Children prefer to acquire information from unambiguous speakers

by

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A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirement for the degree of

Master of Arts

in

Psychology

Waterloo, Ontario, Canada, 2011

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Detecting ambiguity is essential for successful communication. Two studies investigated whether preschool- (4- to 5-year-old) and school-age (6- to 7-year-old) children show sensitivity to communicative ambiguity and can use this cue to determine which speakers constitute valuable informational sources. Children were provided clues to the location of hidden dots by speakers who varied in clarity and accuracy. Subsequently, children decided from whom they would like to receive additional information. In Study 1, preschool- (n=40) and school-age (n=42) children preferred to solicit information from unambiguous than from ambiguous speakers. However, ambiguous speakers were preferred to speakers who provided inaccurate information. In Study 2, when not provided with information about the outcome of the speakers' clues, school-age (n=22), but not preschool-age (n=19), children preferred unambiguous relative to ambiguous speakers. Results highlight a developmental progression in children's use of communicative ambiguity as a cue to determining which individuals are preferable informants.

Acknowledgements

I would like to thank my supervisor, Dr. Elizabeth Nilsen, for her guidance and support, as well as the time and effort that she dedicated to helping me with this work.

Thank you also to my reviewers, Dr. Jonathan Fugelsang and Dr. Tara McCauly for their insightful feedback.

Finally, thank you to the members of the Cognitive Development Lab for their input and help with various aspects of this project and to all of the preschools, schools and families of the Waterloo region for taking the time to participate in this project.

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Introduction

Children are faced with an abundance of information on a daily basis, with much of this information in the form of verbal testimony from other individuals. There are a number of cues children rely on to determine the credibility of such informational sources. In particular, children will more readily accept information from speakers who have demonstrated themselves to be knowledgeable (e.g., Birch & Bloom, 2002; Koenig, Clement & Harris, 2004). However, knowledge alone is not a sufficient criterion for deeming someone to be a valuable informational source. Rather, an optimal informant should also possess the ability to convey his/her knowledge in a way that is accessible and clear to others. For example, when asking for travel directions, an informant's knowledge of the area becomes irrelevant if the information is not provided in an unambiguous fashion. To maximize communicative success, children would benefit from detecting speakers' clarity and using this information when deciding from whom to solicit information. The present study investigated whether preschool- and school-age children use communicative clarity as a cue to evaluate informational sources.

Attending to the characteristics of potential informational sources enables listeners to acquire information more efficiently and effectively. For example, even though children encode information from both reliable and unreliable sources, they only form semantic representations based on information from reliable sources (Sabbagh & Shafman, 2009). A typical paradigm used to investigate the characteristics children attend to when determining speaker credibility involves presenting children with conflicting testimony from two individuals (e.g., different labels for novel objects). Then, children's adoption or application of the information is assessed to determine on which informant

the children relied (e.g., which label was mapped to the novel object; e.g., Birch, Vauthier & Bloom, 2008; Koenig et al., 2004; Pasquini, Corriveau, Koenig & Harris, 2007). In this way, children's preference for particular informant characteristics can be inferred. Using this (or similar) methodology, a number of characteristics affecting children's judgments of informant reliability have been determined. For example, children prefer to learn from speakers who are familiar (Corriveau & Harris, 2009), are adults (as opposed to children; Jaswal & Neely, 2006), are non-dissenting (Corriveau, Fusaro, & Harris, 2009), and are native speakers of the child's own language (as opposed to those with accents; Kinzler, Corriveau & Harris, 2011).

A consistent finding in this body of literature is that children prefer to learn from speakers who are knowledgeable versus those who are not (Sabbagh & Baldwin, 2001; Koenig & Harris, 2005; Birch et al., 2008). Specifically, speakers who demonstrate a history of knowledge (e.g., accurate object labeling; e.g., Corriveau, Meints, & Harris; 2009; Koenig et al., 2004; Scofield & Behrend, 2008) as well as speakers who announce their knowledge (e.g., Koenig & Harris, 2005; Sabbagh & Baldwin, 2001) are preferred to speakers who have a history of inaccurate labeling or announce their ignorance. Children give greater weight to speakers' knowledge than other characteristics. For example, children override their preference for learning from adults when a child informant has demonstrated a history of accuracy or if the information being sought is more child-relevant (Jaswal & Neely, 2006; VanderBorght & Jaswal, 2009). Further, children attend to whether speakers have had the opportunity to acquire particular knowledge, and will excuse inaccuracies if resulting from lack of exposure (e.g., Brosseau-Liard & Birch, in press; Nurmsoo & Robinson, 2009).

Together, the research suggests that children are highly tuned to cues about a speaker's knowledge state. However, speakers must not only possess knowledge to be effective informational sources, they must also be able to convey their knowledge in a coherent manner. Knowledge becomes meaningless if it is not presented in a manner that renders it accessible to a recipient. Certainly, there are undergraduate students who, following an incomprehensible lecture from a learned professor, would attest to this distinction. It is, therefore, beneficial for children to recognize not only who is knowledgeable, but also who possesses the skills to effectively communicate their knowledge. In this study, we sought to determine whether children are more likely to rely on speakers who avoid ambiguous descriptions relative to speakers who use ambiguous language, and further, whether ambiguous speakers are differentiated from speakers who provide inaccurate information.

Successful communication is guided by a number of implicit rules regarding the amount of information and manner through which it should be relayed. When conversing with others, effective speakers provide enough information to avoid ambiguity (Maxims of Quality & Manner; Grice, 1975). For example, when describing a book amongst a stack of books, a clear description would uniquely identify the specific book desired (e.g., "the statistics book") whereas an ambiguous statement would not (e.g., "the book"). Successful listeners must be able to determine when communicative ambiguity has occurred so that miscomprehension can be avoided through the use of clarifying questions. The ability to detect ambiguity is an essential component of children's developing communicative competence. Further, determining which speakers provide the

most unambiguous information would enable children to maximize communicative success.

However, past research has demonstrated that children under the age of 6 have difficulty identifying ambiguous language (e.g., Cosgrove & Patterson, 1977; Ironsmith & Whitehurst, 1978; Robinson, 1981). For example, when provided with ambiguous information, children often believe that the information is sufficient for them to respond accurately (Ackerman, 1981; Robinson & Whittaker, 1985). Early school-age children also overestimate the knowledge to be gained from ambiguous information (Chandler & Helm, 1984; Taylor, 1988; Robinson & Robinson, 1982, Asher, 1976), do not ask clarifying questions (Cosgrove & Patterson, 1977; Ironsmith & Whitehurst, 1978; Robinson, 1981) and believe that if listeners tried harder they would be more successful at understanding ambiguous messages (Robinson & Robinson, 1978). Children under the age of 6 have an especially difficult time identifying communicative ambiguity when they are previously informed of the intended meaning of the statement (Beal & Belgrad 1990; Sodian, 1988). For example, when 4 year olds saw where a sticker was hidden, they were more likely to state that the recipient of an ambiguous clue knew where the sticker was, relative to children who were ignorant of the sticker location (Nilsen, Graham, Smith & Chambers, 2008). In this way, preschool-children show a tendency to conflate their own knowledge of the intended meaning of an inadequate message with that of the ignorant listener. This makes it difficult for children to detect the ambiguity inherent in a message. This pattern of results may be due to a 'curse of knowledge' (Birch & Bloom, 2003; 2004), describing a more pervasive social bias, in which children have difficulty with appreciating the mental states of a naïve others. However, as

children develop (e.g., preschool-age), they become better able to detect ambiguity when they are aware of the intended meaning of the statement (Beal & Belgrad, 1990; Social, 1988).

Despite early school-age children's difficulty with explicitly identifying communicative ambiguity, preschool-age children demonstrate *implicit* sensitivity to communicative ambiguity (Nilsen et al., 2008). For example, children take longer to make a decision on ambiguous versus unambiguous tasks (Bearingson & Levey, 1977; Plumert, 1996), demonstrate more hesitant non-verbal behavior after ambiguous instructions (Beal & Flavell, 1982; Patterson, Cosgrove & O'Brien, 1980) and evidence eye movements reflecting more consideration of alternatives after hearing ambiguous statements (Sekerina, Stormswold & Hestvik, 2004). Whereas children's implicit sensitivity to communicative ambiguity remains consistent across the late preschool years, their explicit evaluation of clarity increases (Nilsen & Graham, in press). Thus, although young children may not explicitly be able to say that a speaker provided insufficient information, they have implicit sensitivity to this fact. Pertinent to the present study, it may be the case that children who are not explicitly able to identify ambiguous speakers are still less likely to rely on them as an informational source.

