



Learning from explaining: Does it matter if mom is listening?

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Abstract

The goal of the current study was to examine whether explaining to another person improves learning and transfer. In the study, 4- and 5-year-olds ($N = 54$) solved multiple classification problems, received accuracy feedback, and were prompted to explain the correct solutions to their moms, to explain the correct solutions to themselves, or to repeat the solutions. Generating explanations (to selves or moms) improved problem-solving accuracy at posttest, and explaining to mom led to the greatest problem-solving transfer. The study indicates that explanation prompts can facilitate transfer in children as young as 5 years and reveals that it matters if mom is listening.

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Introduction

Conversations with others can provide a natural context for people to articulate and specify their ideas. Previous work on peer collaboration and tutoring suggests that generating explanations for another person, rather than oneself, is associated with greater learning (e.g., Manion & Alexander, 1997; Teasley, 1995). Similarly, researchers interested in parent–child communication have long argued that everyday conversations between children and their parents might lead to knowledge acquisition (e.g., Clarke-Stewart, 1973; Fivush & Nelson, 2004). However, it is unclear whether generating explanations stimulates

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learning because of the interaction and input of parents and peers or does so in its own right. To investigate this question, a comparison between explanation to the self and to a partner who simply listens is necessary. Specifically, we compared 4- and 5-year-olds' learning of multiple classification when they were prompted to generate explanations for themselves, for their moms, or not at all.

It may be that prompting children to explain the reasoning behind correct solutions to themselves is a substitute for the positive influences of a listener. For example, Teasley (1995) suggested that any activity that encourages interpretive thinking should increase learning regardless of the presence of a partner. Alternatively, children may alter their explanations for others, but different types of explanations can be equally effective at promoting learning (Renkl, 1997). Nevertheless, there is reason to suspect that explaining to another person improves learning. People often produce more detailed and explicit explanations and justify their ideas more for other people than for themselves (Krauss, 1987; Loewenthal, 1967), and young children adjust their speech based on the age of the listener (Shatz & Gelman, 1973). Explaining to others may increase motivation and support more complete and explicit knowledge. In turn, this improved knowledge should be more easily transferred to new situations and problems.

The impact of a listener on learning has important implications for the benefits of prompting people to explain. In domains ranging from number conservation to the human circulatory system, people learn more if they are prompted to generate their own explanations for correct material and procedures (e.g., Chi, de Leeuw, Chiu, & LaVancher, 1994; Schworm & Renkl, 2007; Siegler, 2002; Wong, Lawson, & Keeves, 2002). This has been labeled the self-explanation effect because explanations are generated *by* the self. However, in nearly all experimental evaluations of the effect, there has been an audience for the explanations, typically the experimenter. The current study reveals whether it matters if the explanations are generated *for* oneself or someone else.

The current study also extends previous research on explanation prompts by examining their effects on transfer of knowledge and skills to novel tasks in young children. The youngest age at which general prompts to explain have been shown to improve transfer is eight (Rittle-Johnson, 2006; Siegler, 2002), and one study failed to find a benefit of explanation prompts at this age (Mwangi & Sweller, 1998). Related research on text comprehension suggests that 6- to 8-year-olds do not benefit from prompts to explain text (Pressley et al., 1992). Thus, an additional goal of the current study was to evaluate the impact of explanation on transfer in young children.

The current study

We evaluated how prompting 4- and 5-year-olds to generate explanations for themselves, to generate explanations for their moms, or not to generate explanations at all affected learning. Moms served as the listeners because this is a more natural context for young children, who might generate better explanations for familiar persons than for unfamiliar persons (French, Lucareillo, Seidman, & Nelson, 1985).

During the study, children were asked to complete a multiple classification task that tapped their ability to detect patterns and integrate two different dimensions simultaneously (Inhelder & Piaget, 1964). The National Council of Teachers of Mathematics (2006) recommended that patterns be a focal point of instruction in pre-K and kindergarten

ten, and success at multiple classification predicts children's performance in a wide variety of domains (Arlin, 1981; Bigler & Liben, 1992). Preschool- and kindergarten-age children often fail multiple classification tasks because they focus on only one dimension (e.g., color) and fail to notice a pattern along each dimension (Arlin, 1981; Inhelder & Piaget, 1964). Finally, 4- and 5-year-olds have failed to learn multiple classification skills in several training studies (Parker, Sperr, & Rieff, 1972; Sigel, Roeper, & Hooper, 1966).

