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Evidence that Two-Year-Old Children are Sensitive to Information Presented in Arguments

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Preschoolers are more likely to endorse testimony supported by strong arguments than by weak, circular ones. Two-year-olds exchange arguments with others, but no experiment has demonstrated that they are sensitive to information presented as argument. In the first phase of this study, 2-year-olds were shown ambiguous pictures—for instance a bird–fish hybrid—and asked what they thought the picture represented. An informant then contradicted them, providing either a strong argument, a circular argument, or no argument, and the children were asked what they now thought the hybrid was. The second phase was identical to the first, with new hybrids, except that the informant never provided any argument for her position. Finally, in the third phase, the informant left the room and the children were asked again to tell what the hybrids from the first two phases were. On the whole, there was an effect of the amount of information provided in the argument so that children were more likely to endorse labels provided by the informant who had supported her answer with a strong argument in the first phase. Moreover, they generalized the trust granted to informants who provided strong arguments. These results constitute the first experimental demonstration that 2-year-olds possess some argument evaluation skills.

We acquire a large number of our beliefs through communication. However, we cannot blindly rely on others' testimony. People have various levels of knowledge and expertise, and they rarely have perfectly aligned incentives. As a result, we can expect

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humans to be endowed with mechanisms of epistemic vigilance (Sperber et al., 2010) that filter communicated information so that most beneficial information is accepted, and most harmful information is rejected. Some mechanisms of epistemic vigilance pay attention to the content of what is communicated—Is it plausible? Is it supported by good arguments?—others to the source of the communication—Is she trustworthy? Is she competent?

Although these mechanisms of epistemic vigilance become increasingly sophisticated with age, their roots can be found in young children. Preschoolers have been shown to rely on a wide variety of cues to weigh the testimony of different informants, such as past accuracy, benevolence, or degree of consensus (for reviews, see Clément, 2010; Harris, 2012; Mills, 2013; Poulin-Dubois & Brosseau-Liard, 2016). A few studies have shown that even younger children, 1- or 2-year-olds, can already perform some basic discrimination in this domain (for reviews, see Harris & Lane, 2014). For instance, they are more likely to take communicated information into account when it does not conflict with their prior beliefs (Tamis-LeMonda et al., 2008), and when it comes from an expert informant (Kim & Kwak, 2011; Walden & Kim, 2005) or a confident informant (Brosseau-Liard & Poulin-Dubois, 2014).

A recent series of experiments have shown that preschoolers can use another mean of assessing communicated information: the relative quality of arguments and explanations (Castelain, Bernard, Van der Henst, & Mercier, 2016; Corriveau & Kurkul, 2014; Koenig, 2012; Mercier, Bernard, & Clément, 2014). For instance, in one experiment, 3- to 5-year-olds were more likely to believe an informant who used a strong, perceptual argument ("the dog went this way because I've seen him go in this direction") than an informant who used a circular one ("the dog went this way because he went in this direction") (Mercier et al., 2014). Moreover, preschoolers seem to extend their trust in informants who have offered good, by contrast with circular, explanations. In one experiment, 3- and 5-year-olds were more likely to accept an explanation coming from an informant who had previously offered a good explanation than one coming from an informant who had previously offered a circular explanation (Corriveau & Kurkul, 2014). For 5-year-olds, this generalization of trust extended to word learning.

Observational data suggest that children engage in simple forms of argumentation before the age of three. Two-year-olds produce justifications and arguments when they disagree with their parents or siblings (Kuczynski & Kochanska, 1990; Kuczynski, Kochanska, Radke-Yarrow, & Girnius-Brown, 1987; Perlman & Ross, 2005). In the course of these disagreements, they are also exposed to arguments (although more so in some cultures, see, Maratsos, 2007; Tizard, Hughes, Carmichael, & Pinkerton, 1983). However, there are no data showing whether children this young are sensitive to the quality of the arguments offered to them. The goal of the present experiment is to offer some preliminary evidence regarding the ability of 2-year-olds to evaluate the information provided in arguments as well as the informants who provide arguments.

