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The Impact of Teacher–Child Relationships on Child Cognitive Performance as Explored by a Priming Paradigm

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The present study involved 120 kindergartners, of whom $n = 60$ were followed up to first grade. Upon making inquiries regarding closeness in teacher–child relationships in the classrooms, the children participated in a laboratory situation in which they were exposed to computerized tasks. These tasks challenged the cognitive processes thought to govern basic knowledge and belief systems. Before each task commenced, however, the image of the child's teacher (affective prime stimulus), with whom the relationship had been measured, was displayed for an experimental group of children. In contrast to a control group being exposed to a neutral prime, it was assumed that the teachers' images displayed in the experimental group would affect cognitive performance in a defined way (i.e., if primed by a person schema of a close relationship, these children should perform better than the rest). Whereas solving scores remained unaffected, children displayed shorter solving times under affective primes when in close relationships with their teachers. This effect could even be evidenced after the transition to school. Results suggest that cognitive processing is much more effective if close teacher–child relationships are involved.

Keywords: teacher–child relationships, closeness, cognitive performance, affective priming

Developmental theorists have long proposed that children's cognitive competencies are mediated by adults. In his early work, Vygotsky (1978) clearly located the motivation of a child's activity within his or her relation to a significant adult rather than within the activity itself. Over the past decade, Pianta and his colleagues (e.g., Hamre & Pianta, 2001, 2005; Pianta, 1992; Pianta, Hamre, & Stuhlman, 2003; Pianta, Steinberg, & Rollins, 1995) have demonstrated how nonparental adults, specifically teachers, become important once children start attending child care and school. When teacher–child relationships were characterized to be close, even kindergartners showed higher levels of classroom participation than when teacher–child relationships were observed as being more distant. Moreover, teachers' close relationships with children provided motivation for them to devote extra time, later in school. In contrast, teacher–child relationships characterized by conflict led to frequent attempts to control children's behavior and thus hindered progression of children's engagement in school (Birch & Ladd, 1998; Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Ladd, Birch, & Buhs, 1999; Pianta et al., 1995).

However, the extent to which close teacher–child relationships may predict academic success is still not clear, even though cognitive research in adults provides increasing evidence that interpersonal relationships can affect cognitive performance. For example, Dreisbach and Boettcher (2011) have recently demonstrated that if a person's self-relevance is questioned by another person, cognitive performance can be negatively influenced. In other words, social judgments that have a negative relevance to another's self can lower cognitive processing of that person. Moreover, when two people jointly participate on the same task, for example, it is assumed that the task is jointly represented by their actors and coactors (e.g., Sebanz, Bekkering, & Knoblich, 2006). Interestingly, it is the relationship between actor and coactor that defines how the task might be commonly represented and, consequently, how successfully interaction will take place. In fact, an induced negative relationship between actor and coactor might result in separate rather than joint task representations, suggesting that the valence of relationships is important for joint cognitive processing (e.g., Hommel, Colzato, & van den Wildenberg, 2009).

In attachment theory, which dominates contemporary research on relationships, it is assumed that people build mental representations of their relationships (so called internal working models [IWMs]) in which the relational schema of the partner, the self, and the relationship is featured. These IWMs developing in a child are thought to organize, filter, and bias the evaluation of interactions with adults in the family and beyond. According to Bowlby (1969), a history of a reliable and effective secure base support will eventually be generalized and generate expectation in valuable relationships. Within the school context, close teacher–child relationships would be expected to offer the child responsive and emotionally supportive stimulation. This is qualitatively similar to that of the secure parent, who is expected to facilitate learning and reasoning in an emotionally balanced manner. Unfortunately, at-

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tachment researchers have not yet been able to adequately explain whether and how these IWMs affect mental processes. Surprisingly, associations between parent–child attachment quality and cognitive performance appeared highly unsatisfactory even though manifold possible influences of IWMs on cognition have been extensively explored (see meta-analysis by van IJzendoorn, Dijkstra, & Bus, 1995). However, global cognitive measures might not capture the links between attachment and cognition, and parent–child relationships are not the only relationships that influence cognition. Thus, in the present study we implemented an experimental approach to evaluate the influence of IWMs of teacher–child relationships on children's cognition.

In children's lives, kindergarten and school teachers become one of the most significant adults beyond the family, even though school settings restrict the intensity and frequency of experiences with them. Close teacher–child relationships have especially proved to be related to various aspects of school adjustment, better learning attitudes, and more self-directedness (e.g., Birch & Ladd, 1998). Researchers thus assume that these associations reflect teachers' secure base function, as known from the Bowlby-Ainsworth attachment theory. Once children have established secure IWMs of the relationship with their teachers, these IWMs might have effects that are distinct from IWMs that children build of their relationships to primary caregivers in families (Ahnert, 2005; Ahnert, Pinquart, & Lamb, 2006; Lamb & Ahnert, 2006). On the basis of research regarding children's relationships with nonparental adults, researchers have suggested that compliance, assistance, and support for a child's basic ability to explore might also become central for teacher–child relationships (Booth, Kelly, Spieker, & Zuckerman, 2003; Pederson & Moran, 1995). Consequently, a teacher's impact on child cognitive performance should be most influential.

Yet, in order to assess how teacher–child relationships influence child cognitive performance, we need to gather compelling assumptions for the association between attachment and cognition. In a heuristic approach, the *attachment—teaching assumption* (Bowlby, 1980), for example, can be useful (see also van IJzendoorn et al., 1995). This assumption claims that adults in close adult–child relationships are better able to informally instruct and teach children who are less distracted by task-irrelevant, attachment-related aspects of the situation. Trusting and trusted teachers (those who form close relationships) might succeed better in their teaching processes than teachers who have established distant relations with children. For example, close and responsive teachers might best understand how to support children's basic cognitive competencies such as classifying, ordering, composing, and comparing, which are cornerstones in intellectual cognitive performance (e.g., Goswami, 2008; Piaget, 1950, 1953; Siegler, 1996). Teachers, as effective instructors, might encourage children to efficiently implement those basic knowledge systems in decision making, when being faced with more complex cognitive challenges in the classroom. If, for example, these basic principles are negatively judged or ignored by teachers, children might fail to efficiently implement their reasoning processes. Thus, a child's basic knowledge might be intact, but he or she might feel restricted in being able to use it for new skills (see debate by Immordino-Yang & Damasio, 2007) as well as to form close teacher–child relationships. Consistent responsiveness that promotes close relationships may help children from close teacher–child relationships to be less timid and anxious in achievement settings (Gersten, Coster, Schneider-Rosen, Carlson, & Ciccetti, 1986; Kesner, 2000).

The *affective state–mastery assumption* (Masters, Barden, & Ford, 1979; Masters, Furman, & Barden, 1977), which shows certain similarities to the attachment–teaching assumption, suggests that positive emotions facilitate intellectual functioning in achievement settings. At the same time, some researchers have argued that dysfunctions of emotional processing are negatively associated with reasoning (Damasio, 1994). Positive mood states, which regularly accompany close relationships, may thus affect performance, not through a reinforcement process but through motivational or arousal components that lie in the rewarding interactions of close relationships. In contemporary research on emotion and cognition, it is assumed that reward-predicting stimuli lead to increases of dopamine levels in the prefrontal cortex (Cohen, Braver, & Brown, 2002), which might heighten cognitive flexibility (Dreisbach & Goschke, 2004; Müller et al., 2007) and improve cognitive consolidation in a variety of cognitive tasks (see Ashby, Isen, & Turken, 1999). Thus, close teacher–child relationships may not only enhance children's attention for intellectual challenges but also encourage them to invest their full intellectual potential, and, consequently, activation of secure IWMs of those relationships should improve the effectiveness of child cognitive processing. Longitudinal investigations by Howes, Hamilton, and Philipsen (1998) showed that the quality of relationships with teachers in child care was the best predictor of children's perceptions of their relationships with their teachers in elementary school, even though Ladd and his colleagues (Birch & Ladd, 1998; Ladd et al., 1999) found that associations between kindergarten teacher–child and elementary teacher–child relationships were not as salient. In the present study, therefore, we aimed to explore whether experiences with kindergarten teachers persist in affecting child cognitive performances at school, given the intense interaction history that typically underlies kindergarten teacher– as compared with school teacher–child relationships.

For a long time, attachment research viewed the IWM as a conceptual metaphor rather than a testable construct (Hinde, 1988), whereas researchers in cognitive psychology have been effectively exploring similar "relational schemata" (Baldwin, 1992). Schemata might dominate the information-processing system and constrain how phenomena are perceived, conceptualized, and acted upon. In general, it is assumed that "schemata" are organized in some form of associative or semantic network, of which activation from one node spreads to other nodes (e.g., Collins & Loftus, 1975; Masson, 1995). Thus, the activation within networks is assumed to be increased if network nodes have been preactivated or *primed* by activating semantically similar nodes. Not surprisingly, a typical procedure to experimentally manipulate the activation level of schemata is the priming paradigm. In priming paradigms, participants respond to a specified task stimulus that is preceded by a task-irrelevant prime (i.e., is not needed to perform the task). More importantly, task processing is facilitated when the preceding prime is *semantically related*, in contrast to unrelated prime–task relations (e.g., Neely, 1991; Neely & Kahan, 2001). In general, the activation of semantic networks should occur automatically, unconsciously, and irrespective of available cognitive resources (e.g., Fischer, Miller, & Schubert, 2007; Fischer & Schubert, 2008; Posner & Snyder, 1975; see also Moors & De Houwer, 2006, for a review).