In the current study, children were shown a series of different colored bugs and were asked to decide which colored bug came next in the pattern. They needed to attend to two dimensions, bug type and color, to solve the patterns correctly. We expected that prompts to explain would improve success on familiar patterns and that prompts to explain to their moms would support the greatest success on novel transfer patterns.

Method

Participants

A total of 54 children (mean age = 5.1 years, range = 4.5–5.9, 29 boys and 25 girls) participated. Families were recruited through a database of families interested in research participation, and most were from white middle-class backgrounds. An additional 13 children did not complete the study because of noncompliance (1), parental interference (3), or high scores on pretest items (9).

Design

Children completed a pretest, an intervention, and a posttest. Children who did not solve most of the pretest patterns correctly were randomly assigned to one of three intervention conditions: no explain, explain to self, or explain to mom ($n = 18$ per condition, with no difference in average age across conditions, $p = .53$). During the intervention, all children solved six patterns and were told the correct answers. Children in the no-explain condition were prompted to repeat the correct answers out loud, children in the explain-to-self condition were prompted to explain how to figure out the correct answer to themselves, and children in the explain-to-mom condition were prompted to explain to their moms. During the posttest, all children solved two patterns similar to those presented during the intervention (familiar trials) and two patterns with a novel structure (transfer trials).

Materials

The multiple classification problems were patterns based on six kinds of bugs and six different colors from a set of counters. For each problem, children were shown six colored bugs. In the easy level of difficulty, children were shown patterns of an ABBABB or BBABBA format, where Bug A was different in kind and color from Bug B (e.g., green grasshopper and blue spider). In the hard level of difficulty, children were shown patterns involving three different colored bugs in the pattern ABCABC or CBACBA, where Bugs A and B were the same color but different in kind and Bugs B and C were the same kind but

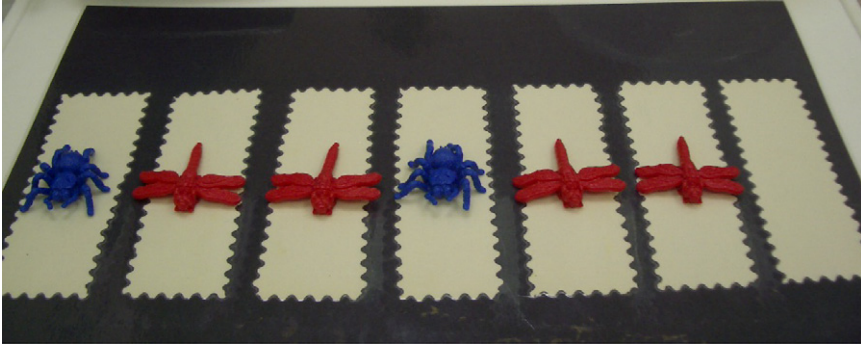


Fig. 1. An easy pattern on the game board. On this pattern, the spiders were blue and the dragonflies were red. The nine potential answer choices were a cross of three bug types (spiders, dragonflies, and caterpillars) and three colors (red, blue, and yellow). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

different in color (e.g., red spider, red bee, and blue bee). A game board with seven spots was used for presenting each pattern (Fig. 1).

Procedure

Children completed the study in a single session at our laboratory. An experimenter described the study to the moms, asked them not to provide help, and obtained written consent. Then moms were seated behind their children and were given magazines. The session was divided into three parts: pretest, intervention, and posttest. The entire session was videotaped.