The experiment has three phases, each designed to assess a different effect of argument evaluation in 2-year-olds. The goal of the first phase is to assess the impact of argument evaluation on the immediate acceptance of the argument's conclusion. The child is exposed to pictures of hybrid objects—for instance, an object that is 75% bird and 25% fish (see, Bernard, Harris, Terrier, & Clément, 2015; Jaswal, 2004; Jaswal & Markman, 2007). The child is asked what he thinks the object is. An informant then tells the child what she thinks the object is, always disagreeing with the child. In one condition, the informant offers no argument, in another she offers a poor, circular

argument (e.g., "It's a fish, because I saw it's a fish"), and in another, she offers a strong argument, one that provides new, relevant information (e.g., "It's a fish because I saw it swimming in the water"). The child is asked again to tell what he thinks the object is, so we can measure the direct effect of argument evaluation—whether or not he is more likely to change his mind when presented with a strong argument. If 2-year-olds evaluate arguments in a way that is similar to 3-year-olds (Mercier et al., 2014), they should be more likely to accept the new label when it is supported by a strong argument which offers new and relevant information, but they should not favor the circular argument over the absence of argument.

The goal of the second phase is to test whether the child trusts more informants who have provided strong arguments, by contrast with weak arguments or no argument. The child is shown new hybrids, asked what he thinks they are, and the informant again disagrees with him. However, in Phase 2, she never offers any argument, simply stating her disagreement before the child is asked again what he thinks the object is. If 2-year-olds generalize their trust toward informants who have provided good reasons in a way that is similar to that of 3-year-olds (Corriveau & Kurkul, 2014), they should be more likely to accept the new label when it comes from the informant who previously provided the strong argument.

The goal of the third phase is to test the depth of the potential changes of mind obtained in the first two phases, in particular those of Phase 1. The informant leaves the room, and the child is introduced to a new picture book containing several pictures and asked to name them. Some of these pictures depict the hybrid objects from the first two phases. This phase assesses how much the child had retained the opinion provided by the informant in the earlier phases. This has never, to the best of our knowledge, been tested in relation with variations in argument strength, even with preschoolers. Two-year-olds might have a tendency to accept what the informant says regardless of the support she provided for her labels (Jaswal & Kondrad, 2016; Mascaro & Morin, 2014). However, we might still observe a delayed effect of argument strength so that labels supported by strong arguments are better retained than labels supported by no argument or by weak arguments.

METHOD

Participants

This experiment involved 50 two-year-olds children from seven French daycare centers in the city of Lyon, France (26 girls, M_{age} = 27.6, SD = 2.59, range 23–32 months). Most of the children came from middle or upper-middle class families. All of the children participated in the experiment individually in a quiet room located in the daycare center. Five participants were excluded: one participant because of a mistake made by the experimenter and the informant, a second because it was not possible to hear her clearly, and the three remaining because they gave no response to at least one of the four hybrids. The analyses were conducted with the 45 remaining participants (22 girls, M_{age} = 27.7, SD = 2.68, range 23–32 months), 16 children in the Strong Argument condition, 14 children in the Circular Argument condition, and 15 children in the Absence of Argument condition. Children did not differ in age across the three experimental groups, $F(2, 42) = .91$, $p = .41$, $\eta^2 = .04$.

Materials and procedure

Hybrid pictures from Jaswal and Markman (2007) formed the main material of this experiment. These hybrid pictures were selected so that most children would form an opinion without being completely certain that it is correct. When the informant disagrees with the child, she does not state an opinion that blatantly contradicts his perception, making the disagreement more pragmatically felicitous. We used images in which one interpretation tended to dominate, rather that images that were more equivocal between the two objects, to help avoid ceiling effects of uniform deference toward the informant (see Jaswal & Kondrad, 2016; Mascaro & Morin, 2014).

Based on another study conducted in a French population (Bernard et al., 2015), we selected four hybrids with a good level of identification by 3-year-olds children: two animals (a bird–fish and a rabbit–squirrel) and two objects (a spoon–key and a car–shoe). Each hybrid was created with 75% of the features from one entity and 25% of the features from the other entity (see Figure 1).

