

Research Article

Does Mother Know Best? Maternal Knowledge Calibration Predicts Children's Oral Language Development

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Received 22 January 2014; Accepted 14 April 2014; Published 30 April 2014

Academic Editor: Glenda Andrews

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For young children, maternal testimony is an important source of knowledge. Research suggests that children privilege assertions expressed with certainty; however, adults frequently overestimate their knowledge, which may lead them to express certainty about incorrect information. This study addressed three questions. (1) To what extent do mothers convey domain knowledge when talking to their kindergartners? (2) Do mothers successfully calibrate their knowledge during these conversations? (3) Does mothers' knowledge calibration predict their children's language outcomes? Forty-nine mother-child dyads read a picture book about a familiar domain. Mothers' assertions of domain knowledge were coded for accuracy and expressed certainty. Results revealed that mothers tended to overestimate their knowledge. Knowledge calibration accuracy positively predicted child outcomes. Successful calibration was associated with stronger vocabulary knowledge and listening comprehension, whereas poor knowledge calibration was associated with weaker child outcomes. Knowledge calibration may be a crucial factor in the successful transmission of knowledge during mother-child conversations and impact children's language development.

1. Introduction

Much of our general knowledge is based on information that other people have provided rather than direct experience. To learn about the dietary habits of lions, for example, you are probably more likely to consult a zoologist than to travel to the savanna to conduct your own first-hand experiments. Such social learning reduces the need for direct observation and inefficient trial-and-error learning and may thus be integral to the development of human culture [1, 2].

For young children, adults may be an especially important knowledge resource. Children often hold the fairly reasonable expectation that knowledge increases with age [3], leading them to privilege information provided by adults [4, 5]. They also tend to privilege familiarity. By age 4, children selectively trust information provided by their mothers and other familiar adults over information provided by strangers [6, 7].

When trusted informants provide children with new knowledge, their testimony may serve to scaffold future learning. The initial, fragile connections formed as a result of the testimony may encourage children's theory development and the construction of elaborated concepts [8]. Yet information obtained from others may not always be accurate. Speakers sometimes convey misleading information due to ignorance, mistaken belief, or even willful deception. Blind trust could consequently result in children constructing erroneous, and potentially even harmful, theories and concepts.

Recent research has focused on the extent to which young children understand that they should not believe everything others tell them. Despite a general expectation that adults are good sources of information, children do appear to recognize that knowledge may vary across individuals. In a standard paradigm [9], children observe two informants labeling familiar objects. One informant labels the objects correctly; the other informant labels the objects incorrectly.

Children are then shown an unfamiliar object, and each informant provides a different label. When asked for the object's name, preschoolers tend to select the label provided by the informant with a history of correctly labeling familiar objects. Similar results have been reported for a variety of domains [10] and levels of expertise within a particular domain [11].

Although this research suggests that young children may be sensitive to an individual's past history as a source of reliable information, the basic paradigm is premised on children's ability to interpret the relative credibility of two (or more) informants. As such, reliability is typically demonstrated through an explicit contrast (e.g., accuracy versus inaccuracy) along a dimension that children can confidently evaluate (e.g., labeling of familiar objects). But under real-life circumstances, relative credibility may be more ambiguous. Children must frequently evaluate testimony without the benefit of explicit contrasts (e.g., "Is John a reliable source?" rather than "Is John more reliable than Sarah?") or about entirely unfamiliar domains (e.g., "Is John a reliable source about xerography?"). Furthermore, there are often few opportunities to immediately discern whether the proffered information is shared by members of the larger linguistic community [12].

Children may thus need to rely upon other available cues to determine whether an informant is, in fact, both knowledgeable and reliable. One possibility is that children moderate their trust according to perceived certainty. Harris [13, p. 118] suggests that the manner in which mothers convey knowledge may provide children with an "implicit epistemology." Children who hear confident, complete assertions may believe that the information is correspondingly certain and complete. By contrast, children who hear tentative, fragmentary assertions may believe that the information is similarly uncertain and incomplete. Recent research supports the proposal that young children will privilege sources that project confidence. For instance, children are more likely to trust an informant who expresses certainty about her testimony (e.g., "This is a spoon") than an informant who expresses uncertainty (e.g., "I think this is a spoon") [14], and they are more likely to extend nonobvious properties to additional exemplars when described by a confident speaker than an uncertain speaker [15]. Children are also sensitive to nonverbal cues, preferring to learn from someone who looks confident than someone who looks uncertain [16]. In fact, projected certainty may be unduly influential, as both children and adults tend to focus on the perceived strength of available evidence with insufficient regard for its credence [17, 18].

Under circumstances in which children are considerably or entirely dependent on testimony, they may be particularly vulnerable to error. First, they must assume that the informant is trustworthy (e.g., "This person wants to give me correct information"), often through evidence of the informant's familiarity and past reliability. Second, the information itself must be assumed to be trustworthy (e.g., "This information is correct"), which could be biased by the speaker's projected certainty. Given this, what happens if a trusted adult confidently provides *incorrect* information?

