

Pragmatics Influence Children's Use of Majority Information

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Abstract

Do children always conform to a majority's testimony, or do the pragmatics of that testimony matter? We investigate children's reasoning about mapping a novel word to a referent in an object-labeling task. Across four conditions, we modified the testimony in an object-labeling task, to account for pragmatic principles, so that the majority does and does not provide an explicit opinion about the alternative object chosen by the minority. Four- and 5-year-olds were given a choice between an object endorsed by a three-person majority, or one endorsed by a single minority informant. In the *unendorsed* condition, informants explicitly unendorsed the unchosen object. In the *nothing* condition, informants said nothing about the unchosen object. In the *ignorance* condition, informants explicitly expressed uncertainty about the unchosen object, and in the *hidden* condition, the chosen object was the only one present at the time of the endorsement. Children were most likely to endorse the majority object in the unendorsed condition, in which the majority explicitly stated that the label applied to only one referent, whereas in the hidden condition, where only one object at a time was present in the discourse, children chose objects endorsed by the majority and the minority equally, with the other two conditions intermediate. This suggests that children might not simply have a conformity bias; rather, they are sensitive to the majority's implied intentions when learning from testimony.

Keywords: social learning; social cognition; consensus; testimony; causal reasoning; pragmatics

Introduction

Learning from others is especially important for young children who are growing up in a complex social world. One way children gain knowledge from others is by learning from testimony. In particular, there is a growing body of literature showing that, similar to adults, children seem to be influenced by the opinions and behavior of a majority group (e.g., Bernard, Proust, & Clément, 2015; Burdett et al., 2016; for a recent review see Huan, van Leeuwen, & Edelson, 2013). For example, children recognize and trust a consensus during word learning. Corriveau, Fusaro & Harris (2009) found that 3- and 4-year-old children view a consensus as a reliable source of information when learning novel object labels. Children were more likely to prefer novel labels that were endorsed by the majority, and to selectively trust individuals who were previously part of the majority in a subsequent task. Bernard et al. (2015) found that slightly older children (4- and 5-year-olds) also

exhibited a consensus effect, even after the majority was shown to give unreliable testimony about object labels. Children are also more likely to copy the majority's behavior (Haun, Rekers, & Tomasello, 2012) and action sequences (Herrmann et al., 2013). As well, children seem to overconform in many situations; majority influence trumps direct source knowledge (Hu et al., 2015), and sometimes even children's own knowledge (Corriveau & Harris, 2010), or the knowledge of competent individuals (Burdett et al., 2016).

On the other hand, we also know from previous work that children are rational learners; they selectively learn from other people's testimony and evaluate the information they receive (for a review, see Mills, 2013; Sobel & Kushnir, 2013; Koenig & Sabbagh, 2013), suggesting that they might not indiscriminately endorse majority opinions. While having a majority bias in word learning is sensible due to the shared, conventional nature of word meanings, in a less socially constructed domain, such as causal learning, children may be less influenced by the majority group (Hu, Buchsbaum, Griffiths & Xu, 2013). Similarly, children are less willing to agree with the majority's action when learning about tools if the majority endorses a function that is considered inefficient or implausible (Schillaci & Kelemen, 2013). Additionally, children selectively learn from informants who display other indicators of reliable knowledge, including a history of providing accurate information (e.g., Pasquini et al., 2007), performing actions successfully (e.g., Wilks, Collier-Baker, & Nielson, 2014), having expertise in the field (Burdett et al., 2016), and having privileged knowledge (Einav, 2014).

Taken together, the current literature about majority influence in children's social learning suggests that children are rational learners, but that the role of consensus widely impacts their reasoning and social learning more generally. Why then do children conform or not conform to the majority? The mechanism that underlies majority influence is still unclear. A bias to copy the majority simply because it is the majority can often be an effective social learning strategy (Laland, 2004; Perreault, Moya, & Boyd, 2012). Conforming to the majority is a simple strategy that is often sensible and an indication of reliability (Corriveau et al., 2009). Alternatively, children might not only be attending to the number of informants, but also use pragmatic inferences for learning.



