# Children's Selective Learning Based on Informants' Informativeness

By

Heyang Yin

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# Preface and Acknowledgments

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# Children's Selective Learning Based on Informants' Informativeness


## Abstract

The selective learning literature has shown that children are able to track informants' epistemic status, such as their history of accuracy, and use this information to decide whether to learn from them. Such selective learning mechanisms allow children with limited information access to the world to learn from more knowledgeable information sources. An optimal knowledge source, however, should not only ensure the accuracy of information, but also provide sufficient information and avoid underinformativeness of speech. *Sins of omission* are a form of underinformative communication; such utterances provide logically true information but might induce false beliefs in listeners. The current paper will summarize the literature on children's selective learning and the developmental trajectory of children's understanding of informativeness. Then, I present ongoing research that investigates whether and how children utilize the sin of omission as a cue in selective learning.


*Key words*: selective learning, informativeness, sins of omission

# Children's Selective Learning Based on Informants' Informativeness

## Introduction

Laura and Nora were playing a hide-and-seek game in the park. Laura could not find where Nora was, but there were three pedestrians, Alice, Bob and Carol. So, Laura decided to ask them for help. Laura said to each of them that she was looking for Nora in the park and whether they each knew where Nora was. All three of the pedestrians had watched Nora hide under a bench on the other side of the park. When Laura asked Alice, she responded, "She is in the park." Laura could not do anything with Alice's information – Laura was already in the park, so this was not helpful in finding Nora. She then asked Bob. Bob saw where Laura was, but he responded, "She is in the restroom in the park." Laura looked in the restroom, but was frustrated after she didn't find Nora there. Because Bob was inaccurate, he was also not helpful. Laura then asked Carol, who said, "She is under a yellow bench near a big tree in the park!" Following Carol's suggestion, Laura found Nora under the yellow bench near a big tree. Carol was helpful in Laura's search. Alice and Bob were not. The fundamental question I would like to ask is whether Alice and Bob were unhelpful in the same way?

At the outset, I would like to argue that the answer is no. Bob's statement was inaccurate; Nora was not in the restroom. In contrast, Alice's statement, "She is in the park" was not inaccurate (i.e., she *was* in the park), but it did not contain information beyond what Laura already knew. In this way, Alice was *underinformative*. It is not inaccurate to say "Nora is in the park" when Nora was in the park, but the more informative description, "Nora is under a yellow bench near a big tree" would provide more information to Laura.

As children have limited information access to the world, it would be important for them to learn from reliable knowledge sources. An optimal knowledge source should not only ensure

the accuracy of information, but also provide sufficient information by attending to the informativeness of speech (Grice, 1975). Children selectively learn from others' information based on those informants' history of reliability (Harris & Koenig, 2006). This phenomenon has become known as selective learning. The majority of the literature on this topic has been focused on contrasting accurate vs. inaccurate speakers, and found that children selectively learn from informants who are accurate over inaccurate. Few investigations, however, have considered whether children learn from informants who are underinformative and whether children treat underinformative speakers the same as an accurate or inaccurate one. The current study examines how children treat underinformative speakers when engaged in a selective learning paradigm. I will summarize the literature on children's selective learning and the developmental trajectory of children's understanding of informativeness. I will then present a set of studies that examine whether and how children utilize informants' underinformativeness a cue to learn selectively.

## Literature Review

### Selective Learning

Children need to learn a large amount of information from others in the social environment. How might children learn from others? One possibility, which was articulated by Piaget is that children are simply credulous – they believe what they are told, until they develop sufficient metacognitive capacities to recognize that others are lying to them. Some have articulated an updated version of this hypothesis (Mills, 2013; Jaswal et al., 2010). They suggested that children are born with a "default bias to trust" and it is only after they develop sufficient cognitive or metacognitive capacities that they learn from others selectively (Jaswal et al., 2014).

The contrasting points are the views articulated by Harris & Koenig (2006) and papers with Fabrice Clement. The idea is that children have a concept of accuracy and use informants' history of accuracy to make generalizations about what kinds of information they might provide in the future. For instance, children are able to track individuals' records of reliability in the past, such as their history of accuracy, and decide whether to learn from them in the future (Clement, Koenig, & Harris, 2004; Koenig, Clement, & Harris, 2004; Koenig & Harris, 2005). As an example, researchers would present children with two informants whose history of accuracy or inaccuracy was established by introducing names of familiar objects. Then the two informants, one previously accurate and the other previously inaccurate, provided contrasting information to children about the names of a novel object. After receiving conflicting labels from the two informants, researchers found children preferred to learn new object names from informants with a history of providing accurate rather than inaccurate information (Koenig & Harris, 2005).

In the real world, however, children may encounter informants who do not provide them with inaccurate information, but who are also not completely accurate. For example, when presented with informants who varied in their degree of accuracy (i.e., one informant labeled 3 out of 4 familiar objects correctly and another labeled 1 out of 4 familiar objects correctly), 4-year-olds chose to rely on new information generated by the more accurate informant (Pasquini et al., 2007). Moreover, children are sensitive to situational cues to accuracy, even if those cues themselves do not indicate epistemic competence or incompetence. For example, when two informants both generated accurate information, 5- and 6-year-olds preferred to learn from the more confident informant (Brosseau-Liard et al., 2014). Similarly, when asked to learn novel labels of novel objects, 4-year-olds were unlikely to learn from individuals who were ignorant of the labels of familiar objects (Koenig & Harris, 2005; Sabbagh & Baldwin, 2001). Four-year-

olds also preferred to rely on the novel information generated by an accurate labeler over a neutral labeler (i.e., one who just said, "let me take a look at that/" (Corriveau et al., 2009). The studies suggested that children not only prefer to rely on accurate over inaccurate informants, but they also prefer them to ignorant and neutral informants, who might not be inaccurate but do generate the appropriate information.

**Conceptualization of Informativeness**

Children's daily communicative environment is more complex than just identifying accurate sources of information and discriminating them from inaccurate ones. It is more likely they will encounter vague information rather than blatantly inaccurate information (Gillis & Nilsen, 2013; Keysar & Henly, 2002; Kraljic & Brennan, 2005). Thus children may need to develop the ability to use information sufficiency to guide their learning.

Informativeness is an epistemic cue, defined as information sufficiency, that we can use to investigate children's selective learning ability. There are many ways one's statements can differ on informativeness. In this paper, I will review three examples: *inadequate explanations, referential ambiguity,* and *sins of omission*(e.g., Corriveau & Kurkul, 2014; Frank & Goodman, 2014; Gillis & Nilsen, 2013; Gweon et al., 2014).. Each of these examples have been described through research in language development and processing, and relate to the selective learning literature.