Study 1

The main goal of the present study was to determine whether children use speaker clarity to determine from whom to solicit information. Certainly, adults often generate utterances that are insufficient for their conversational partners (e.g., Ferreira & Dell, 2000; Kraljic & Brennan, 2005) without recognizing the ambiguity inherent in their utterances (e.g., Keysar & Henly, 2002). This suggests that children will often encounter speakers who provide insufficient information. It would be advantageous for children to be able to identify which individuals are able to pass on information in an effective manner. Given that both school-age and preschool-age children demonstrate an implicit sensitivity to ambiguity, it is anticipated that both age groups will show a preference for soliciting information from unambiguous compared to ambiguous speakers. However, as preschool-age children do not demonstrate an explicit sensitivity to ambiguity, the prediction is that only school-age children will be able to explicitly identify that unambiguous speakers are more helpful than ambiguous speakers. In order to address these hypotheses, preschool-age children (4- to 5-years-old) and school-age children (6- to 7-years-old) engaged in a speaker clarity task. During this task children were presented with clues to the location of a dot hidden under pictures in a book by pairs of alternating, videotaped speakers. These ages were chosen as it has been found that children's ability to appreciate ambiguity emerges at the end of their fifth year (Nilsen & Graham, in press). During the task, each speaker in the pairs consistently provided clues that varied by clarity and accuracy. Specifically, speakers either provided unambiguous clues that clearly identified the correct picture concealing the dot, ambiguous clues that did not provide sufficient information to locate the dot (but were accurate in the sense that the

information was not misleading), and unambiguous but inaccurate clues that clearly identified an incorrect location. For ease of explanation, in the remainder of this paper ambiguous/accurate clues are referred to as "Ambiguous" clues; unambiguous/accurate clues are referred to as "Unambiguous" clues; and unambiguous/inaccurate clues are referred to as "Inaccurate" clues.

After children were presented with the clues from each speaker in the pair, they were asked to indicate who they would like to choose to help them find a special sticker. Although children's speaker choices constituted an overt action, they did not necessitate that children understood why they preferred one speaker over the next. As such, children were asked to rate each of the speaker's ability to provide information. These speaker ratings allowed for an assessment of children's explicit detection of communicative ambiguity. In this way, we were able to determine whether children preferred to rely on unambiguous versus ambiguous speakers, as well as whether children viewed ambiguous speakers as being different from inaccurate speakers. Further, whether children understood why one speaker would be preferred over the other. To link this research with previous work, unambiguous accurate and inaccurate speakers were also compared.

The second goal was to assess whether prior knowledge of the intended meaning of the clue would disrupt children's ability to detect communicative ambiguity and alter subsequent speaker choices. To accomplish this goal, half the children were told where the dot was hidden prior to being provided with the clues. As per previous research (e.g., Sodian, 1988; Nilsen et al., 2008) we anticipated that children would have more difficulty detecting communicative ambiguity in this situation as they would conflate their own knowledge of the intended meaning with the semantic information presented in the clue.

Therefore, we anticipated that children who were provided with prior knowledge would have more difficulty in determining who would be the most helpful informant. However, as this ability develops across the preschool- and early school-age period, it was anticipated that preschool-age children would have more difficulty than school-age children making this decision.

To examine the extent to which search times related to ambiguity detection and speaker choices, children's search latency following the speakers' clues was measured. This level of analysis allowed for an examination of the extent to which children's implicit sensitivity to ambiguity (e.g., longer search times) impacts their explicit evaluations (e.g., speaker ratings). Past research has demonstrated both congruity and incongruity between children's implicit and explicit detection of ambiguity (e.g., Nilsen & Graham, in press). Here we were interested in assessing whether children who show longer search times following ambiguous clues were less likely to determine the ambiguous speaker to be a good informational source. In addition, children's success rate in finding the hidden dots was measured to determine the extent to which the outcome of the clues affected children's subsequent speaker choices and sensitivity to communicative ambiguity.

Method

Participants

Forty children aged 4 and 5 years-old (11 males, M = 59.43 months, SD = 7.30) and 42 children aged 6 and 7 years-old (14 males, M = 85.14 months, SD = 6.20) were recruited from schools and preschools within a mid-sized North American city. An additional 12 children were tested, but their data was not included in the analyses as they

did not follow task instructions. Within each age group, excluded children did not differ from included children in terms of age or verbal skills (*p*s > .53); however, within the older age group, the proportion of boys was greater in the excluded sample compared to the included sample (t (49) = 2.12, p = .04, d = .75). As gender did not significantly relate to the dependent variables, it was not included in the analyses. Parents of all participants reported that their children were fluent in English. Children were assigned to either a knowledgeable condition (n = 19 preschool children; 22 school-age children), or an unknowledgeable condition (n = 21 preschool children, 20 school-age children). The ages of children and the distribution of sex in the knowledgeable and unknowledgeable conditions did not differ from each other (*p*s > .48).

Materials and Procedure

Participants were tested individually by an experimenter in a quiet room within their school setting or in the research laboratory. The speaker clarity task was always administered first, followed by a language task.

Speaker Clarity Task. The speaker clarity task was modeled from previous speaker reliability research wherein children observe two speakers providing information and then are asked to make a choice between the informants. Our task involved presenting children with videotaped clues to the location of 'dots' hidden under pictures in a stimulus book positioned in front of the child (see Figure 1). The clues were presented by alternating pairs of speakers who differed in ambiguity and accuracy (i.e., forming different speaker-type comparisons). Following the clues (i.e., *learning trials*) children were asked to indicate who they would like to solicit information from (*speaker choice*) and to rate the proficiency of each speaker (*speaker rating*).

Before describing the procedures in detail, the materials are described. First, there were three different types of videotaped speakers, namely speakers who consistently presented ambiguous clues, speakers who presented unambiguous clues (that accurately identified a location), and speakers who presented inaccurate (yet, unambiguous) clues. The clues all had the same format (i.e., 'It's under the __one.'). Speakers all maintained a neutral tone of voice and facial expression when generating the clues. Each clue had the potential to be ambiguous or unambiguous and accurate or inaccurate depending on the context in which it was uttered. That is, the clarity of the clue depended on what three pictures were displayed in the stimulus book and the accuracy depended on which picture the dot was concealed under.

Each page of the stimulus book depicted a row of 3 pictures that were either 3 different shapes of the same color (e.g., a red circle, a red triangle, and a red star) or 3 identical shapes of different colors (e.g., a red circle, a green circle, and a yellow circle). On each page, a 'dot' was concealed underneath one of the three pictures. 'Ambiguous' clues were accurate, however, did not provide enough information to identify one of the three pictures. For example, if all three pictures were red, an ambiguous clue would be, "It's under the *red* one." 'Unambiguous' clues were accurate and provided enough information to identify one on the three pictures (i.e., the picture that concealed the dot). For example, if all three pictures were red, but different shapes, an unambiguous clue would be, "It's under the *square* one." 'Inaccurate' clues unambiguously identified one of the three pictures that did not have a dot beneath it. For example, if the dot was concealed under the *triangle* picture which was next to a square and circle, an incorrect clue would be, "It's under the *square* one."

By pairing the different speaker types (ambiguous, unambiguous, and inaccurate), there were three different comparison types: Ambiguous / Unambiguous, Ambiguous / Inaccurate, and Inaccurate / Unambiguous. Each comparison type involved a series of learning trials where children searched for the dots beneath the pictures following clues from alternating speakers. Children were exposed to each of the three speaker-type comparisons three separate times throughout the study, for a total of nine comparisons. These nine comparisons occurred in three blocks. Each block consisted of one of each of the three different comparison types (i.e., the Ambiguous / Unambiguous comparison, the Ambiguous / Inaccurate comparison and the Inaccurate / Unambiguous comparison). The specific order of comparison types within blocks was counterbalanced across children. Each of the 9 comparisons (of alternating speakers) involved different individuals (for a total of 18 speakers). All of the 18 video-taped speakers were Caucasian women between the ages of 22 and 35 with brown hair pulled back from their face. Each speaker wore a uniquely colored t-shirt. All other accessories were removed. Whether a particular speaker gave an ambiguous, unambiguous or incorrect clue was counterbalanced across children. This counterbalancing was essential to ensure children's choices were based on clarity or accuracy rather than some idiosyncratic quality of a particular speaker.

