



Brief article

Older, not younger, children learn more false facts from stories

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Abstract

Early school-aged children listened to stories that contained correct and incorrect facts. All ages answered more questions correctly after having heard the correct fact in the story. Only the older children, however, produced story errors on a later general knowledge test. Source errors did not drive the increased suggestibility in older children, as they were better at remembering source than were the younger children. Instead, different processes are involved in learning correct and incorrect facts from fictional sources. All ages benefited from hearing correct answers because they activated a pre-existing semantic network. Older children, however, were better able to form memories of the misinformation and thus showed greater suggestibility on the general knowledge test.

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1. Older, not younger, children learn more false facts from stories

During childhood, children are busy acquiring a knowledge base that they will add to throughout their lives. During their early school years, in particular, children

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learn large amounts of information everyday. Children learn from traditional sources such as the classroom, non-fiction books and their parents, as well as less reliable sources such as television, movies and fictional stories.

Educators often encourage the use of fiction in the classroom. It is thought to increase student enjoyment and participation (Palmer & Burroughs, 2002) and to help children connect what they learn in the classroom to their daily life (Berson, Ouzts, & Walsh, 1999). One problem, however, is that stories may contain factual errors. For example, Rice (2002) examined 50 popular children's trade books and documented numerous errors. These included labeling a mushroom as a plant and describing snakes as slimy. In reality, mushrooms are fungi and snakeskin is dry. The critical question is: how does reading these errors affect the child?

Adults who read stories containing correct facts later answer more general knowledge questions correctly than if they had not read the stories. In addition, reading errors in stories increases production of those specific incorrect answers on the later test, and reduces correct responding below baseline (Marsh, Meade, & Roediger, 2003). The latter result is key; reliance on the incorrect facts is not limited to when readers had no previous knowledge. Instead, subjects who could have answered the question correctly before reading the story are now responding with the incorrect answer.

In addition to examining *if* children learn falsehoods from fictional stories, it is important to consider whether younger or older children are more likely to learn this incorrect information. The first possibility is that younger children will be more likely to reproduce story errors than will older children. This finding would be compatible with a large body of research documenting that suggestibility declines with age (see Bruck & Ceci, 1999, for a review). The second hypothesis is that older children will be more likely to learn story errors because of their greater overall memory skills. Second graders show better memory for stories than do kindergarteners (Howe, 1991). Older children also have more general world knowledge than younger children and the quality of a knowledge structure has a large effect on later recall (Chi, 1978; Lindberg, 1980; Schneider, Korkel, & Weinert, 1989). Compared to younger children, older children may be more suggestible because they are more likely to remember the story facts.

Our search of the psychology and education literatures yielded only two instances in which researchers quantified children's learning from a specific story. Mayer (1995) concluded that children learned inaccuracies from the story *Dear Mr. Blueberry*, although the only data reported was that five out of fifteen children responded with a factual error to the question "Did you learn anything about whales that you did not already know?" Rice (2002) reached similar conclusions, although again the data were presented in the form of examples rather than aggregate statistics. For example, reading books about whales taught children that whales are unable to smell, but also misled the children into thinking that whale calves do not sleep.

To determine what young children learn from fictional stories, children in three age groups (5.5-year-olds, 6.5-year-olds and 7.5-year-olds) listened to two short stories. Embedded in each story were correct and incorrect facts about the world. The children were then asked a series of general knowledge questions, some of which referred to story facts. Each question was asked first in cued recall form and then

as a two-alternative forced choice question that paired the correct and misinformation answers. To determine if the children's suggestibility was due to source difficulties, children were asked if they had heard their answer in the stories.

2. Method

2.1. Subjects

Fifty-two children participated in the experiment: 16 5.5-year-olds (5 male, 11 female; mean age = 5.58, range: 5.33–5.97), 16 6.5-year-olds (9 male, 7 female; mean age = 6.53, range: 6.00–6.99) and 20 7.5-year-olds (10 male, 10 female; mean age = 7.46, range: 7.05–7.99).