When an informant provides insufficient novel information, this is called an inadequate explanation. For example, consider two informants who each are asked to define the word "little." The first one says "Little means something really little." The second says "Little means something really small." The first informant generates a circular definition – in this case a

definition in terms of itself, which provides nothing new about the meaning of the word. The second informant, who generates novel information in their definition, is more informative than the first; a fact that children recognize (Tippenhauer et al., 2020).

Failing to provide all the information necessary to disambiguate meaning is referred to as referential ambiguity. For example, consider a situation in which there are three hiding black boxes. Two are the same size, and one is larger. Indicating that a hidden object is in the larger box by saying, "It's in the bigger one." is not ambiguous because it indicates one unique location. However, indicating that the hidden object is in the larger box by saying, "It's in the black one", while accurate, does not provide sufficient information to indicate a unique referent. As with inadequate explanations, 6- and 7-year-olds are sensitive to cases of referential ambiguity (Gillis & Nilsen, 2013). Only referring to the target box's color (e.g. the box is black) would be underinformative because color is not a distinguishing feature of the target.

Finally, a sin of omission involves informants providing some, but not all of the pertinent information available to them. (e.g., Gweon et al., 2014). Imagine, for example, there are three boxes on the table, which are red, yellow, and blue. Imagine also that there is a sticker in each box. To describe the stickers in the boxes, a sin of omission would involve a speaker, knowledgeable of this situation, saying that, "there is a sticker in the red box and there is a sticker in the blue box", without mentioning the yellow box. The informant is accurate, but is also misleading because the speaker gives less information than they could. Failure to mention the yellow box in this case could imply that there is not a sticker in the yellow box, and listeners might draw false inferences from the statement.

**Children's Understanding of Informativeness**

Now that I have defined three ways informants can be underinformative, I want to describe research, mostly in language processing or production, on children's understanding of each type of informativity. Then, in the following section, I will link children's understanding of each type of underinformative utterance with the social learning literature.

### *Inadequate Explanations*

Children use different levels of adequate explanations to guide their learning of word meanings. Tippenhauer and colleagues (2020) showed children two individuals who each provided them with the definition of a word. One produced an inadequate definitions, such as ‘‘Silly means when you are silly," whereas the other one produced adequate definitions (e.g., ‘‘Silly means when you are goofy"). The experimenters then asked children, "What do you think the word means?" 5-year-olds selected the more adequate definitions over chance.

Generating adequate explanations seems even more challenging for young children. Four- and 5-year-olds were often unable to provide adequate definitions for words like "learning" and "teaching." For example, compared with older children, they were less prone to give adequate explanations that define learning or learning as a process that would result in gaining knowledge (Sobel & Letourneau, 2015). Similar, when preschoolers were asked to define "science", they often did so in terms of in terms the word or a person who does science (e.g., "science means doing science" or "science is done by scientists", see Weisberg & Sobel, 2022). Rather, they might give inadequate explanations such as circular ones, such as stating "teaching means teach" or "learning means when you learn." In general, children demonstrate sensitivity to the adequacy of explanations, but can have difficulty generating adequate explanations in certain settings before the age of five.

## Referential Ambiguity

Children are sensitive to others' referential ambiguity. This is evident in referent selection tasks, in which children are asked to choose a single matching referent upon hearing referentially ambiguous statements that could be matched with multiple targets. For example, Stiller et al. (2015) presented preschoolers with three visual stimuli: a man without a hat or glasses, a man with glasses but no hat, and a man with both glasses and a hat. Then a speaker said: "my friend has glasses." They asked children to point to the friend mentioned by the speaker. Although the man only with glasses and the man with both hat and glasses both fit with the description, 3-year-olds matched the man only with glasses with the given description, rather than the man with both "hat" and "glasses". One potential interpretation of children's selection is that the utterance "a man with glasses" is perfectly informative to refer to the man only with glasses, but would be underinformative to describe the man with both hat and glasses. The informant would have said "the man with a hat and glasses" if they intended to refer to the man with two features. Similarly, when 5-year-olds heard the utterance, "the dog painted the heart" as a description of the target picture among four pictures, they matched the description to the picture in which the dog only painted the heart, instead of other pictures in which the dog painted not only the heart but also other shapes (Katsos & Smith, 2011). Children not only used speakers' informativeness as a cue to guide their selection of referents, but also awarded larger prizes to the fully-informative informant than the underinformative informant. For example, Papafragou and Tantalou (2004) found that 5-year-olds assigned an underinformative speaker a smaller reward, who omitted information by introducing "the cow wrapped up the carrot", while in the described scenario the cow wrapped both the carrot and a doll.

Some studies used non-verbal cues, such as young children's response time, to measure their sensitivity to referential ambiguous information (Morisseau et al., 2013; Nilsen et al., 2008).

For example, when told to, "find the orange", 3-year-olds' response times were longer when there was more than one orange than when there was only one. Similarly, 4-year-olds had longer response times when hearing a statement to find an object with an ambiguous referent (Nilsen et al., 2008).

Overall, children are sensitive to referential ambiguous language as early as age three. They used cues of informativeness to guide their selection of referent and also responded differently when encountering ambiguous information.

## Sins of Omission

Children make use of informants' sins of omission to guide their learning. For example, Bonawitz et al. (2011) found that when an informant demonstrated only one function of a toy that actually had four functions, most preschoolers, who were not aware of all the toy's functions, did not discover the toy's other three functions even when they were allowed to explore freely with the toy later. Children in the study made the inference that others generate fully informative statements, such that when the teacher only generated one function, that was all there is to learn. Otherwise, from the children's perspective, the informant would have taught other functions of the toy.

Although children demonstrated their sensitivity to others' sins of omission in learning toy functions, young children did not consistently judge the helpfulness of informants based on whether they committed sins of omission. Gweon and Asaba (2018) showed 4- to 7-year-olds two puppet who acted as teachers, demonstrating the same function of two toys. The toy used by one puppet (the underinformative puppet) had four functions, while the toy used by the other puppet (the informative puppet) only had one function. And critically, children knew the number of functions each toy possessed. Each puppet demonstrated a single function on their toy. So, the

underinformative puppet omitted three of the known functions while the informative puppet generated all the available information, even though the number of functions they generated was the same. Children then rated the two puppets based on their level of helpfulness in teaching. The younger children did not differ in the ratings of the two puppets. Only the older children (6- and 7-year-olds) gave higher ratings to the fully-informative teacher. Only these older children stated that the fully informative puppet was a better teacher.

