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Language and the Multisemiotic Nature of Mathematics

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ABSTRACT

This article explores how language and the multisemiotic nature of mathematics can present potential challenges for English language learners (ELLs). Based on two qualitative studies of the discourse of mathematics, we discuss some of the linguistic challenges of mathematics for ELLs in order to highlight the potential difficulties they may have when reading and doing mathematics. Examples, based on a systemic-functional linguistic analysis of texts, are used to show how different mathematical meanings are constructed.

INTRODUCTION

Traditionally, the challenges of mathematics were largely seen as coming from the cognitive demands of mathematics itself. It is undeniable that language and mathematics are connected in math learning, and the relationship of language to mathematics has been consistently addressed in math research. Previous research on the role of language in mathematics has focused on vocabulary or technical terms in math (Adams, 2003); linguistic features that may make mathematical texts hard to understand (Abedi & Lord, 2001; Spanos, Rhodes, & Crandall, 1998; Warren, 2006); the role of language (spoken or written), reading, and writing in facilitating the learning of math (Fortescue, 1994; Johnson, Jones, Thornton, Langrall, & Rous, 1998; Macgregor, 2002; Raiker, 2002; Richard, 2005; Sfard, Nesher, Streefland, Cobb, & Mason, 1998; Siegel & Fonzi, 1995); and the role of English and other languages in teaching bilingual or multilingual students in math classrooms (Adler, 1998, 1999; Barwell, 2003, 2005a, 2005b; Cuevas, 1984; Gorgorió & Planas, 2001; Gutierrez, 2002; Khisty & Viego, 1999; Lager, 2006; Moschkovich, 1999, 2000, 2002; Setati, 2005).

When it comes to the education of English language learners (ELLs), language in mathematics assumes even more significance. The language of schooling, or the academic language used in school (Schleppegrell, 2004), is a challenge for all students, but it is a particular challenge for ELLs. The language of schooling is markedly different from the language used in everyday interactions. This distinction between academic language and everyday language is of particular importance to ELLs, who may pick up everyday language fairly fast and seemingly effortlessly, but need additional assistance and time to develop academic language. Academic language is characterized by its high information density, authoritative tone, technicality, and abstractness (Schleppegrell, 2004). Such characteristics are realized with language choices that are seldom encountered in everyday life. The recognition that language and math learning are simultaneous processes for ELLs is important.

In a recent research review addressing language in mathematics teaching and learning, Schleppegrell (2011) points out, "The words *language* and *mathematics* can be thought of in two different ways: as referring to their relationship as systems of meaning-making and as referring to the role of language in the pedagogical context of mathematics classrooms" (p. 74). These two aspects are addressed in this article, building on Ernest's (2008a, 2008b, 2008c) semiotic theory of mathematical text, which drew on Halliday's (1978) social semiotics or systemic functional linguistics (hereafter SFL). Ernest argues against the conception of mathematics as an idealized independent reality or as purely psychological activity, and proposed instead a social, cultural, and semiotic view of mathematics. Using SFL as a framework, Ernest first defines the semiotic system of mathematics as comprising signs, rules, and meanings, and elaborates on the ideational, interpersonal, and textual meanings of mathematical text. This article also draws on other work within the SFL tradition to exemplify some potential linguistic challenges of the language of mathematics for ELLs and the multi-semiotic nature of mathematics.

By taking a socio-semiotic view of language, SFL makes it possible to systematically examine how mathematics discourse is constructed through language and other semiotic systems. More specifically, SFL enables us to identify the ideational meaning of mathematics (what is being represented), the interpersonal meaning (the relationship established such as the positioning of readers), and the textual meaning (textual organization in the different semiotic systems). SFL research has helped illuminate the various ways language and other semiotic systems are used in constructing mathematics-specific meanings. This article discusses some of the linguistic challenges of mathematics for ELLs based on findings from two related qualitative projects to help us highlight the potential difficulties ELLs may have when reading and doing mathematics.