Children were pre-assigned to a *knowledgeable* condition or an *unknowledgeable* condition. In the knowledgeable condition, children were provided with information about the sticker location prior to receiving clues from the speakers (i.e., they were shown by the experimenter which picture the sticker was hidden under), whereas in the unknowledgeable condition they were not. Otherwise, the procedure was similar in both

conditions: Children first received three practice trials wherein they viewed a video of a speaker giving a clue and subsequently searched for the dot under the shapes. Following the practice trials the children were presented with the nine different speaker comparisons, where they received clues from the videotaped speakers. Children were only allowed to look under one shape following each clue. In order to motivate children to find the dots, they received a stamp in a booklet every time they found a dot. Following two clues from each speaker in the pair (i.e., the four learning trials for each comparison) children were asked to choose who they would like to receive a clue from to help them find a special sticker hidden under one of the shapes on the next page (i.e., *speaker choice*, e.g., "You can choose either the girl in the blue shirt or the girl in the green shirt to help you find the sticker. Who do you want to help you?"). The order of presentation of the two speakers in the experimenter's question was counterbalanced across children. Pictures of the two speakers were used to assist children in making their decision. Following their choice, children were asked to rate how good each speaker was at helping them find the dots (i.e., *speaker rating*, e.g., "How good was the girl in the red shirt at helping you find the dots? Was she always good, sometimes good, or never good?"). The verbal instructions of the rating were accompanied with a visual scale depicting the three options in differently sized bars. "Always good" was the tallest bar, "Never good" was the shortest bar (i.e., just a thin line) and "sometimes good" was half way between never and always. Next, children were played the video of their chosen speaker providing her clue and children searched for the sticker by choosing a shape to lift.

Variables of interest were the children's choice of speakers and ratings of speaker proficiency following the learning trials, as well as children's search latencies and success in finding the dot during the ambiguous learning trials.

Coding. Children's responses were videotaped and later coded to assess their response latencies during the learning trials. The temporal window of observation was the beginning of the adjective that described the target picture (e.g., "b" in "blue") to the point at which a picture was lifted up by the child. Two research assistants, blind to the study hypotheses, coded the video recordings. Adobe Premiere was used as it allows for video-audio synchrony and frame-by-frame analysis. An intraclass correlation (ICC) coefficient of 0.99, $p < .001$ (based on 16 participants, 20% of the sample) demonstrated a high level of agreement between the two coders.

Language Task. In order to ensure that the children in our groups did not differ on their receptive language skills, the Picture Vocabulary subtest of the Test of Language Development Primary Third Edition (TOLD-P:3, Newcomer & Hammill, 1997) was administered. On this test children were asked to point to the picture that represented the word spoken by the experimenter. This test was administered in a standardized fashion. It was found that the receptive language abilities of children in the knowledgeable condition did not differ from that of children in the unknowledgeable condition for either age group ($ps > .20$).

Results

Children's choice of speaker

Three 2 (Knowledge condition: knowledgeable / unknowledgeable) X 2 (Age: preschool versus school-age) univariate ANOVAs examined whether children's

preferences for speakers were impacted by the child's age or knowledge. In order to avoid violating the assumption of independence of observations, the dependent variables chosen were the proportion of times one speaker type was chosen in each comparison type. Specifically, in the two comparisons involving an ambiguous speaker (i.e., Ambiguous/Unambiguous; Ambiguous/Inaccurate) the dependent variable was the proportion of times the *ambiguous* speaker was chosen. For the Inaccurate / Unambiguous comparison, the dependent variable was the proportion of times the *inaccurate* speaker was chosen. In order to determine whether children were showing a preference for one speaker type over another in a given comparison, the proportion of times that type of speaker was chosen was compared to chance (i.e., .5) using single sample *t*-tests.

Ambiguous / Unambiguous comparisons. Analyses of children's ambiguous speaker choices when an ambiguous speaker was compared to an unambiguous speaker revealed a significant main effect of age, $F(1,78) = 7.66$, $p = .007$, $\eta^2 = .09$, but not knowledge, $p = .10$, nor a significant interaction between the two factors, $p = .18$. Older children were less likely to choose the ambiguous speaker ($M = .21$, $SD = .23$) than younger children ($M = .36$, $SD = .29$). However, both age groups were at less than chance levels in choosing the ambiguous speaker (preschoolers: $t(39) = -3.13$, $p = .003$, $d = .48$,school-age children; $t(41) = -8.19$, $p < .001$, $d = 1.26$). Thus, all children avoided soliciting information from ambiguous speakers compared with unambiguous speakers, but the preference for unambiguous speakers was stronger in school-age children.

Ambiguous / Inaccurate comparisons. Children's choice of an ambiguous speaker was examined when this speaker was compared with an inaccurate speaker. The

ANOVA revealed a main effect of knowledge, $F(1,78) = 4.13$, $p = .05$, $\eta^2 = .05$, but not age, $p = .12$, nor was there a significant interaction between age and knowledge, $p = .52$. Across the ages, children in the knowledgeable condition (i.e., previously shown the location of the hidden dot) were less likely to choose the ambiguous speaker ($M = .52$, $SD = .24$) than children in the unknowledgeable condition ($M = .64$, $SD = .29$). Follow-up single sample *t*-tests revealed that children in the unknowledgeable condition chose the ambiguous speaker more than chance, $t(40) = 3.00$, $p = .005$, $d = .48$. However, children in the knowledgeable condition did not differ from chance in the proportion of times they chose the ambiguous speaker, $p = .59$.

Inaccurate / Unambiguous comparisons. Children were also presented with a choice between an accurate and inaccurate speaker (i.e., Inaccurate / Unambiguous). Neither prior knowledge regarding the dot location nor age affected children's choice of an inaccurate speaker (*p*s > .30). Collapsed across knowledge conditions and age, all children chose the inaccurate speaker at less than chance levels ($M = .35$, $SD = .30$, $t(81) = -4.60$, $p < .001$, $d = .50$).[1]

Together the results indicate that children show a clear preference for soliciting information from an unambiguous speaker relative to an ambiguous speaker. However, the school-age children show a greater preference than the preschool-age children. Children viewed the ambiguous speakers as being better informational sources than the inaccurate speakers, particularly when they did not possess prior knowledge of the intended location being referred to by the speakers. Consistent with previous work,

[1] Children in each group (i.e., divided into different cells based on age and knowledge) all chose the inaccurate speaker at less than chance levels (all *p*s < .01).

children prefer accurate speakers to those who have demonstrated a history of providing inaccurate information.

Children's ratings of speaker proficiency

To assess children's explicit detection of communicative ambiguity, children were asked to rate the proficiency of each speaker. For each of the speaker comparisons, we conducted a 2 (Knowledge condition) by 2 (Age) by 2 (Speaker Type – e.g., ambiguous versus unambiguous) mixed model ANOVA. The dependent variable was the children's ratings of 'how good' each speaker was at helping them find the dots. The rating for each comparison ranged from 1(never good) to 3 (always good), which was then summed across the three times the children experienced that comparison type to provide a total score between 3 and 9. Significant interactions were followed up with comparisons using Bonferroni correction (.05/# of comparisons).