2.2. Materials

Four fictional short stories were modified so that each contained six facts about the world; facts were added to the text as seamlessly as possible. The stories described a trip to the Eiffel Tower, a trip to the Leaning Tower of Pisa, some farmyard animals' search for the Sun, and a skunk who learned to defend himself (Ang-elou, 2004a, 2004b; Arnold, 2002; Harrison, 1986). The facts came from Brain Quest: Grade 1 (Feder, 1999) and included the name for a mother sheep, the number of eggs in a dozen, and the French translation of "thank you". For each fact, a misleading version was created. For example, a correct reference to autumn read as "that's another word for fall" whereas the misleading version incorrectly stated "that's another word for spring". In each story, half of the facts were correct and half were misleading. Fact format was counterbalanced across subjects. On average, the stories lasted 4 min, and each child listened to two stories (counterbalanced across subjects).

The general knowledge test contained 24 cued recall questions such as "What's another word for autumn?" Half of the questions referred to facts from the presented stories. The rest tested facts from the two stories that the child had not heard, providing a baseline of what children knew before the experiment. A two-alternative forced-choice version of each question was also created, which required discriminating between the correct and misinformation answers.

2.3. Procedure

The child sat in front of a computer while wearing headphones. The pictures appeared on the computer while the story was presented auditorially. Whenever the narrator reached the end of a page, a tone sounded and the child pressed the spacebar for the next illustration. The children were told to listen to the stories carefully. To ensure that the children were paying attention the experimenter twice asked the child a question about the plot of the story.

After the story phase, the child spent approximately one minute completing two mazes as a short filler task. The child then answered the 24 general knowledge

questions. The experimenter read the questions aloud and the child answered verbally. The child was warned that some of the questions would be very hard and to say, “I don’t know” if she did not know the answer. Each question contained three parts, beginning with the cued recall question, e.g., “What’s another word for autumn?” After responding, the child chose between the correct and misleading answers, e.g., “Is it spring or fall?” This choice was requested regardless of the correctness of the cued recall response. The child was then asked if her chosen answer had been presented in the stories. All three parts of the question were answered before the experimenter asked the questions about the next fact.

3. Results

3.1. Correct answers on cued recall general knowledge test

First, we examined the proportion of the general knowledge questions answered correctly. As shown in the left side of Table 1, the 5.5- and 6.5-year-olds performed very similarly and thus were combined into one group for the analysis (6-year-olds). A 3 (fact framing: correct, not read baseline, misleading) \times 2 (age group: 6-year-olds, 7.5-year-olds) ANOVA was computed on the proportion of the cued recall questions that were answered correctly. As expected, the older children ($M = .51$) answered more questions correctly than the younger children ($M = .33$), $F(1, 50) = 24.58$, $MSE = .05$, $p < .001$. There was also a main effect of fact framing, $F(2, 100) = 7.26$, $MSE = .02$, $p < .001$. Based on previous research this effect was further examined using t -tests. The children correctly answered more questions after having heard the correct answer in the story ($M = .46$) than if they had not listened to the relevant story ($M = .38$), $t(51) = 2.98$, $SEM = .02$, $p < .01$. While numerically performance was reduced below the not-read baseline after hearing the misinformation ($M = .35$), the difference did not reach traditional levels of significance, $t(51) = 1.32$, $p = .20$. There was no interaction between age and fact framing; both age groups showed the same pattern.

Table 1

Proportion of cued recall questions answered correctly or with misinformation as a function of fact framing in the story, and age

Age	Correct answers			Misinformation answers		
	Correct	Not read baseline	Misleading	Correct	Not read baseline	Misleading
5.5-year-olds	.36 (.20)	.28 (.10)	.26 (.14)	.03 (.07)	.04 (.06)	.06 (.12)
6.5-year-olds	.40 (.21)	.34 (.17)	.31 (.24)	.03 (.07)	.02 (.05)	.05 (.13)
<i>M</i> (6-year-olds)	.38 (.20)	.31 (.14)	.29 (.20)	.03 (.07)	.03 (.05)	.06 (.12)
7.5-year-olds	.58 (.20)	.50 (.15)	.44 (.19)	.02 (.05)	.03 (.05)	.13 (.13)

Standard deviations are in parentheses.

3.2. Misinformation answers on cued recall general knowledge test

Misinformation was defined as the specific incorrect answer associated with each question. Other incorrect answers were not counted as misinformation.

As shown in the right side of Table 1, the 5.5- and 6.5-year-olds again performed very similarly and thus were combined into one group for the analysis. Base rate production of misinformation was low for both age groups; it was rare for the children to produce misinformation if they had not heard it in the stories. There was a main effect of fact framing; children were more likely to produce misinformation if they had heard misinformation in the story ($M = .08$) than if they had heard the correct answer ($M = .03$) or had not listened to the relevant story ($M = .03$), $F(2, 100) = 9.55$, $MSE = .01$, $p < .001$.