ENGLISH LANGUAGE LEARNERS IN MATHEMATICS

Research in multilingual classrooms has focused attention on ELLs' use of code-switching, or moving back and forth between languages (Adler, 1999; Setati, 2005), the use of the technical language of mathematics (Khisty & Viego, 1999), and interactions between teacher and students (Moschkovich, 1999, 2000, 2002). In general, previous literature on the linguistic challenges of mathematics discourse identified vocabulary and language structures as challenges for ELLs (Abedi & Lord, 2001; Adams, 2003; Raiker, 2002). Specifically, in their study that examined the effects of reducing problematic linguistic features in standardized mathematics tests, Abedi and Lord (2001) listed the following as potentially problematic for ELLs: unfamiliar or infrequent non-math vocabulary (e.g., 'a certain reference file'); passive voice; long nominal groups (e.g., 'the pattern of the puppy's weight gain'); conditional clauses; relative clauses; complex question phrases (e.g., 'which is the best approximation of the number'); and abstract or impersonal presentations (e.g., '2,675 radios sold' as compared to the more concrete expression of '2,675 radios that Mrs. Jones sold'). Raiker (2002) pointed out the problem with the use of everyday language in mathematics, which, if used imprecisely and inappropriately, may hinder students' learning. Spanos et al. (1998) went beyond vocabulary and sentence-level analysis, defining linguistic challenges as either syntactic, semantic, or pragmatic in nature. Adams (2003), in advocating a more active role of reading in math learning, enumerated the following as possible areas of difficulty: formal definitions; multiple meanings of words (particularly those that are both used in everyday interactions and in mathematics discourse with different meanings); homophones and similar sounding words; the interaction between words, numerals, and symbols; and the significance of order in math. Challenges of the language of mathematics include specialized vocabulary and discourse features along with everyday vocabulary that acquires a different meaning in mathematics such as *equal* and *table* (Dale & Cuevas, 1992).

Practical strategies to work with ELLs in mathematics classrooms have been addressed in recent work. In general, English as a second language (ESL) strategies have been recommended for use with ELLs in mathematics (Coggins, Kravin, Coates, & Carroll, 2007). It has been a common practice in classrooms with ELLs to change and adapt instruction to make content more accessible and comprehensible (Echevarria, Vogt, & Short, 2008). Using cooperative learning groups is a recommendation often found in books that focus on ELLs in the content areas (Herrell & Jordan, 2008; Reiss, 2005, 2008). Drawing on ESL scholarship, two major books (Coggins et al., 2007; Kersaint, Thompson, & Petkova, 2009) have focused on strategies that teachers can use to address ELLs' needs in mathematics.

Despite the few studies that address certain dimensions of language, most previous research focuses on discrete linguistic features rather than dealing with the functions of these features, their role in the construction of mathematics texts as precise, authoritative, and technical, and the challenges that these features pose to ELLs, which are addressed in this article.

MATHEMATICS AND SFL

SFL allows us to focus simultaneously on language and content given that its very framework is based on the notion that languages are not sets of formal rules but resources for making meaning. In his seminal work on mathematics, Halliday (1978) provided a definition of mathematics register:

> A register is a set of meanings that is appropriate to a particular function of language, together with the words and structures which express these meanings. We can refer to a "mathematics register," in the sense of the meanings that belong to the language of mathematics (the mathematical use of natural language, that is, not mathematics itself), and that a language must express if it is being used for mathematical purposes (p. 195).

Mathematics draws on everyday uses of language but also uses language in new ways to construct mathematical knowledge. Mathematics is constructed in different ways from other school subjects (Schleppegrell, 2007), and this discipline-specific nature of language in mathematics is an important consideration for mathematics learning.

SFL scholarship on mathematics has focused on the nature of the mathematical language (Halliday, 1978), the multisemiotic construction of mathematics discourse (Lemke, 2003; O'Halloran, 1999, 2000, 2003, 2005), mathematical discourse in the classroom (Huang, Normandia & Greer, 2003, 2005; Veel, 1999), and the interpersonal relationship established in mathematics discourse (Herbel-Einsenmann, 2007; Morgan, 2005, 2006; O'Halloran, 2004).

