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Does it matter how Molly does it? Person-presentation of strategies and transfer in mathematics

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ABSTRACT

Educational materials often present general concepts or strategies via specific people. Although this practice may enhance interest, it may also have costs for learning and transfer. Linking a strategy to a person (e.g., "Molly's strategy") could result in narrower transfer because students infer that the strategy is specific to the person, rather than a general strategy they should adopt. The present study tested this hypothesis among middle school students (N = 191) who learned a novel strategy for solving a mathematics story problem. For some students, the strategy example was presented via a specific person, and for others it was not. Students then solved posttest problems and rated the generality of the strategy. Students who saw the example without the person were more likely to transfer the strategy to new problems, and this effect was mediated by students' perceptions of the strategy's generality. Thus, associating information with a person substantially limits the extent to which students transfer their knowledge.

1. Introduction

Educational materials often present general principles or concepts via specific people. In science textbooks, this practice is often used to provide a historical context—Natural Selection, for example, is introduced by recounting Darwin's observations on the Galapagos Islands. In mathematics textbooks, novel concepts or strategies are frequently associated with sample students (see Riggs, Alibali, & Kalish, 2015, for a textbook analysis). For example, a textbook might describe an individual encountering a problem ("Molly is trying to figure out…") along with a picture or personifying detail about the individual (Molly is 12-years-old and lives in Wisconsin). The solution strategy itself is often labeled as if it were generated by the individual ("Molly's strategy"). This practice, which we call *person-presentation*, reflects efforts to vivify curricular materials, spark student interest and, by extension, increase learning (Ainley, Hidi, & Berndorff, 2002; Magner, Schwonke, Aleven, Popescu, & Renkl, 2014). In fact, the National Council of Teachers of Mathematics encourages this practice in classrooms: "Some teachers find it effective to name a problem, conjecture or solution method after the student who proposed it" (NCTM, 2000, p. 259). However, research in social cognition suggests that person-presentation may have the opposite of its intended effect. When children learn information about a person, they often interpret that information as specific to that person, and this may inhibit their generalization of that information to new situations (Cimpian & Erickson, 2012; Riggs, Kalish, & Alibali, 2014a, 2014b). In the present research, we investigate whether this same phenomenon occurs when students learn information via person-presentation in curricular materials.

Person-presentation is sometimes used in textbooks in an effort to promote interest. A large body of research demonstrates that interest facilitates learning (see Renninger, Hidi, & Krapp, 2014, for a review). One form of interest that curricular materials can promote is situational interest, in which features of the text focus attention and produce an affective response in the learner (Hidi & Harackiewicz, 2000). Situational interest is thought to be especially important for learning in content domains in which students lack personal interest, such as mathematics (Clinton, Walkington, & Howell, 2013; Hidi, 1990; Hidi & Berndorff, 1998). Textbooks can promote situational interest by including concrete materials (e.g., colorful photographs; Ackerman & Leiser, 2014; Sadoski, Goetz, & Fritz, 1993) or information that demonstrates the relevance of the to-be learned content (Walkington, 2013). Person-presentation may increase situational interest either through the details associated with the person or by demonstrating the relevance of the content, because person-presentation often involves a student using the strategy in a real-world context. Increased interest might enhance students' comprehension of the strategy

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(Cordova & Lepper, 1996; Renninger, 2000).

The very same features that promote student interest may also inhibit students' ability to transfer their knowledge to new contexts. People sometimes have difficulty transferring information learned in perceptually rich, concrete contexts to other contexts that are perceptually dissimilar (Bassok & Olseth, 1995; Day, Motz, & Goldstone, 2015; Rey, 2012). Gentner and colleagues have proposed that dissimilar surface features interfere with students' ability to notice shared relational structures between problems (Gentner & Medina, 1998; Markman & Gentner, 1993). If the initial learning context includes a person as a surface feature, it may be more difficult for students to recognize that a new problem has the same structure and should be solved in the same way. Thus, curricular materials that present information with less perceptual detail may promote greater learning and transfer (Kaminski, Sloutsky, & Heckler, 2008).

