

Overt and Covert Verbal Problem-Solving Strategies: Developmental Trends in Use, Awareness, and Relations With Task Performance in Children Aged 5 to 17

Adam Winsler and Jack Naglieri

Age-related changes in children's use, self report, and awareness of verbal problem-solving strategies (private speech) and strategy effectiveness were explored with a large ($N = 2,156$) cross-sectional sample of children aged 5 to 17. Children's verbal strategies moved from overt, to partially covert, to fully covert forms with age. Self-reports of verbal strategy use were accurate yet incomplete. Awareness of children's use of verbal strategies was low and increased with age. Although verbal strategies were associated with competence among the youngest children, self-talk was unrelated to task performance for older children, suggesting considerable persistence over time of a relatively ineffective strategy. Awareness was not a prerequisite for children's verbal strategy use but was positively associated with strategy effectiveness among those who talked.

Central topics within contemporary cognitive development research include the conditions under which children will use and benefit from various strategies during problem solving, age-related differences in the effectiveness of different strategies, factors that account for children's strategy choice, and the extent to which conscious awareness of strategy use is important for children's strategy selection and effectiveness (Bjorklund & Douglas, 1997; Bjorklund & Rosenblum, 2001; Justice, Baker-Ward, Gupta, & Jannings, 1997; Siegler, 1996; Siegler & Stern, 1998; Whitebread, 1999). One common strategy used by children during a wide variety of cognitive activities is talking aloud to oneself, spontaneously engaging in what is known as private speech (Diaz & Berk, 1992). The present study, with a large ($N = 2,156$), nationally representative, cross-sectional sample of children between the ages of 5 and 17, examined: (a) age-related changes in children's use of overt (out-loud) and covert (whispered, inaudible) verbal problem-solving strategies during a planning task, (b) children's awareness (self-report) of such speech, (c) the accuracy of children's reports of private speech use, and (d) relations between both use and self-report of verbal problem-solving strategies and children's task performance and achievement.

Adam Winsler and Jack Naglieri, Department of Psychology, George Mason University.

This paper was presented at the biennial Conference on Human Development, Charlotte, North Carolina, April 2002. We would very much like to thank Louis Manfra for helpful comments on an earlier draft.

Correspondence concerning this article should be addressed to Adam Winsler, Department of Psychology, 3F5, George Mason University, Fairfax, VA 22030-4444. Electronic mail may be sent to awinsler@gmu.edu.

Historically, it is interesting to note that the neo-behaviorist and Vygotskian notion of "verbal mediation," namely, that overt or covert verbal mediators are what get between the S-R link to direct children's behavior and cognitive activity (Flavell, Beach, & Chinsky, 1966), is typically credited as the birthplace of the last 40 years of research on memory and strategy development (Bjorklund & Douglas, 1997; Harnishfeger & Bjorklund, 1990), and as the birthplace of contemporary research on children's private speech (Berk, 1992). Since that time, research on verbal problem-solving strategies has bifurcated, however, into two separate and unfortunately relatively independent traditions. Within the cognitive and information-processing tradition, much work has been conducted on (verbal) rehearsal or (verbal) labeling as specific mnemonic strategies for recalling lists of words (see Bjorklund & Douglas, 1997, for a review), and of course, the analysis of prompted verbal protocols has provided researchers with an effective window into the cognitive processing of both children and adults (Ericsson & Simon, 1993). However, examination of children's spontaneous use of self-talk or private speech as a self-regulatory strategy in and of itself during children's execution of various problem-solving tasks has almost exclusively been conducted separately within a neo-Vygotskian theoretical tradition (Diaz & Berk, 1992; Winsler, Diaz, Atencio, McCarthy, & Adams-Chabay, 2000).

Vygotskian theory emphasizes the early childhood years as a period during which language, originally a social and cultural tool used for

communication with others, merges with cognition in a new way such that children come to use language in the form of private speech as a tool for guiding, planning, and regulating their own thinking and behavior (Berk & Winsler, 1995; Diaz & Berk, 1992; Luria, 1961; Nelson, 1996; Wertsch, 1985). Accordingly, most of the research on children's spontaneous private speech has focused on the early childhood years—ages 3 to 8 (see Berk, 1992, for a review)—although there have been a few isolated investigations of verbally mediated problem solving among adolescents (Kronk, 1994) and adults (Duncan, 2000; Duncan & Cheyne, 1999; John-Steiner, 1992; McCafferty, 1994).

A primary goal of much of this research has been to explore the early developmental trajectory of children's private speech use and internalization (Berk & Garvin, 1984; Bivens & Berk, 1990; Kohlberg, Yaeger, & Hjertholm, 1968; Winsler, Diaz, et al., 2000). Investigators have largely confirmed Vygotsky's (1934/1986, 1930/1978) original observations of an overall curvilinear developmental trend for overt private speech with such speech increasing in frequency of use during the preschool period, peaking around the ages of 4 to 6, and then becoming less common later as it is gradually replaced with more covert forms of self-talk, including whispers, inaudible muttering, and eventually silent, inner speech. Of course, this developmental pattern is a global one, averaging across many tasks, individual differences among children, and a variety of task conditions and social contexts that are also known to influence children's spontaneous use of private speech during problem solving (Behrend, Rosengren, & Perlmutter, 1989; Frauenglass & Diaz, 1985; Krafft & Berk, 1998; Winsler, Carlton, & Barry, 2000). Furthermore, there appears to be an individual microgenetic (as opposed to ontogenetic) developmental trajectory for the use of private speech such that for a child at any age who is engaged in a moderately challenging task, overt private speech appears to peak during moments of initial task difficulty and then gradually decrease in frequency as the child masters the task over time or over repeated trials (Berk & Spuhl, 1995; Duncan & Pratt, 1997; Winsler, 1998; Winsler, Diaz, & Montero, 1997).

Thus, although there is now a fairly good understanding of the contexts in which, and the frequency with which, young children use overt and covert verbal problem-solving strategies during problem-solving activities, practically nothing is known at present about the long-term, developmental patterns of verbal problem-solving strategy use throughout

childhood and adolescence. In addition to the almost exclusive focus of the private speech literature on early childhood, as noted previously, another limitation of the work in this area has been a reliance on relatively small and nonrepresentative samples. Although this is understandable given the labor-intensive nature of the typical methodology (involving transcription and coding from videotapes or detailed naturalistic observations), it is nevertheless unfortunate. A final limitation of previous work in this area has been the failure to use the same tasks for children of different ages, either across studies, within cross-sectional studies (Berk, 1986), and within longitudinal studies (Bivens & Berk, 1990; Winsler, Diaz, et al., 2000). Given that we know the use of overt verbal strategies during problem solving depends at least somewhat on task variables (Frauenglass & Diaz, 1985), it is difficult to conclude anything about the relative prominence of verbal strategies used by children at different ages when the task has not been fixed. The present study overcomes these limitations by observing children's verbal problem-solving strategies on the same task with a large ($N = 2,156$), nationally representative, multisite sample of children and adolescents between the wide age range of 5 and 17.

In addition to the use of verbal strategies, the present study explored age-related changes in children's awareness of self-talk. Research on children's strategic awareness in general has been particularly interesting recently because, on the one hand, it has shown awareness to be extremely important. Justice and her colleagues (Justice, 1986; Justice et al., 1997), for example, have shown that children's awareness of their own and others' cognitive strategies develops considerably throughout early and middle childhood, and that children's awareness of how strategies work positively predicts both strategy use and effectiveness. Relations between children's awareness and their strategic behavior have also been shown to increase with age (Cavanaugh & Perlmutter, 1982). Finally, awareness of children's strategy use appears at times to be necessary for children's strategy transfer to other situations (Ghatala, Levin, Pressley, & Goodwin, 1986).

On the other hand, however, studies continue to indicate that awareness is not a prerequisite for strategy use or effectiveness. Siegler and his colleagues (Siegler, 2000; Siegler & Stern, 1998) and others (Andreassen & Waters, 1989; Goldin-Meadow, Alibali, & Church, 1993; Karmiloff-Smith, 1992; Kuhn, Garcia-Mila, Zohar, & Anderson, 1995) have shown that often, especially among younger children,

strategies are used (both effectively and ineffectively) without conscious awareness on the part of the child, that awareness of such strategy use comes much later, and that it is only then that awareness begins to be related to children's strategy selection.

Note that although the investigators cited earlier have begun to explore developmental changes in, and correlates of, children's awareness of a few mnemonic and calculation strategies during memory and mathematical tasks, no published studies have investigated children's awareness of their own use of spontaneous self-talk during other, more general, problem-solving tasks. This gap in the literature is surprising given that Vygotsky (1934/1986) suggested long ago that children's developing awareness of their own self-talk might be important for private speech to move into its most mature, useful, and self-regulatory forms. Are there age-related changes in children's awareness and reporting of verbal strategies during the task? Fernyhough (1997; Fernyhough & Russell, 1997) and Winsler (Winsler, Carlton, et al., 2000) suggest that age-related changes in preschool children's use of private speech might be related to new developments in metacognition, such as mentalizing ability, self-awareness, and theory of mind, but awareness of children's self-speech was not specifically explored in these studies. Flavell, Green, Flavell, and Grossman (1997), employing a clinical interview method with 4- to 7-year-olds and adults, found that 4- to 5-year-olds were largely unaware of the phenomena of inner speech (covert verbal thinking) in both themselves and others, whereas 6- to 7-year-olds did demonstrate at least some awareness of such covert, verbally mediated, mental activities.

The only empirical investigation to assess children's awareness of their own self-talk directly is Manfra (2003), who interviewed 3- to 5-year-olds about their use of, and attitudes about, private speech. Manfra found that preschoolers' awareness of private speech use among others was positively correlated with age, verbal ability, and theory of mind, and that although awareness of private speech was generally low for preschoolers, a notable minority of 5-, 4-, and even 3-year-olds demonstrated at least some awareness of their own self-talk. Furthermore, he found that preschoolers have positive views about their self-talk, reporting that such speech is helpful to them during tasks. Finally, Manfra found that although 67% of the preschoolers used private speech during a selective attention task, only 33% of the private speech users acknowledged using such speech. Although those who did report talking to themselves were always accurate, two

thirds of the verbal-strategy-using preschoolers failed to report their speech use. Thus, although awareness of private speech use has recently begun to be investigated among preschoolers, little is known about children's awareness of verbal strategies during middle childhood and adolescence.