The Multisemiotic Construction of Mathematics Discourse

Halliday's (1978) conception of mathematics register has been extended by other researchers to draw more attention to the multisemiotic nature of mathematics discourse. For example, O'Halloran (1999, 2000, 2003, 2004, 2005) offers a theoretically elaborate account. Three semiotic systems are involved in mathematics, fulfilling different functions, with *natural language* introducing, contextualizing, and describing the problem; *symbolism* used for the solution of the problem; and *visual images* dealing with visualizing the problem graphically or diagrammatically. Each semiotic system is further analyzed for their three metafunctions—ideational, interpersonal, and textual—in constructing mathematical meanings.

As far as natural language is concerned, its use in mathematics is characterized by the dominance of relational processes realized through verbs setting up relations, such as *be, have,* and *represent*, and the frequent use of nominalizations, a process whereby verbs denoting processes and adjectives denoting qualities are transformed into nominal groups, such as the verb phrase *add up the two numbers,* and the nominal group *the sum of the two numbers*. The logical relation within clauses and across clauses, typically "involves long and complex chains of reasoning which favor the consequential type relations, or relations of purpose, condition, consequence, concession and manner" (O'Halloran, 2005, p. 80). Interpersonal meaning of natural language in mathematics features the monologic voice of the author/writer as the primary knower. The absence of words of modality, such as *might* and *could*, other mood adjuncts indicating probability, such as *possibly* and *perhaps,* and lexical items that show expressive or evaluative meanings, all make mathematics appear objective, rational, and factual. Textual meaning in mathematics is oriented toward carrying forward the argument, building a foundation for the mathematical content.

The semiotic system of mathematical symbolism is used to encode meanings unambiguously "in ways that involve maximal economy and condensation" (O'Halloran, 2005, p. 97). In terms of ideational meaning, mathematical symbolism contracts the meaning potential of natural language by being primarily concerned with relations and variations among mathematical elements. It expands the meaning potential through the operative process or the arithmetic operations and other processes commonly used in mathematics. Logical reasoning in mathematical symbolism is realized partly through the Rule of Order for operative process, specifying the order of operation. Logical meaning is also organized in an internal–rhetorical way, rather than in an external-experiential manner, which means there will be long implication sequences involved. The interpersonal meaning is even more contracted than that in natural language in mathematics, and constructs mathematical symbolism as non-negotiable and authoritative. Textually, mathematical symbolism is highly conventionalized and standardized, which helps to lay a foundation toward the ideational meaning of the text.

Visual images in mathematics provide more intuitive understandings of representations than natural language and mathematical symbolism. Ideational or representational meaning in visual images mirrors our perceptual experience of the world. However, viewers must know the grammar of visual images in mathematics to interpret and understand them, to uncover the dynamic, multiple time-frames encoded within. Logical reasoning of mathematical images depends to a large extent on spatiality or spatial relations. Interpersonally, mathematical visual images are so designed as to direct viewers to the representational meaning, with high truth value attached to the images, and straightforward and sharp engagement with viewers. Similarly, textual or compositional meaning of images functions to focus viewer attention on the experiential aspect or the mathematical content of the images. Table 1, based on O'Halloran's (2000, 2004) work, helps summarize the key features of each semiotic system in mathematics discourse.

Table 1. Key Features of Semiotic Systems in Mathematics

	Ideational Meaning	Interpersonal Meaning	Textual Meaning
Natural Language	Relational processes, nominalization, complex chain of reasoning	Monologic, factual, rational, objective	Carrying forward argument
Mathematical Symbolism	Limited process types, operative process, rule of order, internal-rhetorical	Non-negotiable, authoritative	Highly conventionalized, spatial positioning
Visual Images	Intuitive and perceptual depiction, grammar of images	High-truth value, direct engagement	Foregrounding experiential meaning

Mathematics in the Classroom

Research on mathematics discourse in the classroom has focused on the use of multiple semiotic systems, the different ways in which mathematics is taught to students of different socio-economic backgrounds, and the different knowledge structures that teacher and students have displayed in their classroom talk.

