Deaf and Hard of Hearing Students' Performance on Arithmetic Word Problems

Merv Hyde, Robyn Zevenbergen, Desmond J. Power

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DEAF AND HARD OF HEARING STUDENTS' PERFORMANCE ON ARITHMETIC WORD PROBLEMS

There has been limited research into the intersection of language and arithmetic performance of students who are deaf or hard of hearing, although previous research has shown that many of these students are delayed in both language acquisition and arithmetic performance. The researchers examined the performance on arithmetic word problems of deaf and hard of hearing students in the South-East Queensland region of Australia; they also examined these students' problem-solving strategies. It was found that performance on word problems was similar for deaf and hearing students, but that deaf students experienced delays in achieving successful performance on word problems relative to their hearing peers. The results confirm the findings of other studies showing that students who are deaf or hard of hearing experience delayed language acquisition, which affects their capacity to solve arithmetic word problems. The study conclusions stress the need for greater use of direct teaching of analytic and strategic approaches to arithmetic word problems.

MERV HYDE,
ROBYN ZEVENBERGEN,
AND DES POWER

All three authors are associated with Griffith University, Gold Coast Campus, Gold Coast, Australia. Hyde is an associate professor and director of the Centre for Deafness Studies and Research, Faculty of Education; Zevenbergen is an associate professor in the School of Education and Professional Studies; Power is an emeritus professor with the Centre for Deafness Studies and Research.

Research on the mathematics achievement of students with hearing loss has chiefly concentrated on these students' skills in operations and number. These studies have generally concluded that there is no central cognitive basis for major differences documented in mathematical performance between deaf and hearing students, and that the achievement differences that are observed are the result of a combination of linguistic, procedural, and experiential delays on the part of deaf students. Increasingly in these studies, it seems that the role of language in mathematics comprehension is being recognized not only in regard to hearing students (Wood, Wood, Griffith, & Howarth, 1986; Zevenbergen, 2000, 2002), but in regard to deaf students as well (Gregory, 1988; Luckner & McNeill, 1994; Serrano Pau, 1995; Titus, 1995; Wood et al., 1986; Zwiebel & Allen, 1988).

Extending beyond lexical and syntactic difficulties to more complex configurations, problems of an everyday nature involving the use of linguistic forms applied to arithmetic concepts and strategies have been found to cause significant difficulty for deaf students (Daniele, 1993; Luckner & McNeill, 1994; Serrano Pau, 1995; Wood et al., 1986). However, the nature of the relationship between language and mathematics understanding and the performance of deaf students has still not been established in any significant detail.

In examining and theorizing about the effects of language on the resolution of mathematical tasks, Wood et al. (1986) argued that the linguistic characteristics of mathematical problems create difficulties for both hearing and deaf students. They contended that both deaf and hearing students are often able to do the arithmetic of questions such as “How many minutes between 10:40 a.m. and 1:20 p.m.?” (p. 157), but that deaf students in particular experience difficulties in transforming the words of the problem into a workable mathematical format. Wood et al. concluded that an appreciation of the role of language delay (especially with more complex syntax) is critical to understanding the performance delays of deaf students; this conclusion represented a break with earlier “deficit” models, which posited that deafness in and of itself causes a cognitive deficit that accounts for an inability to solve problems.

Specific studies of the relationship between language and mathematics have been evident in the study of “everyday” word problems. If the classification of word problems reported by Riley, Greeno, and Heller (1983)—as “change,” “compare,” and “combine” forms, described below—and research reported by Del Campo and Clements (1987) are taken into consideration, it becomes clear that the wording of arithmetic tasks has a significant effect on the successful completion of those tasks. Even where the arithmetic is simple and involves addition and subtraction of two numbers whose sum or difference is less than 10, many students in the upper primary years can experience difficulty finding the correct solution (Lean, Clements, & Del Campo, 1990).

Some researchers (Frostad, 1996; Serrano Pau, 1995; Wood et al., 1986) have claimed that while deaf students consistently show delays in comparison with their hearing peers in arithmetic problem solving, no simple or direct relationship has been established between these delays and the students’ linguistic and experiential deficits, or with their degree of hearing loss. Serrano Pau studied deaf students’ problem-solving ability using “change,” “compare,” and “combine” problems in order to examine this ability in relation to reading comprehension level. While Serrano Pau acknowledged that the relationship between reading comprehension and problem-solving ability was important, he found that ineffective problem-solving strategies largely based on the strategies taught by teachers and adopted by the students were also relevant to poor performance. Other reports also suggest that the ineffective problem-solving strategies adopted by deaf students are largely based on the strategies taught by teachers (e.g., Luckner & McNeill, 1994).