Ambiguous / Unambiguous comparisons. The analysis of ratings for comparisons between ambiguous and unambiguous speakers revealed a main effect of age, $F(1,78) = 4.60$, $p = .035$, $\eta^2 = .06$ and speaker type, $F(1,78) = 24.85$, $p < .001$, $\eta^2 = .24$, but no effect of knowledge, $p = .10$. The main effects of age and speaker type were qualified by a significant speaker type by age interaction, $F(1,78) = 7.47$, $p = .008$, $\eta^2 = 0.09$. Follow-up paired samples *t*-tests indicated that school-age children rated the ambiguous speakers as being less 'good' at providing information ($M = 5.67$, $SD = 1.87$) than the unambiguous speakers ($M = 7.55$, $SD = 1.43$; $t(41) = 4.97$, $p < .001$, $d = 1.13$). However, there was no difference in the ratings younger children made for ambiguous and unambiguous speakers, $p = .09$. School-age children's ratings of the ambiguous speakers were lower ($M = 5.67$, $SD = 1.87$) than preschoolers ratings ($M = 6.83$, $SD = 1.71$, $t(80) =$

2.93, $p = .004$, $d = .65$), whereas there was no difference in how the two age groups rated the unambiguous speakers, $p = .57$. Thus, older children showed an explicit detection of communicative ambiguity that younger children did not demonstrate. There was also a significant interaction between age and knowledge ($F(1, 78) = 6.96$, $p = .01$, $\eta^2 = .08$) such that older children in the knowledgeable condition rated speakers higher ($M = 7.09$, $SD = .70$) than did children in the unknowledgeable condition ($M = 6.08$, $SD = 1.28$; $t(40) = 3.23$, $d = .98$), while there was no difference in the ratings of the younger children, $p = .51$. Therefore, when older children possess prior knowledge, they are more likely to rate both helpful and unhelpful messages higher than when they do not possess prior knowledge. The 3 way interaction and the speaker by knowledge interactions were not significant and therefore were not explored further (speaker by age by knowledge, $p = .18$; speaker by knowledge, $p = .40$).

Ambiguous / Inaccurate comparisons. When children heard clues from ambiguous versus inaccurate speakers, their ratings of speaker clarity revealed a main effect of age, $F(1,78) = 16.48$, $p < .001$, $\eta^2 = 0.17$, such that across speaker types younger children ($M = 6.65$, $SD = 1.10$), relative to older children ($M = 5.58$, $SD = 1.44$), rated speakers as being better at providing information. There was also a main effect of speaker type, $F(1,78) = 10.39$, $p = .002$, $\eta^2 = .12$, and knowledge, $F(1,78) = 6.46$, $p = .013$, $\eta^2 = .08$, which was qualified by a significant speaker type by knowledge interaction, $F(1,78) = 5.61$, $p = .020$, $\eta^2 = .07$. Follow-up paired samples *t*-tests indicated that, collapsed across age, children who were unknowledgeable rated ambiguous speakers higher ($M = 6.39$, $SD = 1.81$) than inaccurate speakers ($M = 5.17$, $SD = 1.70$, $t(41) = 3.52$, $p < .001$, $d = .69$). However, when children were knowledgeable, there was no difference in their

ratings of the ambiguous and inaccurate speakers, $p = .41$. Further, across the ages, knowledgeable children rated the inaccurate speakers higher ($M = 6.32$, $SD = 1.47$) than children who were not knowledgeable ($M = 6.32$, $SD = 1.47$), t (80) = 3.26, $p = .002$, $d = .72$. However, children's ratings of ambiguous speakers were not affected by their knowledge state, $p = .71$. The 3 way interaction and other 2 way interactions were not significant and therefore were not explored further (speaker by age by knowledge, $p = .40$; age by speaker, $p = .28$; age by knowledge, $p = .09$).

Inaccurate / Unambiguous comparisons. Children's ratings of inaccurate and unambiguous speakers revealed a main effect of speaker type, $F(1,78) = 32.95$, $p < .001$, $\eta^2 = .30$, but not knowledge, $p = .38$, nor age, $p = .10$. There was a significant interaction between speaker type and age, $F(1,78) = 6.74$, $p = .01$, $\eta^2 = .08$. Follow-up independent t-tests indicated that across the knowledge conditions, younger children rated inaccurate speakers higher ($M = 6.23$, $SD = 1.82$) than older children ($M = 5.10$, $SD = 1.76$, $t(80) = 2.86$, $p = .005$, $d = .63$), however there was no difference in their ratings of unambiguous speakers, (younger children: $M = 7.15$, $SD = 1.55$, older children: $M = 7.50$, $SD = 1.60$), $p = .32$. Further, both preschool- and school-age children rated unambiguous speakers higher than inaccurate speakers (preschool-age: $t(39) = 2.23$, $d = .54$, school-age: $t(41) = 6.05$, $d = 1.43$, $ps < .03$). The 3 way interaction and other 2 way interactions were not significant and therefore were not explored further (speaker by age by knowledge, $p = .94$; age by knowledge, $p = .19$; speaker by knowledge, $p = .38$).

Together the results demonstrate that school-age children accurately determined that an ambiguous speaker was less proficient at providing information than an unambiguous speaker, but the preschoolers did not evidence such a distinction. When

comparing ambiguous to inaccurate speakers, the preschoolers showed a tendency to overestimate the proficiency of both speakers. Possessing prior knowledge of the intended location only impacted children's ratings of ambiguous speakers when these speakers were compared to incorrect speakers.

Impact of outcome of clues

Recall that on the ambiguous trials the speakers' clues did not disambiguate between the potential locations. However, it was still possible for the children to find the hidden 'dot' by randomly choosing the correct location. Not surprisingly, there was no difference in the number of dots found following ambiguous clues by school-age (M = .35, SD = .08) versus preschool-age children (M = .38, SD = .19; p = .40).

Chi squared analyses were conducted to determine whether children's successful location of the 'dot' on the ambiguous trials influenced their choice of an ambiguous versus unambiguous speaker. (As children in the knowledgeable condition were informed about the location of the dot prior to hearing the clue, analyses were only conducted on the choices of children who were unknowledgeable). To assess the influence of finding the dot, for each of the three Ambiguous / Unambiguous comparisons, we created three groups of children based on the number of dots they found following the two ambiguous clues in the learning trials (i.e., those who found neither of the dots, one dot, or both dots). Then each group's speaker choices were assessed. Children who did not find either of the two dots were less likely to choose the ambiguous speaker than the unambiguous speaker for each of the three Ambiguous / Unambiguous comparisons ($\chi^2(1, n = 15) = 5.40$, $\chi^2(1, n = 19) = 6.37$, $\chi^2(1, n = 17) = 7.12$, respectively for the first, second, and third comparisons, $ps < .05$). In contrast, children who found both dots following the

ambiguous trials were just as likely to choose the ambiguous speaker as the unambiguous speaker for all three comparisons, *p*s > .14. Children who found only one dot following ambiguous clues did not demonstrate a consistent pattern. That is, at the first Ambiguous / Unambiguous comparison they were just as likely to chose the ambiguous speaker as the unambiguous speaker ($p = .32$), however, at the two later comparisons they showed a preference for the unambiguous speaker ($\chi^2(1, n = 16) = 6.25$, $\chi^2(1, n = 19) = 8.90$, respectively for the second and third comparisons, *ps* < .05).

This pattern of results provides some evidence that, when considering ambiguous versus unambiguous speakers, children's decisions about who to solicit information from were influenced by the number of times they located the dot.

Latency during learning trials

We were interested in assessing whether implicit measures revealed sensitivity to ambiguity, and further whether these measures related to children's explicit judgments. Children's response latencies during the learning trials in the Ambiguous/Unambiguous comparisons were subjected to a 2 (Age) by 2 (Speaker type – ambiguous, unambiguous) by 2 (Knowledge condition – unknowledgeable, knowledgeable) mixed model ANOVA. Statistical outliers (i.e., $\pm$3 standard deviations from the mean) were removed from the analyses). Results revealed a main effect of speaker, $F(1,76) = 32.47$, $p < .001$, $\eta^2 = .30$, and knowledge, $F(1,76) = 26.91$, $p < .001$, $\eta^2 = .26$, but not age, $p = .21$. The main effects were qualified by a speaker by knowledge interaction, $F(1,76) = 12.78$, $p = .001$, $\eta^2 = .14$. Follow-up paired samples *t*-tests indicated that children in both knowledge conditions took longer to respond to ambiguous clues (unknowledgeable: $M = 4357$ ms, $SD = 2181$, knowledgeable: $M = 2474$ ms, $SD = 977$) versus unambiguous clues

(unknowledgeable: M = 2463 ms, SD = 1166, $t(38) = 4.78$, $p < .001$, $d = 1.08$; knowledgeable: M = 2033 ms, SD = 770, $t(39) = 3.29$, $p = .002$, $d = .50$). Further, children who were unknowledgeable took longer than children who were knowledgeable when responding to ambiguous clues, $t(78) = 5.02$, $p < .001$, $d = .44$, but there was no difference in response times for unambiguous clues, $p = .20$. The 3 way interaction and other 2 way interactions were not significant and therefore were not explored further (speaker by age by knowledge, $p = .31$; age by knowledge, $p = .30$; age by speaker, $p = .74$).

