children only regarding the grapho-phonemic and the printing mediation measures, despite the likeness in child literacy level within each pair. In the divergence-matched pairs, the only significant correlation appeared in grapho-phonemic mediation, showing that the two mothers in each pair mediated similarly only on this measure. Nonetheless, the correlation in grapho-phonemic mediation among the biological twins, $r = .80$, $p < .000$, was significantly higher than the correlation among the divergence-matched pairs, $r = .54$, $p < .005$, $U = 1.73$, $p < .05$, indicating a more consistent style among the mothers of the biological twins. The current results suggested that mothers of twins possessed a consistent mediation style, which was at least partly independent of their children's literacy level and which they employed for both siblings.

DISCUSSION

The present study assessed the writing mediation of 28 mothers to their kindergarten-age twins and the children's early literacy level (word writing, letter naming and phonological awareness). This design permitted the analysis of a mother's mediation to her two same-age children, who were reared in the same environment and yet revealed different literacy achievements. The study's aim was to investigate the extent to which mothers were sensitive to their child's literacy level in their writing mediation characteristics. At the same time, it attempted to determine if mothers possessed a writing mediation style that they utilized with both of their twins.

The results underscored that, in general, mothers were sensitive to their children's literacy level and mediated writing to their children accordingly, especially in measures directly related to the task of mediation such as helping the child retrieve the correct phoneme, allowing the child autonomy in producing letters, demanding precision in writing, and so forth. The present study also highlighted that along with their sensitivity to the child's level, mothers of twins possessed a mediation style. Moreover, mothers' style of mediating writing to her twins was more consistent than the styles of mediation shown by two mothers mediating writing to their two children who were matched to the twins and exhibited the same gaps in literacy level as the twins (divergence-matched pairs) or even than the styles of mediation shown by two mothers mediating writing to their two children who both revealed a similar literacy score (literacy-matched pairs).

The sensitivity among mothers to their children's literacy level in task-specific aspects of mediation corroborated literature regarding parents' familiarity with their children's general development (Glascoe, 1999), cognitive development (Miller, 1986), and school performance (Korat, 2004). These findings were more pronounced for the twins' results. The *t*-tests revealed that on the task-specific measures, mothers of twins mediated significantly higher to the higher-scoring twin. In the divergence-matched pairs, the mothers of higher-scoring children mediated significantly higher on task-specific measures than did mothers of lower-scoring children. It seems that the mediation of these task-specific measures derived considerably from the child's literacy level. Mothers of twins were sensitive to their children's literacy level, showing awareness of the differences in literacy levels between their twins, and mediating accordingly. Parents are aware of the uniqueness of each of their twins, and they react to these differences in their interactions with them (Lytton & Gallagher, 2002).

The mothers in this study were probably mediating the task-specific measures within the children's zone of proximal development (Vygotsky, 1978). These mediation aspects – grapho-phonemic mediation, printing mediation, demand for precision, and reference to orthography – largely depend on the child's knowledge, to which mothers reacted. According to Rogoff (1990), parental sensitivity involves understanding of the skills and knowledge needed to independently handle the situation and of the necessary course to promote the child's skill development in a particular situation. To assist her child properly, a mother needs to know both how the specific task could be accomplished and how her child is likely to approach it. The mother's initial model of how to mediate is based on her preconceptions about both the task and the child (Rogoff, 1990).

The more general mediation characteristics in the present study appeared to be less affected by early literacy differences between the children. Interestingly, although maternal sensitivity appeared across the board in regard to the task-specific mediation measures, only two correlations emerged for the general mediation measures: between atmosphere and the child's literacy skills in word writing and letter naming. These general measures have more to do with the emotional aspects of the interactions and, as such, hold considerable importance for children's development because they largely predict the security, confidence, and trust between the child and his/her mother (Shonkoff & Phillips, 2002). These general mediation characteristics may be more stable, determined by the parents and their history (Bus & van IJzendoorn, 1995) as well as by cultural beliefs and norms of behavior related to parenting (Korat & Levin, 2001; Lightfoot & Valsiner, 1992). At the same time, a mother's mediation characteristics appear to be molded by her previous experiences with her children; therefore, perhaps these general mediation measures are affected by other differences between the children unrelated to early literacy, which were not assessed in the present study, like children's temperament or behavior (Deater-Deckard & Petrill, 2004).