The procedure lasted between 5 and 10 min and involved four individuals: the child, his caretaker, the experimenter, and an informant. Before starting the experiment, the experimenter invited the child to sit on his caretaker's lap and invited the caretaker to wear headphones. Children were randomly assigned to one of the three experimental conditions: Strong Argument, Circular Argument, or Absence of Argument. The experiment is divided into three different phases (Figure 2) preceded by two familiarization trials.

Familiarization phase

The pictures used in this phase represented a house and a sun. The experimenter showed the pictures one at a time and asked the child "What is this?" If the child gave no answer, the question was repeated.

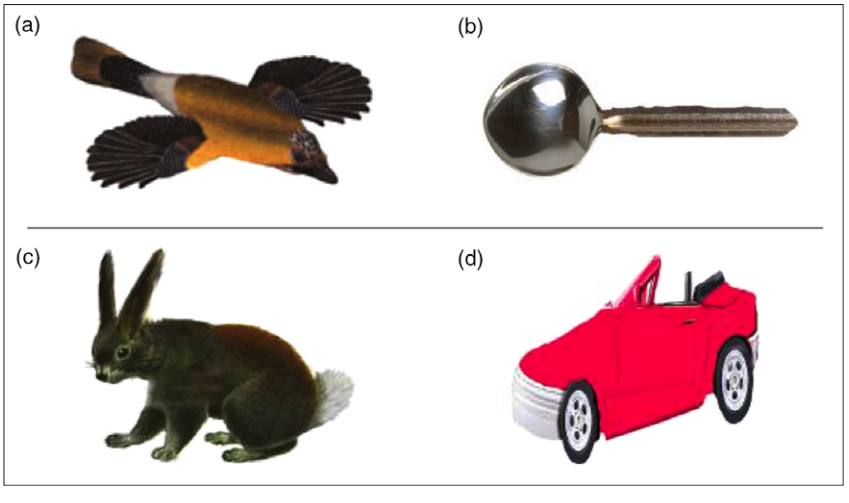

Figure 1 The four hybrids (Phase 1: (a) and (b), Phase 2: (c) and (d)).