Most importantly, as shown in Fig. 1, after hearing a specific piece of misinformation in the story, older children reproduced that misinformation more often on the final test ($M = .13$) than did the younger children ($M = .06$). This resulted in a significant interaction between fact framing and age, $F(2, 100) = 3.27$, $MSE = .01$, $p < .05$. The older children produced more misinformation after hearing it in the story ($M = .13$) than if they had not listened to the relevant story ($M = .03$), $t(19) = 3.15$, $SEM = .03$, $p < .01$. While numerically the younger children's misinformation answers also increased after hearing misinformation in the story ($M = .06$, as compared to the not read baseline, $M = .03$), this difference was not significant, $t(31) = 1.38$, $p = .18$.

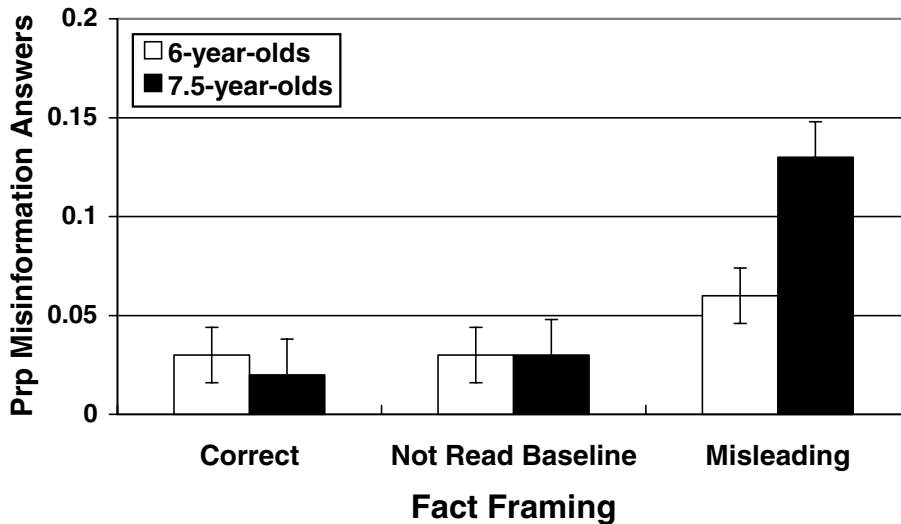


Fig. 1. The effect of fact framing on production of misinformation answers on the cued recall test for both age groups.

3.3. Other wrong answers on the cued recall general knowledge test

It could be that the younger children answered fewer questions with misinformation because they were unwilling to offer answers that could be incorrect. This was not the case. When we examined the proportion of other wrong answers (incorrect answers other than the misinformation), we found that the younger children were *more* likely to answer the questions incorrectly ($M = .29$) than the older children ($M = .16$), $F(1, 50) = 8.18$, $MSE = .07$, $p < .01$.

3.4. Multiple-choice test

Because the children chose between the correct and misinformation answers, the proportion of correct and misinformation answers are compliments of each other. We examined the misinformation responses to see if the age difference found with the cued recall data would also occur with the multiple-choice questions.

As with the cued recall data, there was a main effect of fact framing. Children were more likely to choose the misinformation if they had heard the misinformation in the story ($M = .29$) than if they had heard the correct answer ($M = .19$) or had not listened to the relevant story ($M = .23$), $F(2, 100) = 7.55$, $MSE = .02$, $p < .001$. There was also a main effect of age: younger children answered more questions with misinformation ($M = .27$) than did the older children ($M = .21$), $F(1, 50) = 4.33$, $MSE = .03$, $p < .05$. Critically, the interaction between age and fact framing was not significant. After having heard the misinformation in the stories, the older children were no more likely to choose the misinformation answer ($M = .28$) than were the younger children ($M = .30$). The lack of an age difference here is likely due to the general insensitivity of recognition tests to developmental differences (Brainerd, Reyna, Howe, & Kingma, 1990).

3.5. Source memory

Of interest was children's ability to discriminate between what they had versus had not heard in the stories. A story attribution occurred when the child said that her answer had been presented in the stories. We first computed the proportion of *correct* answers that were correctly attributed to the stories. Idealized performance, however, would involve only making story attributions when the correct answer had in fact been presented. Thus, we also computed a measure of incorrect story attributions, consisting of the proportion of correct answers incorrectly attributed to the stories (that is, when the fact had not actually been presented in the experiment). Incorrect story attributions were subtracted from correct story attributions, yielding a measure of the child's source memory abilities. Older children ($M = .49$) were marginally better at discriminating which correct answers had and had not been in the stories than were the younger children ($M = .30$), $t(50) = 1.95$, $p = .06$.

