

Learning words from reliable and unreliable speakers

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Abstract

Three studies examined whether 3- and 4-year olds would trust a reliable speaker over an unreliable speaker when learning a new word and whether that trust would be reversed, and the word mapping revised, when a trusted speaker later proved unreliable. Study 1 indicated that 3- and 4-year olds trusted a reliable speaker over an unreliable speaker. Study 2 indicated that some 4-year olds reversed trust and revised a word mapping when a trusted speaker later proved unreliable. Study 3 indicated that those 4-year olds who reversed trust and revised the word mapping were likely to maintain the revision and tended to favor the previously reliable speaker over time. These results are discussed in terms of the role of speaker reliability in young children's word learning.

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Young children are regularly required to trust a speaker when learning new words. Recent studies have shown that children do not passively trust any speaker, but instead prefer to trust a speaker who is reliable (Birch, Vauthier, & Bloom, in press; Clément, Koenig, & Harris, 2004; Harris, 2007; Jaswal & Neely, 2006; Koenig, Clément, & Harris, 2004; Koenig & Echols, 2003; Koenig & Harris, 2005; Robinson, 2000) and a speaker who is knowledgeable (Birch & Bloom, 2002; Koenig & Harris, 2005; Sabbagh & Baldwin, 2001; Sabbagh, Wdowiak, & Ottaway, 2003). According to Koenig and Harris (2005), this selective trust is impressive because it requires that children discriminate between a reliable and an unreliable speaker maintain knowledge of this reliability over time, infer a relationship between past and future reliabil-

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ity, and, ultimately, trust the reliable speaker (see also Birch et al., in press; Koenig et al., 2004).

In one demonstration of trust in word learning, Koenig et al. (2004) had 3- and 4-year olds observe two speakers, one who was reliable when labeling familiar objects (e.g., calling a ball “ball”) and one who was unreliable (e.g., calling a ball “shoe”). Children then observed the two speakers label the same novel object with two different novel words (e.g., one speaker called the object a “mido” and the other called it a “toma”). Following this sequence, children were shown the novel object and asked to label it with the correct word. Koenig et al. showed that children who had correctly identified the reliable and unreliable speakers preferred to label the object with the reliable speaker’s word. This preference supported Koenig et al.’s conclusion that children trusted the reliable speaker.

An important feature of the Koenig et al. (2004) study, as in previous studies (Clément et al., 2004; Jaswal & Neely, 2006; Koenig & Echols, 2003; Koenig & Harris, 2005), was that the speaker’s reliability was known before the decision to trust that speaker was made. However, this may not always be the case as a speaker’s reliability is often unknown to children. As a result, at least one important trust-related question remains unanswered in children’s word learning: what happens when the decision to trust a speaker is made before that speaker’s reliability is known?

To be fair, trusting an unknown speaker itself may not be problematic. In fact, there are many examples of children’s willingness to initially trust an unknown speaker, especially in studies of word learning (e.g., Carey & Bartlett, 1978; Markson & Bloom, 1997). Though their focus is usually not trust per se, word learning studies regularly involve a previously unknown speaker who presents children with a novel word. But rather than be skeptical, these studies show that children instead trust the unknown speaker and learn the novel word. In fact, children often quickly learn novel words from unknown speakers, even following as few as one experience with that word—a phenomenon known as fast mapping (Carey & Bartlett, 1978).

Children’s ability to quickly learn the word would seem to depend on their willingness to quickly trust the speaker, something that would be difficult if the speaker had to first establish a record of reliability. Not trusting an unknown speaker would undermine fast mapping. Consequently, it may be to children’s advantage to believe that all speakers are trustworthy (and therefore reliable). This would be especially true for a speaker presenting a novel word because children consider words to be conventional knowledge—knowledge that is common and accessible to all speakers of a language (Clark, 1990; Diesendruck & Markson, 2001). Ultimately, children’s willingness to learn a word from an unknown speaker indicates that trusting the unknown speaker itself may not be problematic. However, trusting an unknown speaker may become problematic, and may be to children’s disadvantage, if that speaker later proves unreliable.