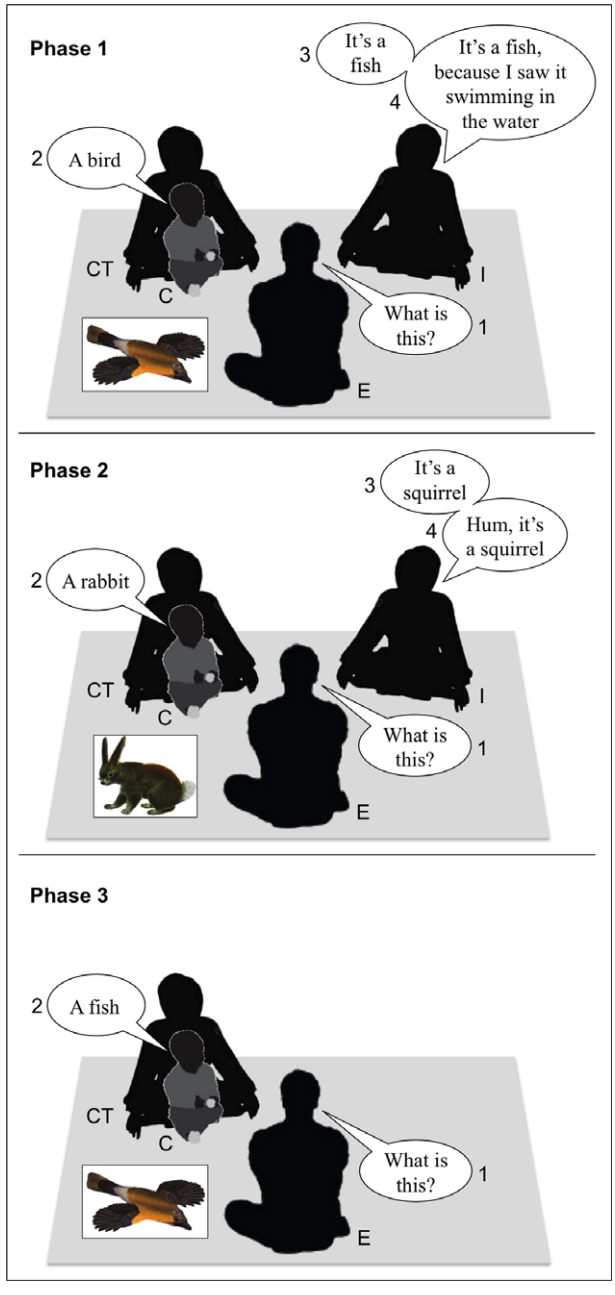

Figure 2 Illustration of the three phases of the experiment. The child (C) is seated on his caretaker's (CT) lap. On his left is the informant (I). The experimenter (E) is seated in front of the child and the informant. In this figure, only the Strong Argument condition is represented. The other conditions would be similar except that in Phase 1 the informant would say: "It's a fish, because I saw it's a fish" (Circular Argument condition) or "It's a fish, hmm it's a fish" (Absence of Argument condition).

Phase 1

The goal of Phase 1 was to test whether children were more likely to believe a label supported by strong arguments than by circular arguments, or an absence of arguments. Two hybrids were used (see Figure 1). The experimenter showed the first hybrid to the child and asked, "What is this?" If the child gave no answer, the question was repeated. If the child gave no answer again, the experimenter asked him a forced-choice question, "Tell me, what is this, a bird or a fish?" (order counterbalanced). After the child answered, for example "bird," the experimenter turned toward the informant and asked, "According to you [informant's name], what is this?" The informant answered the experimenter, systematically giving an answer that contradicted the child's response. Then, she looked at the child and added, depending on the condition: "It's a fish, because I saw it swimming in the water" (Strong Argument condition), "It's a fish, because I saw that is a fish" (Circular Argument condition), or "It's a fish, hmm it's a fish" (Absence of Argument condition).[1] Finally, the experimenter presented the hybrid again to the child and asked, "So, [child's name], what is this?" If the child gave no answer, the question was repeated, and if necessary, a forced-choice question was offered. This was repeated with the second hybrid, with adapted stimuli, the strong argument being: "It's a key, because I saw someone open a door with it."[2]

One point was assigned when children adopted the label of the hybrids provided by the informant. No points were assigned when they maintained their previous response. Each child could obtain a maximum score of 2 points.

Phase 2

The goal of Phase 2 was to test whether children were more likely to believe the label provided by an informant who had previously used a strong argument, rather than by an informant who had previous used a circular argument or no argument. Two new hybrids were used (see Figure 1). The procedure was the same as in Phase 1, except that the informant always behaved as in the Absence of Argument condition. The coding was identical to that of Phase 1.

Phase 3

The goal of Phase 3 was to test whether the children retained the informant's labels endorsed in phases 1 and 2 after a short delay and in the absence of the informant. The informant pretended to have to answer a phone call and left the room. The experimenter told the child that they could continue and that they would look at a little book together. The experimenter presented a book composed of the four previous hybrids and four new nonambiguous items (a ball, a cat, a doll, and a dog). The order of the items was counterbalanced. He opened the first page and asked the child, "What is this?" If the child gave no answer, the experimenter repeated the question two more

[1]The 'hmm' has been added to avoid the awkwardness of repeating the same clause back to back (see Bernard, Mercier, & Clément, 2012).

[2]Strong arguments used in phase 1 for each hybrid objects: bird–fish: "It's a fish, because I saw it swimming in the water." Or "It's a bird, because I saw it flying in the sky." Spoon–key: "It's a key, because I saw someone open a door with it." Or "It's a spoon, because I saw someone eat a yogurt with it."

times if necessary and then went to the next picture. For the hybrid items, as a third option, the experimenter offered a forced-choice question.

One point was assigned when children used the label of the hybrids provided by the informant during phases 1 and 2. No points were assigned when they maintained their first response in phases 1 and 2. Thus, each child could obtain a maximum score of 4 points.