At the beginning of the pretest, children were asked to label an instance of each color and then an instance of each kind of bug. If children had difficulty in labeling an item, a label was provided and they were asked to label the item again. Then, for each pattern, the six colored bugs were placed down one by one on the game board by the experimenter, who said, “Look at these together. What do you think comes right here?” (while pointing to the seventh box). Children were given nine different colored bugs from which to choose. On the pretest (and posttest), children were asked to label their choices and to report how they made their decisions. For the pretest, two hard patterns were presented first, and if children solved two hard patterns incorrectly, they were presented with two easy patterns. For a given difficulty level, if children solved one pattern correctly and one pattern incorrectly, a third pattern was presented. Children who solved two hard pattern problems correctly pretested out of the study; children who solved two easy pattern problems correctly were given hard patterns during the intervention.

Then children were familiarized with the tape recorder and were told they would make a tape to take home. During the intervention, children solved six problems at the appropriate level of difficulty. There was an equal distribution of children across the three conditions who received hard patterns during the intervention, $n_s = 4, 6,$ and 7 for the no-explain, explain-to-self, and explain-to-mom conditions, respectively, $\chi^2(2) = 1.2,$ $p = .55$. We expected condition to have the same effect on learning regardless of pattern difficulty.

After solving each intervention problem, the experimenter told children the correct answer, naming both the color and type of bug. In the no-explain condition, children were asked to repeat the correct answer into the tape recorder and were reminded that they would take the tape home with them. The experimenter gave general encouragement after each trial (e.g., “Thanks for thinking about it”).

In the explain-to-self condition, on the first intervention problem, children were told, “While I get ready for the next problem, I’m going to have you tell yourself about the problems. You can make a tape of what you say so you can listen to it later. I’ll turn on the tape recorder, and when you are done, you should turn it off. Can you explain to yourself how to figure out that the [correct choice] comes next?” The experimenter then turned away, avoided looking at the children, and busied herself getting ready for the next trial. After 5 s, if children had not said anything, the experimenter repeated the last sentence. After an additional 5 s, if children still had not said anything, the experimenter gave general encouragement and moved on to the next problem. On subsequent intervention problems, the experimenter said only the last sentence.

For the explain-to-mom condition, the procedure was the same as for the explain-to-self condition except that children were prompted to explain to their moms. The experimenter had alerted the moms during the prebriefing that their children would be explaining answers to them during the middle part of the session. Moms were asked not to give their children any help and simply to listen. The script was modified so that (a) the explanation prompt directed children to explain to their moms, (b) moms moved their chairs so that they were in view of their children and could see the patterns well, and (c) moms, rather than the experimenter, repeated the explanation prompt if their children had not said anything after 5 s and provided the general encouragement at the end of the trial. At the end of the intervention phase, moms moved their chairs back behind their children. Three moms could not resist giving their children help during the intervention (e.g., “What about the color?”), and their children were excluded from the study.

After the intervention, children solved two familiar problems (identical in structure to the intervention problems) and two transfer problems without feedback. For the transfer problems, children were shown the first through fourth and sixth colored bugs of the pattern and were asked to predict the colored bug that belonged in the fifth spot. The transfer problems assessed whether children had developed a rule that allowed them only to correctly predict the seventh colored bug such as repeating the first colored bug.

Coding

Children’s answer choices and explanations were transcribed from the videotapes. Children’s answer choices were scored, giving one point for each correct dimension. Thus, children received partial credit if they could identify one dimension correctly. Children’s explanations of the correct answers during the intervention were coded for mentioning a pattern. Credit for a pattern explanation was given if children referred to at least two items in the pattern (not including the answer), either in speech (e.g., “Because green, blue, blue, green, blue, blue, green”) or in gesture (e.g., “Because all the bugs in the pattern” while pointing across the bugs in the pattern). Nonpattern explanations included focusing on one previous bug in the pattern (11% of explanations) or saying “don’t know” (13%) or “because I knew it” (13%). An additional person coded 20% of children’s explanations, and the interrater agreement was 94%.