The chief problem with learning a word from an unreliable speaker is that the word may be incorrect. To avoid learning an incorrect word, children would either need to initially distrust an unknown speaker or to initially trust an unknown speaker and then monitor that speaker’s future reliability. Given the preceding discussion, distrusting an unknown speaker from the outset seems unlikely. Yet, continuously monitoring the future reliability of an unknown speaker also seems unlikely—in part because of the immense challenge it would present to young word learners. Among the most obvious challenges would be trusting the original speaker (Koenig et al., 2004; Koenig & Harris, 2005), tracking the original speaker over time (i.e., source monitoring; Gopnik & Graf, 1988; Johnson, Hashtroudi, & Lindsay, 1993), tracking the original word over time, reversing trust when the speaker proved unreliable, and revising the word mapping. These challenges would be in addition to the challenge already inherent in the actual learning of a novel word (Quine, 1960). On the surface this set of challenges seem overwhelming. Yet because chil-

dren are likely to trust an unknown speaker and because that speakers could be unreliable, it is important to know what happens when a children trust an unknown speaker who does proves unreliable.

The three studies that follow were designed to address this question. Of central interest was whether children would reverse trust and revise a word mapping when a trusted speaker later proved unreliable. Study 1 was designed as a replication of Koenig et al.'s (2004) finding that children trusted reliable speakers over unreliable speakers when learning a new word. Study 2 was designed to examine whether children would reverse trust and revise a word mapping when a previously trusted speaker proved unreliable. Study 3 was designed to examine what knowledge children would maintain, and who children would trust, 24 h after having reversed trust.

1. Study 1

Study 1 was designed as a replication of the Koenig et al. (2004) study with one major procedural difference: object selection, rather than word production, was used as the measure of word learning (Birch et al., *in press*; Sabbagh et al., 2003). This difference helped simplify the procedure in Study 1 by reducing word production demands (see Huttenlocher, 1974) and created a more suitable procedure for the central questions asked in Studies 2 and 3. There were also two minor procedural differences between Koenig et al. and Study 1. First, the videos in Study 1 depicted animated, rather than human, speakers and, second, the reliable and unreliable speakers did not alternate when labeling the different objects.

1.1. Method

1.1.1. Participants

Twenty-six 3-year olds (13 boys and 13 girls) ($M = 39$ months, $S.D. = 3.64$ months) and twenty-five 4-year olds (13 boys and 12 girls) ($M = 54$ months, $S.D. = 3.52$ months) completed Study 1. Participating children were recruited from preschools on or near the University of Alabama campus and were most often from white, middle-class families. All children received a colorful sticker for participation.

1.1.2. Procedure

Children sat next to the experimenter at a small table near their preschool classroom and completed three phases of the study: a warm-up, an introductory, and a testing phase.

During the warm-up phase children were asked to conduct various tasks on a set of small wooden blocks (e.g., stacking, arranging, etc.). The warm-up phase was designed to familiarize children with the experimenter and the experimental setting and usually lasted only a few minutes. During the introductory phase children watched a 1-min animated video depicting the image of a familiar object (e.g., a dog) that was labeled with a familiar word by an audio track (e.g., "This is a dog."). The image then disappeared and reappeared with three additional images of familiar distracers (e.g., shoe, tree, and car) and children were asked to select the image that best matched the familiar word (e.g., "Can you help me find the dog?"). The introductory phase was designed to familiarize children with the subsequent testing phase.

During the testing phase children watched a 2-min animated video. The video depicted two speakers, a blue-haired boy and an orange-haired girl, shown sequentially. To begin, the first speaker was introduced and circled a table displaying three familiar objects (e.g., a ball, a key, and a cup) and two novel objects (e.g., a shelving bracket and a t-joint) spaced evenly around

the table. Each object was depicted as a two-dimensional image and was shaped and colored differently from the other objects to maximize dissimilarity. The first speaker pointed to and labeled each individual familiar object either reliably (e.g., labeling the ball a “ball”) or unreliably (e.g., labeling the ball a “key”). The first speaker then pointed to and labeled one of the two novel objects with a novel word (e.g., “This is a jeter.”) and exited the screen.