Closely related to strategy awareness is the accuracy or veridicality of children's self-reports of strategy use. Russo, Johnson, and Stephens (1989) defined veridicality as the degree to which children's reports correspond to criterion observational measures. Bray, Huffman, and Fletcher (1999), in one of the few studies that has systematically examined both strategy use and children's self-reported use, demonstrated with an intellectually diverse sample of 7-, 9-, 11-, and 17-year-olds that children's verbal reports of external strategies (observable behavioral and motor strategies) used during a location memory task are accurate but often incomplete. That is, children do in fact use the strategies they report using, but they often use additional strategies as well that go unreported. It is interesting that Bray et al. found a bias for children to be more likely to report using strategies that are positively associated with task performance than those that were not particularly helpful. Only limited information was gleaned from Bray et al. concerning children's use and report of verbal strategies, however, as verbal strategies were relatively rare on their task and were not the focus of the investigation. The present study examined relations between children's observed and self-reported use of verbal problem-solving strategies with a methodology that satisfies both Ericsson and Simon's (1993) criteria and conditions under which children's strategy use self-reports are likely to be veridical (child report follows immediately after the task activity, a brief interview process is used, and the relevant task materials are still accessible to the child during the interview) and Siegler's recommendations (McGilly & Siegler, 1989, 1990; Siegler, 1987; Siegler & Jenkins, 1989) that researchers use both directly observable criterion measures of children's strategy use and self-report measures.

The final goal of this study was to examine age-related patterns in the associations between children's overt and covert verbal strategy use, report, and task performance. At what age and under what conditions is talking to oneself helpful during a motor planning task? If children do talk aloud to themselves during the task, does it matter for performance whether they are aware of it? Several investigators (Baker-Ward, Ornstein, & Holden, 1984; Fabricius & Cavalier, 1989) have reported that

verbal labeling in the context of a memory task is not helpful for children until they are about 6 years of age, even though 4- and 5-year-olds do spontaneously use this verbal strategy. Such a pattern would be consistent with the current notion of a utilization deficiency (Bjorklund & Coyle, 1995; Bjorklund, Miller, Coyle, & Slawinski, 1997; Miller, 1994) or a utilization inefficiency as some prefer to call it (Hasselhorn, 1995) for the younger children, whereby children spontaneously produce a strategy but experience little or no (or even negative) performance gain from its use. Indeed, it is now clear within the strategy-development literature that relations between strategy use and performance are complex, as various factors, including age, prior knowledge, intelligence, and motivation, influence whether the use of a particular strategy will lead to increased performance (Bjorklund & Douglas, 1997).

Young children appear to be spontaneously strategic even when their performance is not enhanced by it (Sophian & Wellman, 1987), and positive relations between strategy use and task performance gains tend to increase with age (Bjorklund & Douglas, 1997; Hasselhorn, 1995; Schneider & Sodian, 1997). Miller (1990, 1994) has observed a four-stage developmental progression for children's strategy use on at least some tasks that starts off in the first stage with the child not using the strategy. In the second phase, the strategy is used in only a partial, preliminary way by the child. These first two stages can be described as being either a mediation deficiency or a production deficiency, depending on whether the child can be trained to use the strategy. The third stage is that of utilization deficiency—full-blown strategy use is in place without apparent gains in performance. And it is only in the final, fourth phase when improved performance accompanies strategy use.

It is interesting to note that private speech researchers within the Vygotskian tradition have struggled in their own way with what appear to be similarly complex and dynamic relations observed between children's spontaneous self-talk and their task performance (Behrend et al., 1989; Bivens & Berk, 1990; Diaz, 1992; Duncan & Pratt, 1997; Gaskill & Diaz, 1991; Winsler et al., 1997) and have even postulated dynamic, microgenetic models explaining speech-performance relations not unlike Miller's (1990, 1994) utilization deficiency model noted earlier. It would appear that the time is indeed ripe for cross-fertilization to occur between the private speech and strategy-development literatures.

Finally, because numerous investigators have found that intelligence, competence, and knowledge

are related to children's strategy use, strategy transfer, and strategy effectiveness in complex, interacting ways (Alexander, Carr, & Schwanenflugel, 1995; Bjorklund & Schneider, 1996; Borkowski & Peck, 1986; Gaultney, Bjorklund, & Goldstein, 1996; Schneider & Weinert, 1990; Scruggs & Mastropieri, 1988), the present study also explored whether verbal strategy use and speech-performance relations differed for children with high and low achievement. Gaultney et al. (1996), for example, found that the use of memory strategies is more critical in predicting memory performance for lower achieving students than for gifted students.

Method

Participants

Participants included 2,156 children varying in age from 5 to 17, who made up the nationally representative standardization sample for the development and validation of the Cognitive Assessment System (CAS; Naglieri & Das, 1997), an individually administered test of children's cognitive abilities. Children from 68 sites across the country were recruited via letters and consent forms sent home to parents from school. The sample's composition, by design, closely reflected the U.S. population (1990 census data) on the basis of age, gender, race, Hispanic origin, geographic region, parental education, community setting, special educational placement, and special needs (see Table 1). Data collection took place between fall 1993 and spring 1996.

Procedure and Measures

Participants were individually administered the CAS in a small testing room (either on-site at the child's school or at a university laboratory) by qualified, trained examiners during the standardization of the CAS (Naglieri & Das, 1997). Data examined for this study come from one of the CAS subtests tapping children's planning ability, namely Planned Connections, in which children draw lines between printed numbers and letters on a page, in a fashion similar to the Trail-Making Task (TMT; Reitan, 1971), a widely used neuropsychological assessment of executive functioning. Given that the self-regulatory demands of the task were high, because it involves sequential planning and switching from one set to another, verbal strategies and private speech were expected. Previous research on private speech using the TMT (Winsler, Diaz, et al.,

Table 1
Demographic Characteristics of the Sample

Variable	Value	Category or description
Age ^a	9.4 (3.7)	M (SD)
Gender	50%	Male
	50%	Female
Ethnicity	76.8%	Caucasian
	13.7%	African American
	3.0%	Asian American
	.6%	Native American
	6.1%	Other
Hispanic status	11%	Hispanic
	89%	Non-Hispanic
Geographic region	26%	Midwest
	19%	Northeast
	34%	South
	21%	West
Parental educational level	20%	Less than high school
	29%	High school graduate
	29%	Some college
	22%	College graduate
Community setting	74%	Urban/suburban
	26%	Rural
Educational placement	93%	Full-time regular education
	5%	Part-time special education
	2%	Full-time special education
Special needs status	86.6%	No diagnosis
	5.2%	Learning disability
	3.2%	Gifted/talented
	1.3%	Mild mental retardation
	1.1%	Speech/language disorder
	0.8%	Attention deficit/hyperactivity
	0.8%	Severe emotional disturbance
	1%	Other

^aThe age distribution was as follows: 5-year-olds ($n = 293$), 6-year-olds ($n = 297$), 7-year-olds ($n = 299$), 8-year-olds ($n = 195$), 9-year-olds ($n = 191$), 10-year-olds ($n = 188$), 11-year-olds ($n = 97$), 12-year-olds ($n = 98$), 13-year-olds ($n = 99$), 14-year-olds ($n = 99$), 15-year-olds ($n = 102$), 16-year-olds ($n = 98$), and 17-year-olds ($n = 100$).

2000) also suggests that this task would be appropriate for exploring verbal strategies. Planned Connections, for all ages, contains five, progressively more difficult items, or pages. The items require children to draw a line with a pencil connecting consecutive numbers and letters that appear in a quasi-random order on a page in sequential order, with each item containing progressively more things to connect. The 8- to 17-year-olds complete the last two of the items received by the 5- to 7-year-olds and three additional, more difficult items. The last two items of the 8- to 17-year-old version require children to connect both numbers and letters in sequential order alternating between numbers and letters (for example, 1-A-2-B-3-C). Items were con-

structed so that children never need to cross one drawn line over another.

To make sure that the younger children recognized numbers, the 5- to 7-year-olds were first asked to identify numbers 1 through 5 ("What's this number?"). Then, the examiner guided the child through the first sample item by asking him or her to "draw a line from number 1 to 2," and so on. Next, children were told the following: "I'm going to give you some more of these to do. You should always start from the number 1 and draw a line from one number to the next until you get to the last number. Work as quickly as you can without making a mistake and tell me when you are finished" (Naglieri & Das, 1997, p. 26). If a mistake was made

by the children, the experimenter immediately brought them back to their last correct number and asked them to resume from there. Time limits for the items ranged from 60 to 180 s. Specially trained personnel checked all test protocols for accuracy and completeness.

Verbal strategy use and reporting. Standard CAS administration protocol for the Planned Connections subtest involves the examiner observing and recording several common strategies used by children while they are engaged in the task. Thus, on the CAS record form there is a place for examiners to mark off whether during work on any of the Planned Connection items the child "said/repeated the alphabet/number series out loud" or "said/repeated the alphabet/number series to self." Examiners were instructed during their training to include both child whispers and inaudible muttering (clear verbal mouth movements) in the "to self" category. These dichotomous (yes–no) indicators by the examiner thus served as the variables representing whether overt (out loud) or partially covert private speech by the child (speech to the self but with observable whispers or inaudible lip movements) was observed at least once during the task. Note that only the task-relevant forms of self-talk discussed earlier were noted and considered as verbal strategy use. Rare instances of other child verbalizations during the task that were irrelevant to the task at hand (e.g., humming, noises, speech unrelated to the activity) were ignored.