RESULTS

The main analyses test the predictions relative to each phase. In Phase 1, we predicted that children exposed to the strong argument will be more likely to accept the label than those provided with a circular argument or with no argument. In Phase 2, we predicted that children facing an informant who had provided a strong argument in Phase 1 will be more likely to accept the label than those facing an informant who had provided a circular argument or no argument. In Phase 3, we tested two predictions. The first is that the differences potentially observed in phases 1 and 2 will persist. The second is specific to the items from Phase 1: that the difference observed in Phase 1 will be accentuated, so that children revert more to their original beliefs when they had changed their mind on the basis of a circular or no argument than a strong argument. The final analysis bears on the results from all three phases and tests the overall effects of phase and condition. This will allow us to see whether there is an overall superiority, in terms of labels endorsed, for the Strong Argument condition.

Phase 1

There were no significant differences in the initial recognition of the four hybrids (bird–fish = 89% bird; spoon–key = 88% spoon; rabbit–squirrel = 91% rabbit; and car–shoe = 100% car), $F(3, 123) = 1.75$, $p = .17$, $\eta^2 = .04$. Children adopted the label of the informant in 78.1% of the cases in the Strong Argument condition, 67.8% in the Circular Argument condition, and 63.3% in the Absence of Argument condition (Figure 3).

To test our specific hypothesis regarding the three experimental conditions (i.e., rate of adoption of the informant's label in the Strong Argument condition > Circular Argument = Absence of Argument), a contrast analysis[3] was used (see, e.g., Wendorf, 2004). Two contrasts were tested in a regression analysis: a contrast of interest, corresponding to the previous hypothesis regarding the condition difference, and an orthogonal contrast, which tested the residual variance. The hypothesis can be accepted if the contrast of interest predicts the proportion of times (with an arcsine transformation) children adopted the labels provided by the informant in Phase 1 and if the orthogonal contrast does not. Neither contrast of interest, $F(1, 42) = .89$, $p = .37$, nor orthogonal contrast, $F(1, 42) = -.28$, $p = .78$, was significant, so the hypothesis involving condition difference must be rejected.

[3]This kind of analysis is more powerful for testing specific hierarchical hypotheses than classical analyses such as the ANOVA (Brauer & McClelland, 2005).

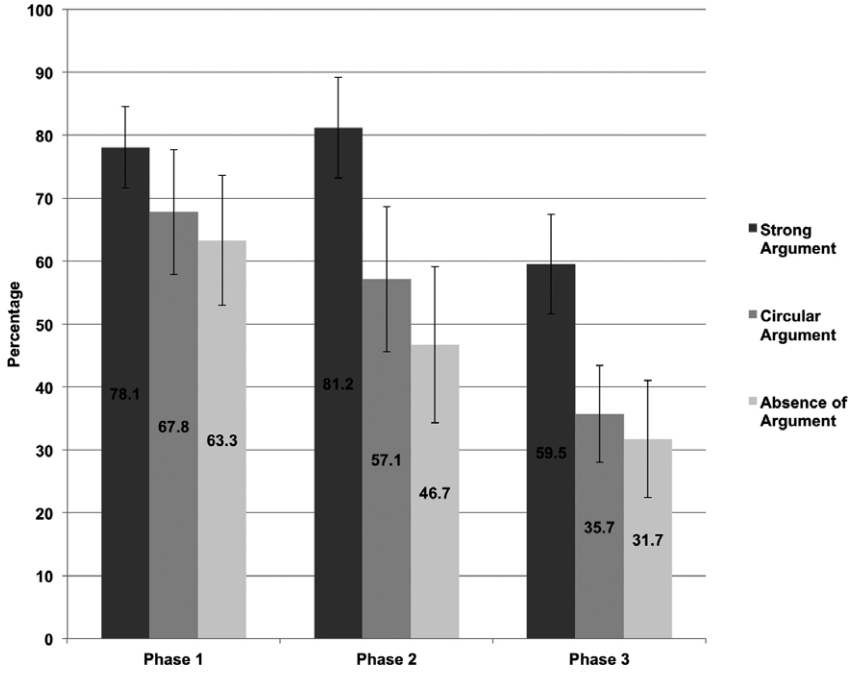

Figure 3 Percentage of the labels adopted by the children in phases 1, 2, and 3 as a function of the experimental conditions.