Relations between children's response latencies and their speaker choices and speaker ratings were examined using Pearson correlations. As there was a significant difference in response latencies between children in the two knowledge conditions, the correlations were conducted separately for each knowledge condition. In both knowledge conditions, the amount of time children took to respond to ambiguous clues did not relate to their choice of speaker, ps > .13. However, when knowledgeable of the intended sticker location, children who demonstrated longer search latencies rated the ambiguous speakers' proficiencies as being lower, $r(41) = -.36$, $p = .02$. This relationship remained when partial correlations were conducted controlling for children's response time following unambiguous clues, $r(37) = -.50$, $p = .001$. In contrast, a significant relation between latency and speaker ratings did not emerge for children in the unknowledgeable condition, $p = .53$.

Discussion

Preschool and young school-age children showed a preference for obtaining information from unambiguous compared to ambiguous speakers. Further, school-age

children rated the ambiguous speakers as being less proficient than the unambiguous speakers. However, compared to preschoolers, the older children were more successful in accurately rating the ambiguous speaker as being less proficient in providing messages. Children did not view the ambiguous speaker as being incorrect, though, as they were more likely to choose an ambiguous speaker over an incorrect speaker. Similarly, their ratings of the speakers demonstrated understanding that ambiguous speakers were better at providing messages than inaccurate speakers. Consistent with previous work (e.g., Jaswal, Carrington Croft, Setia, & Cole, 2010), children preferred to solicit information from unambiguously accurate speakers relative to inaccurate speakers.

Children's prior knowledge of the speaker's intended meaning was manipulated to determine whether children would conflate their prior knowledge with the semantic content of the clue, leading to greater difficulty in appreciating communicative ambiguity. Such conflation has been demonstrated in previous work where children have difficulty suppressing their prior knowledge to evaluate a clue from a naive listener's perspective (e.g., Nilsen et al., 2008). Prior knowledge did not impact children's judgments between ambiguous versus unambiguous speakers. However, knowledge did affect children's speaker preferences when judging between an ambiguous versus inaccurate speaker. In this context, having prior knowledge of the intended location disrupted children's ability to differentiate an ambiguous speaker from an inaccurate speaker. This difficulty was found both in children's choices for speakers as well as in their ratings of speakers.

There are several possibilities for what specific information children are relying on in order to determine that an unambiguous speaker is a better option relative to an

ambiguous speaker. First, it could be that when faced with an ambiguous clue, children feel a sense of uncertainty which influences speaker preferences. Further, this feeling of uncertainty may be relied on without children actually possessing the metacognitive awareness that a clue provided insufficient information (Robinson & Whittaker, 1985). Certainly, children took longer to respond to ambiguous clues relative to unambiguous clues, which is suggestive of increased uncertainty. However, the finding that, even when knowledgeable, children are able to differentiate between ambiguous and unambiguous speakers suggests that this explanation is not sufficient. If children only relied on feelings of uncertainty to detect ambiguity, then children knowledgeable of the intended location would have had more difficulty because the uncertainty is reduced (Robinson & Robinson, 1983). A second possibility is that children detected the ambiguity inherent within the clue and then used this information to form impressions of the speakers. Certainly, past research has shown that children are sensitive to the communicative styles of speakers, in that speakers who follow regular morpholinguistic rules are preferred over those who use irregular rules (Jaswal, McKercher, & VanderBorght, 2008). If children are in fact using their sensitivity to ambiguity to decide from whom to solicit information, they would be demonstrating impressive communicative competence given that previous research has suggested that children have difficulty detecting communicative ambiguity (Ackerman, 1981; Robinson, 2001; Robinson & Whittaker, 1985) and often attribute the associated failure to the listener rather than speaker (Robinson & Robinson, 1978). However, a third explanation for the results of Study 1 is that children relied on the outcome of the speaker's clues, namely whether they found the dot or not. That is, it could be argued that children did not choose the unambiguous speaker more often

because they understood that this individual avoided communicative ambiguity (or even that they detected the communicative ambiguity), but because they were more successful in finding the dots when provided with clues by the unambiguous speakers. Indeed, we did find that children who did not find the dots following ambiguous clues preferred the unambiguous speaker, whereas those children who found dots did not differentiate between the unambiguous and ambiguous speakers. In order to assess whether children actually appreciate the communicative clarity of the speakers, as opposed to the outcomes, children's speaker preferences would need to be assessed under conditions where no feedback regarding the success of a clue was provided. Study 2 addressed this issue by examining children's speaker preference in a context where they did not search for the dot (and therefore did not experience success or failure).

Study 2

Children pay attention to outcomes when making judgments about informational sources. For example, four year-olds track the relative frequency of errors when deciding who would be a preferred informational source (Pasquini et al., 2007). Furthermore, preschoolers use the reactions of bystanders when deciding on the credibility of speakers (Fusaro & Harris, 2008). Thus, it is plausible that children in Study 1 were attending to the outcome (i.e., whether the dot was found) in addition to, or rather than, the communicative clarity of the speakers, to decide that an unambiguous speaker was a more helpful informational source than an ambiguous speaker. To assess whether children were indeed sensitive to communicative ambiguity, children in Study 2 were assessed under conditions where the outcome was not observed. Specifically, in Study 2, following each clue, children were not shown whether their choices of the dot location were successful. As the primary question was whether children would prefer unambiguous speakers over ambiguous speakers, children were only presented with this comparison (as opposed to all three different comparisons of Study 1). As children have been shown to be sensitive to speakers' communicative styles (Jaswal et al., 2008) it was anticipated that school-age children would be able to detect the helpfulness of each speakers' communicative style and prefer to learn from unambiguous over ambiguous speakers, despite being ignorant of the outcome. However, given that preschool-children in Study 1 did not rate ambiguous and unambiguous speakers differently, it was expected that they would be more likely to rely on the outcome as opposed to the quality of the message and therefore would not prefer to learn from the unambiguous speaker when ignorant of the outcome. If children in Study 2 continue to choose unambiguous over

ambiguous speakers, this preference can be attributed to sensitivity to message clarity (or ambiguity) rather than the outcome.

Method

Participants

Nineteen children between the ages of 4- and 5 (10 males; *M* = 58.11 months, *SD* = 6.52) and 22 children between the ages of 6 and 7 (11 males, *M* = 83.77 months, *SD* = 5.99) were individually tested in one session at a research laboratory. Children were recruited from a database of interested families and from community preschools. Participants were all reported by parents to be fluent in English. None of the children had participated in Study 1. The ages of the children did not differ from those in Study 1, *p*s > .40

Materials and Procedure

Speaker Clarity Task. The procedure for the speaker clarity task in Study 2 was identical to that of Study 1 with the following exceptions: First, children were only presented with the Ambiguous / Unambiguous comparison. Children were administered this comparison type three times, all with different pairs of speakers. Second, children were always unaware of the sticker location prior to hearing clues. That is, unlike Study 1, no children were shown where the dot was located before they were presented with clues from the speakers. Finally, children did not find out about the outcome of their choices based on the clues from speakers. Specifically, instead of looking under the pictures in the stimulus book to find the dot (as in Study 1), the children were asked to indicate where they thought the dot was hidden by pointing to the picture. Following

children's point, the next learning trial was administered – thus, children never found out whether the picture they pointed to concealed the dot or not.

Language Task. The Picture Vocabulary subtest of the TOLD-P:3 was administered as described in Study 1. The receptive language abilities of children in Study 2 did not differ from those in Study 1 (preschool-age children, $p = .85$; school-age children, $p = .19$).