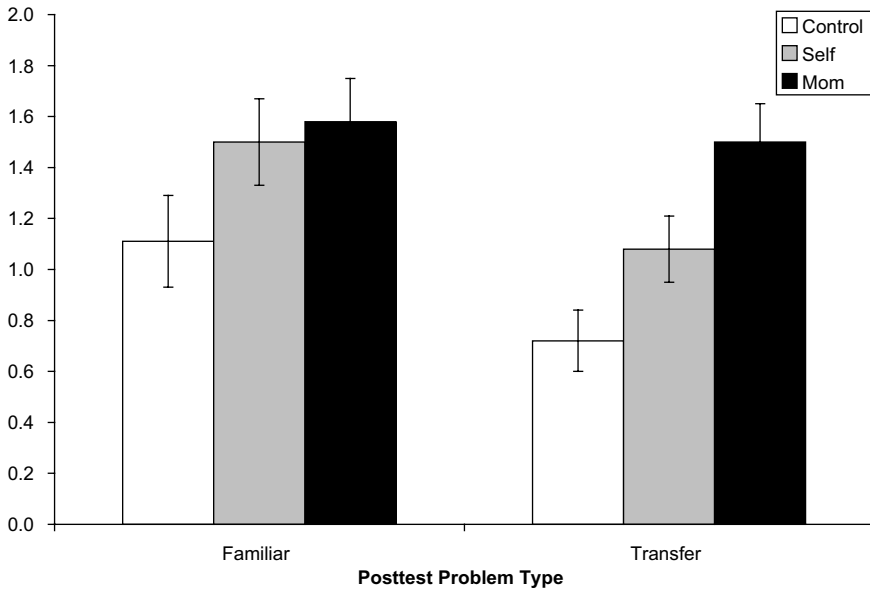


Fig. 2. Mean accuracy scores across the two familiar and two transfer problems at posttest by condition.

Results

Accuracy

The average accuracy at pretest was 0.8 on a 2-point scale (range 0–1.5), indicating that children tended to be correct on one of the two dimensions. Accuracy scores did not differ by condition at pretest, $F(2, 51) = 0.486$, $p = .62$, ($M_s = .70$, $.85$, and $.83$ for no-explain, explain-to-self, and explain-to-mom conditions, respectively).

Accuracy scores on the familiar and transfer problems at posttest varied by condition, as shown in Fig. 2. To compare performance in the three conditions, we conducted two orthogonal planned comparisons. We first tested for an effect of explanation (explain-to-mom and explain-to-self conditions vs. no-explain condition) and then tested for an effect of a listener (explain-to-mom vs. explain-to-self conditions). We included pretest accuracy and age as covariates in these analyses.

On the familiar problems, children who explained had higher accuracy scores than did children who did not explain, $F(1, 49) = 4.792$, $p = .033$, $d = .58$, but accuracy did not differ based on whether children explained to themselves or to their moms, $p = .97$, $d = .11$. On the transfer problems, children who explained had much higher accuracy scores than did children who did not explain, $F(1, 49) = 12.050$, $p = .001$, $d = .97$, and children who explained to their moms had higher accuracy scores than did children who explained to themselves, $F(1, 49) = 4.361$, $p = .042$, $d = .70$. The effect of condition was the same for children who received easy and hard patterns on the familiar problems, $F(2, 46) = 0.272$, $p = .763$, $d = .01$, and on the transfer problems, $F(1, 46) = 0.423$, $p = .657$, $d = .02$. If children's responses were scored using a stricter criterion of getting both dimensions correct, the findings were the same (average percentages correct for the

no-explain, explain-to-self, and explain-to-mom conditions were 42, 72, and 75% on the familiar items and 19, 39, and 64% on the transfer items, respectively). Thus, generating explanations, regardless of a listener, improved learning of the task at hand, but generating explanations for one's mom led to more flexible knowledge that could be transferred to novel problems.

Explanation quality

Why did children in the explanation groups learn more? We explored whether explanation quality during the intervention predicted accuracy at posttest. Indeed, the more often children provided pattern explanations, the better were their posttest accuracy scores, $r(34) = .33$, $p = .05$, and children who provided a pattern explanation on more than half of the intervention trials had better posttest scores ($M = 1.56$, $SD = 0.44$, vs. $M = 1.22$, $SD = 0.57$), $F(1, 34) = 4.510$, $p = .04$, $d = .68$. Note that children in the control condition did not explain, so they were not included in these analyses.