Phase 2

In this phase, no arguments were used—the names of the condition refer to the difference in the way the informant supported her claim in Phase 1. Children adopted the label of the informant in 81.2% of the cases in the Strong Argument condition, 57.1% in the Circular Argument condition, and 46.7% in the Absence of Argument condition (Figure 3). The contrast analysis with the same hypothesis tested in Phase 1 confirmed the hypothesis of a condition difference between the Strong Argument condition and the two other conditions, $F(1, 42) = 2.14$, $p = .039$, for the contrast of interest, $F(1, 42) = -.49$, $p = .62$, for the orthogonal contrast.

Phase 3

For all four hybrids (presented in phases 1 and 2), children provided the label previously supported by the informant in 59.5% of the cases in the Strong Argument condition, 35.7% in the Circular Argument condition, and 31.7% in the Absence of Argument condition (Figure 3).

The contrast analysis with the same hypothesis tested in phases 1 and 2 (i.e., rate of retention of the informant's label in the Strong Argument condition > Circular Argument = Absence of Argument) confirmed the hypothesis of a condition difference between the Strong Argument condition and the two other conditions, $F(1, 42) = 2.18$, $p = .035$, for the contrast of interest, $F(1, 42) = -.02$, $p = .98$, for the orthogonal contrast.

We then examined the hypothesis that children selectively retain the labels directly supported by a strong argument, by contrast with those supported by a circular argument or no argument (i.e., the drop between phases 1 and 3 in labels accepted by the children, as a function of condition). To test whether the difference observed was significant, we looked at the interaction term in the following ANOVA. A mixed-model ANOVA with Condition (Absence of Argument and Circular Argument together, Strong Argument) as between-subjects variables and Phase (Phase 1, Phase 3 with hybrids from Phase 1) as within-subjects variable was calculated for the proportion of times (with an arcsine transformation) children endorse the label given by the informant. This revealed a significant main effect of Phase, $F(1, 43) = 10.91$, $p = .002$, $\eta^2 = .20$, and Condition, $F(1, 43) = 4.13$, $p = .048$, $\eta^2 = .088$, and no interaction effect between these two factors, $F(1, 43) = 1.67$, $p = .20$, $\eta^2 = .037$. This means that children endorsed the informant's label less in Phase 3 than in Phase 1 and that they did so less in the Absence of Argument and Circular Argument conditions than in the Strong Argument condition.

Finally, a mixed-model ANOVA with Condition (Absence of Argument and Circular Argument together, Strong Argument) as between-subjects variables and Phase (Phase 1, Phase 2, Phase 3) as within-subjects variable was calculated for the proportion of times (with an arcsine transformation) children endorse the label given by the informant. This revealed a significant main effect of Phase, $F(2, 86) = 14.01$, $p < .001$, $\eta^2 = .25$, and Condition, $F(1, 43) = 4.55$, $p = .039$, $\eta^2 = .10$, and no interaction effect between these two factors, $F(2, 86) = 1.11$, $p = .30$, $\eta^2 = .025$. This confirms the drop in acceptance in the later phases, as well as the more likely endorsement of the informant's labels in the Strong Argument condition.

DISCUSSION

The goal of this experiment was to test whether 2-year-olds would be more influenced by a strong argument—an argument that brings new and relevant information—than by either a circular argument or an absence of argument. The children were shown pictures of hybrid animals, asked to name them, and then provided with a different label by an informant. For the two hybrids of the first phase, the informant supported her suggestion either with a strong argument, with a weak, circular argument, or with no argument. For the two hybrids of the second phase, the informant did not support her suggestion with arguments. In the third phase, the four hybrids from phases 1 and 2 were presented again, in the absence of the informant, to test how well the children retained the informant's suggestions.

An analysis of the overall results revealed that children were, on the whole, more likely to accept the informant's labels in the Strong Argument condition than in the Circular Argument and Absence of Argument conditions. This result supports the hypothesis that 2-year-olds are sensitive to argument strength.