In addition to children's observed strategy use, standard CAS examination protocol also obtains the children's self-report of their strategy use during Planned Connections. After the child completed all of the Planned Connections items, and while the test booklet with the item pages was still in front of the child, the experimenter inquired about the child's strategy use by saying the following to the child: "Tell me how you did these" (while the examiner flips through the last several items, or pages, in front of the child). If no response is given by the child, the examiner then modified the question to: "How did you complete these pages?" (Naglieri & Das, 1997, p. 29). The examiner was allowed to clarify the question further if needed (if there was still no child response) and was allowed to mention the word "strategy," but examiners were specifically trained not to give any examples of strategies. If the child mentioned a strategy, the experimenter asked if that was all or whether they did something else or used another strategy as well. Examiners then noted on prespecified parts of the child's record form whether the child reported the use of either overt or covert

("in your head") verbal strategies during the task, and these two dichotomous indicators were the raw variables used for children's awareness and self-report of verbal strategy use. Note that although reporting the use of a verbal strategy clearly indicates awareness on the part of the child, lack of reporting a verbal strategy cannot be taken as definitive evidence that the child was unaware. It is, of course, possible for a child to be aware of a verbal strategy used but not report it for whatever reason.

From the previously discussed measures of observed and self-reported speech use, additional dichotomous variables were calculated. The first was to represent definitively whether an overt verbal strategy was used for each participant. Overt verbal strategies were coded to have been used only if such speech was observed by the examiner. It was reasoned that the probability of the examiner failing to record overt speech use by the child when it was indeed present was less than the probability that the child falsely reported overt speech use when none was present. Thus, the rare occasions (.6% of the participants overall) when children reported overt speech use that was not verified by examiner observation were not treated as instances of overt verbal strategy use. Second, cases in which the child reported using a covert strategy (i.e., "said the numbers to myself in my head"), but no evidence of this in the form of visible whispers, inaudible lip movements, or muttering was observed by the experimenter, were taken as evidence that the child had engaged in fully covert, silent, inner speech (verbal thought). Thus, an additional dichotomous variable (1 denotes inner speech occurred; 0 denotes no evidence of such) was calculated and used.

Task performance. The task performance score for Planned Connections was the sum of the total number of seconds it took for the child to complete each item. This was then converted to a standard score with $M = 10$ and $SD = 3$.

Standardized achievement. A subsample of 1,984 children was also administered the Woodcock–Johnson–Revised (Woodcock & Johnson, 1989). The overall skills standard score, which aggregates across children's achievement in math, spelling, and reading, was used ($M = 100$, $SD = 15$). The observed mean for this subsample was $M = 99.4$, $SD = 16.9$.

Results

Preliminary logistic regression analyses revealed no significant differences in children's overt and covert

Table 2
Percentage of Participants Who Used and Reported Overt and Covert Private Speech (PS), by Age

Variable	Age in Years												
	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>n</i>	293	297	299	195	191	188	97	98	99	99	102	98	100
Use													
Used overt PS (%)	43.7	33.0	32.1	42.1	26.2	20.7	33.0	26.5	19.2	18.2	17.6	19.4	10.0
Used partially covert (whispering/muttering) PS (%)	13.4	19.9	18.4	23.1	28.2	23.4	21.7	17.3	22.2	11.1	15.7	11.2	20.0
Reported covert/inner speech (%)	4.1	5.4	6.0	13.3	17.8	23.9	22.7	26.5	16.2	24.2	28.4	33.7	28.0
Overall—Use of (any) verbal strategy (%)	54.6	54.9	54.5	68.2	67.5	60.6	67.0	61.2	53.5	51.5	63.7	60.2	55.0
Awareness													
Reported overt PS (%)	9.6	10.4	7.7	16.4	9.4	9.0	5.2	10.2	9.1	5.1	11.8	5.1	4.0
Reported covert PS (%)	7.8	9.1	12.4	22.1	29.8	31.9	32.0	32.7	30.3	32.3	40.2	39.8	37.0
Overall report (either overt or covert)	16.7	18.9	19.7	36.4	38.7	39.9	36.1	40.8	38.4	35.4	52.0	44.9	41.0

verbal strategy use or self-report as a function of child gender and race. For this reason, gender and race of child were ignored for the remainder of the analyses.

Age Trends in Children’s Use and Report of Verbal Strategies

Use of verbal strategies. The first goal of the analyses was to determine age-related trends in children’s use of overt and covert verbal strategies. Table 2 provides the proportion of participants at each age who were observed to engage in overt private speech, observed to engaged in covert private speech (whispers and inaudible muttering), and reported (but not observed) covert (inner) speech during the task. Figure 1 plots the developmental trajectories for these three types of verbal strategies. Overt (out-loud) private speech, although common among the 5-year-olds (43%), was used less and less as children got older (10% for the 17-year-olds), and was gradually but not completely replaced, first by partially covert whispers and mutterings and finally by fully covert inner speech. Inner speech with no external manifestations was relatively rare for the 5-year-olds (4.1%) and became common for the oldest age groups (33% for 16-year-olds and 28% for 17-year-olds). Thus, clear developmental trends were observed in terms of decreasing reliance on overt private speech and increased reliance on covert verbal strategies among the older children. The linear age trends were confirmed statistically via logistic regression analyses with age (in years) entered as the independent variable and the relevant dichotomous strategy use variable entered as the dependent measure in turn, for overt private speech use, $B = -.12$, Wald $\chi^2(1) = 68.12$, $p < .001$, and for inner speech, $B = .18$, Wald $\chi^2(1) = 120.37$, $p < .001$. Effect size estimates for logistic regression are typically expressed in odds ratio terms. According to these analyses, with each changing year the odds that a child will use an overt verbal strategy on this task decrease by a multiplicative factor of .88 and the odds that he or she will use a fully covert, inner verbal strategy increase every year by a multiplicative factor of 1.19. It is interesting that partially covert but still observable private speech use (whispers and muttering) showed a clear inverted U-shape, nonlinear pattern starting off at 13.4% for the 5-year-olds, peaking at 28.2% for the 9-year-olds, and becoming less common again for the older children.

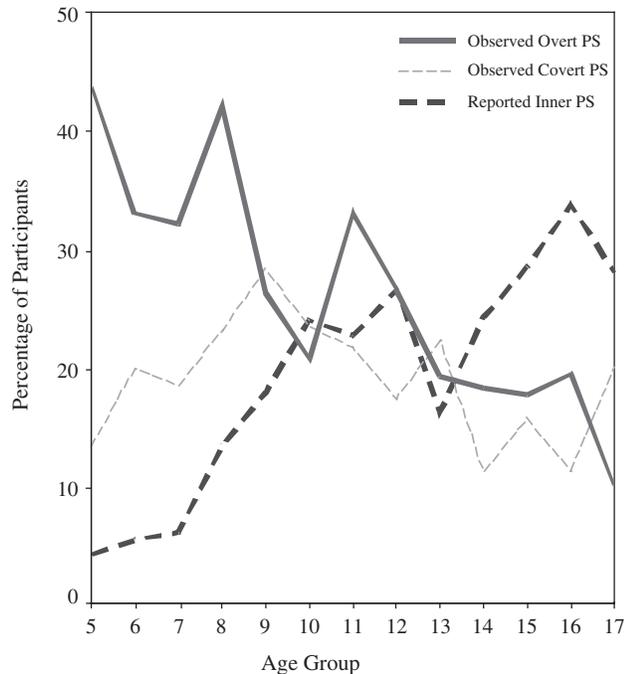


Figure 1. Age-related trends in children's use of overt, partially covert, and covert private speech (PS).

Also listed in Table 2 is the overall proportion of participants at each age who used at least one type of verbal problem-solving strategy (overt private speech, partially covert private speech, fully covert private speech, or any combination of the three) during the task. What is notable from this line in the table is that at all ages a sizable majority of children and adolescents (58.9% overall) chose to verbalize the problem in some way, either out loud or covertly. This figure did not vary systematically with age, $B = .01$, Wald $\chi^2(1) = .69$, $p = .41$. Thus, it appears that the type or manifestation of verbal strategy use, rather than the simple presence of verbal mediation, changes systematically with age—specifically, a change from overt to covert strategies and a nonlinear peak in middle childhood in partially internalized forms of speech.

Self-report of verbal strategies. In terms of children's report of their own overt and covert speech use, Table 2 reveals that children's self-report of covert verbal strategies (regardless of the examiner's observations) increases considerably and in a reasonably linear fashion from the ages of 5 (8%) to 17 (37%), $B = .16$, Wald $\chi^2(1) = 130.57$, $p < .001$. With each advancing year of age, the odds that a child will report using covert private speech increase multiplicatively by 1.174. Results for children's self-report of overt private speech reveal a small, yet statisti-

cally significant, decrease over age in such reporting, $B = -.04$, Wald $\chi^2(1) = 4.17$, $p < .05$. Overall, across all ages, only about 9.2% of children reported talking out loud to themselves during the task. The multiplicative decrease each year in the odds of reporting overt private speech was only .96.

One final pattern noticeable by comparing Figure 1 and Table 2 is that the gap between the number of children who used overt, verbal problem-solving strategies and the number who reported using this strategy was large for the younger age groups and got smaller as children were older. It is interesting that this trend is not due to increases with age in the reporting of overt private speech (because, as discussed earlier, this was not the case) but rather is due to dramatic decreases seen with age in the percentage of children who talk to themselves out loud, with this figure eventually and essentially catching up to the self-reported figure by age 17.

Relations Between Observed and Self-Reported Use of Verbal Strategies

The second major goal of this study was to ascertain the accuracy of children's self-reports of verbal strategy use and to explore relations between use and report of private speech. This was examined in three ways. First, phi correlations were calculated between the two dichotomous variables of children's observed (0,1) and children's reported (0,1) verbal strategies. These correlations were calculated separately by each age group and are reported in the top part of Table 3. As seen from the table, there were significant positive associations between children's reported and observed use of overt private speech for each age group ($r_s = .25$ to $.62$, $p < .05$), with an overall smoothed linear trend for the associations to be stronger for the older children. Thus, in general, children who did talk to themselves out loud during the task were more likely to report the use of this verbal strategy compared with those who were not observed to speak. Alternatively, children who reported talking out loud to themselves were more likely to have done so than children who did not report use of this overt strategy.