Luckner and McNeill (1994) identified three learner capabilities relevant to deaf students when linguistic aspects of mathematics are being considered: (a) intellectual skills, including a knowledge of the concepts and rule structures relating to the problem-solving task, (b) organized information in the form of appropriate schemata to enable an understanding of the problem, and (c) cognitive strategies that allow the learner to select the relevant information and strategies necessary to the problem’s solution. Luckner and McNeill confirmed that students who are deaf have difficulties in relation to arithmetic problem solving and that it is important to identify ways to assist deaf students in developing organizational and procedural skills if their arithmetic problem-solving strategies are to be improved.

In summary, researchers have claimed that while students with hearing loss consistently show delays in comparison with their hearing peers in arithmetic problem solving, no simple or direct relationship has been established between these delays and the students’ linguistic and experiential deficits or their degree of hearing loss (Wood et al., 1986). Indeed, Wood et al. go so far as to suggest that what is clear from the research is that deaf and hard of hearing students as a group show greater variability in their performance on mathematical tasks than the general student population. In consequence, the present study sought to examine the performance of deaf and hard of hearing students on arithmetic word problems with a procedure that offered some comparison to previous studies of hearing students, and, particularly, to examine the use of linguistic information and cognitive strategies by students with hearing loss.

Method

In the present article, we report on a project that examined deaf and hard of hearing students’ performance in solving arithmetic word problems. As previous studies have not considered the procedural strategies used by such students in solving arithmetic word problems, our project investigated the following questions:

1. How do deaf and hard of hearing students compare with their hearing peers in developing the ability to solve arithmetic word problems?
2. Are there identifiable strategies used by deaf and hard of hearing students when attempting to solve arithmetic word problems?

Using the research instrument developed by Lean et al. (1990) and their data on hearing students as a comparison base, this project investigated the strategies used and outcomes achieved by deaf and hard of hearing students in schools in the Australian state of Queensland when solving arithmetic word problems.

Sample

Seventy-seven moderately to profoundly deaf students in the South-East Queensland region (from both mainstream and special education settings) were tested on arithmetic word problems, and a selected group was interviewed about how they worked through the problems presented to them. The students had all been ascertained to be in need of special support because of hearing impairment, whether in regular classes with itinerant teacher support or in special units in regular schools. All had mastered basic number facts (i.e., basic addition and subtraction facts to 100) and had basic English competency skills as determined from school records and teacher judgments. Comparable numbers of boys and girls participated in the study, and the students did not have other significant or uncorrected disabilities. In some cases, the sample size for a particular grade level was low because of the number of students enrolled in the particular year level (see Table 1).

The Task

The arithmetic word problems were those developed by Heller and Greeno (1978) and later used in both Australia and Papua New Guinea with hearing students by Lean et al. (1990). As in the Lean et al. and Serrano Pau (1995) studies, three types of questions — "change," "combine," and "compare"— were used. All questions involved additive or subtractive strategies with numbers where the sum was less than 10. Riley et al. (1983) identified the three arithmetic problem types on the basis of the kind of action needed to solve each type of problem:

- "Change" questions, which involve a process whereby there is an event that alters the value of the quantity, for example: "Peter had 3 oranges. Michelle gave him 2 more oranges; how many oranges does Peter have now?"
- "Combine" questions, which relate to static situations in which there are two amounts. These are considered either as separate entities or in relation to each other, for example: "Sarah has 4 oranges; Michelle has 2 oranges. How many oranges do they have altogether?"
- "Compare" questions, which involve the comparison of two amounts and the difference between them, for example: "Ben has 5 oranges. Alice has 2 more oranges than Ben; how many oranges does Alice have?"

The questions can then be divided into subcategories depending on the position of the unknown quantity within the problem. For example: "John has 2 buckets. Eric has 6 buckets. How many more buckets than John does Eric have?" versus "Gina has some boxes. Ken has 3 boxes. Gina has 1 more box than Ken. How many boxes does Gina have?" Further distinctions in the questions need to be noted. In a "change" question, the direction of change causes distinct characteristics to occur in the question, as change may be increasing or decreasing, and hence require different actions. In a "compare" question, the relationship between the sets (more or less) is a further variable affecting the question. As a result, there are 14 distinct word problems (De Corte & Verschaffel, 1991). The questions vary in level of difficulty and produce substantially different rates of correct response depending on the question type and the variations within each type (De Corte & Verschaffel, 1991; Lean et al., 1990).