Different from children, adults are not only sensitive to others' sins of omission but also use other characteristics of informants (e.g., whether they speak with native or non-native accent) to selectively forgive underinformativeness. Fairchild and Papafragou (2018) presented adult participants with true sentences (e.g., "Some people have dogs as pets in the house"), false sentences (e.g., "All women are doctors who went to medical school") and underinformative sentences such as "Some dogs are mammals." The researchers told the participants that these sentences were produced by either native or non-native speakers. Then adults rated the sentences based on how much sense they thought the sentences made. Adults' ratings of underinformative sentences were lower than true sentences and higher than false sentences. Critically, such ratings for underinformative sentences increased when participants were told they were from a non-native speaker. The study suggested that adults not only register others' underinformativeness, but also selectively excuse it for specific reasons such as a speaker's membership in a linguistic community.

**Integrate Informativeness and Selective Learning**

The reviewed research suggested children's early understanding of others' informativeness and demonstrated children are making inferences about the informativeness of speakers. Whether and how such understanding might influence children's learning choices,

however, has received less systemic investigation. There have been a few attempts to connect the literature of linguistically-oriented research on children's inference-making based on others' informativeness and selective learning. Specifically, the limited number of studies on children's informativeness-based selective learning has mostly focused on two forms of underinformativeness: inadequate explanations and referential ambiguity. The studies found that children younger than five were mostly unable to explicitly convey that an underinformative informant was underinformative, yet still selectively adopt the information provided by an informative informant or asked the speaker for more information.

In the case of underinformativeness in the form of inadequate explanations, 3-, 4-, and 5-year-olds could not explicitly tell whether an informant providing adequate explanations was more reliable than one who provided inadequate explanations (Corriveau & Kurkul, 2014; Okanda et al., 2015; Siegal et al., 2010). For example, 3-year-olds could not explicitly tell whether an informative speaker who used noncircular explanations of science terms (e.g., "Rain falls from the sky because the clouds are filled with water") was better at explaining than an underinformative informant who gave circular explanations (e.g., "Rain falls from the sky because water falls from the sky"). Nevertheless, children as young as 2-year-olds demonstrated a tendency to adopt adequate explanations rather than circular ones about word definitions, as the latter ones only reiterates the word without providing any new information about its meaning such as "little means little" (Castelain et al., 2018; Corriveau & Kurkul, 2014; Mercier et al., 2014).

Similarly, in the face of ambiguous referential information, young children often encountered difficulty explicitly endorsing information provided by the more informative informant. However, they did prefer to seek future information from the informant with a

history of being informative (Beal & Belgrad, 1990; Gillis & Nilsen, 2013). For example, in Gillis and Nelson's study , 4- and 5-year-olds were unable to rate the informative informant who pointed to a set of target boxes and made an unambiguous statement about the contents of the boxes as more informative than a speaker who provided ambiguous referential information. However, those children still chose to solicit information about the contents of a set of new boxes from the informant who did not generate ambiguous utterances. Similarly, Eskritt et al. (2008) presented 4- and 5-year-olds with a series of trials in which they had to find a target cup with hidden stickers among a set of four distinct cups. Children were asked to seek information from one of two informants – one who had previously described the target cup in an unambiguous manner and the other who had been underinformative, by stating ambiguous claims, such as "it's under one of the cups" or "it's under a cup."

These studies suggested that children younger than 5 years old are sensitive to the informativeness of others' statements, and use informative cues to guide their learning. Such sensitivity, however, was absent in properly responding to explicit judgment questions or verbalizing the more informative informant (e.g., who is a better teacher or who is good at labeling objects). The results are consistent with findings from a meta-analysis on selective learning, which suggested that children's responses to explicit judgment questions require making more metacognitive judgments to decide whether an informant is a good information source. Responses to such questions have a separate developmental trajectory and only appear later in development (Sobel & Finiasz, 2020). Contrastively, the ability to endorse whether to use such information seems present much earlier in development (see also Luchkina et al., 2018; Tummeltshammer et al., 2014). Deciding whether to use an informant's information requires

different inferences and metacognitive skills than stating that the informant is a good or bad informant.

### *Sin of Omission as a Cue to Underinformativeness*

The studies reviewed in the previous section suggest that children process different kinds of underinformative statements, and come to use their appreciation of underinformativity in their selective learning. What has not been studied in this context is children's exposure to informants who generate sins of omission. Sins of omission occur when an informant omits information in communication by producing logically true but misleading statements, such as teaching only one toy function and omitting the other three functions (Gweon et al., 2014). As an informant is assumed to be knowledgeable and helpful, committing a sin of omission might lead to children making inaccurate inferences. For example, when introduced to a toy with multiple functions, being told only one function might indicate to the child that the toy might only have one function because the teacher only taught me one. Therefore, children might actively misunderstand the situation (Shafto & Goodman, 2008; Shafto, Goodman, & Frank, 2012). Indeed, the study by Bonawitz and colleagues (2011) suggested that children recognize that the act of teaching only the one function indicated to 4- and 5-year-olds that this was the only function of the toy; when that pedagogy was not present, children explored more and were more likely to discover more about the toy. To our knowledge, children's understanding of sins of omission and selective learning has only been investigated through their explicit judgment of informants (Gweon & Asaba, 2018). This motivates our present investigation – to examine whether informants who generate sins of omission are more, less, or similar to informants who generate fully informative accurate or inaccurate information.

## Goals of Current Research

Whether children use informants' past "sins of omission" to guide their future learning is key to understanding how they learn. As reviewed above, existing research has mostly investigated children's explicit judgment of informants' "sins of omission" rather than how children deal with the information provided by them. It is unclear whether young children deal with information from an informant who commits the "sin of omission" differently than they do with a more informative one or an inaccurate one. In the present study, we contrasted 5- and 6-year-olds' selective endorsement of new information provided by a source that has previously been an informant who has committed "sins of omission" vs. a fully informative one. We also contrasted children's endorsement of an informant committing "sin of omission" with an inaccurate speaker. We focus on children in this age range because they demonstrated inconsistency in tasks involving explicit judgments of underinformativeness, which means that they did not consistently make explicit judgments on others' informative level, but might still be implicitly aware of underinformativeness.