The correlations between observed and self-reported covert private speech use are also provided in Table 3. Recall that because covert verbal strategies include whispering to the self, inaudible muttering to the self, and silent inner speech (the last being impossible for the observer to see and the former two often difficult for an observer to see), the overall correlations between self-reported and observed use of covert verbal strategies were not

Table 3

Speech Use–Report Associations: Conditional Probabilities for Accuracy and Completeness of Children’s Self-Reports of Overt and Covert Private Speech (PS), and Errors in Speech Reporting and Associations Between Speech Use and Report, by Age

	Age in Years												
	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>n</i>	293	297	299	195	191	188	97	98	99	99	102	98	100
Use–report association													
R_{phi} for overt PS	.35*	.46*	.39*	.49*	.46*	.62*	.33*	.49*	.56*	.25*	.55*	.47*	.61*
R_{phi} for covert PS	.30*	.17*	.32*	.21*	.18*	.03	.12	.03	.39*	.31*	.31*	.11	.08
Reporting errors													
Failed to report overt PS (%)	34.5	22.9	24.7	26.2	17.8	11.7	27.8	17.3	11.1	15.2	8.8	14.3	6.0
Failed to report covert PS (%)	9.6	16.2	12.0	14.4	16.2	15.4	12.4	11.2	8.1	3.0	3.9	5.1	11.0
False report of overt PS (%)	.3	.3	.3	.5	1.0	0.0	0.0	1.0	1.0	2.0	2.9	0.0	0.0
Accuracy													
$P(\text{Obs} \text{Rep})$ overt PS	.96	.97	.96	.97	.89	1.00	1.00	.90	.89	.60	.75	1.00	1.00
$P(\text{Obs} \text{Rep})$ covert PS	.48	.41	.51	.40	.40	.25	.29	.19	.47	.25	.29	.15	.24
Completeness													
$P(\text{Rep} \text{Obs})$ overt PS	.21	.31	.23	.38	.32	.44	.16	.35	.42	.17	.50	.26	.40
$P(\text{Rep} \text{Obs})$ covert PS	.28	.19	.35	.38	.43	.34	.43	.35	.64	.73	.75	.55	.45

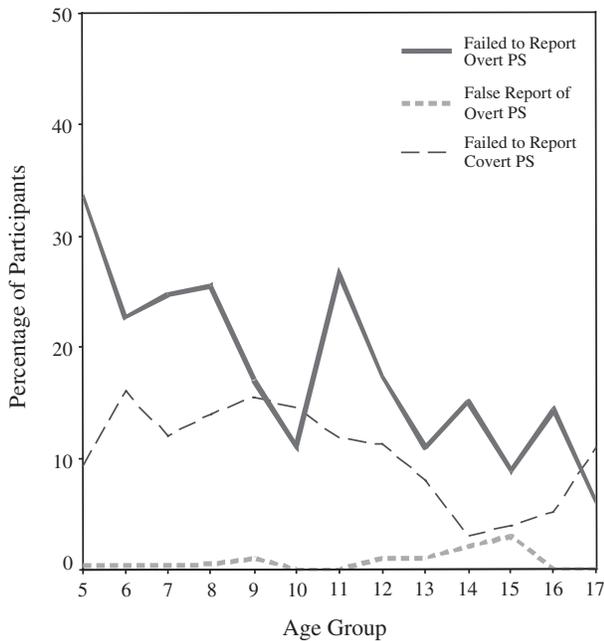


Figure 2. Age-related trends in errors made in children's reporting of their private speech (PS).

expected to be high. Indeed, only for the 5- to 9-year-olds and then again for the 13- to 15-year-olds were there modest and statistically significant positive associations ($r_s = .17$ to $.39$, $p < .05$) between observed and reported covert verbal strategies. To understand why the associations between use and report are stronger for the younger children, it is useful to recall (and as seen in Figure 1) that for younger children, covert private speech is more likely to consist of more visible whispers and muttering, whereas among older children covert speech is likely to be completely unobservable by the examiner. Further clarity on why the associations between use and report of covert verbal strategies get stronger again between the ages of 13 and 15 is offered in the following analyses.

A second way of exploring the accuracy of children's self-report of verbal strategies across age was to calculate and plot several types of reporting errors. These three types of reporting errors are given in Table 3 and are plotted by age in Figure 2. The proportion of participants who failed to report the use of overt private speech when it was clearly observed by the experimenter started at age 5 at 34.5% and decreased in a reasonably linear fashion with age, $B = -1.25$, Wald $\chi^2(1) = 56.64$, $p < .001$., reaching a low of 6% by age 17. Each year the odds

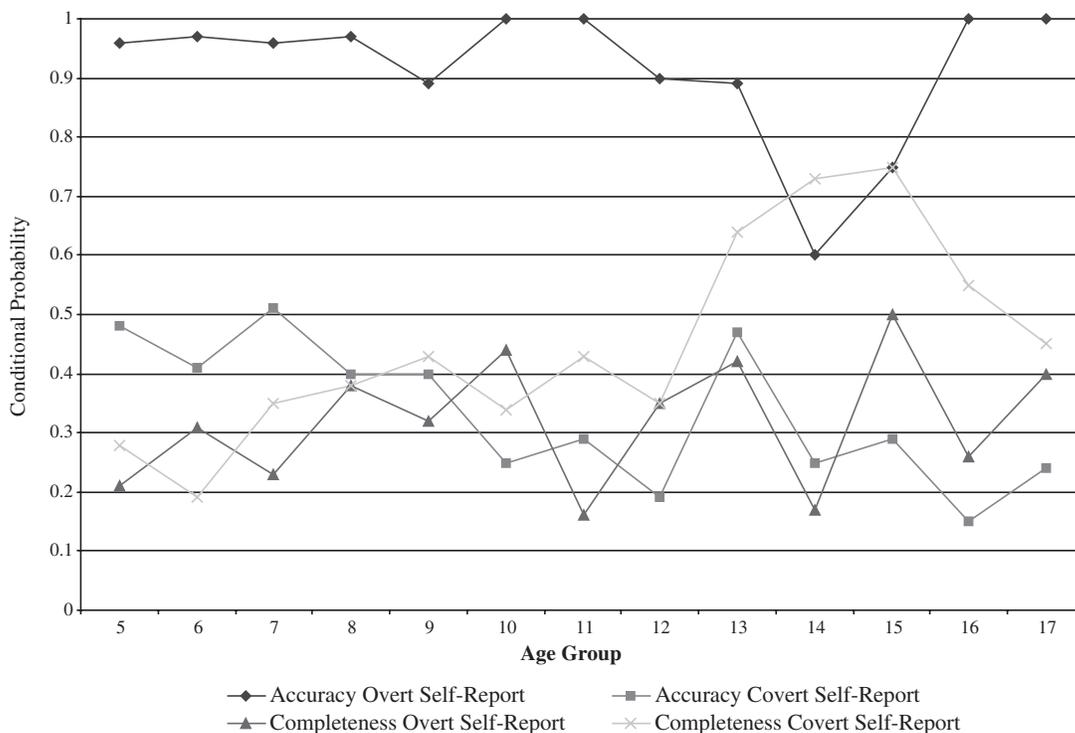


Figure 3. Age-related trends in the accuracy [$P(\text{use}|\text{report})$] and completeness [$P(\text{report}|\text{use})$] use in children's self-reports of verbal strategy use.

that a child will fail to report overt speech when it was used decrease multiplicatively by .882. The proportion of participants who failed to report the use of covert private speech when whispers, muttering, or verbal lip movements were observed by the experimenter was relatively stable at about 13% between the ages of 5 and 12; however, this reporting error was less frequent during the early adolescent years of 13 to 15, when it lowered to about 5%. Finally, falsely reporting the use of overt verbal strategies when none was observed by the examiner was rare (<1%) for all age groups except for the early adolescent years (ages 12–15), when this type of reporting error peaked at about 3%.

The final way we examined the integrity of children's report of verbal strategy use was based on the work of Bray et al. (1999), who defined the veridicality of children's self-reported strategy use as being composed of two separate but related components: accuracy and completeness. Accuracy of children's reported strategy use is operationalized as the conditional probability that the strategy was observed by the experimenter given that it was reported by the child. Completeness of the child's report of strategy use, however, is defined as the conditional probability that the strategy was reported by the child given that it was used and observed. These conditional probabilities for both overt and covert verbal problem-solving strategies are given at the bottom of Table 3 and plotted by age in Figure 3.

Accuracy of children's reports of using overt verbal strategies was generally excellent (conditional probabilities at or greater than .90) for almost all age groups. If children said they talked out loud to themselves, there was a high probability that this was independently observed by the experimenter, as well. It is interesting, however, that during the ages of 13 to 15 there appears to be a temporary slump in the accuracy of young adolescents' self-report of overt verbal strategies such that many more youths than usual reported speaking out loud when this behavior was not corroborated by experimenter observation. The completeness with which children reported their overt verbal strategies, that is, the probability of reporting overt self-talk given that they were observed to engage in out-loud speech to the self, was generally fairly low although it increased with age. The probability of reporting overt speech given that it was present for 5-year-olds was .21, whereas it reached a peak of .50 for 15-year-olds.

The interpretation of the conditional probabilities indicating accuracy and completeness for children's reporting of covert verbal strategies is more compli-

cated than for overt strategies because although experimenter observation of covert verbal strategy use (as evidenced by whispers and muttering) does indicate child strategy use, experimenter failure to observe the child using covert verbal strategies does not necessarily indicate the absence of their use. It could be, and is likely, especially as children get older, that the child did use a fully covert inner speech strategy that was not observable by the examiner. Thus, for the covert verbal strategy measures, the conditional probabilities have a slightly different meaning. In the case of accuracy, the probability that the examiner observes covert strategy use, given that it was reported by the child, is simply a measure of the probability that children's covert verbal strategy use is observable (by being only partially internalized). These figures, also listed in Table 3 and plotted in Figure 3, reveal that children's covert verbal strategies become less observable and more fully covert as children age. At age 5, the chance that such strategy use is observed by the examiner is about .50, and for 16-year-olds this figure reaches its low at .15. It is interesting that there is a noticeable leap in the probability that children's covert strategy use is observable by others at the age of 13 (.47, almost back to its age 5 level), the same early adolescent age at which the accuracy of children's verbal self-reports declines, as discussed previously.