Numerous illustrating examples have been provided by Bargh and colleagues to demonstrate such hidden mechanisms (see Bargh & Chartrand, 1999; Bargh, Chen, & Burrows, 1996; Bargh & Gollwitzer, 1994). For example, when relational schemata were activated unconsciously in an unrelated context (e.g., exposure to words related to politeness), people were then prone to behave congruent to the schema with which they had been primed (e.g., to act more politely), suggesting how strongly activating schemata might unconsciously affect behavior. Moreover, these activations can even extend to behavioral goals and intentions. When being unconsciously primed with words for achievement and goals, such as *strive* and *succeed*, participants outperformed their earlier performance. Furthermore, priming paradigms exploring mental representations of relationships have provided evidence that the activation of person-related schemata can elicit spontaneous affective reactions toward significant others, such as friends, romantic partners, and disliked persons, suggesting how relationship experience might direct attitudes, behaviors, and mood in favor of or against them (Banse, 1999, 2003; Murphy & Zajonc, 1993). Thus, many kinds of mental representations or schemata can be influenced by unconscious activation, which affects mood and cognitive performance to a much larger extent than assumed in psychological research from a decade ago (Bargh & Chartrand, 1999).

The present study was designed to investigate the impact of teacher–child relationships on children's basic cognitive performance. We applied a priming paradigm serving to activate individual teacher–child relationship schemata in kindergarten children. We hypothesize that these IWMs will affect child cognitive processing on selected basic cognitive skills, namely classifying, ordering, comparing, and composing, which are expected to be differentially challenging at a cognitive level. If teachers influenced their students to meet these challenges, a teacher-related schema would predict how effectively students will perform. By means of a priming experiment, we therefore aimed to explore whether (a) children's cognitive processes will be shaped upon presentations of images of kindergarten teachers with whom they had built up a relationship (activation of IWMs), (b) whether the quality of teacher–child relationships influences these cognitive processes (i.e., cognitive processes are facilitated for secure IWMs but not for others), and (c) whether secure IWMs of kindergarten teacher–child relationships have lasting effects on children's cognitive processing.

Method

Sample

Children. The present study involves 120 healthy children (63 girls; 71 firstborns; 42 only children). We recruited them through listings in child care centers and observed them for the first time when they averaged 6 years 7 months (SD = 0 years 4 months) of age. These children were followed up on during the first semester of elementary school and tested a second time (almost 5 months later) when they had reached 6 years 11 months (SD = 0 years 4 months) of age.

Families. The families were representative of middle-class families in Germany with respect to parental age, education, occupation, and income. Mothers were 36 years 11 months (SD = 4 years 11 months) and fathers 39 years 9 months (SD = 6 years 3 months) old on average. The majority of mothers (vs. fathers) had accomplished vocational training (52.8% vs. 41.7%) or had just finished middle or high school education (1.9% vs. 0%), whereas the majority of fathers (vs. mothers) had obtained university degrees (58.3% vs. 45.3%). Families with single-mother status constituted 18.5% of the sample. In the two-parent families, however, 28.8% of the mothers and 2.1% of the fathers stayed at home.

Kindergartens and elementary schools. Out of $n = 34$ child care centers, $n = 50$ care providers (46 female) participated. They averaged 35 years 9 months (SD = 9 years 7 months) of age and had worked as care providers for 14 years 2 months (SD = 8 years 8 months) on average. Each of them was the primary caretaker of the respective target children and responsible for a group of 20.1 children on average ($SD = 3.9$). The kindergarteners entered, later on, $n = 31$ elementary schools, with $n = 47$ teachers (all females) involved. These teachers averaged 40 years 5 months (SD = 10 years 1 month) of age. They had experienced an average of 17 years (SD = 12 years 0 months) of teaching in classrooms and were responsible for 22.3 students on average ($SD = 3.6$) at the time of the testing. All teachers were head kindergarten or school teachers. However, whereas the kindergarten teachers had known the children from preschool onwards, typically for a period of about 3 years, school teachers only got to know the children at school entry, which occurred 5–6 months before they were involved in the follow-up study.

Procedure and Measures

Overall study design. We visited all children in kindergartens and schools and asked their head teachers to report on the quality of the relationships with them. In addition, children were observed with their kindergarten teachers, and, later on, were asked about their school teachers to attain evaluations on the teacher–child relationships from the children's point of view. Furthermore, photos of these teachers were taken. We then exposed the children to a computer-based program in a laboratory situation in order to assess their cognitive performance, while also carrying out the priming paradigm after having incorporated the teachers' images as affective prime stimuli. Half the kindergartners ($n = 60$) were assigned to an experimental group, whereas $n = 60$ of the children were part of a control group. The children were assigned to the respective group according to socioeconomic status (SES) backgrounds, child gender and age, and teacher–child relationships (Student-Teacher Relationship Scale [STRS] Closeness scores; see below). Experimental and control groups differed in the way the computer-based program had been set up (i.e., with and without affective primes; see below).

Teacher–child relationships. In order to categorize the experienced relationship between children and teachers, teachers filled out the STRS (Pianta, 2001), which provides three subscales, namely Closeness, Dependency, and Conflict. After translation into German and administering them in kindergartens and elementary schools, the scales reached alphas similar to those of its origins with, *Closeness* and *Conflict* between .78 and .86, as well as *Dependency* with .46. The present study, however, is based exclusively on the closeness scores of the STRS. Closeness measures the degree to which a teacher experiences affection, warmth, and open communication with a child. Teachers reporting higher Closeness scores sense that the child views the teacher as supportive and appreciates him or her as a resource. Throughout the investigation, we relied on STRS Closeness scores as a continuous variable, as suggested by Pianta (2001). Furthermore, in order to validate teachers' judgments on closeness, we followed Doumen et al.'s (2009) approach and had external observers use the Attachment-Q Sort (AQS; E. Waters, 1995) to observe the teacher–child relationships during a 2-hr session in kindergarten (interrater agreements on two different days within a period of $M = 13.8$ days; $r = .61$). Regression analysis revealed that the STRS Closeness score could be significantly predicted by the AQS score ($\beta = 54.33$, $p < .01$), demonstrating that the higher the observed attachment security between a kindergarten teacher and a child was, the closer this teacher reported on this relationship. This suggests that STRS Closeness of teacher–child relationships has been validated by external observers who were, of course, blind to the teachers' judgments.

Preparation for a priming paradigm. A specialized software was ordered (Ebner, 2007) for which we searched for task items across IQ assessments for children. After completion of a computer-based procedure that administered various cognitive tasks, we tested the handling of the program in a pilot study, ensured its reliability and validity, and used it for the priming procedure. Task items from established cognitive assessments for children between 4 and 10 years were selected. These tasks were cognitively challenging and suitable to be operated on a computer screen using a mouse (see Figure 1 for examples and instructions). We found items that aimed to assess how children classify ($n = 43$ items; from the Basic Assessment for Specific Developmental Disorders in the Preschool Years [BUEVA]; Esser & Wyschkon, 2002, and the General Intelligence Scale [CFT]; Weiss & Osterland, 1997), how they identify logical orders in a sequence ($n = 16$ items; from the Image-Based Intelligence Test for Preschool Children [BIVA]; Schaarschmidt, Ricken, Kieschke, & Preuß, 2004), how they discover part-whole relations ($n = 35$ items; from the Raven Matrices [CPM]; Schmidtke, Schaller, & Becker, 1980; and from the Assessment of Optical Differentiation of Four-Year-Olds [POD-4]; Sauter, 2001), and, finally, how children compose and find analogies ($n = 12$; from CFT; Weiss & Osterland, 1997). Subsequently, a total of $n = 106$ items were subjected to a computer procedure (programming language: Borland Delphi) in order to place them on a computer screen. This program (Ebner, 2007) was set up on Microsoft Windows XP portable computers