In this study, we presented children with two informants, who differed on their level of informativeness (one was fully informative, the other was underinformative, because they committed a sin of omission, Study 1) or who differed between being underinformative and inaccurate (Studies 2-3). We asked whether children recognize the difference between the two speakers, and that each speaker would be more likely to generate similar utterances in the future. We also asked whether children learned novel information (specifically the referents of novel words) from the speakers differently (Studies 1-2). Not to preview the results, but because children did not learn novel labels judiciously in these first two studies, we also considered whether children would make inferences a third type of information judiciously – one that was closer to the familiarization (Study 3)

There are two distinct hypotheses that result from this past research. . One possibility is that children treat underinformativeness just like inaccuracy. They may not endorse the information provided by an underinformative and an inaccurate speaker indiscriminately, but are more likely to endorsement information from a fully informative informant. This is because endorsement of information might require fewer metacognitive abilities than making explicit judgments, and thus might better reflect young children's sensitivity to informativeness (Corriveau & Kurkul, 2014). Alternatively, children might indiscriminately accept information from underinformative and fully informantive informants, but are less likely to accept information provided by an inaccurate speaker. Their use of such an inaccuracy strategy can explain this possibility—- children might only track inaccuracy and treat informants making no errors albeit being underinformative as trustworthy (Pasquini et al., 2007). Underinformativeness, in this way, might be understood not necessarily as epistemic competency. The pragmatic confusability in the form of not providing all information might be due to mere ignorance. After all, the underinformative speaker did not generate any inaccurate information.

**Common Ground vs Privileged Knowledge States**

Finally, we also considered an additional piece of information about speakers' utterances. We were curious whether children's judgments about informants' reliability might be influenced by whether the informants possess prior knowledge of the information they communicate. In the example of Nora and Laura at the beginning of the paper, Laura did not have prior knowledge of Nora's location, whereas Alice, Bob, and Carol do. This matches the privileged condition in our study, in which only the informants but not children knew the information to be told. But let's imagine a different scenario in which Laura knew where Nora was, and these three informants not only did so as well, but knew that Laura knew. In this case, Nora's location was in *common*

*ground*. Does being underinformative in common ground situations differ from being underinformative in privileged ground situations?

Previous research suggested that when children younger than six already knew the information to be told by informants beforehand, they usually had difficulties identifying statements as underinformative (Beal & Belgrad, 1990; Gillis & Nelson, 2013; Sodian, 1988). For example, Nilsen et al. (2008) showed 4-year-olds the location of a hidden sticker in front of an informant. When that informant generated an underinformative statement about the location of the sticker, they judged that individual as more reliable in providing future sticker information than when the informant generated the same information in privileged ground (i.e., the child did not know the location). The behavior might be explained by the "curse of knowledge," in which knowledgeable individuals might have a difficult time appreciating the knowledge states of ignorant and naive individuals (Birch & Bloom, 2002, 2004). In other words, it might be harder for Laura to identify that the statement "Nora is in the park" is underinformative because she already knew it.

This leads to the second goal of the study, which is to explore further whether children's possession of prior knowledge about sticker location before two informants told them would influence their future learning choices for names of novel objects. We anticipate that there are two possibilities for children's learning choices. First, children in the common ground condition might be more likely to adopt object names provided by an underinformative informant than children in the privileged condition. This is because children in the common ground condition might be less sensitive to the speaker's underinformativeness due to the incapability of suppressing their own prior knowledge and properly recognizing the speaker's underinformativeness (Gillis & Nelson, 2013). The second possibility is that children in the

common ground condition might be less likely to adopt information from an underinformative speaker than children in the privileged condition. In the privileged condition, informants might not know the sticker states and their underinfomartiveness might just be ignorant and is still forgivable. Underinformative informants in the common ground, otherwise, are pragmatically weird by providing blatantly providing inconsistent information with children's prior knowledge.

## Experiment 1

We first examined whether 5- and 6-year-olds would recognize speakers' different levels of informativeness when providing information about the presence of stickers in closed boxes. Children were introduced to two informants. On familiarization trials, they were shown three boxes. One informant provided children with information about the content of all three boxes. The other informant provided children with information about only a subset of the boxes (but not all of them). Our questions were (1) whether children recognized that one speaker was more informative than the other (measured by whether children recognized that the speakers would provide different levels of informative statements in the future) and (2) whether children learned novel information differently from the two informants, in the form of learning novel labels for novel objects, similar to Koenig & Harris (2005).

We also varied the extent to which children's judgments of these speakers was determined by their order in which speakers made these utterances and children learned the actual contents of the boxes. In one condition, the speakers generated these utterances, and then the contents of the boxes could be revealed. In this condition, it was possible that children understood that the speakers might not have had full information about the content of the boxes, making the underinformative speaker more excusable. We will refer to this as the *privileged*

*ground* condition. In the other condition, the contents of the boxes are first revealed to both the informants and child participant, and then the two informants generate different utterances describing the boxes. In this *common ground* condition, there is less of a plausible reason to excuse the behavior of the underinformative speaker, and it is more likely that the speaker is being deceptive or otherwise unhelpful in providing information.

## Method

### *Participants*

The final sample consisted of 62 five and 6-year-olds (*M* =69.94, range=60-72 months). There were 29 girls and 33 boys in the sample. Sample size was determined by *a priori* power analysis, performed in Gpower 3.1, assuming the binomial logistic analysis reported below, and $\alpha = .05$, $\beta = .20$ and a large effect size (Odds Ratio = 3.0). Participants were recruited from public birth records or at a local zoo. All were born full-term to monolingual English-speaking families and had no known developmental disabilities. Families were not compensated. We did not collect race, ethnicity, and SES information from participants' parents, but most families were Caucasian and represented middle to upper SES backgrounds. Half of the participants were assigned to the common ground condition and the other half were in the privileged condition.

### *Materials and Procedures*

In both common ground and privileged conditions, the visual stimuli were a series of 6 video clips, corresponding to two familiarization trials and two types of test trials: box and label trials. The two conditions shared the same test trials but only differed in familiarization trials. The materials were filmed at a table with three chairs in the laboratory space. Three lab members (one man and two women) were the actors in the video. The male actor was wearing a blue shirt.

The two female actors were wearing similar white shirts. The two female actors (informants) sat on the left and right of the male actor.

The participants were tested online via zoom or in-person either at a Lab or Zoo. In each study, the experimenter introduced the task by asking, "I've got some friends. Do you want to meet them? They're going to tell and show you something interesting." The reliability of the actors was not mentioned in the introduction.