Procedure

The study had two phases. In phase 1, deaf and hard of hearing students in South-East Queensland completed a test consisting of the 24 word problems developed by Lean et al., 1990 (see Tables 2–4). This instrument had a pencil-and-paper format. Testing was supervised by a trained research assistant (a teacher of the Deaf experienced in mathematics teaching) in conjunction with the classroom teacher. Phase 1 provided baseline data for a comparison of deaf and hard of hearing students' performance to that of the hearing student population in the study by Lean et al., and is reported in detail elsewhere (Zevenbergen, Hyde, & Power, 2001). On the basis of the data through the test, six students at each grade level were selected (to represent the school settings—mainstream and special education—of the deaf and hard of hearing group being studied) and interviewed to provide data on the strategies they used to solve the word problems.

Phase 2 consisted of interviews in which students were encouraged to use a "think aloud" strategy to describe their attempts to solve the tasks. The interviews were videorecorded and were undertaken with a trained research assistant who was fluent in signed English (a communication form commonly used with students in special education settings) and experienced in oral communication with deaf and hard of hearing students.

The text transcripts were analyzed by means of a content analysis procedure outlined by Silverman (1993). This procedure essentially identifies the major lexical items used across syntactic forms in the text of respondents and examines and confirms these across successive transcripts. For example, most of the students associated the phrase "less than" with "take away" (i.e., subtract) in their transcripts; similarly, when using the word *gave,* they interpreted this as indicating subtraction. Some problems that had greater syntactic complexity and that used less familiar terms (e.g., two sentences describing the participants in the problem and their mathematical relationship, followed by a question referring to one of the participants— "How many did she have at the start?") produced varied lexical and mathematical responses, as the students were unsure how the participants in the problem related to each other in an operational sense or how the numerals in the problems associated with the particular participants, or were confused by phrases such as "at the start." The responses offered by the students provided indicators of the problem-solving strategies they were using, the features of the language they were us-

Table 1
Distribution of Study Participants, by Grade Level (N = 77)

Grade	1	2	3	4	5	6	7	8	9	10	11	12
n	3	6	7	4	11	12	6	15	7	3	0	3

Table 2
Performance on "Compare" Questions: A Comparison Between Deaf and Hard of Hearing Students and Hearing Students

"Compare" questions	Student groups	Correct responses (%), by grade						
		1	2	3	4	5	6	7
John has 2 buckets. Eric has 6 buckets. How many more buckets than John does Eric have?	Deaf and hard of hearing[a]	0	0	0	0	18.2	8.3	33.3
	Hearing[b]	38	53	60	78	85	95	94
Nick has 2 cups. Sarah has 7 cups. How many cups less than Sarah does Nick have?	Deaf and hard of hearing	0	0	0	0	27.3	33.3	33.3
	Hearing	34	42	61	72	88	93	96
Gina has some boxes. Ken has 3 boxes. Gina has 1 more box than Ken. How many boxes does Gina have?	Deaf and hard of hearing	0	50.0	85.7	50.0	54.5	83.3	83.3
	Hearing	59	66	74	85	84	93	94
Jo has some dolls. Pat has 5 dolls. Jo has 2 dolls less than Pat. How many dolls does Jo have?	Deaf and hard of hearing	0	0	0	50.0	36.4	16.6	33.3
	Hearing	41	57	49	66	80	88	92
Bill has some trucks. Tina has 5 trucks. Tina has 2 trucks more than Bill. How many trucks does Bill have?	Deaf and hard of hearing	0	16.6	0	25.0	45.5	25.0	50.0
	Hearing	41	42	54	69	77	82	84
Sam has some marbles. Sarah has 6 marbles. Sarah has 2 marbles less than Sam. How many marbles does Sam have?	Deaf and hard of hearing	0	33.3	33.3	0	0	50.0	33.3
	Hearing	17	43	43	56	64	69	67

[a] data from present study.

[b] data from Lean, Clements, & Del Campo, 1990.

ing or that they understood, their cognitive strategies, and their methods of mathematical reasoning.