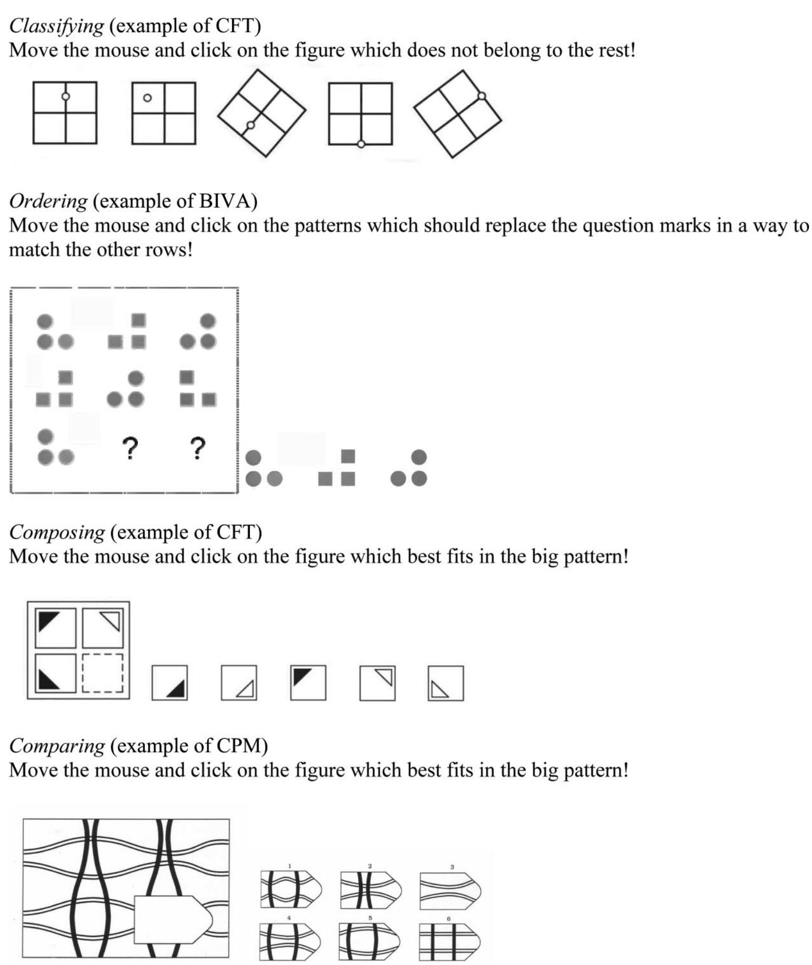

Figure 1. Examples for item sets and instruction used in the priming paradigm. CFT = General Intelligence Scale; BIVA = Image-Based Intelligence Test for Preschool Children; CPM = Raven Matrices.

with Intel 1.5GHz processors and15-in. high-resolution LCD monitors. LCD screens were located in front of the children at a viewing distance of approximately 60 cm. The screen refresh rate was 60 Hz (60 frames per second), allowing frame changes of 17 ms. However, Ebner's (2007) program registered response times (RTs) with millisecond accuracy of the formation and deformation of all pictures involved in the procedure, which were presented against a black-colored background. The specific task item appeared on the screen as well as a spot in the right corner to place the mouse cursor. Children were instructed that by clicking the mouse, the cursor would change from an arrow to a hand icon, which would indicate that the time to solve the task had started, and they were challenged to solve tasks as described in Figure 1. Children were asked to place the mouse cursor as fast as possible at the spot in the right corner when they were done, and the icon then changed back to an arrow. To practice maneuvering the mouse, each item set was preceded by one to five practice items that were not included in later analyses. The program registered the time used to move and relocate the mouse cursor as solving time (ST in ms) and listed solving scores (SS in scores) according to the performance (*right* = 1 or *wrong* = 0). Because operating a computer mouse is known to be somewhat child-unfriendly, we evaluated the practicability of the program in a pilot study with $n = 20$ children not belonging to the total sample of the present study, but who were similar in terms of age and SES background. We were interested as to whether the task items that were originally provided as paper-and-pencil tasks differed from a computer-based administration in order to testify their reliability and to confirm their validity. Thus, each child was exposed to the paper-and-pencil and computer-based condition in a randomized order, and their scores were later evaluated. On average, 7 days (SD = 2.8) had passed between the two administrations. High correlations between the scores of each item ranging between $r = .75$ and $r = .90$ justified that the selected items were just as appropriate for a computer-based program as they were for a paper-and-pencil test.

Conducting the priming procedure. Two types of person schemata were subliminally displayed, with M = 44.4 ms (SD = 6.9), serving as a prime stimulus before each item commenced (i.e., an image of a teacher's portrait as an *affective* prime stimulus, and the same image scrambled as a *neutral* prime stimulus). All children began the procedure with neutral prime stimuli between each task item ("neutral trial") in order to assess individual performance that constitutes a child's baseline. In the second part of the procedure ("affective trial"), the *control group* was provided with a repeat of the neutral trial. For the experimental group, however, the neutral primes had been replaced by affective prime stimuli. Moreover, affective primes differed from child to child because the image of the specific head teacher of that child was used. Thus, each procedure for children of the experimental group was individualized (see Figure 2). To assure that the affective primes were subliminally presented, we ended the procedure by interviewing the children on what they had seen "between" the tasks, and presented them with pictures of people, animals, and daily material, as well as the scrambled images used. In sum, all children were faced with the cognitive tasks items in a fixed order twice. In the control groups, the neutral primes were implemented in the first as well as in the second trial, whereas for the experi-

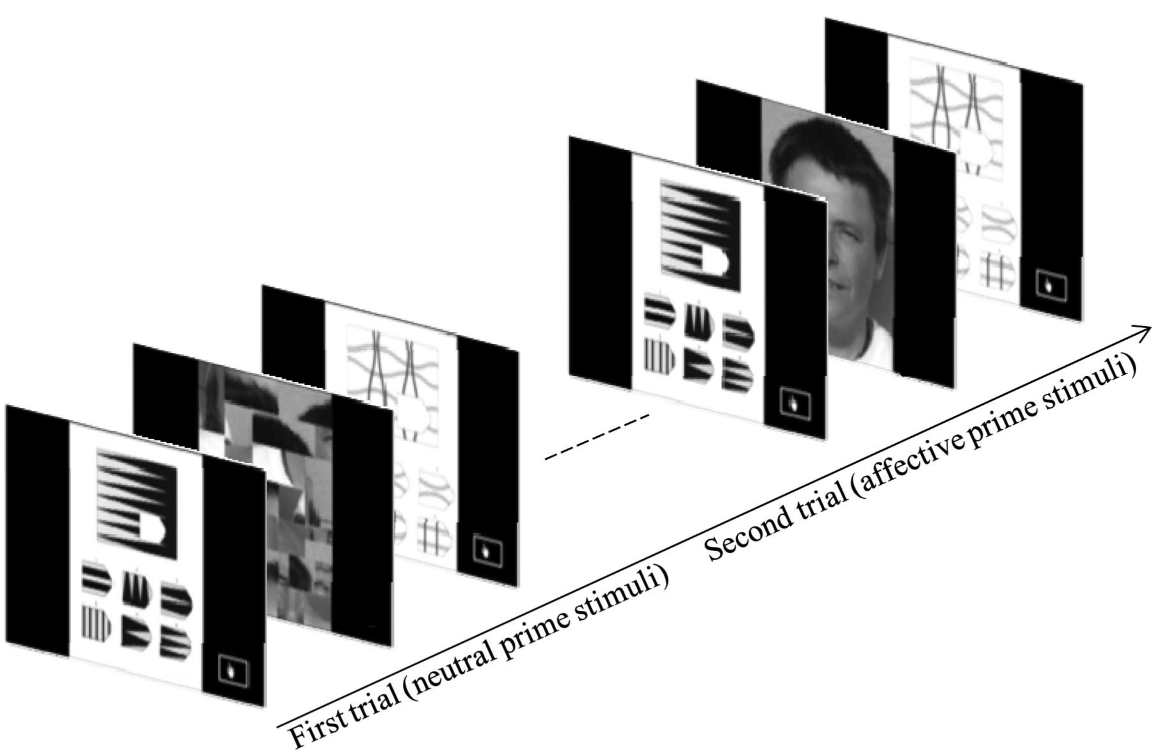

Figure 2. Priming procedure for the experimental group. The control group was provided with a repeat of the neutral trial.

mental groups, neutral primes appeared only in the first trial, and affective primes were implemented in the second trial.

Reliability and validity of the priming procedure. Each priming procedure was followed by a task sequence measuring the attention span. For a fixed period of 30 s, children were asked to mark all pears displayed within a sequence of apples (derived from Schaarschmidt et al., 2004). Because of the time limit, the number of scores (marked pears) served as an individual parameter for attention. Moreover, when all the children had completed the priming procedure, we conducted an item analysis on the neutral trial (not including items for attention). We excluded task items with a difficulty of $p < .5$ and $p > .95$ as well as items with an item selectivity of $r < .30$ from later statistical analyses. As all children completed the priming procedure according to a rigid item order, the exclusion of these items appeared to have no consequences for the unexplainable variance caused by random item positions. To investigate the internal structure of the various task items, we furthermore subjected the scores of the remaining $n = 71$ items to a confirmatory factor analysis using Mplus (Muthén & Muthén, 2010, p. 61). Because of the categorical response format (*right* = 1 or *wrong* = 0), weighted least square estimators were applied, as suggested by Flora and Curran (2004), for categorical data structures. A two-order factor structure results in a root-mean-square error of approximation (RMSEA) of .015 (90% CI [.005, .02]), which is considered a very good fit (e.g., Hu & Bentler, 1999) and is additionally supported by a weighted root-mean-square residual of .94. The model itself assessed the task items on two orders, of which the second order reflects one construct of *Cognition* represented by four factors that appeared on the first order of the model and are best expressed by the following competencies: *Classifying*, *Ordering*, *Comparing*, and *Composing*. The four respective item sets (which assess these competencies) were additionally evaluated by Cronbach's alphas: (a) Classifying (18 tasks, $\alpha = .72$) measures children's competency to categorize objects, (b) Ordering (14 tasks, $\alpha = .71$) assesses the ability to discover rules in logical sequences, (c) Comparing (27 tasks, $\alpha = .85$) measures comparative mental processes, and (d) Composing (12 tasks, $\alpha = .72$) evaluates the process of building-up analogies (see Figure 3).