Results and Discussion

Speaker Clarity Task

Children's choice of speaker. In order to assess whether children showed a preference for one speaker type over another, the proportion of times children chose the ambiguous speaker was compared to chance (.5) using single sample *t*-tests. It was found that school-age children chose the ambiguous speaker at a level less than chance ($M = .36$, $SD = .23$, $t(21) = -2.81$, $p = .01$, $d = .61$). In contrast, the preschool-age children's choice of the ambiguous speaker, ($M = .51$, $SD = .30$) did not differ from chance, $p = .90$. These results suggest that, in the absence of feedback regarding the success of the outcome of each clue, younger children were not able to solicit information from the clearest speaker (i.e., the unambiguous speaker). In contrast, older children solicited information from the speaker who demonstrated communicative clarity, even in the absence of feedback. However, although there was a trend for the preschool-age children to choose the ambiguous speaker more often than the school-age children, this comparison did not reach significance, $t(39) = 1.75$, $p = 09$, $d = .56$.

Children's ratings of speaker proficiency. A 2 (Age) by 2 (Speaker Type – ambiguous versus unambiguous) mixed model ANOVA was conducted with the

dependent variable of children's ratings of "how good" each speaker was at helping them find the dots (with the same procedures as Study 1).

Results demonstrated no significant main effects of speaker type or age, *p*s > .55, however there was a significant age by speaker type interaction, $F(1, 39) = 10.64$, $p = .002$, $\eta^2 = .21$. Follow-up paired samples t-tests indicated that older children rated the ambiguous speakers as being less 'good' at providing information ($M = 6.36$, $SD = 1.36$) than the unambiguous speakers ($M = 7.68$, $SD = .99$, $t(21) = 3.47$, $p = .002$, $d = 1.11$). However, there was no difference in the ratings younger children made for ambiguous and unambiguous speakers, $p = .13$. School-age children's ratings of ambiguous speakers were lower than those of the preschool-age children ($M = 7.32$, $SD = 1.57$, $t(39) = 2.08$, $p = .04$, $d = .65$). Furthermore, school-age children rated the unambiguous speakers as being more proficient than did preschool-age children, ($M = 6.32$, $SD = 2.21$, $t(39) = 2.61$, $p = .01$, $d = .79$. Thus, in the absence of feedback, older children demonstrated an appreciation for speaker clarity that younger children did not demonstrate.

General Discussion

For knowledge to be successfully imparted, speakers must provide information in a way that is clear and accessible to a listener. Two studies investigated whether children use communicative clarity as a cue to establish informant preferences. Specifically, we assessed whether children prefer to acquire information from speakers who demonstrated a history of providing unambiguous descriptions, relative to speakers who provided ambiguous descriptions, (as well as whether ambiguous speakers are preferred to inaccurate speakers and whether children differentiate between unambiguous accurate and inaccurate speakers). In the first study, during exposure to the different speakers, children received information regarding the outcome of speakers clues (i.e., whether the clues lead to successful location of the 'dot') whereas in the second study, children did not receive such information. Several key findings regarding children's application of their ability to detect communicative ambiguity emerged.

First, we found that both preschool-age and school-age children preferred to receive information from unambiguous speakers more often than ambiguous speakers in a situation where the outcome of the speakers' clues was evident. Specifically, in the first study, both age groups of children chose the ambiguous speakers (relative to unambiguous speakers) less often than expected by chance levels. This finding extends previous work demonstrating that 4-and 5-years-olds (but not 3-year-olds) show modest preferences for speakers who do not violate the Gricean Maxim of Quantity (i.e., that speakers should provide enough information to make a statement clear; Grice, 1975; Eskritt, Whalen, & Lee, 2008). In the second study, when children did not have information about the outcome of the speakers' clues, school-age children, but not

preschool-age children, continued to show a preference for unambiguous speakers. Thus, in general, children attend to and use communicative clarity as a cue to determining from whom to solicit information. However, results from both studies highlight a developmental progression in children's use of communicative ambiguity as a cue to informant reliability. In the first study, although preschool-age children showed a preference for unambiguous speakers, they chose these unambiguous speakers less often than the school-age children. Furthermore, in the first study, only the school-age children differentiated the unambiguous from ambiguous speaker in their ratings of communicative proficiency. These findings suggest that preschoolers may not have an explicit understanding of the communicative clarity of speakers. That is, when making their choice, preschoolers may not have clearly understood *why* the unambiguous speakers were preferred. This notion is further emphasized by the fact that in the second study, when not provided with outcome regarding the clues, the preschool-age children did not differentiate between unambiguous and ambiguous speakers in their choices. It is likely that the preschoolers in the first study were assisted by the information regarding the outcome of clues and showed a preference for the unambiguous speakers because there was greater success following their clues. That is, preschoolers likely relied on a cue akin to 'good things happen more often with this speaker,' rather than appreciating that the outcome of the clue was due to the clarity of the speakers' clues per se. In contrast, school-age children, although likely assisted by outcome information, were able to rely on their ambiguity detection skills so that even in a context where the success of speakers' clues was not evident, they preferentially chose unambiguous speakers.

Together, these findings suggest that by the end of the preschool years, children can reflect on the communicative outcomes of speakers and use this as a cue to determining speaker choices, and, at least by 6 or 7-years-old, children demonstrate an explicit appreciation for communicative clarity that can be used as a cue to evaluating informational sources. This finding adds to the growing literature on children's communicative development by demonstrating children's application of ambiguity detection to determine speaker reliability. Previous work has demonstrated that early school-age children have difficulty with detecting communicative ambiguity – for example, by overestimating their knowledge after being presented with ambiguous instructions or by making decisions based on insufficient information (e.g., Beck & Robinson, 2001; Beck, Robinson, & Freeth, 2008; Flavell, Speer, Green, & August, 1981; Ironsmith & Whitehurst, 1978; Robinson & Robinson, 1982; 1983). With this in mind, we found that in the domain of determining speaker reliance, children showed impressive sensitivity. Here, the early school-age children were able to evaluate the linguistic information of the clue based on the contextual backdrop in which it occurred (i.e., depending on the context, the same clue was ambiguous, unambiguous, or inaccurate), track and link the evaluations as a characteristic of the individual speaker, and make preferential judgments accordingly. As children will likely encounter speakers who provide ambiguous information (i.e., given that even adult speakers often fail to provide sufficient information for their interlocutors; e.g., Ferreira & Dell, 2000; Kraljic & Brennan, 2005), showing sensitivity to this cue allows children to maximize communicative success.

Although it is not clear what cognitive abilities are required for children to use communicative ambiguity as a cue to speaker reliability, some researchers have speculated about what is required for their ability to detect ambiguity in general communication (e.g., metacognition; Flavell et al., 1981 or executive function; Nilsen & Graham, in press). For example, successful ambiguity detection requires that children understand the message within the contextual backdrop (i.e., being able to determine what information from the context is relevant to understanding the message). Therefore, when considering referents, children are required to think flexibly about their properties (i.e., being able to consider a blue ball as both "blue" and "ball"). This would require the cognitive abilities of abstraction (i.e., the ability to pick out individual features of objects and experience them separately; Werner, 1984) and cognitive flexibility (i.e., the ability to shift mental sets and be able to switch between viewing different dimensions of an object; Anderson, 2002). Indeed, a recent study suggests that there is a link between ambiguity detection and the cognitive abilities of abstraction and flexibility (Gillis & Nilsen, in prep). Working memory (i.e., the ability to hold information in mind in order to manipulate it) would likely also be involved in ambiguity detection as it could help children to more efficiently assess the context while holding a statement in mind to determine it is clear. In addition, with regards to ambiguity detection from a third person perspective, Nilsen and Graham, (in press) found inhibition to be related to children's ability to detect ambiguity. This was likely the case because inhibition allowed children to more easily disregard their own perspective in order to understand that the listener had not been provided with enough information. In the current study, school-age children, but not preschool-age children, rated unambiguous speakers as more helpful than

ambiguous speakers, and were able to choose the most helpful speaker even when they were not aware of the outcome associated with unambiguous compared to ambiguous clues. This age difference may be due to the development of cognitive skills that support ambiguity detection (e.g., abstraction, cognitive flexibility, working memory, and inhibition).