Next, the second speaker was introduced and circled the same table displaying the same objects. The second speaker pointed to and labeled each individual familiar object either reliably or unreliably (whichever the first speaker had not done). The second speaker then labeled the remaining novel object with the same novel word that first speaker had used (e.g., “This is a jeter.”) and exited the screen.

Finally, the table of objects disappeared from the screen and only the two novel objects reappeared in its place. Children were then asked by the experimenter to select the object that best matched the novel word (e.g., “Look at these things. Can you help me find the jeter? Which one is the jeter?”). Speaker order and speaker gender were counterbalanced such that the first speaker was reliable on approximately 1/2 of trials and the reliable speaker was the orange-haired girl on approximately 1/2 of trials.

1.2. Results—Study 1

In Study 1, a previously reliable speaker and a previously unreliable speaker labeled two different novel objects with the same word. Of interest was whether children would prefer to trust the reliable speaker over the unreliable speaker when deciding which of the two objects correctly mapped to the novel word. To address this issue, selection of the object labeled by the reliable speaker was compared to selection of the object labeled by the unreliable speaker. Study 1 showed that children were likely to select the reliable speaker’s object (i.e., 41 out of 51) ($\chi^2(1, n = 51) = 51.00, p < .001$), a pattern displayed significantly by both 3- and 4-year olds (see Table 1). In addition, Study 1 showed that the proportion of children who selected the reliable speaker’s object was greater than chance, $\chi^2(1, n = 51) = 18.84, p < .001$. There were no speaker order or speaker gender effects.

1.3. Discussion—Study 1

Study 1 showed that in response to the novel word both 3- and 4-year olds were likely to select the object that was labeled by the reliable speaker and, therefore, replicated Koenig et al.’s (2004) findings. Impressively, 73% of 3-year olds and 88% of 4-year olds in Study 1 trusted the reliable speaker. In Koenig et al. 69% of 3-year olds and 65% of 4-year olds who correctly identified the reliable and unreliable speakers trusted the reliable speaker. The small percentage differences across the two studies were likely the result of procedural differences. In Study 1 children were asked to point to an object in response to the word while in Koenig et al. children were asked to

Table 1
The proportion of 3- and 4-year olds in Study 1 who trusted the reliable speaker over the unreliable speaker

	Reliable speaker	Unreliable speaker
3-Year olds	19/26*	7/26
4-Year olds	22/25*	3/25

* $p < .05$.

speak the word in response to the object; presumably pointing was the simpler, less demanding task.

Also, Koenig et al.'s (2004) analysis targeted only those children who had previously identified the reliable and unreliable speaker correctly. In contrast, Study 1 did not separate out those children who had previously identified the speaker but instead targeted all participating children. This difference in the targeted samples makes children's selective trust in Study 1 even more impressive and again suggests that the Study 1 task was simpler. Ultimately however, because the results of the two studies are so similar, Study 1 supports Koenig et al.'s conclusion that 3- and 4-year olds prefer to trust a reliable speaker when learning a new word.

2. Study 2

In both Study 1 and in Koenig et al. (2004) the decision to trust a speaker to learn a word was made after the speaker's reliability was known. Importantly however, prior knowledge of a speaker's reliability may not always be available. Indeed, there may be instances in which the decision to trust a speaker must be made before a speaker's reliability is known. In fact, the literature on children's word learning is full of instances in which a novel word is learned from an unknown speaker (e.g., Carey & Bartlett, 1978; Markson & Bloom, 1997). However, a possible problem could arise if the unknown speaker is trusted and then later proves unreliable. Study 2 was designed to examine this possibility.