Results

The overall results of the present study could not be analyzed for statistical significance because of the small sample size available in each grade level and the difficulty of direct statistical comparison with the original data from Lean et al. (1990), particularly in relation to the different "grade" level descriptions given for deaf students in special school settings in comparison to those provided for students in regular school placements. Further, because the grade range (1–12) used in the present, Queensland, study was broader than that used in the study by Lean et al. (grades 1-7), which was conducted in the Australian state of Victoria, data comparison was only possible for the primary school years. What can be observed, however, are the specific trends that emerged from

Table 3
Performance on "Change" Questions: A Comparison Between Deaf and Hard of Hearing Students and Hearing Students

"Change" questions	Student groups	Correct responses (%), by grade						
		1	2	3	4	5	6	7
Barbara had 2 eggs. Dan gave Barbara 1 more egg. How many eggs does Barbara have now?	Deaf and hard of hearing[a]	66.6	66.6	85.7	75.0	100	66.6	100
	Hearing[b]	90	89	90	95	97	97	97
Jack has 4 pens. Dianne took 3 of Jack's pens. How many pens did Jack have then?	Deaf and hard of hearing	33.3	83.3	85.7	75.0	90.9	66.6	100
	Hearing	90	86	89	95	97	99	99
Jeff had 3 bananas. Carmel gave Jeff some more bananas. Jeff then had 5 bananas. How many bananas did Carmel give Jeff?	Deaf and hard of hearing	33.3	16.6	42.9	25.0	18.2	41.6	50.0
	Hearing	48	63	73	80	86	93	98
Anna had five books. Tom took some of Anna's books. Then Anna only had 2 books left. How many of Anna's books did Tom take?	Deaf and hard of hearing	33.3	50.0	71.4	75.0	54.5	66.6	66.6
	Hearing	76	78	81	85	94	94	94
Paul had some pencils. His father gave him 2 more pencils. Then he had 5 pencils. How many pencils did Paul have at the start?	Deaf and hard of hearing	0	0	28.6	25.0	36.4	58.3	50.0
	Hearing	38	71	66	76	84	93	93
Sally has some pictures. She lost 2 of her pictures. Then she had 3 pictures. How many pictures did she have at the start?	Deaf and hard of hearing	0	0	42.9	0	36.4	50.0	50.0
	Hearing	48	57	65	76	85	89	94

[a] data from present study.

[b] data from Lean, Clements, & Del Campo, 1990.

the responses. Overall, the trends confirm previous research in that the complexity of the word problems created demands and, hence, trends in the performance of deaf and hard of hearing students similar to those characteristic of hearing students, and that the deaf and hard of hearing students experienced delays in achieving successful performance on word problems relative to their hearing peers.

Tables 2, 3, and 4 compare the performance of hearing students and students with hearing loss when responding to the questions originally posed to the hearing students in the 1990 study by Lean et al.

The responses of the deaf and hard of hearing students confirm trends noted in similar studies of word problems involving such students. Students

Table 4
Performance on "Combine" Questions: A Comparison Between Deaf and Hard of Hearing Students and Hearing Students

"Combine" questions	Student groups	Correct responses (%), by grade						
		1	2	3	4	5	6	7
David has 2 dogs and Jim has 4 dogs. How many dogs do they have altogether?	Deaf and hard of hearing[a]	66.6	83.3	100	100	90.9	100	100
	Hearing[b]	79	91	93	98	99	99	100
Helen has 3 ribbons. Lyn also has some ribbons. Helen and Lyn have 7 ribbons altogether. How many ribbons does Lyn have?	Deaf and hard of hearing	0	0	0	25.0	27.3	25.0	66.6
	Hearing	45	63	69	71	75	85	82

[a] data from present study.

[b] data from Lean, Clements, & Del Campo, 1990.

respond to the complexity of the word problem, which varies depending on the syntax of the question and the operation to be undertaken—in the present study, either addition or subtraction. In the "compare" questions group, complexity generally increases with each succeeding word problem (in descending order; see Table 2). This makes it possible to examine students' capacity to deal with increasing syntactic and cognitive demands in the word problems where the nature of the operational relationship between the participants may be more-or-less clear in the linguistic expression.

Similar trends in the delay in making correct responses by deaf and hard of hearing students are evident in the "change" and "combine" question comparisons at the grade levels. Again there is a delay in the proportion of correct responses offered by deaf and hard of hearing students when compared with the responses offered by the students in the study by Lean et al. (1990).