O'Halloran (2000) explored how the three semiotic systems are used in the classroom, and what challenges their use presents to students, particularly when there are constant shifts or movements from one semiotic system to another. Utilizing SFL, O'Halloran (2004) investigated the impact of social class, gender, and school sector on the way mathematical discourse is enacted in secondary school mathematics by analyzing mathematics lessons in three schools: one elite private school for boys, one elite private school for girls, and one public school for working-class students of both sexes. Linguistic analyses demonstrated that the foundation for *interpersonal meaning* was based in lessons for students in the working-class school and female students in the elite private school. By contrast, the foundation for *mathematical content* was based in lessons for male students in the elite private school. These different interpersonal patterns had significant impact on students' perception of, and performance in, mathematics.

In terms of the relation between language and knowledge structure (Mohan, 1986), Huang et al. (2005) found that the linguistic analysis of the teacher's talk and students' talk revealed different underlying knowledge structures possessed by each. The teacher's talk exhibited such knowledge as *classification, principles,* and *evaluation*, whereas students' talk only demonstrated such knowledge structures as *description, sequence,* and *choice.* They argue for explicit instruction to help students gain the linguistic ability the teacher possessed.

Interpersonal Engagement with Mathematics

Research on the interpersonal aspects of mathematics discourse has explored the way students are positioned through their engagement with mathematics texts and a text's voice, as it constructs authors and readers' roles and relationships. Morgan (2005, 2006) focused on the interpersonal meanings that are construed by mathematics discourse. Such interpersonal meanings may impact the perception of the nature of mathematics by students and position them in certain ways. For instance, the use of nominalization and passive voice very often covers up agency, and shows information as given, not to be actively engaged. Definitions in school mathematics texts reveal a one-to-one relationship between word and concept, whereas definitions in academic mathematical research are portrayed as constructed in nature and allowing creativity (Morgan, 2005). If most math texts that students encounter are presented in the format of procedure, students are likely to perceive math as procedural in nature, thus possibly overlooking other aspects (Morgan, 2006). While the format of texts has been a focus of research, the linguistic choices of textbook authors also appear as relevant for understanding engagement. The linguistic choices made by a textbook author can construct texts as authoritative, as demonstrated by the constant use of imperatives, and these choices create roles and relationships within the texts (Herbel-Einsenmann, 2007).

CHALLENGES OF EARLY ELEMENTARY MATHEMATICS FOR ELLs

In this section, we present some of the findings of the research projects we have developed that explored the challenges of mathematics discourse. Our first year-long project analyzed early elementary mathematics textbooks, Grades 1 through 5, particularly *Everyday Mathematics* (University of Chicago School Mathematics Project, 2004) and *Harcourt Math* (Harcourt, 2004). *Everyday Mathematics* (developed by the University of Chicago School Mathematics Project) is a textbook featuring problem-solving activities, whereas *Harcourt Math* can be considered more of a mainstream textbook in content and format. Our second year-long project investigated sample test items from the Indiana Statewide Testing for Educational Progress (ISTEP+) Grades 3 through 5 (Indiana, 2002), the standardized test used in Indiana, and the multisemiotic resources such as written language, visuals, and mathematical symbols employed in their construction. The examples we use are a representative sample of our corpus.