Parameters of the priming procedure. ST (in ms) and SS (error scores reversed) were available for each item, set, and trial. ST per item greater or smaller than three standard deviations from the mean were eliminated, concerning a total of 1.4% of the data; missing data were not imputed. ST have been summed up across the four cognitive item sets. Because logarithms of ST were distributed approximately normally, further analyses are based on *ST* (*log*). Furthermore, using the first trial as a baseline, we calculated the relative times for each child and item during the second trial. These relative ST were later considered parameters of *Gains in time*, which we also averaged for the four item sets. For example, a child who required 20 s for an item in the first trial, and 15 s for its repetition in the second trial, needed 75% of the time from the first trial to process the item a second time, gaining 25% of the time. *Gains in scores* were calculated in a similar manner.

Results

Preliminary Results

Attention, start levels and processing speed, age, and gender. In order to evaluate children's attention quality, a dependent t test based on the scores of the pear marking procedure at the end of each trial was calculated. Children scored even higher on the second than on the first trial, $t(119) = -4.45$, $p < .001$ (M = 10.28 vs. 9.15), which shows that the attention span had been upheld during the procedure. This was true for both the control, $t(59) = -3.52$, $p < .001$ (M = 10.70 vs. 9.84) and the experimental group, $t(58) = -3.10$, $p < .01$ (M = 9.85 vs. 8.44). Furthermore, to ensure that the children had generally started at similar performance levels before they received the affective prime stimuli, one-way analyses of variance (ANOVAs) (factors: control vs. experimental group with covariate age) explored performances in scores and times on the first trial. There were no differences in the scores reached between the control and experimental group, $F(1, 100) = 1.76$, *ns.* Because children performed at a slower pace (longer ST) during the first trial when they were older and classified or ordered the most difficult cognitive challenges, $F(1, 114) =$

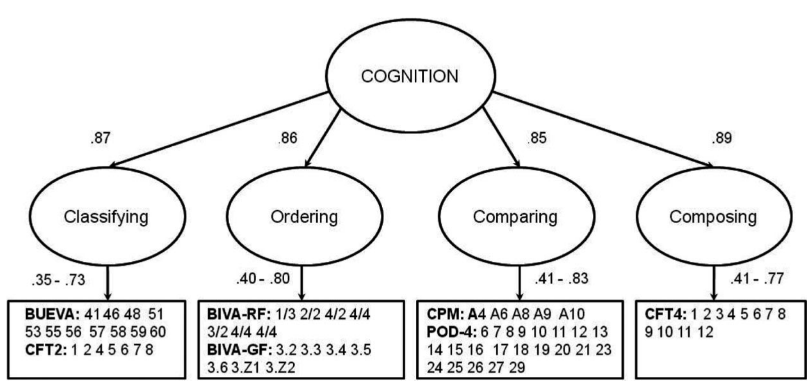

Figure 3. Items and item sets of the computer-based program as result of confirmatory factor analysis. BUEVA = Basic Assessment for Specific Developmental Disorders in the Preschool Years; CFT2 = Subtest 2 of the General Intelligence Scale; BIVA-RF = subtest based on actions of the Image-Based Intelligence Test for Preschool Children; BIVA-GF = subtest based on stories of the Image-Based Intelligence Test for Preschool Children; CPM = Raven Matrices; POD-4 = Assessment of Optical Differentiation of Four-Year-Olds; CFT4 = Subtest 4 of the General Intelligence Scale.

3.30, $p < .05$; and, $F(1, 113) = 3.50$, $p < .05$, we generally controlled for child age in further analyses but left gender unnoted because gender differences in scores and ST were nonsignificant.

Cognitive challenges. In order to evaluate whether the subtests reflected different patterns of cognitive challenges, we explored Gains in time for all four item sets. As a result, Gains in time were the lowest for Composing ($M = 16.9$, $SD = 27.0$), followed by Ordering ($M = 35.8$, $SD = 17.8$), Comparing ($M = 36.84$, $SD = 15.2$), and Classifying ($M = 40.4$, $SD = 21.3$). Several *t* tests (Bonferroni correction included) clearly showed that the four item sets differed significantly as follows: Classifying > Comparing = Ordering > Composing ($p < .001$), which even held if we explored Gains in time separately for the experimental and the control group, suggesting that the item sets reflect different cognitive challenges.

Results on Priming Effects

Does a teacher's image affect child cognitive processing on different challenges? We first analyzed Gains in time, which focus on ST of the second, (affective) relative to the first (neutral) trial (see Method section), and reflect the impact of affective prime stimuli on child cognitive speed processes. Thus, we were specifically interested in (a) how much time was required to solve the tasks while children were primed as well as (b) whether different cognitive challenges may have individually contributed to differences in children's susceptibility to the affective prime stimuli. Several two-level regression models were run separately for the four item sets of cognitive challenges, predicting time gains according to STRS Closeness of student–teacher relationships, membership to experimental or control group, and children's age.

In order to account for the nested design, due to 45 classrooms with an average size of 2.3 children, the regression models considered individual children on Level 1 and teachers on Level 2. Intraclass correlations (ICCs) indicated that up to 21% of the total variance was due to differences between classrooms ($ICC_{Classifying} = .21$; $ICC_{Ordering} = .16$; $ICC_{Comparing} = .12$; $ICC_{Composing} = 7.70e\text{-}09$). Null models were then compared with full models, including closeness and group to check whether model fits improved according to Akaike information criterion (AIC) and the log-likelihood ratio (LLR) test (see Bryk & Raudenbush, 1992). All models also included age (in months) as a covariate, applying grand mean centering for better interpretation. Results revealed that the full model was superior to the null model for Classifying ($AIC_{Null\ model} = 811.69$; $AIC_{Full\ model} = 803.73$; $LLR = 13.95$, $\Delta df = 3$, $p < .01$), Ordering ($AIC_{Null\ model} = 767.36$; $AIC_{Full\ model} = 763.00$; $LLR = 10.37$, $\Delta df = 3$, $p < .05$), but not for Comparing ($AIC_{Null\ model} = 757.18$; $AIC_{Full\ model} = 759.27$; $LLR = 3.91$, $\Delta df = 3$, *ns*) and Composing ($AIC_{Null\ model} = 794.53$; $AIC_{Full\ model} = 799.96$; $LLR = 0.65$, $\Delta df = 3$, *ns*). Most importantly, as shown in Table 1, negative beta coefficients ($\beta_{02Group}$ ranging from -17.6 to -2.8) suggested that the experimental group achieved greater time gains when passing the cognitive tasks than the control group. Moreover, children with higher Closeness scores toward their teachers revealed even higher time gains when they had to *order* ($\beta_{01Closeness} = .22$, $p < .01$). In order to ease interpretation, Figure 4 demonstrates these results, displaying how children's cognitive performance was affected depending on the item set and the type of primes that the children were exposed to, depending on whether they were assigned to the control or experimental group (neutral vs. affective). Note that the affective prime effects additionally varied according to children's closeness to their teachers (whose image served as a prime). Thus, the closer the teacher–child relationship, the more the primes affected the time gains.

We also analyzed *Gains in scores*, which focus on solving scores of the second (affective) relative to the first (neutral) trial (see Method section), and reflect the impact of affective prime stimuli on child cognitive performance. ICCs indicated that up to 23% of the total variance was due to differences between classrooms ($ICC_{Classifying} = .23$; $ICC_{Ordering} = .06$; $ICC_{Comparing} = .05$; $ICC_{Composing} = 1.05e\text{-}08$). Comparisons of null model to full model AICs revealed no evidence for a better fit of the full model regarding the four cognitive tasks, that is, LLR tests were not significant with Classifying ($AIC_{Null\ model} = 727.08$; $AIC_{Full\ model} = 729.43$; $LLR = 3.65$, $\Delta df = 3$, *ns*), Ordering ($AIC_{Null\ model} = 812.50$; $AIC_{Full\ model} = 812.30$; $LLR = 6.19$, $\Delta df = 3$, *ns*), Comparing ($AIC_{Null\ model} = 774.52$; $AIC_{Full\ model} = 773.78$; $LLR = 6.74$, $\Delta df = 3$, *ns*), and Composing ($AIC_{Null\ model} = 774.52$; $AIC_{Full\ model} = 773.78$; $LLR = 0.22$,

Table 1
Estimates for Two-Level Regressions Based on Gains in Time for Four Cognitive Challenges

	Classifying		Ordering		Comparing		Composing	
Parameter	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*
Random effects								
σ^2	22.04		47.68		19.47		1.91e−06	
τ_{00}	330.87		184.93		197.82		3.37e+02	
Fixed effects								
γ_{00}	42.73***	5.51	28.59***	4.47	31.16***	4.33	18.82**	5.34
β_{01}*Closeness*	.13	.10	.22**	.08	.09	.07	−.04	.09
β_{02}*Group*	−17.60***	4.86	−5.46	4.18	−3.15	3.86	−2.80	4.60
β_{03}*Age*	−.47	.48	−.06	.38	−.61	.38	.09	.47

Note. σ^2 = within-group variance; τ_{00} = between-group variance; γ_{00} = averaged intercept across classrooms; β_{01} = slope; group: 1 = control group, 0 = experimental group.
** $p < .01$. *** $p < .001$.