Usually, shared and nonshared environmental effects on twins or siblings are inferred and, less often, are observed directly. Researchers have claimed that direct measurement is necessary before firm conclusions can be drawn about shared and nonshared influences (Shonkoff & Phillips, 2002). The present methodology allowed for direct observation of these environmental effects. The videotaped interactions and the matching procedures between biological twins, divergence-matched pairs, and literacy-matched pairs provided an opportunity to directly tease apart shared and nonshared environmental effects regarding early literacy and maternal literacy mediation. Twins emerged as different in their literacy levels, and their mothers responded to these differences in their mediation of task-specific measures. At the same time, mothers demonstrated a mediation style that they employed with both of their twins. Significant correlations emerged between the mother's mediation to her two children, across the board, including task-specific and general mediation measures. Mothers who mediated higher to one twin mediated higher to the second twin. For example, a mother who demanded more precision or referred more to orthography with one of her twins also did so with her other twin. Likewise, a mother who created a better atmosphere or gave more reinforcements to one of her twins acted similarly with her other twin.

The picture differed considerably among the pairs of children who were not twins and who did not share the same environment. Almost no significant correlations emerged between the two mothers' mediation to divergence-matched pairs, whose literacy gap resembled those of the biological twins, or between the two mothers of literacy-matched pairs, whose members shared similar literacy achievements. Two mothers mediated differently to their children, regardless of their literacy level. The only mediation measure that emerged as extremely sensitive to the child’s literacy level was grapho-phonemic mediation, and, even in this measure, mothers of twins again showed greater similarity in their mediation to twins than did two mothers of non-twins. The present results corroborate

previous studies that reported stability in maternal mediation to siblings. These studies referred to general characteristics of the interaction like mutuality, cooperation, or control (Deater-Deckard & O'Connor, 2000; Dunn, Plomin, & Nettles, 1985) and characteristics of verbal interactions (Haden, 1998; Moore, Cohn, & Campbell, 1997). The present study broadened this conclusion of stability across twins to early literacy writing interactions.

In sum, the present study supported the stance that in early literacy interactions mothers reveal sensitivity to the differences between their children, but this sensitivity expresses itself mainly in those aspects of the mediation that are task-specific and dependent on the child's literacy level and not on the more general characteristics of the interaction. Together with this sensitivity to children's level of development, mothers also demonstrate a mediation style that they employ on both of their twins.

REFERENCES

Adams, M. J. (1991). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Aram, D. (2002). Joint writing in Hebrew of dictated words versus proper names: Analysis of low SES mother-kindergartner dyads. *Journal of Research in Childhood Education, 17*, 47-61.

Aram, D. & Levin, I. (2001). Mother-child joint writing in low SES: Sociocultural factors, maternal mediation, and emergent literacy. *Cognitive Development, 16,* 831-852.

Aram, D., & Levin, I. (2002). Mother-child joint writing and storybook reading: Relations with literacy among low SES kindergartners. *Merrill Palmer Quarterly, 48,* 202-224.

Aram, D., & Levin, I. (2004). The role of maternal mediation of writing to kindergartners in promoting literacy achievements in school: A longitudinal perspective. *Reading and Writing: An Interdisciplinary Journal, 17,* 387-409.

Baker, L., Fernandez-Fein, S., Scher, D., & Williams, H. (1998). Home experiences related to the development of word recognition. In J. L. Metsala, & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 263-288). Hilldsale, NJ: Erlbaum.

Berninger, V., Yates, C., Cartwright, A., Rutberg, J., Remy, E., & Abbot, R. (1992). Lower level developmental skills in beginning writing. *Reading and Writing: An Interdisciplinary Journal, 4,* 257-280.

Bissex, G. L. (1980). *GNYS AT WRK: A child learns to write and read*. Cambridge: Harvard University Press.

Bornstein, M. H. (2001). Parenting: Science and practice. *Parenting: Science and Practice*, 1, 1-4.

Burns, M. S., & Casbergue, R. (1992). Parent child interaction in a letter writing context. *Journal of Reading Behavior, 24,* 289-312.

Bus, A. G., & van IJzendoorn, M. H. (1995). Mothers reading to their 3-year-old: The role of mother-child attachment security in becoming literate. *Reading Research Quarterly, 30*(4), 998-1015.

Bus, A. G., van IJzendoorn, M. H., & Pellegrini, A. D. (1995). Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. *Review of Educational Research, 65,* 1-21.

Collins, W. A., Maccoby, E. E., Steinberg, L., Hetherington, E. M., & Bornstein, M. H. (2000). Contemporary research on parenting: The case for nature and nurture. *American Psychologist, 55,* 218-232.