**Familiarization Clips.** Children were shown two familiarization videos. In both familiarization videos, the male actor introduced the two female actors as his friends: Abby and Paloma. The two female actors waved "hi" when the male actor introduced them before the trial started. In the common ground condition, the male actor then placed three boxes next to each other on the table. He opened them one by one (from right to left) to show whether there was a sticker inside. If there was a sticker, he said, "in this box, there is a sticker." When there was no sticker, he said, "in this box, there is no sticker." On one trial, all three boxes contained stickers. On the other trial, the first two boxes contained stickers and the third did not. After the final statements about the stickers' location, both the actors and the child were clear of the sticker location, and thus everyone was on the common ground of this knowledge.

The male actor then asked each of the female informants to tell him about the boxes. One informant (fully informative) pointed to all of the boxes and correctly stated whether there was a sticker inside. The other informant (underinformative) pointed to all but one of the boxes (when all three boxes contained stickers) or only one of the boxes (when only two contained stickers) and stated that that box contained a sticker. Of importance, is that the underinformative informant did not mention the contents of some of the boxes, but was never inaccurate in the

boxes that she did label. We counterbalanced which female actor was informative, and which actor talked first in familiarization was also counterbalanced.

In familiarization trial one, three black boxes were on the table, and each of them had a sticker inside. The fully informative actor introduced all three boxes, while the underinformative one only introduced two boxes. In familiarization trial two, three blue boxes were on the table, and only two of them had a sticker inside. The fully informative actor introduced both boxes with stickers, while the underinformative one only introduced one box.

In the privileged condition, all the stimuli were the same except that the two female actors introduced their descriptions of the sticker information before the male actor opened the three boxes one by one. Thus, the child was unclear of the sticker location when both female speakers made statements.

In the common ground condition, after playing each familiarization video, where two female actors described the boxes with stickers, the experimenter asked two memory check questions: "which boxes have stickers?" and "What did Abby and Paloma say about the boxes?" In the privileged condition, the same questions were asked but the question "what did Abby and Paloma say about the boxes" were asked first. Children only passed the memory check if they pointed to all the boxes with stickers and accurately recalled what the two female actors said. If they gave wrong answers, they would be reminded about the correct answers.

**Test Trials**. After familiarization, children were shown two types of test trials: box trials and label trials. There were two of each type of trial, and the order in which children received them was counterbalanced.

On the two box trials, only the male actor sat on the center of the screen. In each trial, he brought two new boxes on the table, each with a sticker inside. As in the familiarization trials, he

introduced the two boxes by opening them one by one and saying, "in this one, there is a sticker!" In the informative trial, after demonstrating the two new boxes, he said, "one of my friends looked at the boxes and said there is a sticker in this one and this one" by pointing to both boxes with a sticker inside. In the underinformtive trial, the male actor said, "one of my friends looked at the boxes and said there is a sticker in this one" by only pointing to one of the two boxes. Photos of the two female actors appeared on two sides of the screen. The male actor asked "which friend said that?" to ask children to attribute the statement given by the male actor to one of the female actors. The order of underinformative trials and informative trials was counterbalanced.

In each of the label trials, the male actor and two female actors were present. The male actor placed a novel object on the table and asked each female actor, ‘‘Can you tell me what’s this?’’ One novel object was a transparent spike object, and the other was a green bell-shaped object (Figure 1). Using one object at a time, the two female actors provided contrasting labels for the two objects by repeating their labels three times. For example, one actor pointed to the object and labeled it by saying, "it’s a toma, toma, it’s a toma", whereas the other actor said, "it’s a mido, mido, it’s a mido". In each trial, the number of syllables of the labels was the same: both were single-syllable or double-syllable words. The order and label of the two objects were counterbalanced. After watching the two actors introduce contrasting labels for each novel object, the male actor repeated the labeling information from both actors and asked children to choose one label. For example, "Abby thinks it is a mido and Paloma thinks it is a toma. What is it?" If the children said, "I don’t know", the experimenter would repeat the question and ask the children to give a forced-choice answer.

The children then received two types of test trials: box trials and label trials (Table 2). For the box trials, an experimenter produced an informative or underinformative statement about the position of stickers in boxes and asked children to attribute the given information to one of the two informants. In the label trials, the two informants introduced conflicting labels for a novel object and the experimenter asked children to correctly label the novel object.

The experimenter later showed participants two box trial videos one by one. After watching each trial video, the experimenter asked the participant to match the description with the actor by asking, "who do you think said that?" If the children said "both of them" or "I don't know", the experimenter would repeat the question and ask the children to give a forced-choice answer.

After completing the trials, children were given a standard "unexpected contents" false belief task. The experimenter showed children a crayon box and asked them what was inside. After children responded with "Crayons" or an appropriate synonym, children were shown the actual contents of the box, which were candles or stickers. The experimenter then put the actual content back into the box and closed the box. The experimenter then asked the "false-belief-other" question: "if your friend (a person who was established prior to asking this question) comes in here. He/She has never seen this box before. What will he/she think is in the box?" Children answering "crayons" would be marked as passing the false belief task while answering "candles" or "stickers" were coded as not passing the task.

**Results**

Children were coded as responding correctly to the box trial questions if they attributed the underinformative statement to the previously underinformative speaker and the informative statement to the informative speaker. They were coded as responding correctly to the questions

in label trials if they adopted the label for novel objects provided by the informative speaker rather than the underinformative one. Children were coded as responding correctly on the box trials 81% of the time in the common ground condition and 69% of the time in the privileged condition. Similarly, children were coded as responding correctly on the label trials 52% of the time in the common ground condition and 57% of the time in the privileged ground condition.

To analyze these data, we constructed a Generalized Estimating Equation (GEE) on children's responses to the questions, assuming a robust correlation matrix, and a binomial response variable. This controlled for the within-subject variance among the trials. Trial number, children's age (in months), Trial Type (Box vs. Label), and condition (Common vs. Privilege) were the independent variables. We started by building a robust factorial model. None of the interactions were significant. When removed, the model was a better fit to the data (as measured by lower QICC values). This resulted in a main effect only model. The only significant main effect was of trial type, with children performing less accurately on the Label Trials than the Box trials, B = -0.94, SE = 0.28, 95% CI [-1.50, -0.38], Wald (1) = 10.92, $p < .001$. No other effect was significant (all Wald $\chi^2$-values < 0.31, all $p$-values > .57).