After all, adults tend to "grossly overestimate" their knowledge [19, p. 1122], resulting in poor calibration of what is and is not known [20]. Such overconfidence may lead individuals to project certainty when providing information, even if their knowledge is actually incomplete or erroneous. For example, parents frequently use unconventional words not shared by the larger linguistic community to label unfamiliar objects for their preschoolers (e.g., "This is a squisher") [21]. If children view their mothers as trusted and reliable sources of knowledge [7], they may accept such information indiscriminately, particularly when it is conveyed with certainty. But if children credulously accept that the unfamiliar object is called a "squisher," they would have made an error.

In the current study, we investigated how mothers serve as a source of new knowledge for their children during book-reading interactions. Young children may consider adults as trusted resources for new knowledge, particularly when opportunities for first-hand experience are limited [22]. To provide children with the best opportunities for knowledge development, however, mothers must provide information that is reliable and trustworthy. Given this, we first examined the extent to which mothers successfully calibrated their knowledge when discussing a picture book with their kindergartners. Shatz et al. [23] identified a distinct category of metacognitive utterances used to mark the degree of certainty with which speakers make assertions. Parents frequently use such "modulation of assertion" utterances to mark their perceived confidence when explaining new information to their children [21]. We examined the extent to which mothers similarly marked their knowledge (or ignorance) when discussing a familiar content domain (i.e., animals) during a typical book-reading interaction. Furthermore, we investigated whether mothers' projected confidence varied as a function of the accuracy of their assertions.

Our second goal was to examine whether mothers' calibration of content-related knowledge was associated with their children's oral language skills. One of the most important predictors of children's language development is their knowledge base [24, 25]. In the more immediate sense, background knowledge may help children encode, retrieve, and comprehend new information that they encounter. More broadly, knowledge may also help children learn how to think about and use what they have comprehended [26]. For example, the depth and breadth of children's background knowledge is positively related to both their vocabulary knowledge and listening comprehension skills, and these relationships appear to be mutually reinforcing [27, 28]. However, research has tended to focus on the content of children's knowledge without fully addressing the sources of their knowledge. We suggest that mothers can be a valuable resource for children's knowledge development, and that their successful knowledge calibration may significantly impact children's overall language outcomes. By at least four years of age, children appear sensitive that modulation of assertion utterances can indicate a speaker's relative certainty [29]. However, children, like adults, may also be biased to believe that assertions expressed with certainty are more reliable than those expressed with uncertainty [14, 16]. Given this, it is possible that mothers who appropriately modulate

their knowledge may implicitly indicate for their children whether information should be considered with credulity or skepticism. Over time, children of mothers who “know what they know” may be more likely to build accurate and rich knowledge bases than children of mothers who are less skilled at calibrating their knowledge.

We thus propose that well-calibrated mother-child conversations may be an important contributor to children’s language development. We hypothesized that mothers’ ability to successfully calibrate their content related assertions would be positively related to their children’s vocabulary knowledge and listening comprehension abilities. Specifically, we predicted that successful knowledge calibration (i.e., accurate assertions are expressed with certainty; incorrect assertions are expressed with uncertainty) would be associated with stronger child outcomes, whereas poor knowledge calibration (i.e., accurate assertions expressed with uncertainty; incorrect assertions expressed with certainty) would be associated with weaker outcomes.

2. Method

2.1. Participants. Forty-nine mother-child dyads were recruited from a large-scale study aimed at improving children’s vocabulary and conceptual knowledge [30]. A subset of families were randomly selected from the larger sample to represent a range of demographic characteristics.

Children were spring-semester kindergartners ($M = 73.01$ months, $SD = 3.89$; 21 boys and 28 girls) from the greater Detroit area. All children were native English speakers and were Caucasian (52%), African-American (30%), Asian (4%), Middle Eastern (4%), and bi-/multiracial (10%). Mothers ($M = 36.14$ years, $SD = 6.07$) were Caucasian (58%), African-American (20%), Asian (4%), Middle Eastern (4%), bi-/multiracial (6%), and other (8%). They reported a range of annual household incomes ($Mdn = \$35,000$; range = less than \$15,000 to greater than \$100,000) and educational backgrounds ($Mdn =$ some college; range = did not complete high school to doctoral degree). All mothers reported that English was the primary language spoken in their homes.

Additional four dyads were tested but excluded from the final sample because the interaction was conducted in a language other than English (2) or the dyad failed to complete the procedure (2).

2.2. Procedure

2.2.1. Wordless Picture Book. To examine mothers’ conveyance of information to their children, we created a context that would elicit child-directed speech about a particular domain. Mothers were asked to engage in a wordless picture book task with their children. Wordless picture books draw on preexisting domain knowledge [31] and encourage explanation and discussion [32] without being confounded by a reader’s literacy level. Furthermore, mothers may devote more attention to knowledge building when engaging their children with informational books as compared to narrative storybooks [33].

The picture book was adapted from illustrated informational books on the life cycles of three animal species; Siberian tigers [34], Great Pacific octopuses [35], and loggerhead sea turtles [36]. We selected these books because all mothers were presumed to possess knowledge about the general domain (i.e., animals), while knowledge of the specific species (i.e., tigers, octopuses, and sea turtles) was presumed to vary across individuals. Words were removed from all the books, and they were bound together into a single volume.