Damast, A. M., Tamis-LeMonda, C. S., & Bornstein, M. H. (1996). Mother-child play: Sequential interactions and the relation between maternal beliefs and behaviors. *Child Development, 67,* 1752-1766.

Deater-Deckard, K. (2000). Parenting and child behavioral adjustment in early childhood: A quantitative genetic approach to studying family processes and child development. *Child Development, 71,* 468-484.

Deater-Deckard, K., & O'Connor, T. G. (2000). Parent-child mutuality in early childhood: Two behavioral genetic studies. *Developmental Psychology, 36,* 561-570.

Deater-Deckard, K., & Petrill, S. A. (2004). Parent-child dyadic mutuality and child behavior problems: An investigation of gene-environment processes. *Journal of Child Psychology and Psychiatry, 45,* 1171-1179.

Deater-Deckard, K., Pike, A., Petrill, S. A., Cutting, A., Hughes, C., & O'Connor, T. G. (2001). Nonshared environmental processes in social-emotional development: An observational study of identical twin differences in the preschool period. *Developmental Science, 4,* F1-F6.

DeBaryshe, D. B., Buell, M. J., & Binder, J. C. (1996). What a parent brings to the table: Young children writing with and without parental assistance. *Journal of Literacy Research, 28*, 71-90.

Dunn, J. F., Plomin, R., & Nettles, M. (1985). Consistency of mothers' behavior toward infant siblings. *Developmental Psychology, 21*, 1188-1195.

Durkin, D. (1966). *Children who read early: Two longitudinal studies*. New York: Teachers College Press.

Evans, M. A., Moretti, S., Shaw, D., & Fox, M. (2003). Parent scaffolding in children's oral reading. *Early Education and Development, 14*, 361-388.

Glascoe, F. P. (1999). The value of parents' concerns to detect and address developmental and behavioural problems. *Journal of Paediatrics and Child Health, 35*, 1-8.

Gundlach, R. A., McLane, J. B., Stott, F. M., & McNamee, G. D. (1985). The social foundations of children's early writing development. In M. Farr (Ed.), *Advances in writing research*: *Vol. 1. Children's early writing development* (pp. 1-58). Norwood, NJ: Ablex.

Haden, C. A. (1998). Reminiscing with different children: Relating maternal stylistic consistency and sibling similarity in talk about the past. *Developmental Psychology, 34*, 99-114.

Hall, N. (2000). Interactive writing with young children. *Childhood Education, 76*, 358-364.

Holden, G. W. (1997). *Parents and dynamics of child rearing*. Boulder, CO: Westview Press.

Kochanska, G. (1997). Mutually responsive orientation between mothers and their young children: Implications for early socialization. *Child Development, 68*, 94-112.

Kelly, J. F., Morisset, C. E., Barnard, K. E., Hammond, M. A., & Booth, C. L. (1996). The influence of early mother-child interaction on preschool cognitive/linguistic outcomes in a high-social-risk group. *Infant Mental Health Journal, 17,* 1-11.

Korat, O. (2004). Mothers' and teachers' attributions of the academic functioning of Israeli second graders: A comparison between social groups. *Early Childhood Research Quarterly, 9,* 485-501.

Korat, O., & Levin, I. (2001). Maternal beliefs, mother-child interaction, and child's literacy: Comparison of independent and collaborative text writing between two social groups. *Applied Developmental Psychology, 22,* 397-420.

Levin, I., & Bus, A. (2003). How is emergent writing based on drawing? Analyses of children's products and their sorting by children and mothers. *Developmental Psychology, 39,* 891-905.

Levin, I., & Korat, O. (1993). Sensitivity to phonological, morphological, and semantic cues in early reading and writing in Hebrew. *Merrill-Palmer Quarterly, 39,* 213-232.

Levin, I., Share, D. L., & Shatil, E. (1996). A qualitative-quantitative study of preschool writing: Its development and contribution to school literacy. In M. Levy, & S. Ransdell (Eds.), *The science of writing* (pp. 271-293). Mahwah, NJ: Erlbaum.

Lightfoot, C., & Valsiner, J. (1992). Parental beliefs systems under the influence: Social guidance in construction of personal cultures. In I. E. Sigel, A. V. McGillicudy-DeLisi, & J. Goodnow (Eds.), *Parental beliefs systems* (pp. 393-414). Hillsdale, NJ: Lawrence Erlbaum.

Lytton, H., & Gallagher, L. (2002). Parenting twins and the genetics of parenting. In M. H. Bornstein (Ed.), *Handbook of parenting: Vol 1. Children and parenting* (2nd ed., pp. 227-255). Mahwah, NJ: Lawrence Erlbaum.