2.1. Method

2.1.1. Participants

Twenty 3-year olds (11 boys and 9 girls) ($M=42$ months, $S.D.=2.75$ months) and twenty-three 4-year olds (13 boys and 10 girls) ($M=53$ months, $S.D.=3.66$ months) completed Study 2. Children participating in Study 2 were recruited from the same sample as Study 1 children and again received a colorful sticker for participation.

2.1.2. Procedure

The warm-up and introductory phases used in Study 2 were identical to those used in Study 1 and were followed by the testing phase.

During the testing phase children again watched a 2-min animated video. The Study 2 video was similar to the Study 1 video except that the speaker's reliability was presented after, and not before, the presentation of a novel word. The first speaker entered the screen and pointed to and labeled one of the two novel objects (e.g., the shelving bracket) with a novel word (e.g., "This is a koba."). The first speaker then exited the screen and children were shown both novel objects (e.g., the shelving bracket and a t-joint) and asked to select the one that best matched the novel word (e.g., "Look at these things. Can you help me find the koba? Which one is the koba?"). The first speaker then re-entered the screen and pointed to and labeled each individual familiar object either reliably (e.g., labeling the ball a "ball") or unreliably (e.g., labeling the ball a "key"). The first speaker then exited the screen again.

Next, the second speaker entered the screen and pointed to and labeled the remaining novel object (e.g., the t-joint) with the same novel word (e.g., "This is a koba."). The second speaker then pointed to and either reliably or unreliably labeled each individual familiar object (whichever the first speaker had not done). The second speaker then exited the screen.

Table 2

The proportion of 3- and 4-year olds in Study 2 who initially trusted the unknown speaker and then reversed trust when that unknown speaker proved unreliable

	Unknown/unreliable speaker	Reversed trust
3-Year olds	10/11	3/11
4-Year olds	13/13	7/13*

* $p < .05$.

Finally, the table of objects disappeared from the screen and only the two novel objects reappeared in its place. Children were again asked to select the object that best matched the novel word (e.g., “Look at these things. Can you help me find the koba? Which one is the koba?”). Speaker order and speaker gender were counterbalanced such that the first speaker was reliable on approximately 1/2 of trials and the reliable speaker was the orange-haired girl on approximately 1/2 of trials.

2.2. Results—Study 2

In Study 2, an unknown speaker (i.e., the first speaker) labeled a novel object with a novel word and later proved either reliable ($n = 19$) or unreliable ($n = 24$) when labeling a set of familiar objects. Because the unreliable speaker was the primary interest, only those data pertaining to the unreliable speaker are presented here. Of interest was whether children would reverse trust when the unknown speaker proved unreliable. To address this issue, selection of the object labeled by the unknown speaker was compared to later selection of that same object after the unknown speaker was determined to be unreliable. Study 2 showed that children were likely to initially trust the unknown speaker (i.e., 23 out of 24). However, Study 2 also showed that children were likely to reverse trust when that previously unknown speaker proved unreliable (i.e., 10 out of 24 children reversed trust)—demonstrating a significant change in performance, $p < .01$ (McNemar’s). Importantly, as displayed in Table 2, this result varied by age as 4-year olds who initially trusted the unknown speaker (i.e., 13 out of 13) were the most likely to reverse trust when that unknown speaker proved unreliable (i.e., 7 out of 13 children reversed trust), $p < .05$ (McNemar’s) (see Table 2).

2.3. Discussion—Study 2

Study 2 showed that some 4-year olds reversed trust and revised a word mapping after observing a previously trusted speaker prove unreliable. In fact, more than one-half of the 4-year olds who had initially trusted the unknown speaker and who had initially mapped the novel word incorrectly later reversed that trust and revised that mapping after witnessing that unknown speaker unreliably labeled three familiar objects. This reversal of trust was impressive because those 4-year olds had to initially trust the unknown speaker, track two speakers and two words over time, elect to reverse trust when the unknown speaker later proved unreliable, and ultimately elect to revise the word mapping (Birch et al., *in press*; Koenig et al., 2004).