A second finding from the current study was that prior knowledge of location did not disrupt children's ability to differentiate between ambiguous and unambiguous informants (or between unambiguous and inaccurate speakers). That is, even when children were provided with information about the location of the hidden dot prior to receiving clues, they showed a preference for unambiguous versus ambiguous speakers. Previous research has found that children have difficulty with detecting communicative ambiguity when provided with prior information about the intended meaning of a statement (e.g., Nilsen et al., 2008; Sodian, 1988). In the present investigation, we found that children were able to differentiate between unambiguous and ambiguous speakers even when knowledgeable of the intended location. Thus, at some level, children did not act purely on their prior knowledge, but attended to the information presented by speakers. However, a key difference between past work and the first study is that in children in previous studies have had to evaluate clues from the perspective of naive listener (i.e., rather than from their own perspective). Thus, to accurately assess the knowledge state of another person, children had to suppress their own knowledge. As such, the tasks in previous studies (i.e., third person tasks) likely required more cognitive demands (e.g., inhibitory control, Nilsen & Graham, in press) than in the present task where the same degree of suppression was not required to be successful.

Prior knowledge did, however, disrupt children's ability to differentiate between ambiguous and inaccurate speakers. That is, when not informed about the location of the dot, children of both ages showed a preference for an ambiguous speaker versus an inaccurate speaker (with ratings that matched this preference), suggesting that children clearly differentiate these speaker types. However, the children who were informed about the location of the dots prior to hearing the speakers' clues, responded at chance-levels when deciding between ambiguous versus inaccurate speakers. Why might this pattern of results have emerged? First, for the unknowledgeable children, it is likely that the ambiguous speakers were preferred as the clues these speakers provided were the only ones that potentially led to a successful outcome (albeit at a 1/3 chance). Conversely, when children are provided with prior knowledge, they could rely on this information to find the dot, thereby making it more difficult to differentiate between ambiguous and inaccurate speakers. However, given that knowledgeable children differentiate between unambiguous/ambiguous speakers, this explanation is not entirely sufficient as we found that children were not solely relying on prior information. Thus, a second explanation is that it may be the case that when children are knowledgeable of the dot location, they develop an expectation for what information the clue will contain. Violations of this expectation, whether it is due to ambiguity or inaccuracy, are treated equally as an indication of a poor informant, thereby leading to no differentiation between the ambiguous and inaccurate speakers.

Finally, findings provide insight into the relations between implicit and explicit appreciation of communicative ambiguity. In order to assess more implicit measures of children's sensitivity to ambiguity, children's response latencies were assessed. In

contrast, the speaker proficiency ratings allowed for an analysis of children's explicit evaluations of speaker clarity. Across both knowledge conditions children took longer to respond to ambiguous clues, a finding consistent with previous literature wherein preschoolers show nonverbal behaviors that reflect hesitancy to act following ambiguous instructions (Patterson, Cosgrove, & O'Brien, 1980). Children's longer latencies for ambiguous clues in the unknowledgeable condition are not surprising given that these children did not have enough information (either through prior information or the linguistic clue) to adequately hone in on a target location. However, longer latencies following ambiguous clues (relative to latencies following unambiguous clues) of children who were informed about dot location is suggestive of children's implicit sensitivity to the ambiguity in the message. That is, if children relied solely on the prior information, response times would not differ following ambiguous and unambiguous clues. While longer search latencies did not relate to children's decisions about the ambiguous speaker in the unknowledgeable condition, they did relate to children's decisions in the knowledgeable condition. When provided with prior information about the location of the 'dot,' children who took longer to respond to ambiguous clues were more likely to rate the ambiguous speaker as less proficient at providing clues. The lack of relation between latency and explicit evaluation for children who were not informed about the intended location is consistent with previous research. For example, Sekerina and colleagues (2004) found that although children's eye movements following ambiguous pronouns showed evidence of ambiguity sensitivity, their explicit responses did not. Such findings suggest that there is incongruence between children's explicit recognition of ambiguity and the degree to which they unconsciously access multiple

referential interpretations (Sekerina et al., 2004). However, the finding that implicit appreciation of ambiguity was related to explicit speaker ratings in the knowledgeable condition suggests a stronger relation between children's implicit and explicit appreciation of ambiguity than has been demonstrated previously (e.g., Nilsen & Graham, in press). In this condition, children did not have to rely solely on the clue to find the dot. As such, it may be the case that the children who demonstrated rapid search times were the ones who relied more on the prior information rather than processing the clue itself. Conversely, the children who were taking longer to respond may have detected that there was something odd or inadequate about the clue (i.e., as discussed above, a violation of expectations). As a result, the slower children responded, the less likely they were to rate ambiguous speakers as proficient at providing information.

The present findings contribute to a growing literature focusing on how children selectively acquire information from others. We find that communicative clarity is a cue children rely on to assess speakers, however it is one that comes on-line at a later age than many of the other cues children rely on (e.g., speaker knowledge, which children as young as 24 months rely on; Koenig et al., 2004; Koenig & Woodward, 2010). While much of the previous research has focused on children's attention to the characteristics of the speakers (e.g., age, knowledge, accuracy; Birch, Vauthier & Bloom, 2008; Koenig et al., 2004; Jaswal & Neely, 2006), this work adds to the handful of studies demonstrating that children are also sensitive to the process by which information is delivered, that is *how* informants convey information. For example, past research has demonstrated that, children prefer speakers who use confident non-verbal cues (Birch, Akmal, & Frampton, 2010; Tenney, Small, Kondrad, Jaswal, & Spellman, 2011) and preschoolers prefer

speakers who use expected past tense for words (Jaswal et al., 2008). Here we find that communicative clarity/ambiguity also plays a role in children's evaluations of the informant. However, to understand *why* children in the present study showed an avoidance of ambiguous speakers, additional research will be needed. It is clearly a useful strategy for children to prefer to acquire information from unambiguous speakers, and children's ratings of the speakers demonstrate that school-age children understand that these speakers are more proficient at providing information. However, we do not know whether children are making other attributions of the speakers based on their communicative clarity. That is, children might view ambiguous speakers as, for example, being purposefully tricky or as less informed in some way. It may be that these attributions are what drive children's preferences. The present work operates as a starting point in which these further questions can be addressed.

A limitation of this study was that children were not able to interact with the speakers. Videotaped speakers allowed the study to be tightly controlled, however it did not allow for insight into children's ability to detect ambiguity in everyday interactions. It is possible that children would pay attention to different aspects of the communication process if they were communicating with an individual in person, as opposed to assessing individual statements. For example, children might not focus on the clarity of the message as their cognitive resources may be taxed by other conversational demands. Another limitation is that children's assessments of message quality took place after hearing both adequate and inadequate messages from two different speakers. It is possible that this comparison and delay in message evaluation may have affected children's ability to assess the helpfulness of the messages. For example, comparing an

inadequate speaker to an adequate speaker may highlight the helpfulness of the adequate speaker which otherwise may have been ignored. Future studies could evaluate children's ability to detect ambiguity in a more naturalistic setting.

A further limitation is that the current study only assessed children's appreciation of communicative ambiguity in terms of a speaker's ability to provide sufficient information to disambiguate amongst referents. While detecting this type of ambiguity is a key skill in children's developing communicative competence, there are a number of other ways that communicative ambiguity occurs in our language system. Indeed, our language system is inherently ambiguous in that the same words can have very different meanings depending on the intentions of the speaker and the contextual backdrop. As such, listeners must rely on a number of cues to decipher meaning (e.g., context; tonality; facial expression; semantic content of utterance). The present work could be extended by assessing the degree to which children use other aspects of communicative ambiguity as a cue to determining speaker reliability. For example, assessing whether children are less likely to rely on information from speakers who demonstrate incongruent (relative to congruent) communicative cues (e.g., discrepancy between a facial expression and either tonality or verbal content). Furthermore, the relative salience of communicative ambiguity cues compared to other speaker variables could be assessed (e.g., contrasting age of speakers or confidence of speakers with communicative clarity) Although not a direct test of children's use of communicative ambiguity as a cue to speakers' communicative competence, the comparison between unambiguous accurate and inaccurate speakers (i.e., Unambiguous / Inaccurate comparisons) has implications for the speaker reliability literature. Specifically, in previous studies, children who encountered

inaccurate speakers (e.g., those who provide an incorrect object label) were aware of the inaccuracy at the time the speaker spoke (i.e., children knew the correct label for the object). As such, children have a sense of the speaker's credibility as soon as the verbal testimony is provided. In our study, however, children were not aware of the speakers' accuracy until after performing a search. This scenario more closely parallels children's everyday experiences in that, often, children learn novel information without immediately knowing about the validity of the speaker's statement. Children of both ages showed a clear preference for the unambiguous accurate speakers, suggesting that children do not need to form immediate appraisals of speakers. Rather, judgments about speaker reliability can be formed by receiving subsequent information after the speaker's provide their testimony. These findings add to recent work demonstrating that children can track speaker's reliability over time and update their appraisals accordingly (e.g., Schofield & Behrend, 2008).