Figure 1. The arrow indicates the toy labeled by an informant as the referent of a novel word. The goal of the participant is to infer whether a novel word (e.g., “*modi*”) means the blue toy, the purple toy, or both.

This second line of reasoning is consistent with the literature on using pragmatic cues to guide learning. Grice (1975) proposed that participants in conversation obey the maxims of cooperative communication—be truthful, informative, relevant, and clear. Specifically, the Maxim of Quantity (be informative) and the Maxim of Relevance (be relevant) are both crucial for motivating our hypothesis. To be informative means to give as much information as needed, and no more. To be relevant means to say things that is pertinent to the given context. Children might assume informants are being informative and relevant with their testimony, influencing what they learn.

Frank and Goodman (2014) showed that during word learning, children are indeed sensitive to speakers’ communicative intentions, leading children to make inferences that go beyond explicit testimony. This suggests that children can make use of pragmatic principles in word learning inferences. For instance, Figure 1 illustrates a task similar to Frank and Goodman (2014). If the speaker only calls the toy on the right (marked by the arrow) “a *modi*,” children can infer that ‘*modi*’ means the *blue toy*, and not the *purple toy*, for example, by assuming that speakers are using language relevantly and informatively.

However, in previous testimony research, the majority’s opinion of the minority choice has been left ambiguous, and children’s pragmatic reasoning abilities were not considered. For example, when the majority suggest that object X is the referent of a novel label or suggest using strategy X (e.g., Corriveau et al., 2009; Haun et al., 2012), this could pragmatically imply that object Y was not a referent or that they should not use strategy Y, otherwise the speaker would have referred to this option as well, in order to be informative (Frank & Goodman, 2014). Pragmatic inferences may help children reason: “If the majority labeled object X as a *modi* and did not comment on object Y, they must believe that only object X is the *modi*. If the majority wanted me to know that object Y is also a *modi*, then they would have told me, because they had the opportunity to speak about object Y.” Accordingly, the language used could imply that the options are mutually exclusive and only one object is a *modi*, for example, providing additional evidence against the minority opinion.

Given children’s sensitivity to pragmatically implied information, we conducted the present study to investigate

how pragmatics can influence the strength of the majority influence in children. We examined 4- and 5-year old children’s preference for the majority in an object labeling task. Specifically, we compared children’s tendency to conform when the majority does and does not provide an explicit opinion about the minority’s choice.

Pragmatic knowledge versus consensus

In the present study, we investigate children’s reasoning about the mapping of a novel word to a referent in an object-labeling task, when presented with a three-person majority and a conflicting minority informant. There were four testimony conditions—the *unendorsed* condition, the *nothing* condition, the *ignorance* condition, and the *hidden* condition—that varied in the informativeness of the testimony and the relevance of the object(s) present in the situation. In the most explicit case, the unendorsed condition, the majority endorsed one object and unendorsed the other object, while the minority informant provided the opposite testimony. Here, children learn from declarative testimony that makes the extent of the novel label explicit, and no pragmatic inference is needed. We hypothesize that, since the testimony in this condition explicitly states that the labels are mutually exclusive, the testimony provided by the majority group will outweigh the evidence provided by just one minority informant, and children will be more likely to endorse the majority testimony.

In the nothing condition, the informants endorsed one object and said nothing about the other. This condition was intended to replicate previous work, in which the informants’ knowledge or belief about the unchosen object was left ambiguous. We predict that children will favour the majority endorsement, because, as in our example (Figure 1), they will make a pragmatic inference that the speakers are using language informatively, and so the majority must believe that the novel label does not apply to the unchosen object, otherwise they would have referred to the unchosen object using the label as well. Therefore, similar to the unendorsed condition, children in the nothing condition will infer that the labels are mutually exclusive. However, we predict that they will endorse the majority less often than in the unendorsed condition since there is additional ambiguity than when the majority explicitly states their opinion.

In the ignorance condition, the informants endorse one object but express uncertainty in their beliefs about the unchosen object. Since the majority provides information with low certainty about the extension of the novel label, their testimony should carry less weight in determining whether the unchosen object can also be referred to using the novel label. Further, the informants’ uncertainty suggests that the label may not be mutually exclusive, and could apply to both objects. Thus, children should be less likely to endorse the majority’s testimony, compared to the unendorsed and nothing conditions.