Of course, the strongest evidence for reversing trust would have been if 4-year olds had unanimously elected to revise the word mapping. Because this was not the case, Study 2 does permit an alternative explanation for 4-year-old’s trust reversal. Hearing two different objects labeled with one word may have made 4-year olds confused as to which of the two novel objects correctly

mapped to the word, thereby causing them to choose between the objects randomly. However, there are at least two reasons not to favor this alternative. First, despite also hearing two different objects labeled with one word, children in Study 2 who had observed the reliable speaker first did not choose between the two objects randomly (e.g., only one child who had observed the unknown speaker become reliable later reversed trust).¹ Second, previous studies of word learning indicate that 4-year olds often assume that words are mutually exclusive and thus avoid mapping two words to one object (Markman & Wachtel, 1988; Merriman & Bowman, 1989). In the end, the results of Study 2 favor the explanation that some 4-year olds were capable of reversing trust and revising a word mapping when a trusted speaker proved unreliable.

Also worth noting is that children in Study 2 were more willing to trust the unreliable speaker than were children in Study 1. In Study 1, 20% of children (i.e., 10 out of 51) ultimately decided to trust the unreliable speaker. In Study 2 however, 58% of children (i.e., 14 out of 24) ultimately decided to trust the unreliable speaker. One possible explanation for this difference is that the children in Study 2, unlike the children in Study 1, had initially committed to trusting an unknown speaker. Perhaps this initial trust acted as a precedent that caused some children to trust that speaker again later, even though that speaker ultimately proved unreliable. A second possible explanation is that using a speaker's reliability retrospectively is more difficult than using it prospectively. In Study 2, the decision to trust the speaker was made before that speaker's reliability was known whereas in Study 1 the speaker's reliability was known before the decision to trust that speaker was made.

3. Study 3

Study 2 showed that some 4-year olds reversed trust and revised a word mapping when a previously trusted speaker proved unreliable. To reverse trust and revise the mapping, those 4-year olds must have at one time trusted two different speakers and must have at one time mapped the same word to two different objects. Consequently, two unresolved issues from Study 2 are: (1) which of the two speakers would be trusted over time and (2) which of the two mappings would be maintained over time. Study 3 was designed to address these issues by examining those individuals who reversed trust and revised a mapping after a 24-h delay.

3.1. Method

3.1.1. Participants

Twenty-two 4-year olds (12 boys and 10 girls) ($M = 51$ months, $S.D. = 7.63$ months) completed both sessions of Study 3. This total does not include 20 additional 4-year olds who completed Session 1 but did not reverse trust and so were ineligible to complete Session 2. Children participating in Study 3 were recruited from the same sample as Studies 1 and 2 children and again received a colorful sticker for participation.

3.1.2. Procedure

Study 3 consisted of two separate sessions administered 24 h apart. Session 1 was similar to Study 2 except that the unknown speaker always proved to be unreliable. During Session 1, the

¹ When the unknown speaker proved reliable, 18 out of 19 children maintained the original mapping and did not reverse trust.

first speaker entered the screen and pointed to and labeled one of the two novel objects with a novel word (e.g., 'blurg') and then proved unreliable. The second speaker entered the screen and labeled the remaining novel object with the same novel word and then proved reliable. As in Study 2, children were asked to match the novel word with the correct novel object. The goal of Session 1 was simply to obtain a group of children who reversed trust and who could participate in Session 2, a follow-up administered 24 h later.

During Session 2, children first saw a computer display of three objects and then saw an animated video which included the original reliable and unreliable speakers. The display depicted three objects on the screen simultaneously: (1) the object previously labeled by the reliable speaker, (2) the object previously labeled by the unreliable speaker, and (3) a new novel object. While the objects were depicted, children were asked to complete two tasks. First, children were asked to select the object that best matched the original novel word (e.g., "Look at these things. Can you help me find the blur? Which one is the blur?"). Second, children were asked to select the object that best matched a new novel word (e.g., "Look at these things. Can you help me find the yeck? Which one is the yeck?"). The three objects then disappeared from the screen and the animated video was started.