We next considered whether responses to the box and label conditions differed from chance. Performance in the box trials was significantly higher than what would be expected by chance in Chi-square test, $X^2(2, N = 62) = 47.52$, $p < .001$. Performance on the label trials, however, did not significantly differ from chance in Chi-square test, $X^2(2, N = 62) = 4.94$, $p = .09$.

Finally, we considered whether children's false belief performance mediated these findings. We ran a Spearman correlation analysis between children's overall performance and false-belief understanding, but did not find a significant relation, r(60) = .06, $p = .65$. In each

condition (Box vs. Label), false-belief understanding also does not predict children's performance (both *p*-values >.61).

**Discussion**

The results of Experiment 1 suggest that the children we tested recognized that a fully informative speaker will continue to make fully informative descriptions, whereas an underinformative speaker will continue to make underinformative statements. What children did not do, however, is generalize the difference between the fully informative and underinformative speakers to the novel labels those informants generated. That is, children did not learn from these informants judiciously.

It is worth attention that children made both inferences above regardless of the condition they were in (common ground vs. privileged). Children did not perform differently in the two conditions, which is inconsistent with both of our initial hypotheses. Therefore, children in the common ground did not conflate their prior knowledge about sticker position with the information provided by speakers, because this would predict a higher possibility of adopting the underinformative speaker's information in the common ground condition than in the privileged condition. Having prior knowledge about sticker positions also did not make the speaker's underinformativeness more salient for children, otherwise the results would have shown children's lower ratio of learning from the underinformative speaker in the common ground than in the privileged ground. Such results might suggest that children did not judiciously differentiate an underinformative and a fully informative speaker in future learning under any circumstance. It is also possible that the current learning task of learning labels from speakers might not be proper to reflect the subtle differences of learning across conditions. Similarly, in the prior work of

Gillis and Nilsen (2013), 6- and 7-year-olds did not demonstrate significant differences in evaluating speakers' informativeness in the common ground and privileged conditions.

An open question is if children do not learn differently from a fully informative vs. an underinformative informant, both of whom did not make a mistake, do they distinguish between an underinformative informant from one who is inaccurate? Do they differentiate similarly in the common vs. privileged ground? We will investigate this question in Experiments 2 and 3.

## Experiment 2

In Experiment 2, we considered how children make inferences about an underinformative speaker and an inaccurate speaker. We investigated whether 5 and 6-year-olds would recognize speakers' inaccuracy and underinformativeness in providing information about stickers in closed boxes in privileged ground. We also examined whether they would selectively learn labels from them based on the history of providing sticker information.

### Method

#### *Participants*

The final sample consisted of 31 children who were 5- to 6-year-olds ($M$ = xx, range= 60-83 months). Sample size was determined by the same *a priori* power analysis from Study 1. There were 13 girls and 15 boys in the sample. Participants were recruited from public birth records, at a local zoo or a local museum.

#### *Materials and Procedure*

The procedure was similar to Experiment 1, children were shown two familiarization trials and two types of test trials. The familiarization was similar to the privileged condition in Experiment 1, except that the fully informative speaker was replaced by an inaccurate speaker.

Before children knew the content in each box, the inaccurate female actor pointed to all boxes with stickers one by one and said, "in this one, there is no sticker." The underinformative female actor still pointed to only some of the boxes with stickers and said, "in this one, there is a sticker." We counterbalanced which female actor was inaccurate. The order of which actor talked first was also counterbalanced. Then the experimenter opened the three boxes one by one to show the content in each box.

The box trials consisted of an inaccurate trial and an underinformative trial. In the inaccurate trial, after demonstrating the content of two boxes and each of them had a sticker inside, the male actor said, "one of my friends looked at the boxes and said there is no sticker in this one and no sticker in this one" by pointing to both boxes. Photos of the two female actors appeared on two sides of the screen. The male actor asked "which friend said that" to ask children to attribute the statement given by the male actor to one of the female actors. The underinformative trial was the same as the one in Experiment 1. The order of underinformative trials and inaccurate box trials was counterbalanced. The label trials are the same as in Experiment 1. Children also received the "unexpected content' false belief task after completing all test trials.

**Results**

The coding of the box and label trials was the same as in Experiment 1. Children were coded as responding correctly on the box trials 80.6% of the time and 51.6% of the time on the label trials. We constructed a Generalized Estimating Equation (GEE) on children's responses to the questions, assuming a robust correlation matrix, and a binomial response variable. This controlled for the within-subject variance among the trials. Trial number, children's age (in months) and Trial Type (Box vs. Label) were the independent variables. We started by building a

robust factorial model. None of the interactions were significant. When removed, the model was a better fit to the data (as measured by lower QICC values). This resulted in a main effect only model. The only significant main effect was of trial type, with children performing less accurately on the Label Trials than the Box trials, B = -1.37, SE = 0.43, 95% CI [-2.21, -0.52], Wald (1) = 10.10, $p < .001$. No other effect was significant (all Wald $\chi^2$-values < 0.14, all $p$-values > .71).

We next considered whether responses to the box and label conditions differed from chance. Performance in the box trials was significantly higher than what would be expected by chance in Chi-square test, $X^2(2, N = 31) = 30.55$, $p < .001$. Performance on the label trials, however, did not significantly differ from chance in Chi-square test, $X^2(2, N = 31) = 0.87$, $p = .65$).

Finally, we considered whether children's false belief performance mediated these findings. We ran a Spearman correlation analysis between children's overall performance and false-belief understanding, but did not find a significant relation, $r(29) = .29$, $p = .11$. In each condition (Box vs. Label), false-belief understanding also does not predict children's performance (both $p$-values >.10).

**Discussion**

Experiment 2 suggested that the 5- and 6-year-olds in our study properly attributed new information to the inaccurate and underinformative speakers. However, similar to the results in Experiment 1, children did not generalize the difference to guide future learning of novel labels.

A potential interpretation to the results is that children in our study had a different recognition of inaccurate and underinformative speakers, but they did not generalize such differences to learning in a new domain such as object labels. In other words, children might

regard the underinformative informant more or less reliable than the other informant, but they did not incorporate such recognition in our label trials because past informativeness in telling sticker information might not be related to capabilities in introducing labels for novel objects. As a result, we were curious about whether and how children might generalize their recognition of inaccuracy vs. underinformativeness to their future learning. In Experiment 3, we added a new task to understand children's learning from informants from a different knowledge domain: pointing task. This task is about children's endorsement of sticker location from informants' future information. Compared with label trials, the pointing task is more similar to informants' information generated in familiarization trials in which two informants established their history of informativeness. Both the pointing task and familiarization trials are about the location of stickers in boxes. Different from Experiment 2 in which all information in familiarization was in privileged ground, information in the familiarization of Experiment 3 was in common ground.