The Challenges of Noun Groups in Early Elementary Mathematics Textbooks

In this section, we discuss the long and complex nature of noun groups, and highlight the potential challenges they may present to ELLs in making texts harder to understand and act upon. Noun groups are often found in academic registers, but how they are used varies in different disciplines (Fang, Schleppegrell, & Cox, 2006). Our analyses show that in mathematics noun groups have a specific role in the construction of texts as precise, authoritative, and technical, and tend to be long and complex, consisting of the head and multiple pre- and post-modifiers. In terms of the ideational meanings, most of these modifications specify the requirements to be met in reaching a solution to the task, but the complexity of the nominal group structure obscures these meanings, thus making them hard to act upon. Embedded clauses as post-modifiers increase the complexity of the nominal group structure. After tackling the linguistic complexities of nominal groups, the linguistic representations are linked to the mathematical content. The following three examples selected from the textbooks are used to discuss some potential challenges of nominal groups in more explicit terms, and particularly in relation to SFL.

1. "Name a group of nickels, dimes and quarters that has the same value as the 1 half dollar" (Harcourt Math, Grade Two, p. 207).
2. "Sort your group's arrays into piles that have the same number of dots" (University, Grade Two, p. 110).

3. "Draw a bag from which pulling a red cube is most likely and pulling a blue cube is least likely" (Harcourt Math, Grade Two, p. 300).

Distinguishing the head noun from its multiple modifiers requires a level of linguistic awareness that ELLs may not have yet developed. Determining the relations between the head noun and its surrounding elements in terms of modification is important for ELLs' understanding of the mathematical task and performance on the task as expected. There may be linguistic clues that students can use to determine the head noun, but finding and using such clues may not be an easy task for ELLs. The linguistic complexity can be illustrated by the following table, where the elements that modify the head of the noun group, both before and after, are shown.

Table 2. Nominal Group Examples

Examples	Other Elements	Pre-Modifier(s)	Head Noun	Post-Modifier(s)
1	*Name*	*a*	*group*	*of nickels, dimes and quarters that has the same value as the 1 half dollar.*
2	*Sort*	*your group's*	*arrays*	*(into piles) that have the same number of dots.*
3	*Draw*	*a*	*bag*	*from which pulling a red cube is most likely and pulling a blue cube is least likely.*

In example 1, the head noun is *group*, but it is very likely that ELLs may consider *quarters* as the head noun. Thus, there is a conflict here; both *quarters* and *group* can be interpreted as the head. Moreover, at least superficially, *quarters* seems more likely to be the head given its proximity to the embedded clause *that has the same value as the one half dollar*. However, there are linguistic clues that help decide that *group,* not *quarters,* is the head of the noun group. The preposition *of* is used together with *group* (a word that encodes part-whole relationship in its lexical meaning) and the conjunction *and* (in *nickels, dimes and quarters)* to construe the part-whole relation between *group* and *nickels, dimes* and *quarters.* The same part-whole relation is also implied by the lexical relations between *1 half dollar* and *nickels, dimes* and *quarters*, with dollar being the largest denomination. An additional linguistic clue is the third person present tense of *has*, which would be wrong in terms of subject-verb agreement if the head noun were *quarters*.

This task requires students to find a group of coins, and this group of coins needs to have the same value as one half dollar. Here, the use of the relational process *have* also obscures the fact that students have to use the operation of addition to find the group of coins meeting the requirement. Textually, the use of noun groups creates a linguistic order that is different than the order in which students work to reach a solution. The linguistic order is from *name a group of nickels, dimes and quarters,* to *has the same value as the 1 half dollar*. However, in actually carrying out this task, the students may first need to count the coins, sort them into a group, and then name it. The actual *activity sequence* (i.e., the sequence of activities in which students need to engage to complete the task) is the reverse of the linguistic order. Further complicating this is the meaning of "if…then," which is made implicit by the use of the noun group and the imperative mood of the main verb *name*. A more congruent expression might be *if you find a group of nickels, dimes and quarters and they have the same value as the 1 half dollar, name this group*. Interpersonally, this example uses a process in the imperative, *name*, implicitly addressing the reader. This can be considered an exclusive imperative, which constructs students as performers of actions (Herbel-Einsenman, 2007). The choice of this imperative implies that students are being inducted into the mathematics community.