Finally, the language used in the testimony for the hidden condition was exactly the same as in the nothing condition, but only one object—the endorsed toy—was present. The

hidden condition relies on the pragmatic understanding that the speaker is being informative and relevant in their testimony, and is therefore only speaking about object that is present in the discourse context. The result is that, if children make this pragmatic inference—speakers cannot comment on objects that they and their communicative partners do not see—then in the hidden testimony, the majority provides no or the least amount of evidence against the minority’s choice. On the other hand, if children are not sensitive to the pragmatics of the testimony, then the results for the hidden condition should be the same as the nothing condition, with children endorsing the majority’s choice.

Whereas the current literature supports children’s conformity bias as a learning strategy, a pragmatic explanation would suggest that children do not indiscriminately conform to the majority. The overarching aim is to show that children are sensitive to pragmatic principles even if they have a general tendency to trust the majority. That is, the extent of children’s conformity depends on the pragmatics of the testimony. Specifically, as the majority’s testimony becomes more explicit in their negative judgment of the minority’s opinion, children will be more likely to adopt the majority’s endorsement over the option endorsed by the minority informant. Thus, we predict that the tendency to endorse the majority will decrease over the conditions: unendorsed condition (most majority endorsement); then, nothing condition; then, ignorance condition; and finally, the hidden condition should exhibit the least majority bias. Alternatively, if children do exhibit a global conformity bias, then they should indiscriminately endorse the majority’s opinion regardless of the testimony.

Methods

Participants. Participants were 112 preschoolers, 49 females and 63 males (mean age = 4 years 8 months; range = 47 – 71 months). An additional 23 were excluded from the study because of experimenter error (9), participant distraction (9), failure to make a choice (2), and failure to remember object label (3). Participants were recruited from the University of Toronto database or from public neighbourhood parks and museums.

Participants were randomly assigned among the four

between-subject conditions: the unendorsed condition (n = 28, M= 59 months, range = 50 – 71 months, 32% female), the nothing condition (n = 25, M= 57 months, range = 48 – 71 months, 40% female), the ignorance condition (n = 31, M= 58 months, range = 47 – 71 months, 52% female), and the hidden condition (n = 28, M= 56 months, range = 48 – 67 months, 50% female).

Materials and Procedure. Children were tested individually. In all conditions, each participant participated in two test trials, a *modi* trial and a *dax* trial. Each trial featured two novel objects for a total of four unique objects of differing shape and colour in order to reduce extension.

The trial presented first was counterbalanced across participants. The object pairs and side on which each object was presented were held fixed but the object chosen by the majority and minority was counterbalanced.

To begin each condition, children sat at a table across from the experimenter. The experimenter introduced children to two novel objects and explained that they were unknowledgeable about the labels of the objects. The experimenter suggested that the participant watch a film to learn about the objects’ label. Participants then watched a pre-recorded film of four female informants evaluating the objects on a 13” laptop screen.

A film consisted of four video clips, each featuring a female informant sitting by herself at a table with the same novel objects. Informants wore different colour shirts. In the first three clips, the three-person majority each endorsed one object with the novel label, and in the final clip the one minority informant endorsed the other object with the same novel label, repeated three times so that the frequency with which each participant heard the label used to refer to each object was equal. Each clip concluded with the informant picking up the toy they had endorsed. The identity of the minority informant was counterbalanced across participants. Figure 2 displays schema for the videos shown.

In the unendorsed condition, each majority informant endorsed one object while explicitly unendorsing the other object by saying, “That’s a *modi* (pointing to target toy); that’s not a *modi* (pointing to other toy).” In the ignorance condition, each majority informant endorsed one object while expressing uncertainty about the other object by saying, “That’s a *modi* (pointing to target toy); I don’t know