The video depicted two brand new novel objects being labeled by the previously reliable and unreliable speakers. During the video, each speaker pointed to and labeled a different novel object with the same novel word (e.g., "clem"). The speakers then exited the screen leaving only the two novel objects. Children were asked to select which of the two novel objects best matched the new novel word (e.g., "Look at these things. Can you help me find the clem? Which one is the clem?"). Speaker order was counterbalanced such that the first speaker was the previously reliable speaker on approximately 1/2 of trials.

3.2. Results—Study 3

In Study 3, children who had previously reversed trust were presented with three objects after a 24-h delay: (1) the object previously labeled by the reliable speaker, (2) the object previously labeled by the unreliable speaker, and (3) a new novel object. Of interest was whether children who had initially revised the word mapping would maintain this revision over time. To address this issue, selection of the object previously labeled by the reliable speaker was compared to selection of the other two objects. Study 3 showed that in response to the original word children were likely to select the reliable speaker's object (i.e., 13 out of 22) but that children were unlikely to select either the unreliable speaker's object or the new novel object, $\chi^2(2, n = 22) = 7.18, p < .05$ (see Table 3).

Of additional interest was whether children would prefer to map a new novel word to the unreliable speaker's object. To address this, selection of the object previously labeled by the unreliable speaker was compared to selection of the other two objects. Study 3

Table 3

The proportion of 4-year olds in Study 3 who selected the reliable, unreliable, or new object in response to the original and novel words after a 24-h delay

	Reliable speaker's object	Unreliable speaker's object	New novel object
Original word	13/22*	6/22	3/22
New novel word	2/22	4/22	16/22*

* $p < .05$.

showed that in response to a new novel word children were unlikely to select either the unreliable speaker's object or the reliable speaker's object but that children were instead likely to select the new novel object (i.e., 16 out of 22), $\chi^2(2, n=22)=15.64, p<.001$ (see Table 3).

Also in Study 3, children who had previously reversed trust were presented with the original reliable speaker and the original unreliable speaker, each of whom used the same new novel word to label one of two new novel objects. Of interest was whether children would trust the previously reliable speaker. To address this issue, selection of the reliable speaker's newly labeled object was compared to selection of the unreliable speaker's newly labeled object. Study 3 showed that in response to a new novel word children were likely to select the reliable speaker's object (i.e., 12 out of 16)² more often than the unreliable speaker's object, $\chi^2(1, n=16)=4.00, p<.05$.

3.3. Discussion—Study 3

Study 3 showed that children who had previously revised a word mapping maintained that revision over time. Of the three objects in the selection array, which included the object originally labeled by the reliable speaker, the object originally labeled by the unreliable speaker, and a previously unlabeled (i.e., new) novel object, a majority of children preferred to select the reliable speaker's object—thus indicating that children had maintained the revised mapping. This is noteworthy considering that in order to maintain the revised mapping children had to disregard both the original mapping and the source of that mapping over a 24-h delay. Though tracking a mapping and a speaker over time would be a significant challenge for children, this result suggests that children are more than capable of meeting that challenge.

Study 3 also showed that children preferred to map the new novel word to the new novel object. This finding is interesting considering that, in theory, the object originally labeled by the unreliable speaker and the new novel object should have been equal candidates for the new novel word (i.e., neither object was determined to be a "blurg" and therefore either could be a "yeck"). Yet, in practice, the two objects were not treated equally. This is also interesting considering that the object originally labeled by the unreliable speaker was ultimately deemed ineligible for both the original novel word and for the new novel word. It is unclear from Study 3 under what conditions an object previously labeled by an unreliable speaker would become eligible for a new word.