In example 2, the head noun is *arrays* (which is then post-modified by an embedded clause) *that have the same number of dots*. The adverbial *into piles* indicates the resulting state for the arrays, but similar to example 1, *piles* is positioned right before the embedded clause. Thus, ELLs may well take *piles* as the head of the noun group. There are also clues to help them to decide which is the head and therefore better understand the task. First, there is the part-whole relation between *arrays* and *piles,* and therefore we can put arrays into piles, not the other way around. So if *piles* is the head and is subsequently modified by the embedded clause, then what do we do with *the piles that have the same number of dots*? Second, if students know that an adverbial can be moved from its usual end-position before an extended element (in this case, the embedded clause), they may have more confidence to overrule the interpretation that *piles* is the head. Students must meet the requirement for the array to be sorted; that is, they have the same number of dots. Similar to example 1, the use of the relational process *have* again obscures the operation of counting. The linguistic order is from *sort into piles* to *have the same number of dots*. To translate such linguistic representation into the right activity sequence, it is necessary to first unpack the relational process *have* by figuring out the underlying operative process of *counting*. Students first need to do the counting of the number of dots in the arrays and then sort them into piles. Here again, the "if…then" type of relationship is implicitly constructed by the noun group. A more congruent form for example 2 might be *if the arrays have the same number of dots, sort them into piles*. Interpersonally, here again we see a process in the imperative, *sort*, which is an exclusive imperative, constructing students as performers of actions.

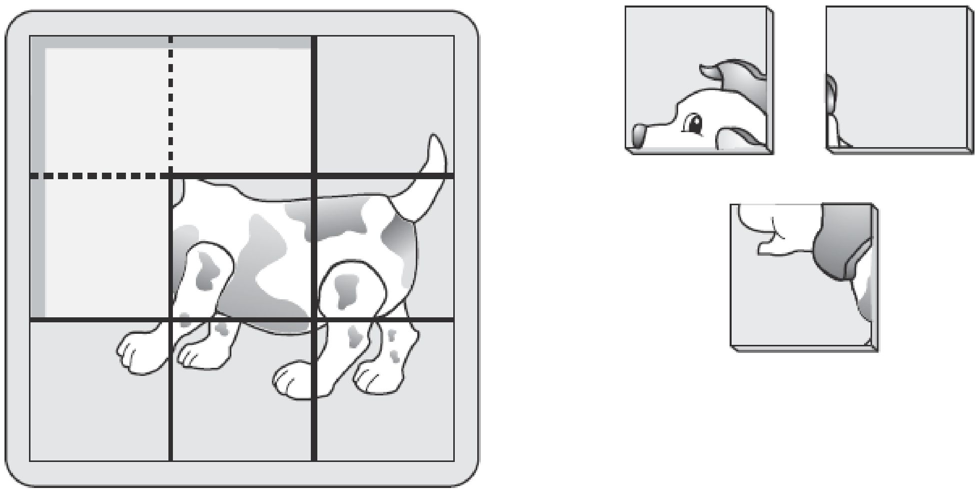
In example 3, the head is easy to identify, but the difficulty comes from the fact that *from which* is shared by *pulling a red cube is most likely* and *pulling a blue cube is least likely.* Alternatively, our analysis reveals that *from which* has been omitted from the second clause *pulling a blue cube is least likely;* ellipsis of this kind is common in academic English. The prepositional phrase *from which* is moved to the initial position of the embedded clause, disrupting the usual flow of the clause. Students unfamiliar with such features of academic English may get confused. Two requirements are to be met simultaneously: both *pulling a red cube is most likely* and *pulling a blue cube is least likely.* In addition, students need to consider how the number of cubes of one color relative to another may affect the likelihood of their being pulled.

These examples show that ELLs would need a high level of linguistic awareness to be able to unpack the noun groups in such a way that their underlying mathematical meanings can be uncovered and acted upon. These are all challenging tasks for ELLs, and what they face in assessment is often no less formidable, as the example below shows.