The ability to communicate and successfully interact with others is an important aspect of becoming a well-functioning individual. Detecting communicative ambiguity allows children to avoid miscommunication and unsuccessful interactions. Relevant to the present research, children must develop mechanisms that allow them to learn where to gain important information. Children are unable to process all of the new information they encounter, therefore they must be able to select what is most relevant and important to learn. An efficient way to do so is to determine which individuals are credible sources of information. The current study adds to the growing literature investigating how children decide what constitutes a credible source of information by demonstrating that communicative ambiguity is an important cue.

If, as discussed above, the detection of communicative ambiguity is related to children's executive function skills, it may be the case that clinical populations of children who evidence executive difficulties (e.g., children with ADHD or Autism) will show difficulties with this important communicative skill. For example, children with ADHD have been found to generate less requests for confirmation of understanding requests (e.g.,Landau & Milich, 1988) which may indicate that they have difficulty with detecting ambiguity. Certainly, other aspects of communication have been related to executive dysfunction, including children`s ability to perspective take, pay attention during communication and the quality of their vocabulary (Nilsen & Graham, 2009; Bishop & Norbury 2005). Further, communicative difficulties have been shown to co-occur with a number of pediatric psychopathologies (e.g., Pinborough-Zimmerman, Satterfield, Miller, Bilder, Hossain,& McMahon, 2007). As such, future research could examine ambiguity detection in clinical populations of children and/or examine whether there are negative consequences for disruptions to this skill (e.g., increased responding to insufficient information; increased frustration, etc.).

In conclusion, children show a preference for learning from unambiguous relative to ambiguous speakers, highlighting that speaker clarity is an important cue that children rely on to selectively acquire information from others. Whereas preschool-age children require information regarding the outcome of speaker's clues, school-age children use explicit detection of communicative ambiguity to guide speaker preferences. This sensitivity to communicative clarity allows children to hone in on speakers who provide the greatest chance for the children's successful acquisition of information.

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Table 1

Mean proportion of times children chose speakers (SD) in Study 1

	Preschool-age children		School-age children	
Comparisons	Knowledgeable	Unknowledgeable	Knowledgeable	Unknowledgeable
Ambiguous / Unambiguous				
Ambiguous	.37 (.27)	.35 (.31)	.29 (.26)	.12 (.16)
Unambiguous	.63 (.27)	.65 (.31)	.71 (.26)	.88 (.16)
Ambiguous / Inaccurate				
Ambiguous	.49 (.23)	.57 (.28)	.55 (.24)	.70 (.28)
Inaccurate	.51 (.23)	.43 (.28)	.45 (.24)	.30 (.28)
Inaccurate / Unambiguous				
Inaccurate	.39 (.25)	.38 (.30)	.36 (.27)	.27 (.35)
Unambiguous	.61 (.25)	.62 (.30)	.63 (.27)	.73 (.35)

Table 2

Children's mean ratings of speakers' proficiency (SD) in Study 1

	Preschool-age children		School-age children	
Comparisons	Knowledgeable	Unknowledgeable	Knowledgeable	Unknowledgeable
Ambiguous / Unambiguous				
Ambiguous	6.63 (1.77)	7.00 (1.67)	6.41 (1.65)	4.85 (1.79)
Unambiguous	7.32 (1.25)	7.43 (1.33)	7.77 (1.15)	7.30 (1.69)
Ambiguous / Inaccurate				
Ambiguous	6.63 (1.57)	7.14 (1.28)	6.45 (1.82)	5.60 (1.98)
Inaccurate	6.89 (1.45)	5.95 (1.63)	5.81 (1.33)	4.35 (1.39)
Inaccurate / Unambiguous				
Inaccurate	6.32 (1.49)	6.14 (2.10)	5.45 (1.57)	4.70 (1.92)
Unambiguous	6.95 (1.72)	7.33 (1.39)	7.63 (1.14)	7.35 (2.01)

Table 3

Mean proportion of times children chose speakers (SD) in Study 2

Speaker Type	Preschool-age children	School-age children
Ambiguous	.51 (.30)	.36 (.23)
Unambiguous	.49 (.30)	.64 (.23)

Table 4

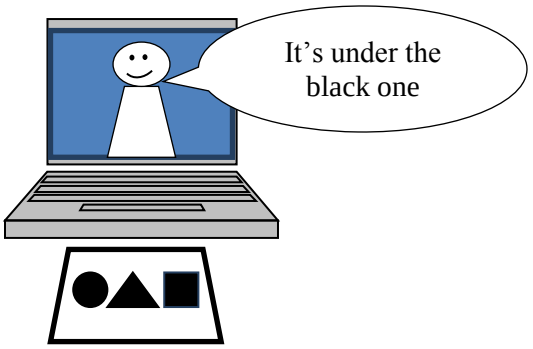
Children's mean ratings of speakers' proficiency (SD) in Study 2

Speaker Type	Preschool-age children	School-age children
Ambiguous	7.32 (1.57)	6.36 (1.36)
Unambiguous	6.32 (2.21)	7.68 (.99)

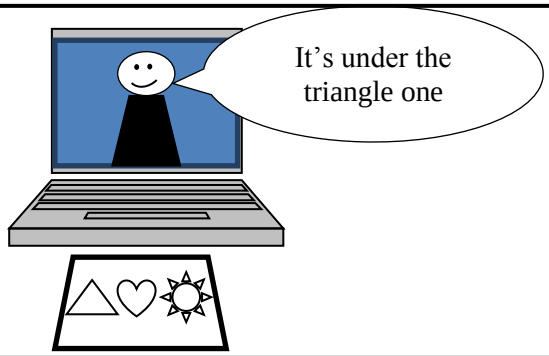
Figure Captions

Figure 1. Example of speaker comparison procedures (Unambiguous / Ambiguous comparison depicted here)

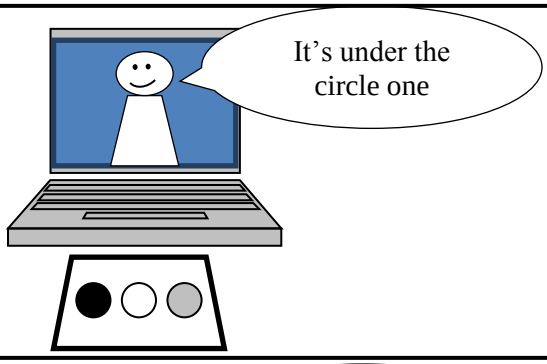
Learning Trial 1:
Ambiguous Clue



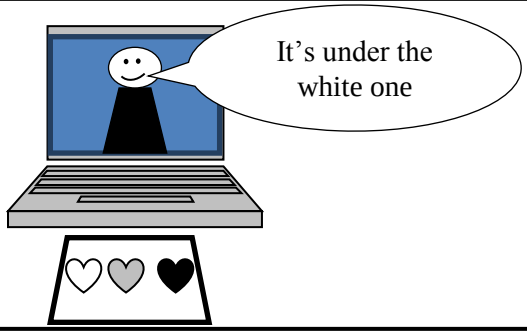
Learning Trial 2:
Unambiguous Clue



Learning Trial 3:
Ambiguous Clue



Learning Trial 4:
Unambiguous Clue



Speaker Choice