We also explored whether the presence of one's mom influenced explanation quality. We predicted that prompts to explain to another person should encourage more explicit comments about the pattern than prompts to explain to oneself. Children in the explain-to-mom condition ($M = 0.61$, $SD = 0.46$) tended to provide more pattern explanations during the intervention than did children in the explain-to-self condition ($M = 0.43$, $SD = 0.44$). The proportion of children who provided a pattern explanation on more than half of the trials was also greater in the explain-to-mom condition (67 vs. 44%). However, neither difference was reliable, $F(1, 34) = 1.530$, $p = .22$, $d = .40$, and $\chi^2(1) = 1.80$, $p = .18$. Although not significant, the moderate effect size, combined with the difficulty of eliciting clear verbal explanations from young children, suggests that children in the explain-to-mom condition may have been more likely to explicitly think about the patterns than were children in the explain-to-self condition.

Discussion

First, the findings add to a growing body of literature that explanation prompts are an effective way to improve learning by extending this benefit to improved transfer in children as young as 4 or 5 years and to a Piagetian-like multiple-classification task on which previous training studies have not been successful with children this young. Second, the findings reveal that having a listener for the explanations matters. Learning in a social context emerges partially from the act of explaining with another person in mind, not just from the support and knowledge provided by the other person.

Implications for learning from explaining

The benefit of generating explanations often is referred to as the self-explanation effect because explanations are self-generated (Chi, Bassok, Lewis, Reimann, & Glaser, 1989). However, self-explanations often are not generated *for* oneself. Given the findings of the current study, self-explanations may be generated *by* the self, but their effectiveness may partially depend on being generate *for* someone else. Clearly, whether a

listener is present and who the listener is are important considerations for understanding self-explanation.

Having an intended audience for the explanations may improve explanation quality. Past research has found that explanations that adults generate for others tend to be longer and more detailed and to include more alternative ideas and better justifications than those generated for the self (Krauss, 1987; Loewenthal, 1967). An audience may hasten representational redescription in which implicit knowledge becomes more explicit (Karmiloff Smith, 1993). In the current study, children who explained to their moms were somewhat more likely to reference the pattern, in speech or in gesture, than were those who explained to themselves, and frequency of pattern explanations was predictive of posttest performance. These children were also more likely to solve the transfer problems correctly, and doing so required attention to the entire pattern. Explaining to their moms may prompt children to be more explicit and/or to generate more generalizable rules. Eliciting clear explanations from young children is a challenge, and future research is needed to confirm these suggestive findings and to evaluate whether older children and adults benefit from the presence of a listener.

Learning in a social context

Both parent–child conversations and peer collaborations are central sources of learning. Past research often has focused on the knowledge and support offered by the conversational partner directly such as the supports offered by mothers (French et al., 1985) or the conflicting viewpoints provided by a peer (Tudge & Rogoff, 1989). The current research indicates that the benefits of learning with others goes beyond the support and knowledge provided by the conversational partner. Explaining to moms led to greater knowledge transfer even when moms simply listened.

This may have occurred in part from improved explanation quality. Explaining to one's mom may also increase general motivation. Wanting to show their moms “what they know” may have motivated children to be more focused on the task at hand. However, the simple presence of their moms was not adequate to engender this motivation given that moms were in the room for children in all conditions. Thus, the social context of explaining to others may encourage greater motivation on the task and/or promote better explanations even when the partners do not provide any input.

An open question is whether the effects of a listener would be different if the listener were less familiar or less knowledgeable. First, is there something special about moms, with whom children have extensive histories of interaction and norms, or will the same benefit be seen in children explaining to their dads, teachers, or unfamiliar adults? Second, does it matter if the listener is less knowledgeable and presumably does not know correct explanations? Indeed, explaining to a less knowledgeable listener may increase the clarity and depths of the explanations. These are important questions for future research.

Conclusion

Prompts to explain improve learning, even for young children, and having an audience for the explanations facilitates transfer of this knowledge to novel problems. Presence of a

listener may provide a natural context for helping children to stay motivated and integrate knowledge across multiple dimensions of a problem. The general lesson might be that if you are having difficulty in understanding something, you should try explaining it to your mom.

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