In the case of the completeness of children's reports of covert strategy use, the conditional probability of reporting such strategy use given that it was observed is the probability that children report their use of partially covert whispers and muttering. This figure generally increased with age, starting at about .19 for the 6-year-olds and peaking nonlinearly at .75 for the 15-year-olds, and going back down to .45 for the 17-year-olds.

Strategy Use–Performance Relations

The final goal of this study was to elucidate relations between children's verbal strategy use and their task performance and achievement. First, simple point-biserial correlations were calculated between children's use of each of the three strategies (dichotomous yes–no for each of overt, partially covert, and inner speech strategies) and both their standard score on the Planned Connections task and their Woodcock–Johnson–Revised overall skills score. Overall, across all ages of children, there was no relation between verbal strategy use and task performance. Associations between children's verbal strategy use and task performance were $-.04$, $.02$,

and .03 (all *ns*) for overt, partially covert, and inner speech, respectively. To see if this was consistent across all age groups, the same point-biserial correlations were calculated separately for each age group. The lack of association between speech and performance was consistent across the board except that inner speech (children reporting talking to themselves in their head without independent observation by the examiner) was positively associated with task performance ($r_s = .23$ and $.19$, $p_s < .05$) for the 13- and 14-year-olds.

In terms of associations with children's general academic achievement, overall, children's overt verbal strategy use was slightly negatively related to achievement ($r = -.10$, $N = 1,437$, $p < .0001$), indicating a small effect for children who were not achieving as well academically to be more likely to use overt self-talk during the planning task. As before, we calculated these correlations separately for each age group and found that the association between achievement and overt speech use was different between the 5-year-olds and the rest of the group. For 5-year-olds, talking out loud to oneself during the task was positively associated with achievement ($r = .16$, $N = 202$, $p < .05$, difference between the 5-year-old r and the 6- to 17-year-old r , $z = 3.82$, $p < .001$). Similarly, children's partially covert speech use (whispers and muttering) was not associated with achievement ($r = .01$, *ns*) when all children and adolescents were combined. However, when this analysis was done separately for each age group, the same pattern reversal was found for the 5-year-olds. Within this youngest age group, the children who whispered and muttered to themselves during the task were more likely to be those who had achieved more academically ($r = .17$, $p < .05$, difference between two r_s , $z = 2.38$, $p < .05$). Similarly, fully covert, inner speech use was generally not associated with achievement for most children ($r = .05$, *ns*); however, it was positively related to academic competence for the 5-year-olds ($r = .15$, $p < .05$, difference between two r_s , $z = 2.11$, $p < .05$). Thus, 5-year-olds who are doing well academically are more likely to engage in all three forms of verbal strategies than are those whose achievement scores are lower; however, this pattern is either not true (in the case of covert strategies) or is reversed (in the case of overt verbal strategies) for older children.

To examine whether the relation between verbal strategy use and performance was different for highly competent children academically compared with less competent children, we conducted two-way factorial ANOVAs with strategy use (yes, no)

and achievement (high, low) as the two independent variables, and performance on the task as the dependent measure. Children scoring in the top quartile on the Woodcock-Johnson-Revised overall achievement and skills score made up the high-achieving group and children in the bottom quartile formed the low-achieving group. These analyses were first conducted separately for each age group, then, because the pattern of findings for the youngest three age groups (5, 6, and 7) were similar within themselves and different from that of the remaining older age groups, age groups were collapsed into early childhood (5-, 6-, and 7-year-olds) and middle childhood or adolescent age groups (ages 8–17). For overt verbal strategy use among the young children (ages 5–7), there was a only a significant effect for achievement group, $F(1, 312) = 81.27$, $p < .001$, with high achievers understandably doing better on the task ($M = 11.42$, $SD = 2.61$) than low achievers ($M = 8.38$, $SD = 2.98$, $d = 1.09$). There were no effects for strategy use or for a Use \times Achievement Group interaction. The same was found for overt verbal strategy use among the older children—a significant achievement effect, $F(1, 339) = 107.07$, $p < .001$, with no interaction between strategy use and competence group. The same pattern was found for both younger and older children's use (report) of inner speech—no interaction between achievement group and strategy use.

For partially covert verbal strategy use (whispers and muttering) among the younger group of children, however, there were significant main effects for strategy use, $F(1, 312) = 4.74$, $p < .05$, and achievement group, $F(1, 312) = 43.81$, $p < .001$, and a significant interaction, $F(1, 312) = 4.25$, $p < .05$. For the children of high ability, it did not matter for performance whether they talked quietly out loud to themselves ($M = 11.45$, $SD = 2.62$) or not ($M = 11.41$, $SD = 2.65$, $d = .02$); however for the lower achieving children, those who engaged in partially covert private speech did significantly better on the task ($M = 9.70$, $SD = 3.02$) than those who did not ($M = 8.08$, $SD = 2.90$, $d = .55$). This was only true for the 5- to 7-year-olds, however, as only the achievement group effect was significant among the 8- to 17-year-olds, $F(1, 343) = 87.01$, $p < .001$.

Because overt verbal strategies were found to be positively associated with achievement for 5-year-olds in the earlier analyses, the same ANOVA model with overt strategy use (yes, no) and achievement (low, high) as independent variables and task performance as the dependent measure was also conducted just for the 5-year-olds. This analysis revealed a significant interaction between strategy

use and achievement level in predicting performance, $F(1, 81) = 5.01$, $p < .05$. Talking out loud appears to have facilitated task performance for the less academically skilled 5-year-olds and impeded task performance for the more academically skilled youngsters. Five-year-olds in the lower achievement group did better on the task if they talked out loud to themselves ($M = 9.22$, $SD = 3.06$) than if they did not ($M = 7.89$, $SD = 2.85$, $d = .45$), whereas among the higher achievement group, overt speech users did poorer on the task ($M = 11.69$, $SD = 2.47$) than those who did not use the overt verbal strategy ($M = 13.00$, $SD = 1.78$, $d = .62$).

Also of interest was whether reporting, awareness, and accuracy of verbal strategy use were associated with children's task performance and academic competence. The first way we assessed this was to compare the task performance and Woodcock-Johnson-Revised scores for those who did report using verbal strategies with those who did not via independent samples t tests. Those who reported talking out loud to themselves during the task were no different from those who did not in terms of their general achievement, $t(1, 435) = .32$, *ns*; however, there was a nonsignificant trend for reporters of overt speech use to do better on the task ($M = 10.33$, $SD = 3.11$) than those who did not report such speech ($M = 9.93$, $SD = 2.98$), $t(2, 129) = 1.79$, $p = .07$. The same analysis was performed for the reporting of covert verbal strategy use. Those who reported talking to themselves inside their head did no better on the task than those that did not report using the covert strategy, $t(2, 129) = 1.35$, *ns*; however, those who reported covert speech to themselves were generally higher achievers ($M = 101.08$, $SD = 14.85$) than those who did not ($M = 98.93$, $SD = 17.41$, $d = .13$), $t(1, 435) = 2.05$, $p < .05$.

A second analysis strategy examined (within those who did talk) whether it mattered that they reported such strategy use. Thus, on the subsample of children who did use the verbal strategy, t tests were conducted to see whether task performance or general achievement were different for those who reported or failed to report their speech use. For those who were observed talking out loud to the self during the task ($n = 632$), children who reported such overt verbal strategy use did better on the task ($M = 10.32$, $SD = 3.14$) than those who did not report using it ($M = 9.55$, $SD = 3.00$), $t(630) = 2.88$, $p < .01$, $d = .25$. Furthermore, for those who talked, children who reported such overt verbal strategy use did better on the Woodcock-Johnson-Revised ($M = 100.43$, $SD = 16.54$) than those who did not report

using it ($M = 95.40$, $SD = 17.85$), $t(413) = 2.68$, $p < .01$, $d = .29$. Recall that age of child is not a factor here, as standardized scores for performance are used in all of these analyses. The same analysis was not conducted for children's covert speech because the dual nature of the variable, which includes both inner speech (not observable by the examiner) and whispers and mutterings (observable by the examiner), would make interpretation of this analyses unclear.

To assess whether accuracy of children's self-reporting of strategy use was related to academic competence, we first classified children into a global dichotomy of those who did ($n = 684$) or did not ($n = 1,447$) make one of the three strategy-reporting errors (reported overt talk when none was observed, failed to report overt speech when it was present, failed to report covert speech when whispers or muttering was observed). Then we conducted t tests to see whether children who made errors in reporting speech use were different in performance from those who did not make such errors. Children who were inaccurate in their reporting of verbal strategies did worse on the task ($M = 9.77$, $SD = 2.98$) than those who did not ($M = 10.06$, $SD = 3.00$), $t(2, 129) = 2.01$, $p < .05$, $d = .10$. Similarly, children who were inaccurate reporters did poorer on the Woodcock-Johnson-Revised ($M = 96.83$, $SD = 17.15$) than those who did not make strategy reporting errors ($M = 100.68$, $SD = 16.59$), $t(1, 435) = 4.07$, $p < .001$, $d = .23$.

Discussion

Strategy development researchers have recently called for more research to be conducted on children's spontaneous (as opposed to trained) strategy use (Bjorklund et al., 1997) and for strategy research to be conducted using a wider variety of tasks and settings than the standard memory recall and mathematical tasks commonly used (Bjorklund & Rosenblum, 2001; Crowley & Siegler, 1999; Ellis, 1997). Meanwhile, private speech researchers have recently expressed a need for work to be done on children's awareness of self-speech as a self-regulatory strategy (Winsler, Carlton, et al., 2000). The present study addressed both of these gaps by examining children's spontaneous use, and awareness, of overt and covert verbal strategies during a motor-planning task with a large, nationally representative sample of children between the ages of 5 and 17.