Person-presentation may be a special type of concrete detail with unique implications for learning. When there are cues that facts are specific to individuals (e.g., specific labels), children tend to assume that the information should be restricted to the individual in the initial learning context (e.g., Hollander, Gelman, & Raman, 2009; Riggs et al., 2014a). In contrast, when there are cues that the information is general (e.g., a generic label), children generalize the information widely (Cimpian, 2016; Graham, Nayer, & Gelman, 2011). Thus, if person-presentation leads students to assume that strategies are specific to the people presenting them, they may not see the strategy as one that is generally applicable and appropriate for them to adopt.

Past research on person-presentation in adults suggests that it may indeed inhibit transfer. Riggs et al. (2015) presented undergraduates with an example of a problem-solving strategy that was either linked to a specific person or presented without a person. Students who saw the example linked to a person received varying amounts of detail regarding that person (e.g., background information and a picture). Students were more likely to transfer the strategy when it was introduced without a person, regardless of the amount of additional detail associated with the person. These results suggest that person-presentation negatively affects adults' transfer, above and beyond the additional details that including a person entails.

In light of the frequency of person-presentation in middle-school mathematics textbooks (Riggs et al., 2015), it is important to know whether middle-school students also experience learning costs when strategies are associated with a person. Previous research has demonstrated the negative effect of person-presentation in a college-age population in a laboratory setting; however, this research may have limited applicability to younger students and authentic instructional contexts. A college student participating in a research study for course credit may have different motivations about learning than would a middle-school student in the course of their regular school day. Thus, the current study was conducted in middle school classrooms and the materials were administered by teachers.

The goal of the present research was to examine whether person-presentation of novel problem solving strategies affects middle school students' transfer. We hypothesized that strategies presented via person-presentation will be transferred at lower rates compared to strategies that are presented without a person. We also sought to extend prior research by investigating *why* person-presentation may incur such learning costs. Toward this end, we measured students' inferences about the generality of the strategy. We hypothesized that person-presentation would lead students to assume that the strategy is specific to the person presenting it. A strategy associated with Molly, for example, might be interpreted as information about Molly rather than as a strategy that other people should use. Thus, linking a strategy to a specific person may result in narrower transfer. If this is the case, then person-presentation may affect performance *via* its influence on participants' interpretation of the generality of the strategy.

We also examined the relationship between encoding of the person in the strategy example and transfer. Here, we consider two potential hypotheses. First, it may be that the more students encode about the person, the less likely they are to transfer the strategy. Children and adults show this pattern when learning facts about specific people (Archambault, O'Donnell, & Schyns, 1999; Riggs et al., 2014a, 2014b), so it is possible that this might apply to learning strategies, as well. Alternatively, if students are highly engaged in the strategy example, they may remember the person and transfer the strategy. If the first hypothesis is confirmed, it would suggest that person-presentation affects transfer by diverting students' attention away from the strategy itself. If the second hypothesis is confirmed, it would suggest that person-presentation increases situational interest, which leads to better encoding of the content of the example.

2. Methods

2.1. Participants

Participants were recruited from private religious schools in a mid-sized city in the midwestern United States. We contacted schools until we had agreements from enough schools to insure a sufficient number of seventh and eighth grade pre-algebra students to attain the desired sample size. All pre-algebra students in the relevant grades participated as part of their regular math instruction. This recruitment method yielded a sample of 196 students. We excluded 3 students for leaving the posttest entirely blank and 2 students for writing the multiplicative strategy on their desks while they read the strategy example. Thus, the final sample included 191 participants.

The study was deemed to be exempt research by our institutional IRB because it involved normal educational practices in an established educational setting. As such, we did not collect demographic information from individual participants; however, we did obtain demographic information about each school (see Table 1). Because we included all pre-algebra students at each school, it is likely that our sample reflected the demographic makeup of the schools.

2.2. Task domain

As our experimental task, we selected algebra story problems about constant change. The teachers reported that students had not encountered constant change problems in their curriculum prior to the

Table 1
Demographics of participating schools.

School	n	% FRL	% Female	% White	% Black	% Hispanic	% Asian	% > 1 Race
1	54	0	54	75	6	4	11	4
2	17	16	51	76	9	5	4	6
3	15	1	60	62	20	7	5	6
4	30	2	45	97	1	1	1	0
5	13	0	75	81	6	6	3	4
6	26	0	48	77	7	8	3	5
7	36	9	49	82	11	4	2	1

Note. "FRL" indicates the percentage of students eligible for Free and Reduced lunch.