The Challenges of a Multisemiotic Mathematics Test Item

In this section, we describe the various semiotic systems used in a test item which foregrounded the mathematical information while backgrounding other elements that were used in contextualizing this item. The following example is from the Grade 3 ISTEP item sampler (Indiana, 2002), published online as an example of test items typically found on this standardized test.

4 Jack is trying to finish the puzzle below.



What fraction of the pieces did Jack NOT put in the puzzle?

- ○ $\frac{3}{6}$
- ✓ ○ $\frac{3}{9}$
- ○ $\frac{6}{12}$
- ○ $\frac{6}{9}$

This test item is multimodal in that it employs a verbal statement, visuals, and symbolism in presenting the problem. The verbal statement sets up the context, the visuals represent the context in a more explicit way, while the symbolism (the fractions) is presented in the choices. This item may be challenging for ELLs in the following ways. First, as O'Halloran (2005) argues, there is the foregrounding and framing of mathematical information and the reduction or elimination of other irrelevant information. The visual of the puzzle game is particularly revealing of such foregrounding. The visual only presents a snapshot of the game; neither the process of the game nor the completion of it is mentioned, which may be the major concern of the children engaged in such games.

A closer look at the visual shows that the pieces left out were already organized in their correct positions despite the spaces in between. It seems the sorting of the pieces based on their shape and size is not the issue as far as the visual representation is concerned. It is the mathematical information that is the concern of the test designer. Thus, we argue that there is a strict framing of what students are expected to find in this visual representation and what they can bring to the item. Students may have to learn to reorder or edit their life experiences to work with the strong framing in mathematics problems to perform well on standardized tests, as the mathematics aspects may have never been their concern in their previous engagement with the puzzle game. Their attention may have been on the color, shape, size, image, etc., while doing puzzle games, but attention to these aspects of the representation in this problem may decrease their chances of finding the solution. Thus, a child's intent, interest, and purpose may put them at a disadvantage when interpreting the signs and language presented in this problem. Similarly, the WH-interrogative question (*What fraction…?*) also assumes the mathematical information that students may possibly extract from the visual. It is argued that it may take time for students to discover such a foundation of mathematical information. If such discovery fails, reaching a solution may be out of the question.

The transition from one semiotic system to another may even be more challenging for ELLs. The beginning verbal statement contained two key pieces of information: trying to finish and the puzzle game. This information was then presented in the visual. There were pieces of the puzzle left out, which related to the process of *finish,* and other pieces that were already placed in the puzzle. However, such information is only meaningful when it comes to the question, which asked for the specific mathematical information expected from students. The question contained the nominalization *fraction,* and the very way the question was phrased raised the same problems as were discussed in the section above. In the noun group *fraction of the pieces*, *the pieces* refers to the total number of pieces and *fraction* refers to the pieces that were not yet put in the puzzle. Thus, to work out the answer, students need to go back to the visual. They need to recognize in the visual the part-whole relationship between the total number of pieces and the left-out pieces, count both, and then convert it to a fraction representation. Working back and forth between these different semiotic systems might be very challenging for ELLs.

CONCLUSION

Research on the role of language in mathematics and on the multisemiotic nature of mathematics discourse has helped to identify the challenges that mathematics poses to students, particularly ELLs, and to develop strategies to deal with such challenges. While previous literature on the challenges of the language of mathematics focuses on vocabulary, language structures, and coping strategies, SFL provides a linguistic framework for the systemic examination of the construction of the mathematics discourse, particularly the multiple semiotic systems employed. SFL researchers have contributed to our understanding of mathematics through the exploration of how language, visuals, and symbolism complement and build on each other in constructing mathematical meanings, how mathematics discourse is enacted and unfolds in the classroom, and how students are positioned in the discourse. As the findings presented here show, the language features such as noun groups in early elementary mathematics textbooks are not only linguistically complex, but also obscure the mathematical content in different ways, making mathematical texts hard to engage with. The multisemiotic construct of an ISTEP test item illustrated how the various semiotic systems used colluded to the foundation of mathematical information, and how the transition from one semiotic system to another may cause problems for ELLs.

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