Maccoby, E. E. (2000). Parenting and its effects of children: On reading and misreading behavior genetics. *Annual Review of Psychology, 51,* 1-27.

Meadows, S. (1996). *Parenting behavior and children's cognitive development*. Bristol: Psychology Press

Miller, S. A. (1986). Parents' beliefs about their children's cognitive abilities. *Developmental Psychology, 22,* 276-284.

Moore, G. A., Cohn, J. F., & Campbell, S. B. (1997). Mothers' affective behavior with infant siblings: Stability and change. *Developmental Psychology, 33,* 856- 860.

Muter, V., Hulme, C., Snowling, M., & Taylor, S. (1997). Segmentation, not rhyming, predicts early progress in learning to read. *Journal of Experimental Child Psychology, 65,* 370-396.

Naslund, J. C., & Schneider, W. (1996). Kindergarten letter knowledge, phonological skills and memory processes: Relative effects on early literacy. *Journal of Experimental Child Psychology, 62,* 30-59.

Pratt, M. W., Kerig, P. K., Cowan, P. A., & Cowan, C. P. (1992). Family worlds: Couple satisfaction, parenting style, and mothers' and fathers' speech to young children. *Merrill Palmer Quarterly, 38,* 245-262.

Reese, E., Cox, A., Harte, D., & McAnally, H. (2003). Diversity in adults' styles of reading books to children. In A. van Kleeck, S. A. Stahl, & E. B. Bauer (Eds.), *On reading books to children* (pp. 37-57). Mahwah, NJ: Lawrence Erlbaum.

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press.

Scarborough, S., & Dobrich, W. (1994). On the efficacy of reading to preschoolers. *Developmental Review, 14,* 245-302.

Sénéchal, M., LeFevre, J., Thomas, E. M., & Daley, K. E. (1998). Differential effects of home literacy experiences on development of oral and written language. *Reading Research Quarterly, 33,* 96-116.

Shatil, E., Share, D. C., & Levin. I. (2000). On the contribution of kindergarten writing to grade one literacy: A longitudinal study in Hebrew. *Applied Psycholinguistics, 21*, 1-21.

Shonkoff, J. P., & Phillips, D. A. (2002). *From neurons to neighborhoods: The science of early childhood development*. Washington, DC: National Academy Press.

Teale, W. H. (1986). Home background and young children's literacy development. In W. H. Teale, & E. Sulzby (Eds.), *Emergent literacy: Writing and reading* (pp. 173-206). Norwood, NJ: Ablex.

Tudge, J., & Putnam, S. (1997). The everyday experiences of North American preschoolers in two cultural communities: A cross-disciplinary and cross-level analysis. In J. Tudge, M. J., Shanahan, & J. Valsiner (Eds.), *Comparisons in human development: Understanding time and context* (pp. 252-279). New York: Cambridge University Press.

van Kleeck, A., & Stahl, S. A. (2003). Preface. In A. van Kleeck, S. A. Stahl, & E. B. Bauer (Eds.), *On reading books to children* (pp. vii-xiii). Mahwah, NJ: Lawrence Erlbaum.

Vygotsky, L. S. (1978). *Mind and society: The development of higher psychological processes*. Cambridge: Harvard University Press.

Wasik, B. H., & Herrmann, S. (2004). Family literacy: History, concepts, services. In B. H. Wasik (Ed.), *Handbook of family literacy* (pp. 3-23). Mahwah, NJ: Lawrence Erlbaum.

Table 1

Descriptive Statistics: Means, Standard Deviations, and Ranges (N = 56)

			M	*SD*	*Min*	*Max*
Child's measures	Early literacy skills	Word writing	9.44	2.93	1.00	15.00
		Letter naming	17.30	7.49	1.00	27.00
		Phonological awareness	2.84	0.95	1.00	4.00
Mother's measures	Task-specific mediation measures	Grapho-phonemic mediation	5.73	1.36	2.79	7.97
		Printing mediation	4.37	0.67	2.94	5.00
		Demand for precision	3.42	0.59	1.63	4.00
		Reference to orthography	1.95	0.49	1.00	3.00
	General mediation measures	Atmosphere	2.82	0.38	1.33	3.00
		Mutuality	3.08	0.48	1.50	4.00
		Reinforcements	7.03	3.26	0.75	17.25
		Task perception	1.85	0.36	1.00	2.00