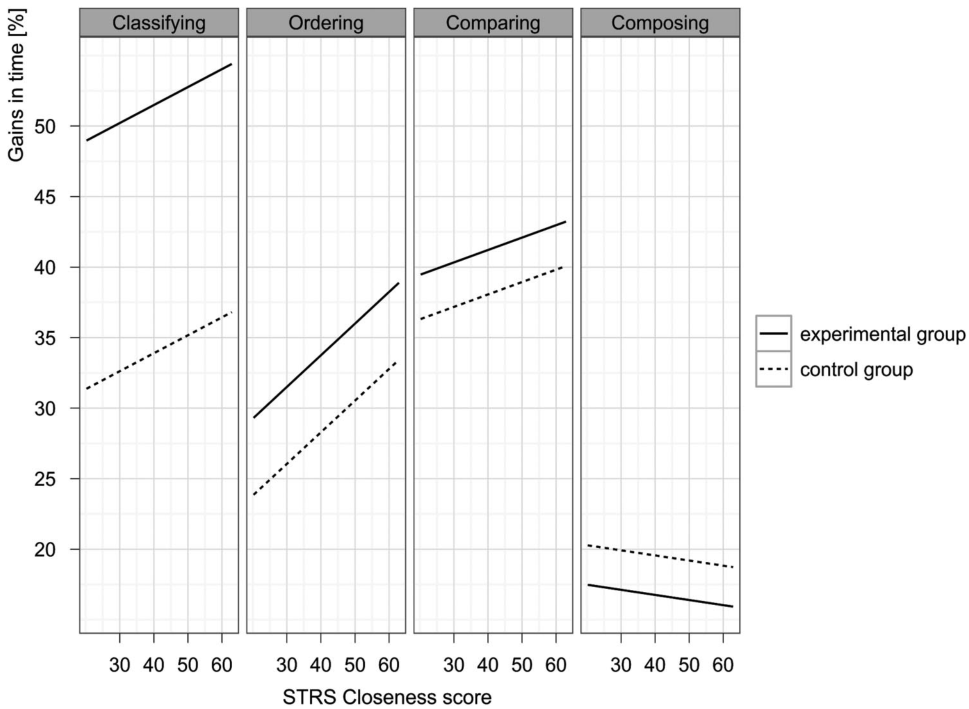

Figure 4. Gain in time as related to closeness in control and experimental groups for four cognitive challenges. STRS = Student-Teacher Relationship Scale.

$\Delta df = 3$, *ns*). On the basis of SS, the different cognitive tasks seem to be insensitive to reflect influences of prime stimuli.

How distinctively does a teacher's image affect child cognitive processing? To achieve greater insight into the times that children gain throughout the procedure, we calculated path analyses as provided by Mplus (Muthén & Muthén, 2010) and analyzed ST (log) and SS across the procedure separately, for the experimental group in kindergarten. We tested (a) whether ST (log) of the neutral trial generally predict those of the affective trial and, most interestingly, (b) whether these times can be predicted by the quality of teacher–child relationships as measured by STRS Closeness. The nested design of the present study called for two-level path analyses. Due to the nested sample, there were considerable ICCs for ST (log) at the neutral trial (Time 1 [T1]); $ICC_{T1} = .51$, and at the affective trial (Time 2 [T2]); $ICC_{T2} = .34$, in the null model. For the two-level path analyses, we provide estimates on both within levels (for the individual children) and between levels to consider classroom effects. The parameters were estimated on the basis of the robust maximum likelihood ratio estimator, which permits nonnormality of the data. The covariate age was centered at grand means (see Table 2).

Model fits based on ST (log) were superior for the *experimental* group (Model KIGA [KIGA = kindergarten]), with RMSEA = .000, comparative fit index (CFI) = 1, and Tucker-Lewis Index (TLI) = 1.36. To reassure these first results, a similar path model for the *control* group was computed but did not display sufficient model fit indices (RMSEA = .13, CFI = .98, TLI = .83). Thus, only the experimental sample was able to provide significant insight into the priming effects of the present procedure. The simplified Figure 5 (displaying within-level standardized estimates only; for details see Table 2) presents ST during the affective trial as predicted by children's closeness with their teachers whose image had been used as a prime stimulus. In more detail, the negative standardized coefficient of closeness on ST T2 (−.52) suggested that the closer the teacher–child relationships, the faster the children performed the cognitive tasks during the affective trials. On the basis of the parameters of the Model KIGA, calculations illustrate that a close child (with an STRS Closeness score of 1 *SD* above mean) would eventually only need 77% of the ST than a distant child (with an STRS Closeness score of 1 *SD* below mean) may take when completing the affective trail. (In detail: The closeness difference results in a predicted difference of logarithms of ST of about −.26 because the sum of direct and indirect effects is $-.007 + .003 \times .52 \times 47.1 = -.26$. Preconditioned that log[a]–log[b]=log[a/b], the close child takes exp[−.26] = 77% of the time that a distant child would take.) In addition, children's age had only a weak impact on children's final performance (standardized coefficient = .36), and children's ST (T1) revealed weak influences on T2 (standardized coefficient = .37) being overshadowed by the affective prime effect. Interestingly on the between level, Model KIGA displays a significant standardized coefficient = .99, suggesting that ST T2 was significantly predicted by ST T1. Thus, performing at a certain speed in both trials might be more likely due to the conditions of the classroom than of an individual child. This is in line with the high ICCs of the kindergarten sample that had indicated that children under the care of the same teacher were considerably similar in terms of the ST (see above).

Finally, we analyzed children's SS in the same way as their ST and tested (a) whether scores of the neutral trial generally predict scores of the affective trial and (b) whether these scores would be associated

Table 2
Estimates for all Parameters of Two-Level Path Analytic Models

Variable	Model KIGA				Model KIGA*				Model SCHOOL			
	St. Est.	(*SE*)	*Est.*	(*SE*)	*St. Est.*	(*SE*)	*Est.*	(*SE*)	*St. Est.*	(*SE*)	*Est.*	(*SE*)
Within-level												
T1 = neutral trial												
On closeness KIGA	.34	(.22)	.003	(.002)	.13	(.23)	.08	(.13)	−.02	(.18)	.00	(.002)
On closeness school									−.02	(.12)	.00	(.001)
On age	.37*	(.18)	.02*	(.01)	−.12	(.11)	−.34	(.32)	.05	(.17)	.003	(.008)
Residual variance	.75	(.16)	.02	(.01)	.97	(.07)	126.90	(55.04)	1.00	(.02)	.04	(.01)
T2 = affective trial												
On T1	.37*	(.17)	.52*	(.21)	.92***	(.05)	1.12***	(.11)	.37†	(.21)	.33	(.20)
On closeness KIGA	−.52**	(.18)	−.01**	(.00)	−.20	(.13)	−.14	(.09)	−.33*	(.14)	−.003**	(.00)
On closeness school									.08	(.13)	.001	(.00)
Residual variance	.73	(.15)	.04	(.01)	.16	(.09)	31.61	(10.34)	.75	(.14)	.02	(.01)
Closeness school												
Intercept											34.39**	(6.45)
On closeness KIGA									−.05	(.12)	−.05	(.12)
Residual variance									1.00	(.01)	446.20	(5.40)
Between-level												
T1 = neutral trial												
Intercept			7.37**	(.22)			34.58*	(15.94)		6.94a**	(.11a)	
On closeness KIGA	−.43	(.35)	−.01	(.01)	.70	(1.36)	.30	(.39)				
Residual variance	.81	(.30)	.03	(.02)	.50	(1.92)	6.96	(41.11)	1.00b	(.00b)	.01b	(.01b)
T2 = affective trial												
Intercept			−.43	(2.77)			−19.90*	(12.93)		−1.70	(2.36)	
On T1	.99**	(.30)	.94*	(.37)	.99***	(.23)	1.42***	(.38)	.98**	(.26)	1.18***	(.34)
On closeness KIGA	.57	(.41)	.01	(.01)	−.02	(.21)	−.01	(.14)				
Residual variance	.18	(.47)	.01	(.02)	.04	(.24)	1.11	(4.45)	.04	(.51)	.001	(.01)

Note. Model KIGA and Model SCHOOL are based on solving times, whereas Model KIGA* is based on solving scores. *St. Est.* = standardized estimates; *Est.* = unstandardized estimates; KIGA = kindergarten.
[a] Denotes means, not intercepts. [b] Denotes variance, not residual variance.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

with the closeness of the teacher–child relationships. For this Model KIGA* (* = based on SS), there were considerably lower ICCs as opposed to Model KIGA; that is, during the neutral trial, ICC_{SS-T1} = .08, and during the affective trial, ICC_{SS-T2} = .12 in the null model. Model fits were very good for both the experimental group, with RMSEA = .02, CFI = 1.00, TLI = 1.00, and the control group (RMSEA = .00, CFI = 1.00, TLI = 1.08), due to the fact that children's scores of the first trial (on T1) predicted scores on T2 to a large degree (standardized coefficient = .92), slightly moderated by child age. However, the model failed to demonstrate significant ef-