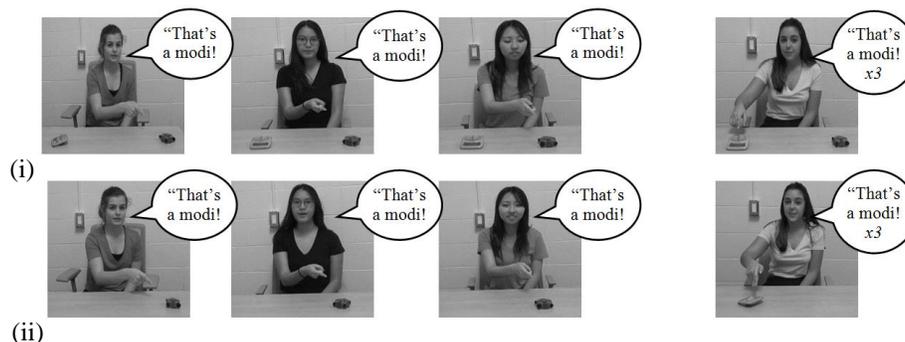


Figure 2. Schema of the videos seen by children. (i) Stimuli placement for the Unendorsed, Ignorance and Nothing condition. Testimony from the Nothing condition. (ii) Stimulus placement and testimony from the Hidden condition.

if that's a modi (pointing to other toy)." In the nothing condition, the majority informants endorsed one object and did not comment on the other object by saying, "That's a modi (pointing to target toy)." In the hidden condition the informant sat at the table with only one object and evaluated that object by saying, "That's a modi (pointing to target toy)." In all conditions the minority informant endorsed the other object with the same novel label three times. For instance, in the unendorsed condition the minority informant said "That's a *modi* (pointing to other toy); that's not a *modi* (pointing to target toy). Look at that *modi* (pointing to other toy); that's not a *modi* (pointing to target toy). It's a pretty cool *modi* (pointing to other toy); that's not a modi (pointing to target toy)". The minority scripts in the other conditions followed in the same manner.

Once the film ended, the screen turned black and the objects were brought back. The experimenter then asked the participant to identify the referent of the novel label by asking, e.g., "Can you show me a modi?" Participants' first gestural or vocal response was recorded.

Results

Table 1: Participant scores by condition

Condition	Score		
	0	1	2
(1) Unendorsed	0	4	24
(2) Nothing	3	9	13
(3) Ignorance	4	8	19
(4) Hidden	6	12	10

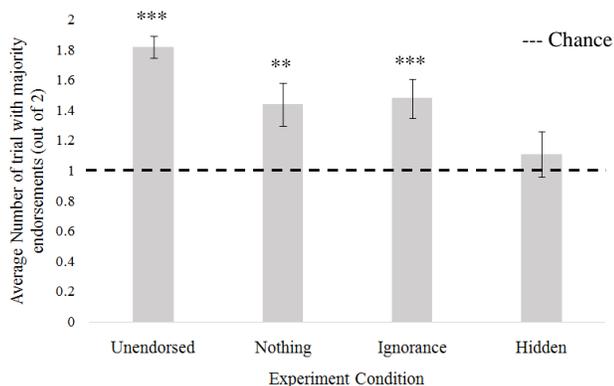


Figure 3. Average number of responses (\pm 1 s.e.) endorsing the majority object. There was a significant effect of condition. Children chose the majority's object most often in the unendorsed condition, and least often in the hidden condition. ** $p < 0.01$ *** $p < 0.001$.

Participants were assigned a score (0, 1, or 2) based on the number of trials in which they endorsed the majority informants' testimony (see Table 1).¹ Children's mean responses for all conditions are shown in Figure 3. For all conditions, chance level was a mean score of 1.

¹Analysis using a mixed logistic regression model—structuring outcomes as binary responses—did not change our findings

Children chose the majority's referent to the novel object significantly more often than chance in the unendorsed ($t(27) = 11.15, d = 4.29, p < .0001$); nothing ($t(24) = 3.09, d = 1.26, p < 0.01$); and ignorance conditions ($t(30) = 3.72, d = 1.36, p < 0.001$). In contrast, in the hidden condition, participants were not more likely to adopt the majority's opinion than the minority's ($t(27) = 1.11, d = 0.39, p = 0.24$).