In Phase 1, there was no significant advantage, in terms of children's acceptance of the informant's label, for the Strong Argument condition. Given the high rates of acceptance in the Circular Argument and the Absence of Argument conditions, the lack of significant difference is likely due to a ceiling effect. The high rates of acceptance in the absence of a strong argument could be due to two main causes. First, given that the pictures were ambiguous, deference toward a plausibly better informed source, especially since the experimenter, by asking the informant her opinion, might

also have suggested that she had relevant knowledge (Jaswal & Markman, 2007). Second, children could attempt to be polite or to ingratiate with the informant (see, Jaswal & Kondrad, 2016). Note that in the experiment showing that 3-year-olds tend to favor testimony supported by a perceptual over a circular argument, the two arguments were pitted against each other in a within participant design (Mercier et al., 2014). In the present experiment, we chose a between participant design to avoid burdening the memory of the 2-year-olds, and this difference in design might explain the differing outcomes.

In Phase 2, there was a significant advantage, in terms of children's acceptance of the informant's label, for the Strong Argument condition. This was obtained even though the informant did not provide any argument in this phase, extending prior results showing that preschoolers generalize their trust in informants who have previously provided good explanations (Corriveau & Kurkul, 2014). Descriptively, the emergence of this difference seems due to a drop in the acceptance of the labels provided by the informant who had previously provided a weak argument or no argument (see Figure 3). This drop might be due either to children's growing suspicion toward the competence of an informant who keeps providing labels that contradict his initial impression, or to a waning motivation to be polite with the informant. The fact that the acceptance of the labels provided by the informant who had previously given a strong argument did not drop at all in Phase 2 suggests that the children might have accepted her labels in Phase 1 for reasons different from the reasons for which they accepted the labels supported by either a circular argument or an absence of argument. In particular, acceptance of the informant's label in the Strong Argument condition might be due to an appreciation of the information presented in the strong argument, whereas acceptance in the other two conditions might be due to deference toward the informant or politeness.

In Phase 3, we observed an effect of condition so that the labels which had been provided by the informant who used a strong argument in Phase 1 tended to be better retained than those provided by an informant who had used a circular argument or no argument. However, there was an overall drop in the endorsement of the labels previously provided by the informant (Figure 3). Among the hybrids from Phase 1, those which had been supported by a strong argument were more likely to have been retained than those supported by a circular argument or no argument. However, maybe due to the small number of observations, this effect was not significant (absence of significant interaction in the repeated-measure ANOVA).

The theoretical import of our results is that they constitute the first, to the best of our knowledge, experimental demonstration of argumentation skills in 2-year-olds. They thus support the view that argumentation skills start developing very early (Mercier, 2011), a view recently buttressed by a series of experiments in argument evaluation (Bernard et al., 2012; Castelain et al., 2016; Koenig, 2012; Mercier, Sudo, Castelain, Bernard, & Matsui, 2017; Mercier et al., 2014) and production (Köymen, Mammen, & Tomasello, 2015; Köymen, Rosenbaum, & Tomasello, 2014) in preschoolers. All of these results support the importance of argumentation, and the exchange of reasons more generally, in our species (Mercier & Sperber, 2011, 2017; Tomasello, 2014).

A limit of the current experiment is that the children were not required to understand that the information presented—especially in the Strong Argument condition—was presented as an argument. However, the main relevance of the information

presented is as an argument for the conclusion that the informant has just offered. Indeed, the fact that the children were, overall, more influenced by the speaker who provided strong arguments suggests that they had drawn the appropriate link between the information presented in the argument and the conclusion it supported.

Methodologically, the present study offers two important contributions. First, it developed an experimental paradigm that allows testing argumentation skills in very young children. Second, it highlights the importance of testing how well information acquired through testimony is retained. The significant drop in the endorsement of labels provided by the informant observed in Phase 3 suggests that some of the apparent changes of mind observed in testimony experiments might be relatively short-lived. More regular testing of the temporal robustness of the beliefs acquired through testimony (e.g., Corriveau & Harris, 2009), and of their robustness to the departure of the informant who provided the testimony (e.g., Haun, Rekers, & Tomasello, 2014), would bring valuable information, going beyond the question of whether children endorse testimony toward a better understanding of how they do so.

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