Finally, Study 3 showed that children who reversed trust tended to favor the reliable speaker over time. When observing the previously unreliable speaker and the previously reliable speaker provided the same novel word for two separate novel objects a majority of children trusted the previously reliable speaker. This finding suggests that children believed that the speakers maintained the quality of being either unreliable or reliable (at least when compared to each other) over the 24-h delay. Recall that an unresolved issue from Study 2 was whether reversing trust was caused by children's belief that the speaker was temporarily inaccurate or by children's belief that the speaker was permanently unreliable. Of these two beliefs, Study 3 suggests that children who reversed trust were not merely making temporary judgments. This would support Harris' (2007) suggestion that children form a cognitive profile of a speaker, which would include information about that speaker's reliability.

² Due to experimenter error, only 16 children were presented with the reliable and unreliable speakers in Study 3.

4. General discussion

The studies reported here demonstrated that the majority of 3- and 4-year olds preferred to trust a reliable speaker over an unreliable speaker when mapping a novel word to a novel object and that 3- and 4-year olds were willing to trust an unknown speaker (i.e., Study 1). In addition, these studies demonstrated that some 4-year olds were willing to reverse trust and revise a word mapping when a previously trusted speaker proved unreliable (i.e., Study 2). Furthermore, these studies demonstrated that children who reversed trust and revised a word mapping maintained the revision and favored the reliable speaker over time (i.e., Study 3). The final two results merit additional discussion.

First, it is significant that 4-year olds were able and willing to reverse trust and revise a word mapping. Discussions of word learning have commonly centered on the process of forming an initial word mapping and adding that word to the lexicon (e.g., Carey & Bartlett, 1978; Markson & Bloom, 1997). Study 2 reveals a part of the word learning process that has traditionally been absent from these discussions (though see Clark, 1993; Merriman, 1986): the part that permits revising a word mapping and, when needed, subtracting that word from the lexicon. The findings from Studies 2 and 3 are relevant to such discussions because they demonstrate that some 4-year olds are able and willing to revise an existing word mapping when given reason to believe that the mapping is incorrect.

However, when such a revision process would be initiated and how such a revision process would operate are questions that remain unanswered. Revision could be initiated when an unknown speaker proves unreliable. That is, children could begin distrusting the unreliable speaker as soon as that speaker incorrectly labels a familiar object. The previously learned word would then be immediately marked for revision. Revision could also be initiated when the reliable speaker provides a more suitable alternative for the original mapping. That is, children could continue trusting an unreliable speaker until a reliable speaker correctly labels a familiar object. The alternative would then replace the original mapping. Given the findings of the current studies, whether the revision process is initiated by distrust in an unreliable speaker or by trust in a reliable speaker (or by both) remains an open question.

A process for revising word mappings could greatly complicate discussions of word learning. For example, revising a word mapping would require that the trustworthiness of the original speaker, the original word, the trustworthiness of the new speaker, and the new word all be continuously monitored (see Harris, 2007, for discussion of children's formation of a cognitive profile). Including a process for revising word mappings would also represent a significant departure from – and a much needed addition to – common discussions of word learning.

Second, it is significant that 3- and 4-year olds differed in their ability and willingness to reverse trust and revise a word mapping. In Study 2, some 4-year olds reversed trust after the trusted speaker proved unreliable. In contrast, only a few 3-year olds reversed trust. Importantly, Study 2 is not the first study to show trust-related differences between 3- and 4-year olds (e.g., Koenig et al., 2004; Pasquini, Corriveau, Koenig, & Harris, 2007). Notably however, previous studies have also shown that 3- and 4-year olds detect speaker reliability similarly (Koenig et al., 2004). Consequently, it remains unclear why 3-year olds in Study 2, and in previous studies, would presumably detect but not use information about a speaker's reliability the same as 4-year olds.

One potential explanation for the difference between 3- and 4-year olds is the increased demand of the task. In Study 2, children had to initially trust the speaker, track two speakers and two words over time, elect to reverse trust when the trusted speaker proved unreliable, and ultimately elect to

revise the word mapping. Contrast the demands of Study 2 with the demands of Study 1 in which children had to track two speakers over time and elect to trust the speaker who proved reliable. The increased task demands in Study 2 may have ultimately affected 3-year-old's ability to use information about a speaker's reliability to reverse trust.