The results generally reflect the students' better performance on the "change" problems than on the "combine" and, in particular, the "compare" problems. Older (high school age) students appeared to perform better than younger (elementary school) students. As hard of hearing and deaf students age and have greater experience with English, mathematics, and school in general, they seem better able to respond to the questions, thereby suggesting a "delay" rather than "deficit" explanation of their the ability to respond correctly to the word problems. A more detailed analysis and discussion of these data, derived from phase 1 of the present study, is reported in Zevenbergen et al. (2001).

For all items, however, student performance was influenced by the linguistic expression involved. These influences were further examined in phase 2 of the present study (see below).

Decontextualized Problems

Decontextualized problems involve manipulation of mathematical symbols in a manner that is not embedded in a "real" context, for example: "What is the sum of 4 and 3?" or "What number is 2 more than 4?" The linguistic component of some of these problems still created significant problems for many of the students with hearing loss. The word *twice* was particularly difficult, with many of the students asking what it meant. While some students below grade 6 were able to offer the correct response, they were not able to justify their answer logically (except in one case) and could not transfer their knowledge of *twice,* a sign that they did not have a strong understanding of this term. Decontextualized items appeared to be the most difficult for the students. The linguistic and conceptual complexity of *twice* was problematic for most students, but equally difficult was deciding whether to use division or multiplication to arrive at the correct answer. In transferring their knowledge of *twice,* many students took it to be related to the process of doubling, and multiplied when division was called for.

The concept of *less* was also particularly difficult for the students. At the decontextualized level, where the binary oppositional terms *more* and *less* are used, fewer students were able to respond correctly to the item where the relational term *less* was integral to the item. Further through the tasks, students misconstrued items that used the term *less* in a number of different ways. On the "compare" tasks asking which number is 2 less than 3, some students took the use of *less* to connote subtraction and were able to respond correctly, in spite of their appearing not to understand the task. However, most students saw the task as a comparative one in which they had to identify which was the lesser in value: 2 or 3. The signifier *than* seemed to be neither understood nor used, as many of the students did not know the word or its role in the sentence. This resulted in the frequent misinterpretation of the task as being to determine "which is more, 3 or 4?"

Similar difficulties were experienced where students could not interpret the subtle use of *is,* so that they regularly interpreted a question such as "5 is 1 more than which number?" as being "5 and 1 more is which number?" A similar reliance on the use of *more* and *less* to mean, respectively, "addition" and "subtraction" appeared to result in the production of errors by the students.

Contextualized Word Problems

Contextualized word problems place mathematical manipulation in an everyday context. These are examples of questions in a quasi-social context: "If Mary has 4 apples and Peter has 3 apples, how many apples do they have together?" and "If Simon makes 4 cakes and Jenny makes 2 more than Simon, how many does Jenny make?"

Where the problems were stated simply and in order of operation, there was a greater likelihood of the deaf students being able to offer correct responses. The actions involved in the tasks (giving and taking) provided strong contextual cues for the students as to the appropriate operation. Difficulty arose when the indefinite *some* came into the word problems. Not only was the amount missing, but it also produced confusion as to the appropriate operation to be undertaken. Where the nonstated amount was noted in the first line of the problem, the students experienced great difficulty in making sense of the task. In those items where an amount was not plainly stated, students were confused as to the requirement of the task (i.e., to find how many were there at the beginning). The students searched for key words (such as *lost*) that could offer some cues concerning what they might need to do. In one item where something was "lost," students took this as a cue for subtraction. Where the first line was ambiguous, many students seemed to ignore it and saw it as having no relevance to the task. They then proceeded to operate on the numbers given, using whatever cues they could extract from the text of the task.

Items with "compare" tasks proved difficult because of the structure of their closing sentences, which required a comparison to be made and a difference noted. As with the other decontextualized tasks, students were at risk of interpreting the task as one asking which is the bigger or smaller quantity and naming that quantity or interpreting the "more" or "less" in the wording to signify addition or subtraction.

Discussion and Conclusion

As described, an inherent restriction on the present study was the low number of students available from the regional population, and consequently the low numbers of students represented at each grade level. This made statistical intergrade comparisons and comparison with the original data of Lean et al. (1990) difficult. In addition, students in the special education settings were, at times, ascribed to class levels based on the teacher's judgment of their achievements and could not at all times be equated to students at the grade levels described for children in regular class programs. It is still possible, however, to draw several conclusions.