We also found a significant effect of condition on children's tendency to choose the majority object, one-factor ANOVA $F(3,108) = 5.3, MSE = 2.39, p < 0.01$. Planned two-sample t-tests for independent samples demonstrated that the unendorsed condition was significantly different compared to all the other conditions: unendorsed vs. nothing: $t(51) = -2.45, d = 0.67, p < 0.01$; unendorsed vs ignorance: $t(57) = -2.19, d = 0.58, p < 0.05$; and, unendorsed vs. hidden: $t(54) = 4.31, d = 1.15, p < 0.0001$. Similarly, children's performance in the hidden condition was significantly different from the ignorance condition, $t(57) = 1.92, d = 0.50, p < 0.05$; and, marginally different from the nothing condition, $t(51) = 1.61, d = 0.44, p = 0.06$. There was no significant difference in children's performance in the nothing condition compared to the ignorance condition, $t(54) = -0.23, d = 0.06, p = 0.41$.

Follow-up polynomial contrasts indicate a significant linear trend, $F(1, 108) = 13.67, p < 0.001, \text{partial } \eta^2 = 0.11$. The linear trend suggests that deference to majority decreases across ordered conditions: unendorsed ($M = 1.82, SD = 0.074$), nothing ($M = 1.44, SD = 0.711$), ignorance ($M = 1.48, SD = 0.724$), and hidden ($M = 1.11, SD = .079$).

Discussion

To be rational yet efficient social learners, it would be beneficial for children to learn through explicit instruction as well as pragmatic inferences. This study provides the first empirical evidence that children consider pragmatic inferences when learning from testimony provided by a majority and minority group. We examined the effects of the pragmatic cues in informants' testimony on children's tendency to defer to the majority. Our study found that although children tend to be influenced by the majority, they also weigh informants' opinions using pragmatic cues to assess the meaning of their testimony. By assuming that informants are being cooperative in their communicative intent (e.g., Maxim of Quantity; Maxim of Relevance), children are evaluating the pragmatic implications of the language used and making inferences that go beyond the literal meaning of the testimony.

We found that when learning from explicit, declarative testimony, as was the case in the unendorsed condition, 4- and 5- year old children were significantly more likely to endorse the majority object—their tendency to endorse the majority option was almost at ceiling. In this condition, the informants' opinions about both of the novel objects were made explicit in the language of the testimony. They endorsed one object using the novel label (e.g., *modi*) and provided additional evidence that the unchosen object was not a *modi*. In this case, following the majority is a sensible

strategy since the explicit endorsement of only one object by three people might outweigh the evidence provided by just one minority informant.

There was also a consensus effect in both the nothing condition—replicating the findings in previous work (e.g., Corriveau et al., 2009)—and the ignorance condition. And yet, in these conditions the majority bias was significantly less than in the unendorsed condition, suggesting that children are aware of the additional ambiguity in these conditions. By contrast, children did not exhibit a majority bias in the hidden condition. The crucial difference between these conditions is the pragmatic inferences made, given the ambiguity of the learning situation.

When the speaker's testimony is ambiguous, as in the nothing condition, children might rely on pragmatic cues to infer the speaker's intent. According to the pragmatic account, a crucial step in the inferential process is the assumption that the speaker, in this case, the informants, is being cooperative with their utterance, and has the goal of being informative. Accordingly, if the speaker had wanted to label both objects then they had the ability to do so, as in the unendorsed and ignorance conditions. The fact that the informants only ever labeled one object in the nothing condition led children to infer that the novel label is only applicable to one object in the given situation, leading to the conclusion that the unchosen object is not a referent of the novel label. However, in the hidden condition, only one object was present, invoking a different pragmatic inference than in the nothing condition—the inference that speakers are only discussing objects relevant to the current situation. Consequently, even though the testimony in these two conditions was identical, children's inferences differed. Children in the hidden condition were no more likely to endorse the majority's testimony than the minority's. This suggests that children's inferences from consensus are influenced by their sensitivity to pragmatic cues embedded in the testimony.

A somewhat unexpected finding was that children were also more likely to choose the majority's object in the ignorance condition. In the ignorance condition, we intended for the uncertainty about the extension of the object label to come from the uncertainty in the speaker's knowledge. Since informants expressed low certainty in their testimony, there should be less evidence against the unchosen object being e.g., a *modi*, and by association, against the minority. However, children might instead have interpreted the statement of ignorance as a comment about the object rather than about the informants' knowledge. Children might have inferred that the majority was certain about one object having many features of e.g., a *modi*, but was uncertain about the other object due to its ambiguous or hard to categorize appearance. Future work should disambiguate the type of uncertainty being conveyed.