Overall, and remaining relatively stable across all age groups, approximately 60% of children and

adolescents used some type of verbal mediation strategy, either overt, partially covert, or fully covert, during the connect-the-dots planning activity. What changed systematically with age was the overt-to-covert quality of children's verbal strategies. For 5- to 8-year-olds, overt self-talk was most prominent, but by age 17 it was the least common form of verbal regulation. Similarly, inner speech, or fully covert verbal thinking, although present among the youngest age groups, was relatively rare for the youngest children and rose to become the most common form of verbal strategy use among children aged 14 and beyond. The developmental progression from overt to more covert types of private speech observed here is consistent with Vygotskian theory and the existing longitudinal and cross-sectional private speech literature (Berk, 1986; Bivens & Berk, 1990; Winsler, Diaz, et al., 2000). However, because this literature has been limited by the use of disparate tasks across ages and studies, small sample sizes, and an upper age limit for participants of about 8 to 9 years, the present study provides a crucial source of extension and replication. Also consistent with the extant literature is our finding that partially internalized whispering and muttering during problem solving follows a curvilinear inverted U-pattern, peaking at about age 9. Previous research, however, because of a restricted range of participant ages capped at about 9 has, of course, only been able to document the first (increasing) half of this nonlinear function. The fact that 10% to 30% of children ages 11 to 17 still spontaneously used fully overt self-talk without being prompted to do so suggests that, despite the focus on early childhood in the literature, private speech continues to command a nontrivial presence within the arsenal of cognitive problem-solving tools and strategies available to children throughout middle childhood and adolescence.

This study provides some of the only data on children's self-reported awareness of their spontaneous use of private speech during a problem-solving task and the accuracy of such reports throughout middle childhood and beyond. Two indicators of awareness were available in the present study: the proportion of children at each age who reported using verbal strategies and the conditional probability of children reporting the use of (both overt and partially covert) private speech given that it was observed. This latter figure also provides information as to the completeness of children's self-reports (Bray et al., 1999). Recall that these self-report indicators of awareness, although they yield useful information about children awareness of verbal strategies, are limited because lack of self-

report is not definitive evidence of children's lack of awareness.

In terms of covert speech, we found evidence that older children are more aware of their covert verbal strategies than younger children. Children's reporting of the use of covert verbal strategies increased considerably with age. Furthermore, the probability that the children reported talking to themselves "in their head" given that whispers, muttering, or inaudible verbal lip movements were observed by the experimenter also increased dramatically with age. Although there were age-related increases, children's awareness of their covert verbal strategies (and the completeness of their self-report) appears, at least from the self-report measure, to continue to be limited. Even as it peaked at the ages of 14 to 15, the probability of children reporting covert strategies given that they were observed was only .75, and at the final age of 17, this figure was only .45.

A different pattern was observed for children's awareness and reporting of their overt self talk. Strong evidence for age-related increases in children's awareness of overt self-talk would have emerged if children's post hoc self-reporting of self-talk increased with age (especially in the presence of declining use), but this was not the case. Only about 10% of children reported that they talked to themselves out loud during the task and this figure did not vary by age, even though actual (observed) use of overt self talk was much more common, especially among the younger children (shifting from 43% to 10% from the youngest to the oldest age group). Analysis of the probability of children reporting the use of overt self-talk given that its use was observed did reveal a modest overall pattern of increases with age, as seen in Figure 3, but wide variability between adjacent older age groups, the presence of only a modest increase (from .20 to .40), the generally low mean levels of awareness and completeness at all ages, and the fact that reporting of self-speech did not increase with age suggest only partial support for the conclusion that there are modest age-related developments in children's awareness of overt verbal strategies.

One possibility is that children feel some degree of embarrassment in reporting that they were talking out loud to themselves and that true developmental increases in awareness of self-talk were masked by participants' reluctance to report this behavior. Although we are not aware of any empirical data on this, anecdotal reports involving teachers discouraging children from talking out loud during their work are common, and contemporary societal norms, misperceptions, and customs associating

overt speech to the self among adults with such things as mental illness might find their way into the self-reporting behavior of children. Manfra (2003) found that young preschool children's attitudes about the use of private speech among other children are more negative than their views of private speech use among themselves, which suggests that even 3- to 5-year-olds may be sensitive to such sentiments. Manfra also reported that several children as young as age 4, during interviews about private speech use, revealed that their preschool or kindergarten teachers discourage them from talking to themselves.

Although there appear to be modest age-related increases in children's awareness and reporting of their verbal self-regulatory strategies, it is also clear that, across most of the age groups, only a minority of children and adolescents show awareness of their overt and covert verbal strategies. The fact that the number of children who used verbal strategies was considerably greater than the number who reported them at all ages provides additional strong evidence that conscious awareness of strategy use is not a prerequisite for strategy selection (Siegler, 2000). As has been shown with other tasks and other strategies (Kuhn et al., 1995; Siegler, 2000; Siegler & Stern, 1998), awareness of strategy use in many cases appears to come only after children have spent some time engaging in the strategic behavior. In the case here of verbal strategies during a motor-planning task, it appears that awareness (self-reporting) of such strategic behavior does not come to a majority of children even by the end of adolescence.

Given that age does not appear to be that strong a predictor of children's awareness of verbal self-regulatory strategies, it makes sense to explore other possibilities. One such possibility, and a phenomenon already documented by Bray et al. (1999) in the context of children's motor strategies during an external memory task, is that the children have a bias toward reporting only strategies that were either perceived by them to be, or were in fact, helpful in terms of improving task performance. That is, with limited cognitive processing resources and multiple strategies both historically available and recently used, problem solvers tend to become consciously aware of only those selected strategies that helped them reach goal attainment (Bray et al., 1999). If strategy effectiveness is indeed an important determinant of awareness, awareness of the verbal strategies used here by the children would not be expected to be high because talking to oneself, overall and across all children, did not appear to facilitate task performance.

Another possibility is that awareness of children's use of private speech is more related to the quantity or quality of the verbal strategy used by the child. Manfra (2003) reported that among preschool children interviewed about their private speech use after completing a selective attention task, the degree to which children's use of private speech during the task was loud, overt, and frequent (and thus more noticeable by the child) was a better predictor of children's self-reported use of speech than was age. Given that children's self-talk in this study was, as expected, found to change in nature with age, going from more overt to more covert in nature, the verbal strategies used by the older children may be less salient and not noticeable enough to bring the child into a state of strategic awareness, at least not enough to report it. If this were true, however, children whose verbal strategies were of the overt type should be more likely to report strategy use than those whose speech during the task was partially internalized. We tested this possibility and found that saliency of speech use did not matter, which appears to argue against this possibility—39% of those who were observed to use overt private speech reported the use of some type of verbal mediation (either overt or covert or combined), whereas the figure was similarly 42% for those whose observed speech use was partially internalized.

Results from the present study show that children's self-reports of their spontaneous verbal strategy use during such tasks are accurate, even for the youngest children. Children's reports of speech use were positively associated with actual use at all ages, false reports of children's verbal strategies were rare, and the conditional probability that speech was observed given that speech use was reported by the child was typically between .90 and 1.00. This general pattern of findings, that children's self-reports of strategy use are accurate but not particularly complete, thus replicates that of Bray et al. (1999). Showing that this is also true for children's report of verbal (as opposed to motor) strategies, however, is novel, as Bray et al. did not find the self-reports of verbal strategy use with their 7-, 9-, 11-, and 17-year-olds during an external memory task to be accurate. Further research will have to determine whether children's self-reports of verbal strategy use are generally accurate or whether verbal self-report accuracy varies as a function of either the type of tasks or the type of verbal strategy used. It appears from this investigation that if children say they talked to themselves, such reports can be believed. However, because

awareness and reporting of children's self-speech are limited at all ages (yet increasing), the completeness of children's verbal self-reports is wanting. That is, children's failure to report verbal strategy use does not necessarily mean that the strategy was not used by the child.

Something of note appears to be going on with respect to children's awareness, use, and report of both overt and covert private speech use during early adolescence, between the ages of 13 and 15. At ages 14 and 15, the accuracy of young adolescents' reports of overt verbal strategy use (which were usually .90 to 1.0) plummeted to .60 and .75, respectively. Furthermore, it was only among the 13- to 15-year-olds that we witnessed reasonable awareness and completeness probabilities of covert speech (conditional probabilities of reporting covert speech use, given that it was observed, being noticeable greater than .5). In addition, correlations between report and observation of covert speech for the 13- to 15-year-olds returned to their statistically significant levels of early childhood and generally not after age 9. Finally, although false reports of overt self-talk were practically nonexistent for all other age groups, they rose to about 3% for the 13- to 15-year olds. Such a pattern of findings suggests the early adolescent years witness greater sensitivity to and awareness of self-speech. It is during this brief period, when youth were very aware of their partially internalized whispers and mutterings and when they were more likely to think others could hear their own inner verbal speech, that their own exaggerated reports of overt self-talk were not to be trusted. This pattern of findings, one worthy of further empirical investigation, is consistent with the "imaginary audience" literature that finds that young adolescents show extreme sensitivity to, distorted perceptions of, and preoccupation with others' thoughts and perceptions of themselves (Ryan & Kuczkowski, 1994; Vartanian, 2000).

Thus, it appears that the majority of children at all ages spontaneously use verbal strategies during motor-planning tasks, yet only a minority of them are aware of (report) such private speech use. The next question is: Does it help them? That is, does children's speech use matter for performance? Overall, across all age groups and children, the use of overt and covert verbal strategies was unrelated to children's performance on the task. Such a finding may be interpreted as another example of a utilization deficiency (Miller, 1994) in that children are spontaneously using a strategy without reaping any apparent task gain from it. However, the usual developmental trajectory for a utilization deficiency

is that the strategy eventually becomes associated with improved task performance among older children (Bjorklund & Douglas, 1997). In the present study, no evidence for increased effectiveness among older children was found. More likely here is that such overt and covert verbal strategies were once positively associated with performance on such a task, when the children were younger, and that what we have observed is considerable persistence of spontaneous verbal strategy use long after task performance gains have disappeared. There is considerable evidence that private speech is associated with increased task performance on other tasks among preschool and early elementary school children (Bivens & Berk, 1990; Gaskill & Diaz, 1991; Winsler et al., 1997). Such persistence of relatively ineffective, earlier, immature strategies by children when other strategies are available is not only known to occur but appears to be an important component of strategy selection and competition in general (Siegler & Stern, 1998). However, this is the first study to show the persistence of an apparently ineffective strategy occurring over such a protracted (13-year) age period.