The performance of the students in the present study is essentially similar to that reported by Wood et al. (1986) for deaf students in the United Kingdom and for the Australian hearing students reported by Lean et al. (1990)—a difference being that the deaf students' performance in the present study was delayed in comparison to the reported performance of hearing students. Further, the data collected in the present research project support the notion that the specificity of language used in mathematics—or more specifically, arithmetic word problems—creates difficulties for students with hearing loss. These students' difficulties in the present study were based on the variability of syntactic expression in the word problems, lack of knowledge of key terms, and passive forms of expression in some problems.

Many of the students with hearing loss in the present study relied on a top-down approach to comprehending the tasks, seemingly accepting that they would not understand everything that was written. Relying on this reading strategy, they attempted to use their understanding of what they identified as key words and apply this knowledge to constructing the meaning of the tasks. The overgeneralization of the meaning of some key words resulted in many incorrect responses. With their restricted understanding of semantics, deaf students are often compelled to rely on fragments of sentences (a lexical "strategy") to make sense of that to which they can gain access. The complex semantics of English in the word problems and the lack of redundant and supportive information found in arithmetic word problems hinders the capacity of deaf students to make sense of the tasks, and hence their capacity to offer correct responses.

For example, as reported by Kelly, Lang, Mousley, and Davis (in press), the present results support the "consistency" hypothesis proposed by Lewis and Mayer (1987), under which deaf students were said to be more likely to misunderstand a relational statement and commit an error of reversal when an arithmetic problem was not consistent with the statement's relational term—for example, when they were required to add when the relational term was *less than* (Kelly, Lang, Mousley, & Davis, in press). In some ways, this may be a feature of English that, with its high level of redundancy and syntactic variability, can lead to a degree of unpredictability in the language when used in arithmetic word problems.

An interesting follow-up with signing deaf and hard of hearing students might be to examine the use of Auslan (or other natural sign languages) in the mathematics development of children who are deaf. A natural sign language may be more capable of using space (for example, in describing the positional relationships between the elements of or participants in an arithmetic word problem), the direction of movement of operational elements of a problem (such as John "giving" something to Mary), and emphasis (for example, forms of stress or focus on the actual key words in a problem) more effectively than spoken or signed English, while at the same time providing iconicity for many sign/lexical representations of task components or actions.

In addition, it seems that it would be appropriate for teachers to make greater use of direct teaching of specific language-related and metacognitive strategies for addressing arithmetic word problems. As summarized by Marschark, Lang, and Albertini (2002), students who are deaf may not have the broad knowledge and experience to "strategically apply [their] knowledge spontaneously" (p. 125). In referring to deaf students' lack of metacognitive skills, Marschark et al. suggest "that their teachers may take a more concrete and focused approach to problem solving, hoping that their students will have a clear understanding of a particular strategy" (p. 132). Kelly, Lang, and Pagliaro (in press) point out that in their study of deaf students the majority of mathematics teachers appeared to emphasize drill-and-practice problems over "true" problem-solving approaches. Further, the teachers tended to avoid teaching the deaf students "analytical strategies while focusing primarily on understanding the particular problem goal and pertinent problem information" (p. 7). This can restrict deaf and hard of hearing students' capacity to address new or less familiar problems and force them to rely on the features of the range of problems for which they have instructional experience.

There could be significant benefit if fewer assumptions were made about learning transfer from a limited number of problems examined in the classroom and if there were greater generalization and "situating" of arithmetic problems in a more extensive range of social, cultural, or vocational contexts for deaf students. Although some limited examination of this aspect was attempted in the "contextualized" analysis we have described in the present article, this approach to the study of learning and performance, proposed by Vygotsky (1934/1986) and reported by Cobb and Bowers (1999), holds further promise for a better understanding of the development of competence in mathematics by students who are deaf. That is, situating problems in more social and vocational contexts that are more reflective of the real world could enhance the potential of deaf students to develop more analytic and strategic problem-solving proficiencies.

In summary, Australian deaf and hard of hearing students were shown to be delayed in comparison to their hearing peers in attempting the arithmetic problems used in the present study. While this confirms the findings of several previous studies, an analysis of the cognitive and linguistic strategies used by the students with hearing loss has helped reveal several of the procedures used by these students in attempting the problems. These procedures suggest that the students' application of their restricted understanding of the syntax and semantics of English may be a particular difficulty represented in the overuse of some solution strategies, and that more "situated," authentic approaches to problem solving could be used by teachers to expand the experiential, linguistic, and strategic competence of deaf students in addressing arithmetic word problems. However, it should be recognized that when using such an approach, teachers should be aware of the extra layers of complexity created by such tasks—layers of complexity we allude to in the present study.

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