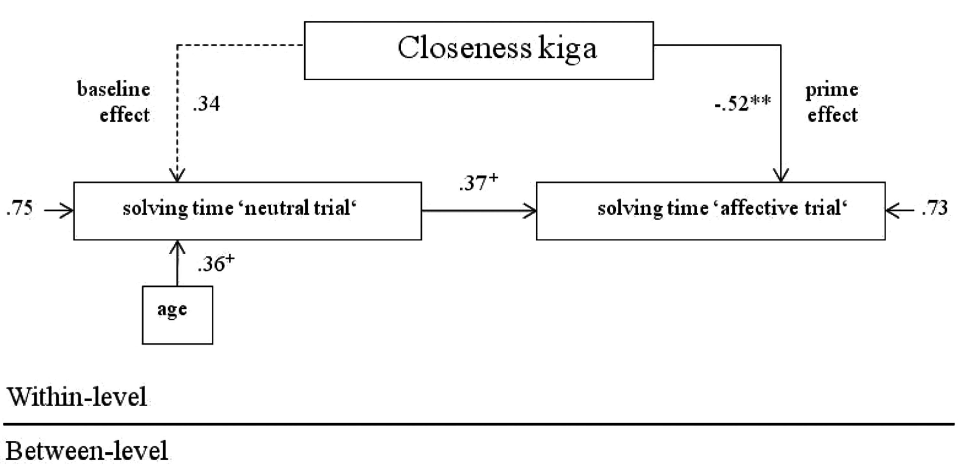

Figure 5. Two-level path analytic model (Model KIGA) for the experimental kindergarten group. KIGA = kindergarten.

fects of closeness on SS during the second trial (T2 standardized coefficient = −.20; for more details, see Table 2).

How long lasting is the effect of a teacher's image on children's cognitive processing? To answer the question as to whether children's experiences with teachers in kindergarten might still be influential on children's cognitive processing in school, even though they had acquired different teachers by then, we analyzed the small sample of kindergarteners who we had followed up on in elementary school (Model SCHOOL). We once more used two-level path model structures to analyze ST from the second priming procedure (when the children had already had experiences at school) and included STRS Closeness scores from children's relationships with school teachers *and* past kindergarten teachers to predict the ST under affective prime conditions. On the basis of 43 classrooms with an average size of 1.35 children, there were considerable ICCs for ST at the neutral trial (ICC_{ST-T1} = .25) and the affective trial (ICC_{ST-T2} = .38), respectively. Because closeness had no significant effect on ST of neutral or affective trials, these paths were omitted on the between level of the Model SCHOOL. The model then displayed good model fit indices (RMSEA < .05, CFI = .99, TLI = .94) and revealed a significant effect for kindergarten closeness on ST throughout the affective trial (standardized coefficient = −.33), whereas school teachers' closeness did not have any effect (see Table 2). In addition, kindergarten and school teacher–child closeness were not associated (standardized coefficient = −.05). Standardized coefficients for ST T1 and age on T2 showed rather weak effects; see Figure 6 for significant estimates on the within level. As was true for the Model KIGA, the between level of the Model SCHOOL displayed a significant standardized coefficient = .98, suggesting that ST T2 was significantly predicted by ST T1 as a consequence of the high ICCs of the sample. In sum, systematic prime effects on children's cognitive performance could be demonstrated for kindergarten teacher–child relationships, but not for the relationships of the same children with their school teachers. Most interestingly, children's closeness to their kindergarten teachers was still predictive for child cognitive performance at school, when they had already acquired different teachers.

Discussion

In this study, we aimed to develop a straightforward approach to mentally represented relationship schemata of significant adults in children's lives. Because kindergarten and school teachers become some of the most significant adults beyond the family, we applied a priming paradigm in order to explore how striking the impact of teacher–child relationships might be on children's cognitive functioning. Up until now, priming paradigms have usually been carried out in adult psychology in order to evidence how stimuli from social environments unconsciously affect cognition and emotion, through activating neighboring notes in the semantic networks of the brain. Numerous studies have demonstrated that activated schemata from memory can affect semantically related schemata, thereby facilitating or disturbing various types of behaviors, intentions, and mood. In the center of such research approaches is the concept of relationship schemata (e.g., Baldwin, 1992), which is in agreement with the tradition of attachment theory, whereby IWMs are assumed to contain basic elements of the relationships and their qualities. It has recently been suggested by H. S. Waters and Waters (2006) that IWMs of "good" relationships can be characterized as "secure base scripts" that provide children with prototypes of interactions to be expected of a significant adult, to address a child's needs appropriately. Consequently, children's IWMs should be the consequence of interactional histories with an adult, allowing for expectations of close interrelations with them.

Although Piaget (1950, 1953) focused almost exclusively on cognition and the development of logic, and did not fully appreciate the fundamentally social-emotional nature of the processes he described, it is obvious that cognitive processes in children do not happen in a purely rational domain, separated from social interac-

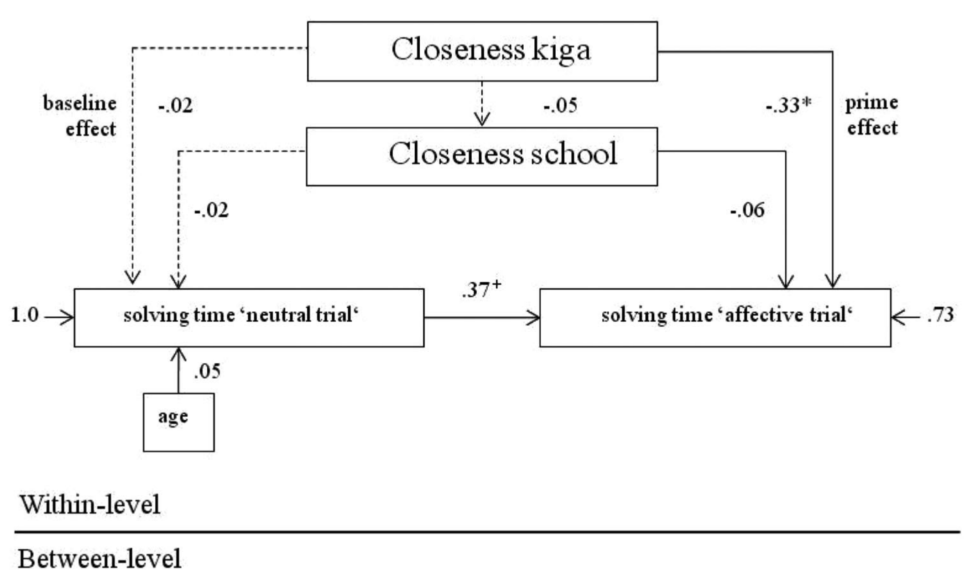

Figure 6. Two-level path analytic model (Model SCHOOL) for the experimental school group of the follow-up sample. kiga = kindergarten.

tions. For example, Harris and his colleagues (Corriveau & Harris, 2009; Corriveau et al., 2009) have convincingly demonstrated how children's early knowledge might not only rely on familiar adults, but rather on those with whom children have experienced close interactions. Nevertheless, children are most attentive toward supported cognitive processing by close adults. They are able to invest in challenging activities using their full potential if outcomes can eventually be shared with those who supported them (e.g., Dykas & Cassidy, 2011). Thus, before the knowledge eventually distills into a rational, rather unemotional form, dedicated adults help to shape children's reasoning and decision making (e.g., Davis, 2003; Immordino-Yang & Damasio, 2007).

In the present study, we explored relationship schemata that children build up and maintain of their teachers. We have attempted to demonstrate how influential these schemata can be on children's functioning and decision making. When IWMs of children's teachers were activated through the priming procedure, children appeared highly influenced when accomplishing cognitive tasks. Once the image of the child's teacher was displayed, children displayed better cognitive processing—they were faster than children who had been exposed to a neutral prime. Moreover, those who had developed close relationships with their teachers surprised us by implementing a much more effective method of cognitive processing. The closer the relationship with their teachers, the faster they executed the tasks. A path analytic model even made it possible to predict the time it took for the children to solve the tasks. We detected a prime effect showing that a typical child from close teacher–child relationships would eventually need only 77% of the ST that a child in a less close relationship would need. Surely, one could argue that teachers are closer to students who perform faster and better. However, in the present study, this can be rebutted by the two-level path model that allows for within comparisons of the group level: Children performing at a quick pace in the experimental groups performed similarly quickly to other children of the same classroom, whereas individual teacher–child relationships varied. In other words, even in classrooms with fast cognitive-proceeding children, the association held between ST and closeness with the teacher. In addition, closeness of the teacher–child relationship in the control groups was not able to predict ST neither for the first nor for the second trial.

However, there was no distinction on more global measures of cognitive performance as is usually provided by SS. This finding confirms the reported weak link between IQ scores and attachment in previous studies (van IJzendoorn et al., 1995), which were not able to demonstrate associations of test errors and (low) scores of attachment quality. ST were the parameter of the present study, which evidenced this link, even though ST can clearly be associated with development of intelligence. Children who are aware of being able to perform easily are internally driven when performing, and, in the long run, are willing to invest further in academic achievements. These drives (called *self-efficacy*, *goal pursuit*, and *feeling of competence*), which are thought to improve intrinsic motivation for academic tasks, help children to take on increasing responsibility for their own learning, and in turn improve intelligence (see also Sternberg & Grigorenko, 2004; Waterhouse, 2006).