## Experiment 3

In this experiment, we investigated whether 5 and 6-year-olds would recognize speakers' inaccuracy and underinformativeness in common ground. We also examined whether they would selectively learn labels from them based on their history of providing sticker information. Importantly, we added a new pointing trial to understand children's endorsement of speakers' information about new sticker locations.

### Method

#### *Participants*

The final sample consisted of 28 children who are 5- to 6-year-olds ($M$ = 70.39, range= 60-82 months). There were 14 girls and 14 boys in the sample. Participants were recruited from

public birth records, at a local zoo or a local museum. The data collection is still ongoing and the anticipated sample size is 31.

***Materials and Procedure***

The procedure was similar to previous experiments, children were shown two familiarization trials and box and label trials. We added a new pointing trial after box and label trials so that children's choices in box and label trials would not be influenced by the newly added test trial.

In particular, the familiarization trials were similar to Experiment 2, except that the two female actors introduced the sticker information after the male actor opened the three boxes one by one. Thus, the child was aware of the sticker location before both female speakers made statements.

The box and label trials are the same as in Experiment 2. But we also added a pointing trial. In this trial, the male actor brought out two closed boxes and said "there are two boxes and only one of them has a sticker inside". The two female actors then generated different information about the sticker location, with each of them pointing to different boxes to indicate the location of the sticker. Then the experimenter would ask children where the sticker is. The sticker position told by two actors was counterbalanced. After all test trials, children also received a false belief task after completing the test trials.

**Results**

Children were coded as responding correctly on the box trials 80.4% of the time, 50% of the time on the label trials, and 67.9% of the time on the pointing trials.

To analyze these data, we constructed a Generalized Estimating Equation (GEE) on children's responses to the questions, assuming a robust correlation matrix, and a binomial

response variable. This controlled for the within-subject variance among the trials. Trial number, children's age (in months) and Trial Type (Box vs. Label vs. Pointing) were the independent variables. We started by building a robust factorial model. None of the interactions were significant. When removed, the model was a better fit to the data (as measured by lower QICC values). This resulted in a main effect only model. The only significant main effect was of trial type, Wald (2) = 12.32, $p < .01$. Children performed less accurately on the Label Trials than the Box trials, B = -1.45, SE = 0.46, 95% CI [-2.35, -0.55], Wald (1) = 9.92, $p < .01$. Children's performance on the Label Trials was also marginally less accurate than the Pointing Trials, B = -1.03, SE = 0.57, 95% CI [-2.14, -0.08], Wald (1) = 3.30, $p = .07$. There is also a significant effect of trial number because we only had one trial in the pointing task but two trials in each of the box and labeling task. No other effect was significant (all Wald $\chi^2$-values values < 0.20, all $p$-values > .38).

We next considered whether responses to the box, label and pointing conditions differed from chance. Performance in the box trials was significantly higher than what would be expected by chance in Chi-square test, $X^2(2, N = 28) = 70.41$, $p < .001$. Performance on the label trials, however, did not significantly differ from chance in Chi-square test, $X^2(2, N = 28) = .29$, $p = .87$. Performance in the pointing trials also did not differ significantly from chance in Binomial test, $p = .08$.

Finally, we considered whether children's false belief performance mediated these findings. We ran a Spearman correlation analysis between children's overall performance and false-belief understanding, but did not find a significant relation , r(25) = -.04, $p = .86$. In each

condition (Box vs. Label vs. Pointing), false-belief understanding also does not predict children's performance (both *p*-values >.48).

**Discussion**

The results in Experiment 3 suggested that children recognized the speakers' underinformativeness and inaccuracy. Children were more likely to choose the box indicated by the underinformative speaker rather than the inaccurate speaker in the pointing trial. This is different from their choices in label trials. On those trials, children again responded at chance levels (no differently from the previous experiments). However, children's performance in pointing trials did not differ from chance significantly, but rather showed a marginal trend. As the data collection is still ongoing, we may need more data to reach our final conclusion. If the pattern continues as future data unfolds, the results in this experiment may imply that children use speakers' history of informativeness to guide their learning only in pointing trials, but not when choosing labels for objects.

Why did we observe endorsing preference in pointing trials, but not in label trials? One possibility is that children in our study only used informants' past underinformativeness or inaccuracy to decide whether to endorse new information that was relevant to speakers' history of telling information, such as sticker location in boxes. However, when encountering information in a new domain that might be irrelevant to speakers' information history like object labels, they did not generalize speakers' reliability. There might be no sufficient evidence that a speaker demonstrating inaccuracy in telling sticker locations may still be unreliable in introducing names for novel objects, because both speakers demonstrated linguistic competency

in the past. They were native speakers of English and did not make any grammar or lexical mistakes while talking.

Children's performance of learning labels from inaccuracy vs. underinformative speakers in privileged (Experiment 2) vs. common ground (Experiment 3) also demonstrated similar patterns. This is parallel to findings in Experiment 1, in which conditions (common vs. privileged ground) did not influence children's endorsement of labels. A more in-depth interpretation of these results are in the following general discussion.

## General Discussion

The results in Experiments 1, 2 and 3 suggested that 5- and 6-year-olds in our study were aware of speakers' informativeness level and inaccuracy. They used the cue to guide their learning of sticker location in Experiment 3, but did not apply it to learn novel labels differently from the two speakers. The results provided insights into selective endorsing of information, which extended prior research on children's judgments of speakers of different informativeness levels. Prior findings illustrated young children's preference to a fully informative speaker than an underinformative speaker when given a binary choice (Gweon & Asada, 2018). Our study found that children did not extend the preference toward the fully informative speaker in contrast to the underinformative speaker for endorsing novel labels. This could not be explained by children's insensitivity to speakers' informativeness level, as children's performance in box trials in Experiment 1 suggested their recognition of speakers' different informativeness levels.