Table 2

Correlations Between the Children's Early Literacy Skills and Maternal Mediation Measures

		Child's early literacy skills (N=56)		
	Maternal mediation measures	Word writing	Letter naming	Phonological awareness
Task-specific mediation measures	Grapho-phonemic mediation	.82***	.77***	.45***
	Printing mediation	.73***	.83***	.33**
	Demand for precision	.46***	.51***	.23*
	Reference to orthography	.31**	.37**	.25*
General mediation measures	Atmosphere	.31**	.31**	.14
	Mutuality	.02	.03	.02
	Reinforcements	.07	.03	.14
	Task perception	.02	.07	.11

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

Table 3

T-Tests and Correlations Comparing Three Groups on Children's Early Literacy: Biological Twins, Divergence-Matched Pairs, and Literacy-Matched Pairs

	Biological twins (*N* = 28)				Divergence-matched pairs (*N* = 27)				Literacy-matched pairs (*N* = 28)			
Children's early literacy measures	Higher scoring twin	Lower scoring twin			Higher scoring child	Lower scoring child			Child A	Child B		
	M (SD)	*M (SD)*	*t*	*r*	*M (SD)*	*M (SD)*	*t*	*r*	*M (SD)*	*M (SD)*	*t*	*r*
Word writing	10.56 (2.74)	8.33 (2.75)	5.19***	.66***	10.68 (2.65)	8.19 (2.73)	4.79***	.50**	9.45 (2.78)	9.44 (3.14)	0.07	.83***
Letter naming	20.14 (6.22)	14.46 (7.68)	5.03***	.65***	20.81 (5.62)	14.00 (7.23)	4.62***	.31	17.39 (6.57)	17.21 (8.43)	0.18	.78***
Phonological awareness	3.10 (0.86)	2.58 (0.99)	3.04**	.55**	2.95 (0.95)	2.74 (0.99)	1.04	.40*	2.93 (0.89)	2.75 (1.02)	-0.95	.42*

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

Table 4

T-Tests and Correlations Comparing Maternal Mediation Measures: Biological Twins, Divergence-Matched Pairs, and Literacy-Matched Pairs

		Biological twins (*N* = 28)				Divergence-matched pairs (*N* = 27)				Literacy-matched pairs (*N* = 28)			
Maternal mediation measures		Higher scoring twin	Lower scoring twin			Higher scoring child	Lower scoring child			Child A	Child B		
		M (*SD*)	*M* (*SD*)	*t*	*r*	*M* (*SD*)	*M* (*SD*)	*t*	*r*	*M* (*SD*)	*M* (*SD*)	*t*	*r*
Task-specific measures	Grapho-phonemic mediation	6.11 (1.27)	5.35 (1.36)	4.86***	.80***	6.20 (1.22)	5.32 (1.25)	4.00***	.54**	5.57 (1.31)	5.80 (1.43)	-0.65	.68***
	Printing mediation	4.58 (0.56)	4.15 (0.71)	3.66***	.54**	4.65 (0.51)	4.11 (0.67)	3.33**	-.02	4.29 (0.67)	4.44 (0.68)	-1.25	.58***
	Demand for precision	3.60 (0.45)	3.26 (0.67)	2.75*	.41*	3.67 (0.48)	3.19 (0.63)	3.20**	.04	3.39 (0.62)	3.46 (0.58)	-0.45	.06
	Reference to orthography	2.01 (0.47)	1.89 (0.52)	1.56	.68***	2.07 (0.43)	1.86 (0.53)	1.48	-.16	1.84 (0.49)	2.07 (0.49)	-1.72	-.02
General measures	Atmosphere	2.86 (0.34)	2.79 (0.44)	0.82	.38*	2.85 (0.37)	2.80 (0.42)	0.45	-.20	2.72 0.49)	2.92 (0.23)	-1.97	.09
	Mutuality	3.22 (0.48)	2.96 (0.49)	3.18**	.55**	3.16 (0.52)	3.02 (0.46)	0.96	-.02	3.00 (0.48)	3.18 (0.48)	-1.38	.02
	Reinforcements	6.54 (3.17)	7.53 (3.34)	-1.68	.55***	7.02 (2.99)	7.06 (3.54)	-0.05	.16	6.54 (3.08)	7.54 (3.42)	-1.15	.00
	Task perception	1.88 (0.30)	1.82 (0.33)	0.96	.62***	1.89 (0.28)	1.81 (0.36)	0.83	-.22	1.91 (0.27)	1.79 (0.3)	-1.58	.15

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