Together, the results go beyond asking whether or not children have a conformity bias, and explore children's sensitivity to pragmatically implied information. Children's tendency to conform might not simply be driven by a 'copy-

the-majority' strategy (Laland, 2004), since they did not conform to the majority equally across conditions. Instead, the extent to which children prefer members of the majority as informants might vary with the pragmatics of the language used in the testimony. Children may not be overestimating the value of the majority's opinions compared to the minority's testimony. Instead, children are sensitive to the language used by informants, and hence, are selective about situations in which they should go with the consensus view. This finding is consistent with previous work suggesting that children are able to make sophisticated inferences about implicit, intended meaning in speakers' utterances (e.g., Frank & Goodman, 2014).

An interesting question is whether our results are specific to the use of an object-labeling task. For instance, children may be more likely to conform to a majority in a labeling task because the meanings of words are socially determined (Hu et al., 2013). In addition, labels may have stronger implications due to other constraints on word learning, such as mutual exclusivity—each object has only one category label (Markman, 1989), and the shape bias—differently shaped objects usually have different category labels (Landau, Smith & Jones, 1988). For example, if an informant labels Object 1 as *a modi*, this strongly implies that Object 2, which is very differently shaped, is *not a modi*. This would provide additional evidence against the minority, by suggesting that *both* objects cannot be *modis*.

In our experiment, we were able to modify the testimony so that the strength of the implications regarding the novel label for the object(s) varied by condition. However, if children were exclusively following these types of language learning constraints, they should have assigned a novel label to only one object in all conditions. On the contrary, children's performance followed a linear trend and did not favour the majority label in the hidden condition.

However, future work should examine children's endorsements of majority and minority information in other domains such as causal learning (e.g., Hu et al., 2013). Causal tasks do not rely on the conventions and social construction that make learning labels special. Since causal actions on objects might not be mutually exclusive by nature—one causal action does not necessarily imply that the other actions are ineffective—future work can directly examine how making actions appear mutually exclusive using pragmatic principles can affect children's reasoning. We would be interested in children's reliance on consensus during a causal task, and in turn, how they are making pragmatic inferences about the efficacy of each action.

One further question concerns the operationalization of consensus and the presentation of a majority group versus the minority informant. In this paper, we presented the informants individually, and in a sequential manner with the majority group first, similar to previous work by Haun et al. (2012) and Burdett et al. (2016), and importantly, this was held constant across all of the conditions. However, in both Bernard et al. (2015) and Corriveau et al. (2009), the majority and minority informants were all presented

together, and at the same time rather than one after another. It is possible that this difference in the format of majority presentation might change the pragmatics of the situations, for example if children believe that the dissenter in a simultaneous presentation is attempting to correct the majority's misinformation. Future work could compare simultaneous and sequential presentation of the informants to see how this changes children's inferences.

Finally, it is difficult to quantify our predictions without formalizing our assumptions. A Bayesian model could produce quantitative predictions regarding the ordering of our conditions, and the magnitude of the differences between them. This type of model could examine how a rational learner would balance a majority opinion against the pragmatic implications of their testimony, without a conformity bias, and test those predictions against children's behaviour, building on previous models of learning from testimony (e.g., Buchsbaum et al., 2012) and of making pragmatic inferences (e.g., Frank & Goodman, 2014).

In sum, this research sheds light on how pragmatic principles can inform children's learning from conflicting majority and minority groups. In conditions where the testimony explicitly stated, or pragmatically implied, that the labels were mutually exclusive, children were more likely to adopt the majority's label than the minority's label. However, when the testimony had weaker implications about the labels of the novel objects, children were not more likely to rely on the consensus view. This suggests that children might not simply have a conformity bias. Instead, children can make sophisticated inferences that go beyond the literal meaning of the testimony. By doing so, they consider both the explicit statements made by informants, as well as the pragmatic inferences implied by the majority opinion in their learning from the social world.

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