However, not every prime stimulus provided in the present study elicited the prime effect. The determining factors were the type of cognitive task (classifying, ordering, comparing, or composing) and the type of teacher (kindergarten or school teacher). In the present study, children systematically differed from the first to the second trial with regard to improving their cognitive performance on some tasks. Classifying and ordering tasks appeared to have significantly greater gains in time when children completed the second trial. Obviously, the prime effects were also more influential on these tasks. In other words, these item sets, which revealed potential in improving the performance during the procedure (greater time gains), appeared more capable than others of being influenced by the prime effects (i.e., they were more susceptible to the relationship influences that consequently affected children's performance). We speculate that relationship influences may be more likely found along the "zone of proximal development," which holds that if a significant adult helps the child to perform on a level that he or she would not have reached without sensitive guidance, the child will pursue the task to its full potential (see Sternberg & Grigorenko, 2004; Vygotsky, 1978).

Several studies on children's attachments with nonparental adults help to identify children's relationships beyond the families, before and after school entry (see Ahnert et al., 2006; Howes & Spieker, 2008; Pianta, 2001). During these stages, children begin to acquire event-based information of their teachers' tendencies to be available and sensitive to their needs, in order for them to be able to master new cognitive challenges. To become significant for a child, and to form close relationships, teachers function commonly to provide *assistance*, to varying degrees. For example, when children are situated in cognitively challenging contexts and their relationships with their teachers are of good quality, teachers' assistance might lead to successful joint interactions (e.g., Hommel et al., 2009; Sebanz et al., 2006), which help the children to improve their knowledge. Teachers also function to provide a *safe haven* where children can go to receive help in facilitating effortful control and compliance with the requirements. While under the supervision of excellent teachers, they learn to understand their relevance for learning, as self-relevance evaluations by others affect cognitive functioning (e.g., Dreisbach & Boettcher, 2011). Teachers eventually function to provide a secure base from which children can engage in exploration, and from which their intellectual activities can be scaffolded in an emotionally balanced way. These functions might work on different levels in kindergarten and in school. For example, there is a consensus that the relationships between kindergarten teacher and child and elementary teacher and child are somewhat dissimilar (Howes, Phillipsen, & Peisner-Feinberg, 2000; Pianta et al., 1995). In general, teachers reported less intense relationships with children when they have recently entered school, which may reflect a decreasing emphasis on teacher–child relationships in school. This might be the reason as to why, in the present study, systematic prime effects on children's cognitive performance could be demonstrated for kindergarten teachers persisting long into the school context.

Future research, however, might find it worthwhile to look into the impact of teacher–child relationships at school on students' cognitive functioning, even though school contexts provide different possibilities and unequal demands regarding the ways in which children interact with their teachers. If interactions within children's relationships with kindergarten versus school teachers are so different, we would also expect to find distinct IWMs for those relationships resulting in the coexistence of multiple and potentially divergent IWMs, with diverging consequences for children's development. For example, teacher–child relationships may have the greatest (primarily concurrent) effect on children's competency in a specific classroom (see Pianta, Nimetz, & Bennett, 1997), whereas kindergarten teacher–child relationships may be more closely associated with children's development over time (Burchinal et al., 2002). This debate might be confirmed by the findings of the present study, in which children's closeness to their kindergarten teachers was still predictive for child cognitive performance at school, when they had already acquired different teachers. Moreover, this finding emphasizes the importance of kindergarten teachers in preparing children for school, enhancing children's feeling of self-efficacy when performing.

However, there are several limitations of the study. One of them is the fact that school teacher–child relationships might be measured too early to be influential enough on children's cognitive performance to override experiences with the kindergarten teacher. Furthermore, due to the recruitment of middle- to upper-class children, we were only able to provide data of a homogenous sample of children who were well adjusted to kindergarten and school. It would be informative to also explore conflictual relationships in order to shed more light on the impact of teacher–child relationships on children's cognitive performance. Investigating more than just close relationships might allow for greater generalization of the results. Despite having room for further improvements, however, we demonstrated in the present study how social relationships in achievement settings enhance the performance of kindergarteners in a variety of basic cognitive-intellectual tasks. To the best of our knowledge, we provided the first evidence demonstrating that not only a general person-related prime but also the quality of the prime-associated teacher–child relationship affected cognitive processing, which was evidenced in children with experiences of close relationships with their teachers benefiting more from the prime than children who lacked such experiences.

References

Ahnert, L. (2005). Parenting and alloparenting: The impact on attachment in human. In C. S. Carter, L. Ahnert, K. E. Grossmann, S. B. Hrdy, M. E. Lamb, S. W. Porges, & N. Sachser (Eds.), *Attachment and bonding: A new synthesis* (pp. 229–244). Cambridge, MA: MIT Press.

Ahnert, L., Pinquart, M., & Lamb, M. E. (2006). Security of children's relationships with nonparental care providers: A meta-analysis. *Child Development, 77,* 664–679. doi:10.1111/j.1467-8624.2006.00896.x

Ashby, F. G., Isen, A. M., & Turken, A. U. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review, 106,* 529–550. doi:10.1037/0033-295X.106.3.529

Baldwin, M. W. (1992). Relational schemas and the processing of social information. *Psychological Bulletin, 112,* 461–484. doi:10.1037/0033-2909.112.3.461

Banse, R. (1999). Automatic evaluation of self and significant others: Affective priming in close relationships. *Journal of Social and Personal Relationships, 16,* 803–821. doi:10.1177/0265407599166007

Banse, R. (2003). Beyond verbal self-report: Priming methods in relationship research. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion* (pp. 245–274). Mahwah, NJ: Erlbaum.

Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist, 54,* 462–479. doi:10.1037/0003-066X.54.7.462

Bargh, J. A., Chen, M., & Burrows, L. (1996). Automaticity of social behavior: Direct effects of trait construct and stereotype-activation on action. *Journal of Personality and Social Psychology, 71,* 230–244. doi:10.1037/0022-3514.71.2.230

Bargh, J. A., & Gollwitzer, P. M. (1994). Environmental control of goal-directed action: Automatic and strategic contingencies between situations and behavior. *Nebraska Symposium on Motivation, 41,* 71–124.

Birch, S. H., & Ladd, G. W. (1998). Children's interpersonal behaviors and the teacher–child relationship. *Developmental Psychology, 34,* 934–946. doi:10.1037/0012-1649.34.5.934

Booth, C. L., Kelly, J. F., Spieker, S. J., & Zuckerman, T. G. (2003). Toddler's attachment security to child care providers: The safe and secure scale. *Early Education and Development, 14,* 83–100. doi:10.1207/s15566935eed1401_6

Bowlby, J. (1969). *Attachment and loss; Vol. 1. Attachment*. New York, NY: Basic Books.

Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models in social and behavioral research: Applications and data analysis methods*. Newbury Park, CA: Sage.

Burchinal, M. R., Peisner-Feinberg, E., Pianta, R., & Howes, C. (2002). Development of academic skills from preschool through second grade: Family and classroom predictors of developmental trajectories. *Journal of School Psychology, 40,* 415–436. doi:10.1016/S0022-4405(02)00107-3

Cohen, J. D., Braver, T. S., & Brown, J. W. (2002). Computational perspectives on dopamine function in prefrontal cortex. *Current Opinion in Neurobiology, 12,* 223–229. doi:10.1016/S0959-4388(02)00314-8

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82,* 407–428. doi:10.1037/0033-295X.82.6.407

Corriveau, K., & Harris, P. L. (2009). Choosing your informant: Weighing familiarity and recent accuracy. *Developmental Science, 12,* 426–437. doi:10.1111/j.1467-7687.2008.00792.x

Corriveau, K. H., Harris, P. L., Meins, E., Fernyhough, C., Arnott, B., Elliott, L., . . . de Rosnay, M. (2009). Young children's trust in their mother's claims: Longitudinal links with attachment security in infancy. *Child Development, 80,* 750–761. doi:10.1111/j.1467-8624.2009.01295.x

Damasio, A. (1994). *Descartes' error: Emotion, reason, and the human brain*. New York, NY: Putnam.

Davis, H. (2003). Conceptualizing the role of influence of student-teacher relationships on children's social and cognitive development. *Educational Psychologist, 38,* 207–234. doi:10.1207/S15326985EP3804_2

Doumen, S., Verschueren, K., Buyse, E., De Muner, S., Max, K., & Moens, L. (2009). Further examination of the convergent and discriminant validity of the student-teacher relationship scale. *Infant and Child Development, 18,* 502–520. doi:10.1002/icd.635

Dreisbach, G., & Boettcher, S. (2011). How the social-evaluative context modulates processes of cognitive control. *Psychological Research, 75,* 143–151. doi:10.1007/s00426-010-0298-z

Dreisbach, G., & Goschke, T. (2004). How positive affect modulates cognitive control: Reduced perseveration at the cost of increased distractibility. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30,* 343–353. doi:10.1037/0278-7393.30.2.343

Dykas, M. J., & Cassidy, J. (2011). Attachment and the processing of the social information across the life span: Theory and evidence. *Psychological Bulletin, 137,* 19–46. doi:10.1037/a0021367

Ebner, G. (2007). IntPrim Version 1.0.2: Computer-based program to assess cognitive basic skills for children between four and nine years. Vienna, Austria: Department of Developmental Psychology, University of Vienna.