Another explanation for the difference between 3- and 4-year olds can be derived from the literature on false belief. During the standard false belief task children are presented with a character that holds a belief that is known to be false. When asked to reason about the character's future behavior many 3-year olds, unlike many 4-year olds, ignore the character's false belief in favor of their own knowledge (Wimmer & Perner, 1983). Study 2 is conceptually similar to the false belief task in that children ignore a perceived false belief (i.e., the second speaker's word for the object) in favor of their own knowledge (i.e., the first speaker's word for the object). However, this explanation loses some plausibility given Harris' (2007) report that 3-year olds who fail the false belief task nonetheless display selective trust of reliable and unreliable speakers.

An alternative to the false belief explanation is that 3-year olds make all-or-nothing (i.e., dichotomous) assessments of a speaker's reliability (Harris, 2007). This suggestion is consistent with studies in which 3-year olds make little distinction between speakers who are occasionally incorrect (i.e., 75% reliable) and speakers whose are frequently incorrect (i.e., 25% reliable) (Pasquini et al., 2007). For Study 2, this explanation would suggest that 3-year-old's initial assessments of the trustworthiness of an unknown speaker may be less flexible than 4-year-old's and would therefore result in fewer reversals when the trusted unknown speaker proved unreliable.

Related to this explanation, previous research has shown that 3- and 4-year olds differ in their ability to adequately monitor the source of information (e.g., Gopnik & Graf, 1988; Wimmer, Hogrefe, & Perner, 1988) and that, for 3-year olds, source monitoring is very much a work-in-progress. Recent findings have even shown that monitoring and retaining knowledge about the source of information is related to children's later confidence in that information (Robinson, Haigh, & Nurmsoo, 2008). If 3-year olds initial assessments of trustworthiness are less flexible as Pasquini et al. (2007) and Harris (2007) might suggest and 3-year olds are less able to monitor and retain the source of information as Robinson et al. might suggest, then it follows that 3-year olds in Study 2 might be less likely to use source information to reverse trust, even if they were able to detect the source's unreliability.

Finally, it is significant that 4-year olds who reversed trust later trusted the reliable speaker when mapping a new novel word. Any child in the current studies who reversed trust and revised a mapping must have, at one time, trusted two different speakers and mapped the same word to two different objects. This pattern of responses suggests that the decision to trust the reliable speaker in Study 1 (see also Koenig et al., 2004) and the decision to reverse trust and revise the mapping in Studies 2 and 3 was not temporary and was not based simply on local assumptions about the situation. Instead, this pattern suggests a more permanent decision based on global assumptions about the speaker—again supporting Harris' (2007) notion of a cognitive profile. That is, children must have concluded that a speaker who had been reliable (or unreliable) in the past was likely to be reliable (or unreliable) again in the future.

It is important to note that while the current studies focused on trust within the domain of word learning, children's willingness to reverse trust in Study 2 and children's preference to later trust, and maintain information from, the reliable speaker in Study 3 may have meaningful implications for trust in other domains as well. Indeed, children may profit from the option to reverse trust in any domain in which their knowledge depends on an outside source. Likewise, reversing trust alone would be unhelpful in any domain if not accompanied by the capacity to: (a) retain the identity of the unreliable source and (b) revise the knowledge acquired from that unreliable source.

5. Conclusions

Overall the results of the present studies suggest that, when learning words, 3- and 4-year olds can use knowledge of a speaker's reliability prospectively to determine the trustworthiness of that speaker's future testimony (see also Harris, 2007; Koenig et al., 2004). In addition, the results of the present studies suggest that, when learning words, some 4-year olds can use knowledge of a speaker's reliability retrospectively to determine the trustworthiness of that speaker's past testimony. It is this latter finding that may have the most significant implications for children's trust, especially in the domain of word learning.

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