Our results in Experiment 2 and preliminary results in Experiment 3 also suggested that 5- and 6-year-olds only used speakers' past underinformativeness or inaccuracy as a cue for their future reliability when told information on sticker location, but not labels for novel objects. The extent to which children endorse speakers' information from their prior epistemic competence

speaks to two different theoretical accounts of selective learning. The "rational learning account" argues that children are developing conceptual knowledge early on. This is suggestive of the connectivity between different domains, which they use to selectively generalize informants' reliability across domains (Sobel & Kushnir, 2013). For example, children realized that informants who reliably provided object labels were similarly trustworthy in introducing object functions because of the conceptual knowledge that objects' labels also imply their functions (Birch et al., 2008; Koenig & Harris, 2005). Children also extended an informant's accuracy in syntax (e.g., subject-verb agreement) to introduce labels for novel objects as they registered the conceptual knowledge of subject-verb relationships (Sobel & Marcris, 2013). Therefore, children would infer whether the history of a speaker's reliability is relevant to the new domain and use that to decide whether they are reliable in the future. This account is consistent with our experiment results suggesting children's different selective learning preference in pointing and label trials. If someone is not reliable in one domain such as sticker position, the person might still be reliable in the other domain like providing labels.

Another theoretical account of selective learning, the associative learning account, states that children associate previous reliability to future reliability across all different domains (Harris et al., 2018; Heyes, 2015; Pasquini et al., 2007). If one informant is unreliable in one domain, they would be consistently unreliable in any information they provide in the future. This account is also supported by a series of experimental studies. For example, older preschoolers demonstrated a preference to learn novel labels of objects from a more informative speaker who previously gave noncircular explanations to scientific phenomena, suggesting their broad generalization from one domain to another (Corriveau and Kurkul, 2014). Similarly, 5-year-olds generalized an informant's reliability in informatively explaining familiar words' definitions to

learning novel labels (Tippenhauer et al., 2020). Based on this account, the children would have not consistently trusted the inaccurate speaker in both the label trial and the newly added trial. However, the theory doesn't seem to hold considering the data.

Surprisingly, our results in Experiment 1 also found that children's performance in the box and label trials did not differ significantly in the two experimental conditions (common ground vs. privileged). Similarly, their performance of learning labels from inaccuracy vs. underinformative speakers did not differ significantly in privileged (Experiment 2) vs. common ground (Experiment 3) conditions. No significant difference between their label learning performance was found in the two conditions across our three experiments. These results are inconsistent suggesting that children might conflate their prior knowledge about sticker position with information provided by speakers. The results also do not support our hypothesis that having prior knowledge about sticker positions would make speakers' underinformativeness or inaccuracy more salient. A potential explanation to the observed pattern might be related to how far children can generalize speakers' informativeness level to their future learning. It is possible that children in our study had different recognitions towards speakers in privileged vs. common ground, but they did not generalize such differences to learning in a new domain. In other words, the informants could be more or less reliable in the privileged ground than common ground, but this would not influence children's decision about from whom to learn new labels in the future.

Together, our study found that children distinguish between speakers of different informativeness levels and inaccuracy, which they also used as a cue to guide their future information endorsement selectively across domains. Future research may continue to investigate when and how children use speakers' informativeness as a cue and the underlying mechanism.

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## Appendix

### Table 1

*Stimuli and Speaker Behaviors in Familiarization Videos*

| | Familiarization Video 1 in Experiment 1 | Familiarization Video 2 in Experiment 1 | Familiarization Video 1 in Experiments 2 and 3 | Familiarization Video 2 in Experiments 2 and 3 |
|---|---|---|---|---|
| Stimuli | Three black boxes on the table and all of them have a sticker inside | Three blue boxes on the table and two of them have a sticker inside | Three pink boxes on the table and all of them have a sticker inside | Three blue boxes on the table and two of them have a sticker inside |
| Informant ive speaker's Behaviors | Informative speaker pointed to three boxes and said "there is a sticker in this one" | Informative speaker pointed to two boxes with stickers and said "there is a sticker in this one" | Inaccurate speaker pointed to three boxes and said "there is no sticker in this one" | Inaccurate speaker pointed to two boxes with stickers and said "there is no sticker in this one" |
| Underinfo | Underinformativ | Underinformative | Underinformative | Underinformative |

| | | | | |
|---|---|---|---|---|
| rmantive speaker's Behaviors | e speaker pointed to two boxes with stickers and said "there is a sticker in this one" | one pointed to only one box with sticker and said "there is a sticker in this one" | speaker pointed to two boxes with stickers and said "there is a sticker in this one" | speaker pointed to only one box with sticker and said "there is a sticker in this one" |

**Table 2**

*Stimuli and Speaker Behaviors in Box Trials*

| | Box Video 1 in Experiment 1(Informative Trial) | Box Video 2 in Experiment 1 (Underinformative Trial) | Box Video 1 in Experiments 2 and 3 (Underinformative Trial) | Box Video 2 in Experiments 2 and 3 (InaccurateTrial) |
|---|---|---|---|---|
| Stimuli | Two red boxes and both have stickers | Two yellow boxes and both have stickers | Two red boxes and both have stickers | Two yellow boxes and both have stickers |
| Speaker | Male actor made | Male actor made | Male actor made an | Male actor made an |

| | | | | |
|---|---|---|---|---|
| Behaviors | an informative statement by saying "one of my friends looked at the boxes and said there is a sticker in this one and this one" by pointing to both boxes | an underinformative description by saying "one of my friends looked at the boxes and said there is a sticker in this one" by pointing to one box | underinformative description by saying "one of my friends looked at the boxes and said there is a sticker in this one" by pointing to one box | inaccurate description by saying "one of my friends looked at the boxes and said there is no sticker in this one and no sticker in this" by pointing to both boxes |

**Table 3**

*Stimuli and Speaker Behaviors in Label Trials*

| | Label Video 1 in Experiments 1, 2 and 3 | Label Video 2 in Experiments 1, 2 and 3 |
|---|---|---|
| Stimuli | Transparent spike object | Green bell-shaped object |

| | | |
|---|---|---|
| Speaker Behaviors | One speaker named it as "mido" while the other speaker named it as "toma" | One speaker named it as "dax" while the other speaker named it as "lif" |

**Table 4**

*Stimuli and Speaker Behaviors in Pointing Trial*

| | Pointing Video in Experiment 3 |
|---|---|
| Stimuli | Two red boxes on the table |
| Speaker Behaviors | The male actor said "I hid a speaker in one of the two boxes and let my friends tell you wher is". One speaker pointed to the left box while the other speaker pointed to the right box |

**Figure 1**

*Stimuli Used in Novel-object Trials*

**Figure 2**

*Screenshot of Familiarization Video Stimuli*

**Figure 3**

*Screenshot of Box Video Stimuli*

**Figure 4**

*Screenshot of Label Trial Video Stimuli*