Esser, G., & Wyschkon, A. (2002). *BUEVA: Basisdiagnostik für umschriebene Entwicklungsstörungen im Vorschulalter* [Basic Assessment for Specific Developmental Disorders in the Preschool Years]. Göttingen, Germany: Beltz.

Fischer, R., Miller, J., & Shubert, T. (2007). Evidence for parallel semantic memory retrieval in dual tasks. *Memory & Cognition, 35,* 1685–1699. doi:10.3758/BF03193502

Fischer, R., & Schubert, T. (2008). Valence processing by passing the response selection bottleneck? Evidence from the psychological refractory period paradigm. *Experimental Psychology, 55,* 203–211. doi:10.1027/1618-3169.55.3.203

Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods, 9,* 466–491. doi:10.1037/1082-989X.9.4.466

Gersten, M., Coster, W., Schneider-Rosen, K., Carlson, V., & Ciccetti, D. (1986). The socio-emotional bases of communicative functioning: Quality of attachment, language development, and early maltreatment. In M. Lamb, A. L. Brown, & B. Rogoff (Eds.), *Advances in developmental psychology* (Vol. 4, pp. 105–151). Hillsdale NJ: Erlbaum.

Goswami, U. (2008). *Cognitive development: The learning brain*. East Sussex, England: Psychology Press.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72,* 625–638. doi:10.1111/1467-8624.00301

Hamre, B. K., & Pianta, R. C. (2005). Can instructional and emotional support in the first-grade classroom make a difference for children at risk of school failure? *Child Development, 76,* 949–967. doi:10.1111/j.1467-8624.2005.00889.x

Hinde, R. (1988). Continuities and discontinuities. In M. Rutter (Ed.), *Studies of psychosocial risk: The power of longitudinal data* (pp. 367–383). Cambridge, UK: Cambridge University Press.

Hommel, B., Colzato, L. S., & van den Wildenberg, W. P. (2009). How social are task representations? *Psychological Science, 20,* 794–798. doi:10.1111/j.1467-9280.2009.02367.x

Howes, C., Hamilton, C. E., & Philipsen, L. C. (1998). Stability and continuity of child-caregiver and child-peer relationships *Child Development, 69,* 418–426. doi:10.2307/1132175

Howes, C., Phillipsen, L. C., & Peisner-Feinberg, E. (2000). The consistency of perceived teacher-child relationships between preschool and kindergarten. *Journal of School Psychology, 38,* 113–132. doi:10.1016/S0022-4405(99)00044-8

Howes, C., & Spieker, S. (2008). Attachment relationships in the context of multiple caregivers. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research and clinical applications* (pp. 317–332). New York, NY: Guilford Press.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1–55. doi:10.1080/10705519909540118

Immordino-Yang, M. H., & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, Brain, and Education, 1,* 3–10. doi:10.1111/j.1751-228X.2007.00004.x

Kesner, J. (2000). Teacher characteristics and the quality of child–teacher relationships. *Journal of School Psychology, 38,* 133–149. doi:10.1016/S0022-4405(99)00043-6

Ladd, G. W., Birch, S. H., & Buhs, E. S. (1999). Children's social and scholastic lives in kindergarten: Related spheres of influence? *Child Development, 70,* 1373–1400. doi:10.1111/1467-8624.00101

Lamb, M. E., & Ahnert, L. (2006). Nonparental child care. In W. Damon, R. M. Lerner, K. A. Renninger, & I. E. Sigel (Eds.), *Handbook of child psychology; Volume 4: Child psychology in practice* (pp. 950–1016). Hoboken, NJ: Wiley.

Masson, M. E. J. (1995). A distributed memory model of semantic priming. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 3–23. doi:10.1037/0278-7393.21.1.3

Masters, J. C., Barden, R. C., & Ford, M. E. (1979). Affective states, expressive behavior, and learning in children. *Journal of Personality and Social Psychology, 37,* 380–390. doi:10.1037/0022-3514.37.3.380

Masters, J. C., Furman, W., & Barden, R. C. (1977). Effects of achievement standards, tangible rewards, and self-dispensed achievement evaluations on children's task mastery. *Child Development, 48,* 217–224. doi:10.1111/j.1467-8624.1977.tb04262.x

Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin, 132,* 297–326. doi:10.1037/0033-2909.132.2.297

Müller, J., Dreisbach, G., Goschke, T., Hensch, T., Lesch, K.-P., & Brocke, B. (2007). Dopamine and cognitive control: The prospect of monetary gains influences the balance between flexibility and stability in a set-shifting paradigm. *European Journal of Neuroscience, 26,* 3661–3668. doi:10.1111/j.1460-9568.2007.05949.x

Murphy, S. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with optimal and suboptimal stimuli exposures. *Journal of Personality and Social Psychology, 64,* 723–739. doi:10.1037/0022-3514.64.5.723

Muthén, L. K., & Muthén, B. O. (2010). *Mplus user's guide* (6th ed.). Los Angeles, CA: Author.

Neely, J. H. (1991). Semantic priming effects in visual word recognition: A selective review of current findings and theories. In D. Besner & G. W. Humphreys (Eds.), *Basic progress in reading–visual word recognition* (pp. 264–333). Hillsdale, NJ: Erlbaum.

Neely, J. H., & Kahan, T. A. (2001). Is semantic activation automatic? A critical re-evaluation. In H. L. Roediger (Ed.), *The nature of remembering: Essays in honor of R. G. Crowder* (pp. 69–93). Washington, DC: American Psychological Association. doi:10.1037/10394-005

Pederson, D. R., & Moran, G. (1995). A categorical description of infant-mother relationships in the home and its relation to Q-sort measures of infant-mother interaction. *Monographs of the Society for Research in Child Development, 60,* 111–132. doi:10.2307/1166174

Piaget, J. (1950). *The psychology of intelligence*. London, England: Routledge. (Original work published 1947)

Piaget, J. (1953). *The origin of intelligence in the child*. London, England: Routledge.

Pianta, R. C. (1992). Teacher-child relationships and the process of adjusting to school. *New Directions for Child Development, 57,* 61–80. doi:10.1002/cd.23219925706

Pianta, R. C. (2001). *STRS: Student-Teacher Relationship Scale*. Lutz, FL: Psychological Assessment Resources.

Pianta, R. C., Hamre, B., & Stuhlman, M. (2003). Relationships between teachers and children. In W. M. Reynolds & G. E. Miller (Eds.), *Handbook of psychology,* (Vol. 7: Educational Psychology, pp. 199–234). Hoboken, NJ: Wiley.

Pianta, R. C., Nimetz, S. L., & Bennett, E. (1997). Mother-child relationships, teacher-child relationships, and school outcomes in preschool and kindergarten. *Early Childhood Research Quarterly, 12,* 263–280. doi:10.1016/S0885-2006(97)90003-X

Pianta, R. C., Steinberg, M. S., & Rollins, K. B. (1995). The first two years of school: Teacher-child relationships and deflections in children's classroom adjustment. *Development and Psychopathology, 7,* 295–312. doi:10.1017/S0954579400006519

Posner, M. I., & Snyder, C. R. R. (1975). Attention and cognitive control. In R. L. Solso (Ed.), *Information processing and cognition: The Loyota Symposium* (pp. 55–85). Hillsdale, NJ: Erlbaum.

Sauter, F. (2001). *POD-4: Prüfung optischer Differenzierungsleistungen bei Vierjährigen* [Assessment of Optical Differentiation of Four-Year-Olds]. Göttingen, Germany: Hogrefe.

Schaarschmidt, U., Ricken, G., Kieschke, U., & Preuß, U. (2004). *BIVA: Bildbasierter Intelligenztest für das Vorschulalter* [Image-Based Intelligence Test for Preschool Children]. Göttingen, Germany: Hogrefe.

Schmidtke, A., Schaller, S., & Becker, P. (1980). *CPM: Raven-Matritzen-Test* [Raven Matrices]. Weinheim, Germany: Beltz.

Sebanz, N., Bekkering, H., & Knoblich, G. (2006). Joint actions: Bodies and minds moving together. *Trends in Cognitive Sciences, 10,* 70–76. doi:10.1016/j.tics.2005.12.009

Siegler, R. S. (1996). *Emerging minds: The process of change in children's thinking*. New York, NY: Oxford University Press.

Sternberg, R. J., & Grigorenko, E. L. (2004). Successful intelligence in the classroom. *Theory Into Practice, 43,* 274–280. doi:10.1207/s15430421tip4304_5

van IJzendoorn, M. H., Dijkstra, J., & Bus, A. G. (1995). Attachment, intelligence, and language: A meta-analysis. *Social Development, 4,* 115–128. doi:10.1111/j.1467-9507.1995.tb00055.x

Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Waterhouse, L. (2006). Multiple intelligences, the Mozart effect, and emotional intelligence: A critical review. *Educational Psychologist, 41,* 207–225. doi:10.1207/s15326985ep4104_1

Waters, E. (1995). The Attachment Q-Set (Version 3.0). *Monographs of the Society for Research in Child Development, 60,* 234–246.

Waters, H. S., & Waters, E. (2006). The attachment working models concept: Among other things, we build script-like representations of secure base experiences. *Attachment and Human Development, 8,* 185–197. doi:10.1080/14616730600856016

Weiss, R., & Osterland, J. (1997). *CFT: Grundintelligenzskala* [General Intelligence Scale]. Göttingen, Germany: Hogrefe.

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