Next, we computed the proportions of correct and incorrect story attributions for *misinformation* answers. The proportion of incorrect attributions was subtracted from the proportion of correct attributions and this measure was examined for

age effects. This analysis excluded seven subjects who did not choose any misinformation answers on the multiple-choice test (3 younger and 4 older children). Source memory for misinformation paralleled what was observed for correct answers; older children ($M = .66$) demonstrated better source memory for their answers than did the younger children ($M = .26$), $t(43) = 3.09$, $SED = .13$, $p < .01$.

4. Discussion

We found that early elementary school aged children learned information from fictional stories. Children of all ages later correctly answered more general knowledge questions after having heard the correct answers in a story. There were also negative effects of listening to a story. Hearing misinformation in a story increased the likelihood that children of all ages would choose the misinformation answer on a later multiple-choice general knowledge test. Only the older children (7-year-olds), however, reproduced the stories' errors on a cued recall test.

The children's suggestibility on the cued recall test was not due to difficulties with source memory. The older children, who were more likely to produce misinformation on the final test, were *better* at source discrimination than the younger children. The correlation between misinformation produced on the recall test and source ability was positive, $r(45) = .38$, $p < .05$ (and remained significant when age was partialled out, $r(42) = .31$, $p < .05$). The children with better source memory abilities were more likely to produce misinformation on the test. This differs from episodic memory paradigms where children with better source memory are less susceptible to leading questions (Giles, Gopnik, & Heyman, 2002).

The differential age effects in story costs and benefits suggests that separate processes may be involved in learning correct versus misleading information. Because most of the correct facts were likely to have been learned prior to the experiment, hearing them in the story activates pre-existing associations in semantic memory. This simple process is equally effective in both the younger and older children, thus there are no age differences in story benefits. In contrast, false facts are unlikely to be represented in memory pre-experimentally and instead require the formation of new associations. Because the older children have better episodic memory abilities, they are better able to remember the misinformation and more likely to produce it on the cued recall test.

Our result parallels Marsh, Balota and Roediger's (2005) findings with college students and older adults. Both age groups learned correct facts from the stories, but the college students learned more of the misinformation. Marsh, Balota, and Roediger (2005) used neuropsychological tests to provide additional support for the idea that different processes are involving in learning correct versus incorrect facts. Among older adults, story benefits were related to preserved semantic knowledge (e.g., as measured by the Boston Naming Test), whereas learning misinformation correlated with associative memory abilities.

This is not the first time that older children have been shown to be more suggestible than younger children. In fact, such a result was directly predicted by fuzzy-trace

theory (Ceci & Bruck, 1998; Reyna & Brainerd, 1998). According to the theory, older children will be more suggestible than younger children whenever suggestibility effects depend upon verbatim memory, as in our paradigm. Fuzzy-trace theory also predicted the finding that older children are more suggestible in the Deese–Roediger–McDermott (DRM) paradigm, although this effect occurs for different reasons (Deese, 1959; Roediger et al., 1995). In the DRM procedure participants study lists of words that are all highly related to a critical non-presented word. Many researchers have found that older children are more likely to falsely remember the critical non-presented word on a later test than are younger children (Brainerd, Forrest, Karibian, & Reyna, 2006; Brainerd, Reyna, & Forrest, 2002; Dewhurst & Robinson, 2004; Howe, Cicchetti, Toth, & Cerrito, 2004). Brainerd and Reyna (in press) showed that older children are more susceptible to illusions dealing with semantic relatedness (such as the DRM) because younger children have difficulties in connecting semantically related words. In contrast, the effects described here are not dependent on semantically relating the false facts. Rather, older children are more suggestible to learning story errors because younger children are less likely to remember the false facts from the stories.

Fictional stories can be a valuable learning tool for elementary school students. After listening to correct information embedded in a story, children are more likely to produce that correct answer on a later test. Fictional stories, however, can also have negative effects. Children also learn errors from the stories, and older children with their better memory abilities learn the most misinformation. Fictional stories presented in the classroom should be carefully examined to ensure that they are not teaching children incorrect facts about the world.

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