Consistent with the interpretation that verbal strategy use on this task may once have had a different functional significance for younger children were several findings involving relations between speech use and child achievement and competence interacting with age, and relations between speech use and task performance interacting with child competence, especially among the 5-year-olds. Overall (across all other ages) children who talked to themselves on the planning task demonstrated lower achievement on the Woodcock-Johnson-Revised compared with those who did not use verbal strategies. However, the 5-year-olds who used verbal strategies (regardless of whether it was overt, partially covert, or fully covert) were instead those who were achieving well academically. More important, verbal strategy use was actually helpful for task performance for lower achieving 5- to 7-year-olds whereas it either impeded performance or did not matter for the higher functioning young children. This finding is consistent with other studies in the literature that have found strategy use can at times compensate for low ability or achievement (Bjorklund & Schneider, 1996; Gaultney et al., 1996; Scruggs & Mastropieri, 1988).

Awareness of verbal self-regulatory strategies appears to be important. Regardless of actual speech use, children who reported talking to themselves did better on the task than those who did not, and those who were aware of (i.e., reported) covert speech had

higher standardized achievement scores than those who did not. Furthermore, if children talk to themselves, it appears it is better for them to be aware of it. For those who actually did talk to themselves out loud during the task, those who reported such speech use did better on the task than those who failed to report it. Finally, accuracy of reporting verbal strategy use was associated with increased task performance and achievement. The finding that verbal strategy users did better on the task when they were aware of such speech use compared with when speech use went unreported is open to several interpretations. One is that children need to be aware of their private speech before it can be useful to them. That is, awareness of verbal strategy use on this task might be a prerequisite for strategy effectiveness. Other studies on memory and math strategies do not find this to be the case, however (Siegler, 2000; Siegler & Stern, 1998). Another possibility, suggested by Bray et al. (1999), is that verbal strategies helped some children of varying ages and not others, and only those who were in fact assisted by the private speech became aware of the strategy use. That is, strategy effectiveness comes first and actually drives to some extent children's awareness, reporting, and memory of strategy use. These are critical questions in need of further study, not only for the use of verbal self-regulatory strategies but for other strategic behaviors as well.

In terms of the implications for educational practice, the current study raises several possibilities. First, to the extent that children's awareness of their own verbal strategies is positively related to increased performance, and overall levels of children's awareness of their verbal self-regulatory strategies are low, interventions designed to increase children's awareness of the use of private speech as a strategic tool may be worthy of consideration. Such a recommendation is consistent with the thrust of several, more general, educational interventions that have as their goal teaching children not only to become more strategic in their learning but also to reflect on and become more aware of various problem-solving and learning strategies (Moely, Santulli, & Obach, 1995; Naglieri & Gottling, 1997; Naglieri & Johnson, 2000; Pressley, 1995). Second, the finding that verbal strategy use was particularly helpful for the lower achieving 5- to 7-year-olds suggests that young children who are struggling in academic achievement in the early grades may be good recipients for strategic intervention (Naglieri & Gottling, 1997).

One of the contributions of the present study is that it brings together two previously separate research traditions: research on children's spontaneous use of private speech for self-regulation and research on children's strategy use and metacognition during cognitive tasks. Research on children's self-talk can benefit from seeing private speech as one of several potential strategies that children use to regulate behavior, and research on the relation between private speech and task performance can profit from noting advances within the strategy development literature in understanding the conditions under which strategies are and are not useful for children on various tasks (i.e., utilization and production deficiencies, persistence of ineffective strategies, processes of strategy selection and competition, and so on). At the same time, strategy-development research can advance by increased consideration of the functional role of spontaneous verbal strategies and the combination of verbal and nonverbal strategies used by children during various cognitive tasks.

Finally, although the present investigation offers several methodological strengths to the study of children's use and awareness of verbal problem-solving strategies (i.e., a large, nationally representative sample of children from a wide range of ages; the use of one extensively pilot-tested and standardized age-normed task of comparable difficulty across all ages; and the presence of both self-report and criterion measures of strategy use), it is not without its limitations. One limitation of the design was that we were not able to record the speech used by the children and categorize it in terms of content as is typically done in investigations of children's private speech. In the present study, children's task-relevant speech during their problem-solving activity that included discussion or labeling of the current or subsequent number(s) or letter(s) being connected on the page was noted and coded as strategic. However, other forms of private speech, both that which is clearly self-regulatory and metacognitive, evaluative, or strategic in perhaps a different way (i.e., "Now where did I see that number?" or "I need to slow down" or "I'm almost done!") and that which is off task and seemingly nonstrategic (i.e., singing, talking about something else) were not investigated and should be the topic of future research.

A second limitation was that only simple presence of verbal strategy use sometime during the task (yes, no) was noted here. Measures of the quantity and frequency of children's private speech use during such tasks are needed to shed light on other

potentially important dimensions of children's verbal strategy use. Furthermore, information as to inter-rater reliability for observing children's verbal strategies (and recording those reported) was not available and represents an important need for future research using similar methodology. Another limitation of the present study is that only verbal strategies were explored. Although it was important for this early work to focus on fundamental questions related only to children's verbal strategies, it is clear that multiple strategy use is the norm for children's cognitive and problem-solving activities (Bjorklund & Rosenblum, 2001; Crowley & Siegler, 1993; Miller & Coyle, 1999; Siegler, 1996) and that future work should examine the use of verbal strategies combined with nonverbal strategies on a wider variety of tasks to gain a better understanding of the developmental context for children's strategy selection and strategy utility.

References

- Alexander, J. M., Carr, M., & Schwanenflugel, P. J. (1995). Development of metacognition in gifted children: Directions for future research. *Developmental Review, 15*, 1–37.
- Andreassen, C., & Waters, H. S. (1989). Organization during study: Relationships between metamemory, strategy use, and performance. *Journal of Educational Psychology, 81*, 190–195.
- Baker-Ward, L., Ornstein, P. A., & Holden, D. J. (1984). The expression of memorization in early childhood. *Journal of Experimental Child Psychology, 37*, 555–575.
- Behrend, D. A., Rosengren, K. S., & Perlmutter, M. (1989). A new look at children's private speech: The effects of age, task difficulty, and parent presence. *International Journal of Behavioral Development, 12*, 305–320.
- Berk, L. E. (1986). Relationship of elementary school children's private speech to behavioral accompaniment to task, attention, and task performance. *Developmental Psychology, 22*, 671–680.
- Berk, L. E. (1992). Children's private speech: An overview of theory and the status of research. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self-regulation* (pp. 17–53). Hillsdale, NJ: Erlbaum.
- Berk, L. E., & Garvin, R. A. (1984). Development of private speech among low-income Appalachian children. *Developmental Psychology, 20*, 271–286.
- Berk, L. E., & Spuhl, S. T. (1995). Maternal interaction, private speech, and task performance in preschool children. *Early Childhood Research Quarterly, 10*, 145–169.
- Berk, L. E., & Winsler, A. (1995). *Scaffolding children's learning: Vygotsky and early childhood education*. Washington, DC: National Association for the Education of Young Children.
- Bivens, J. A., & Berk, L. E. (1990). A longitudinal study of the development of elementary school children's private speech. *Merrill-Palmer Quarterly, 36*, 443–463.
- Bjorklund, D. F., & Coyle, T. R. (1995). Utilization deficiencies in the development of memory strategies. In F. E. Weinert & W. Schneider (Eds.), *Memory performance and competencies: Issues in growth and development* (pp. 161–180). Hillsdale, NJ: Erlbaum.
- Bjorklund, D. F., & Douglas, R. N. (1997). The development of memory strategies. In N. Cowan & C. Hulme (Eds.), *The development of memory in childhood* (pp. 201–246). East Sussex, England: Psychology Press.
- Bjorklund, D. F., Miller, P., Coyle, T. R., & Slawinski, J. L. (1997). Instructing children to use memory strategies: Evidence of utilization deficiencies in memory training studies. *Developmental Review, 17*, 411–441.
- Bjorklund, D. F., & Rosenblum, K. E. (2001). Children's use of multiple and variable addition strategies in a game context. *Developmental Science, 4*, 184–194.
- Bjorklund, D. F., & Schneider, W. (1996). The interaction of knowledge, aptitudes, and strategies in children's memory performance. In H. W. Reese (Ed.), *Advances in child development and behavior* (Vol. 26, pp. 59–89). San Diego, CA: Academic Press.
- Borkowski, J. G., & Peck, V. A. (1986). Causes and consequences of metamemory in gifted children. In R. J. Sternberg & J. C. Davidson (Eds.), *Conceptions of giftedness*. New York: Cambridge University Press.
- Bray, N. W., Huffman, L. F., & Fletcher, K. L. (1999). Developmental and intellectual differences in self-report and strategy use. *Developmental Psychology, 35*, 1223–1236.
- Cavanaugh, J. C., & Perlmutter, M. (1982). Metamemory: A critical examination. *Child Development, 53*, 11–28.
- Crowley, K., & Siegler, R. S. (1993). Flexible strategy use in young children's tic-tac-toe. *Cognitive Science, 17*, 531–561.
- Crowley, K., & Siegler, R. S. (1999). Explanation and generalization in young children's strategy learning. *Child Development, 70*, 304–316.
- Diaz, R. M. (1992). Methodological concerns in the study of private speech. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self regulation* (pp. 55–81). Hillsdale, NJ: Erlbaum.
- Diaz, R. M., & Berk, L. E. (Eds.). (1992). *Private speech: From social interaction to self regulation*. Hillsdale, NJ: Erlbaum.
- Duncan, R. M. (2000). Experimental studies of the forms and functions of private speech in young adults. (Doctoral dissertation, University of Waterloo, Canada, 2000). *Dissertation Abstracts International, 60*(7-B), 3552.
- Duncan, R. M., & Cheyne, J. A. (1999). Incidence and functions of self-reported private speech in young adults: A self-verbalization questionnaire. *Canadian Journal of Behavioural Science, 31*, 133–136.
- Duncan, R. M., & Pratt, M. W. (1997). Microgenetic change in the quantity and quality of preschoolers' private

- speech. *International Journal of Behavioral Development*, 20, 367–383.
- Ellis, S. (1997). Strategy choice in sociocultural context. *Developmental Review*, 17, 490–524.
- Ericsson, K. A., & Simon, H. (1993). *Protocol analysis: Verbal reports as data*. Cambridge, MA: MIT Press.
- Fabricius, W. V., & Cavalier, L. (1989). The role of causal theories about memories in young children's memory strategy choice. *Child Development*, 60, 298–308.
- Fernyhough, C. (1997, April). *Private speech and self-regulation: A link with mentalising abilities?* Paper presented at the biennial meeting of the Society for Research in Child Development, Washington, DC.
- Fernyhough, C., & Russell, J. (1997). Distinguishing one's own voice from those of others: A function for private speech? *International Journal of Behavioral Development*, 20, 651–665.
- Flavell, J. H., Beach, D. R., & Chinsky, J. H. (1966). Spontaneous verbal rehearsal in a memory task as a function of age. *Child Development*, 37, 283–299.
- Flavell, J. H., Green, F. L., Flavell, E. R., & Grossman, J. B. (1997). The development of children's knowledge about inner speech. *Child Development*, 68, 39–47.
- Frauenglass, M. H., & Diaz, R. M. (1985). Self-regulatory functions of children's private speech: A critical analysis of recent challenges to Vygotsky's theory. *Developmental Psychology*, 21, 357–364.
- Gaskill, M. N., & Diaz, R. M. (1991). The relation between private speech and cognitive performance. *Infancia y Aprendizaje*, 53, 45–58.
- Gaultney, J. F., Bjorklund, D. F., & Goldstein, D. (1996). To be young, gifted, and strategic: Advantages for memory performance. *Journal of Experimental Child Psychology*, 61, 43–66.
- Ghatala, E. S., Levin, J. R., Pressley, M., & Goodwin, D. (1986). A componential analysis of the effects of derived and supplied strategy-utility information on children's strategy selections. *Journal of Experimental Child Psychology*, 41, 76–92.
- Goldin-Meadow, S., Alibali, M. W., & Church, R. B. (1993). Transitions in concept acquisition: Using the hand to read the mind. *Psychological Review*, 100, 279–297.
- Harnishfeger, K. K., & Bjorklund, D. F. (1990). Children's strategies: A brief history. In D. F. Bjorklund (Ed.), *Children's strategies: Contemporary views of cognitive development* (pp. 1–22). Hillsdale, NJ: Erlbaum.
- Hasselhorn, M. (1995). Beyond production deficiency and utilization inefficiency: Mechanisms of the emergence of strategic categorization in episodic memory task. In F. E. Weinert & W. Schneider (Eds.), *Memory performance and competencies: Issues in growth and development* (pp. 141–159). Hillsdale, NJ: Erlbaum.
- John-Steiner, V. (1992). Private speech among adults. In R. M. Diaz & L. E. Berk (Eds.), *Private speech: From social interaction to self-regulation* (pp. 285–296). Hillsdale, NJ: Erlbaum.
- Justice, E. M. (1986). Developmental changes in judgments of relative strategy effectiveness. *British Journal of Developmental Psychology*, 4, 75–81.
- Justice, E. M., Baker-Ward, L., Gupta, S., & Jannings, L. R. (1997). Means to the goal of remembering: Developmental changes in awareness of strategy use-performance relations. *Journal of Experimental Child Psychology*, 65, 293–314.
- Karmiloff-Smith, A. (1992). *Beyond modularity: A developmental perspective on cognitive science*. Cambridge, MA: MIT Press.
- Kohlberg, L., Yaeger, J., & Hjertholm, E. (1968). Private speech: Four studies and a review of theories. *Child Development*, 39, 691–736.
- Krafft, K. C., & Berk, L. E. (1998). Private speech in two preschools: Significance of open-ended activities and make-believe play for verbal self-regulation. *Early Childhood Research Quarterly*, 13, 637–658.
- Kronk, C. M. (1994). Private speech in adolescents. *Adolescence*, 29, 781–804.
- Kuhn, D., Garcia-Mila, M., Zohar, A., & Anderson, C. (1995). Strategies for knowledge acquisition. *Monographs of the Society for Research in Child Development*, 60(4, Serial No. 245).
- Luria, A. R. (1961). *The role of speech in the regulation of normal and abnormal behavior* (J. Tizard, Ed. & Trans.). New York: Liveright.
- Manfra, L. (2003, April). Awareness of the use of private speech in preschool children. In A. Winsler (Chair), *Awareness, attitudes, and beliefs concerning children's private speech: Perspectives from children, parents, and teachers*. Symposium presented at the biennial meeting of the Society for Research in Child Development, Tampa, FL.
- McCafferty, S. G. (1994). Adult second language learners' use of private speech: A review of studies. *Modern Language Journal*, 78, 421–436.
- McGilly, K., & Siegler, R. S. (1989). How children choose among serial recall strategies. *Child Development*, 60, 172–182.
- McGilly, K., & Siegler, R. S. (1990). The influence of encoding strategic knowledge on children's choices among serial recall strategies. *Developmental Psychology*, 26, 931–941.
- Miller, P. H. (1990). The development of strategies of selective attention. In D. F. Bjorklund (Ed.), *Children's strategies: Contemporary views of cognitive development* (pp. 157–184). Hillsdale, NJ: Erlbaum.
- Miller, P. H. (1994). Individual differences in children's strategic behavior: Utilization deficiencies. *Learning and Individual Differences*, 6, 285–307.
- Miller, P. H., & Coyle, T. R. (1999). Developmental changes: Lessons from microgenesis. In E. K. Scholnick, K. Nelson, S. A. Gelman, & P. H. Miller (Eds.), *Conceptual development: Piaget's legacy* (pp. 209–239). Mahwah, NJ: Erlbaum.
- Moely, B. E., Santulli, K. A., & Obach, M. S. (1995). Strategy instruction, metacognition, and motivation in the

- elementary school classroom. In F. E. Weinert & W. Schneider (Eds.), *Memory performance and competencies: Issues in growth and development* (pp. 301–321). Hillsdale, NJ: Erlbaum.
- Naglieri, J. A., & Das, J. P. (1997). *Cognitive Assessment System*. Itasca, IL: Riverside.
- Naglieri, J. A., & Gottling, S. H. (1997). Mathematics instruction and PASS cognitive processes: An intervention study. *Journal of Learning Disabilities, 30*, 513–520.
- Naglieri, J. A., & Johnson, D. (2000). Effectiveness of a cognitive strategy intervention in improving arithmetic computation based on the PASS theory. *Journal of Learning Disabilities, 33*, 591–597.
- Nelson, K. (1996). *Language in cognitive development: The emergence of the mediated mind*. New York: Cambridge University Press.
- Pressley, M. (1995). A transactional strategies instruction Christmas carol. In A. McKeough & J. Lupart (Eds.), *Teaching for transfer: Fostering generalization in learning* (pp. 177–213). Hillsdale, NJ, Erlbaum.
- Reitan, R. (1971). Trail Making Test results for normal and brain-damaged children. *Perceptual and Motor Skills, 33*, 575–581.
- Russo, J. E., Johnson, E. J., & Stephens, D. L. (1989). The validity of verbal protocols. *Memory & Cognition, 17*, 759–769.
- Ryan, R. M., & Kuczowski, R. (1994). The imaginary audience, self-consciousness, and public individuation in adolescence. *Journal of Personality, 62*, 219–238.
- Schneider, W., & Sodian, B. (1997). Memory strategy development: Lessons from longitudinal research. *Developmental Review, 17*, 442–461.
- Schneider, W., & Weinert, F. E. (1990). *Interactions among aptitudes, strategies, and knowledge in cognitive performance*. New York: Springer-Verlag.
- Scruggs, T. E., & Mastropieri, M. (1988). Acquisition and transfer of learning strategies by gifted and nongifted learners. *Journal of the Education of the Gifted, 9*, 105–121.
- Siegler, R. S. (1987). The perils of averaging data over strategies: An example of from children's addition. *Journal of Experimental Psychology: General, 116*, 250–264.
- Siegler, R. S. (1996). *Emerging minds: The process of change in children's thinking*. New York: Oxford University Press.
- Siegler, R. S. (2000). Unconscious insights. *Current Directions in Psychological Science, 9*, 79–83.
- Siegler, R. S., & Jenkins, E. (1989). *How children discover new strategies*. Hillsdale, NJ: Erlbaum.
- Siegler, R. S., & Stern, E. (1998). Conscious and unconscious strategy discoveries: A microgenetic analysis. *Journal of Experimental Psychology: General, 127*, 377–397.
- Sophian, C., & Wellman, H. (1987). The development of indirect search strategies. *British Journal of Developmental Psychology, 5*, 9–18.
- Vartanian, L. R. (2000). Revisiting the imaginary audience and personal fable constructs of adolescent egocentrism: A conceptual review. *Adolescence, 35*, 639–661.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher mental processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds. & Trans.). Cambridge, MA: Harvard University Press. (Original work published 1930).
- Vygotsky, L. S. (1986). *Thought and language* (A. Kozulin, Trans.). Cambridge, MA: MIT Press. (Original work published 1934).
- Wertsch, J. V. (1985). *Vygotsky and the social formation of mind*. Cambridge, MA: Harvard University Press.
- Whitebread, D. (1999). Interactions between children's metacognitive abilities, working memory capacity, strategies and performance during problem-solving. *European Journal of Psychology of Education, 14*, 489–507.
- Winsler, A. (1998). Parent-child interaction and private speech in boys with ADHD. *Applied Developmental Science, 2*, 17–39.
- Winsler, A., Carlton, M. P., & Barry, M. J. (2000). Age-related changes in preschool children's systematic use of private speech in a natural setting. *Journal of Child Language, 27*, 665–687.
- Winsler, A., Diaz, R. M., Atencio, D. J., McCarthy, E. M., & Adams Chabay, L. (2000). Verbal self-regulation over time in preschool children at-risk for attention and behavior problems. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 41*, 875–886.
- Winsler, A., Diaz, R. M., & Montero, I. (1997). The role of private speech in the transition from collaborative to independent task performance in young children. *Early Childhood Research Quarterly, 12*, 55–73.
- Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock-Johnson Revised tests of cognitive ability: Standard and supplemental batteries*. Itasca, IL: Riverside.