Dyads were given up to 15 minutes to “read” the book ($M = 10.29$ minutes, $SD = 3.21$). They were not provided with any specific instructions on how to engage with the book or what information to discuss.

2.2.2. Vocabulary Knowledge. Following the picture book interaction, children’s vocabulary knowledge was measured with the Peabody Picture Vocabulary Test-III (PPVT-III), a receptive vocabulary test yielding both raw scores and standard equivalent scores related to national norms [37]. The reported reliability for the PPVT-III ranges from 0.91 to 0.94. Standard scores were used as the outcome measure in our analyses.

2.2.3. Listening Comprehension. Children’s listening comprehension was measured with the Listening to Words and Stories (LWS) level 1 subtest of the Stanford Early School Achievement Test 10th edition (SESAT-10), which yields both raw scores and percentile ranks related to national norms [38]. The subtest is comprised of 40 multiple-choice questions and assesses listening comprehension through dictated selections and questions from literary, informational, and functional materials. The reported reliability for the SESAT-10 ranges from 0.69 to 0.97. Raw scores were used as the outcome measure in our analyses.

2.3. Coding and Reliability. Mother-child conversations were transcribed and verified (by a second transcriber) using the Codes for the Human Analysis of Transcripts (CHAT) system, available through the Child Language Data Exchange System (CHILDES) [39]. Transcripts were searched for assertions made by mothers relating to the target domain (i.e., animals). Assertions of domain knowledge included labeling (e.g., “The tiger is eating the boar; the boar is called the prey”); conveyance of nonperceptual information related to the target domain (e.g., “Tigers are meat eaters”); and content-related corrections to children’s comments (e.g., “That’s not a zebra; it’s one of the tigers in the moonlight”). Assertions were excluded if they were opinions, descriptions of perceptually available information, specific to the children’s or family’s experience, or direct repetitions. Transcripts were independently searched by the first author (AP) and a trained research assistant who was blind to the study’s hypotheses. Disagreements were resolved through discussion.

Assertions were then coded along two dimensions. First, each assertion was coded for accuracy. Accuracy (or inaccuracy) was verified through a series of internet searches. To be deemed accurate, the information had to be corroborated by at least two reliable sources (e.g., online encyclopedia,

National Geographic). Assertions were coded dichotomously as correct (e.g., “ink is one of the octopus’s protection mechanisms”) or incorrect (e.g., “octopuses only have one eye”). Second, each statement was coded for projected certainty. We adapted the coding scheme used by Ruffman et al. [40] and searched for the following terms: bet, could be, expect, figure, guess, maybe, might, perhaps, possibly, predict, probably, reckon, suppose, think, and wonder. Context was then used to determine whether the term was truly intended to modulate the speaker’s certainty. Assertions were coded dichotomously as certain (e.g., “tigers are carnivores”) or uncertain (e.g., “maybe turtles are herbivores”). Accuracy and certainty were independently coded by the first author and a trained research assistant (89.63% and 98.99% agreement, resp.). Disagreements were resolved through discussion.

3. Results

3.1. Do Mothers Convey Domain Knowledge during Book-Reading Interactions? We first examined the extent to which mothers conveyed domain knowledge to their children while discussing the wordless picture book. Across the 49 transcripts, we identified 384 maternal assertions of domain knowledge. This represented just 6.41% of the total number of utterances spoken by mothers during the book-reading interaction.

On average, mothers expressed 7.86 assertions of domain knowledge ($SD = 7.69$) during the interaction. Assertions were positively correlated with the overall amount of maternal language ($r = 0.54, P < 0.0005$), suggesting that mothers who talked more during the book-reading interaction were also more likely to convey information about the target domain described in the picture book. By contrast, mothers’ assertions of domain knowledge were not significantly correlated with their level of education ($r = 0.09, P = 0.562$). Although education has been positively linked to the breadth and depth of one’s own background knowledge [41], these findings suggest that mothers who possessed more limited educational backgrounds were nonetheless as likely to discuss content-related information with their children as mothers who were more highly educated.

Mothers were significantly more likely to convey accurate information ($M = 6.27$ assertions, $SD = 6.47$) than incorrect information ($M = 1.55, SD = 1.85$) when discussing the picture book with their children, $t(48) = 5.90, P < 0.0005$, two-tailed, Cohen’s $d = 1.24$. Accuracy was not significantly related to the overall amount of mothers’ language ($r = 0.18, P = 0.231$) or maternal education ($r = 0.01, P = 0.965$).

3.2. Do Mothers Successfully Calibrate Their Domain Knowledge? We next examined the extent to which mothers calibrated their domain knowledge when discussing the picture book with their children. Overall, mothers were significantly more likely to express information with certainty ($M = 5.67$ assertions, $SD = 6.02$) than uncertainty ($M = 2.18, SD = 3.67$), $t(48) = 3.86, P < 0.0005$, two-tailed, Cohen’s $d = 0.58$. This suggests that mothers tended to project confidence when discussing content-related information with their children.

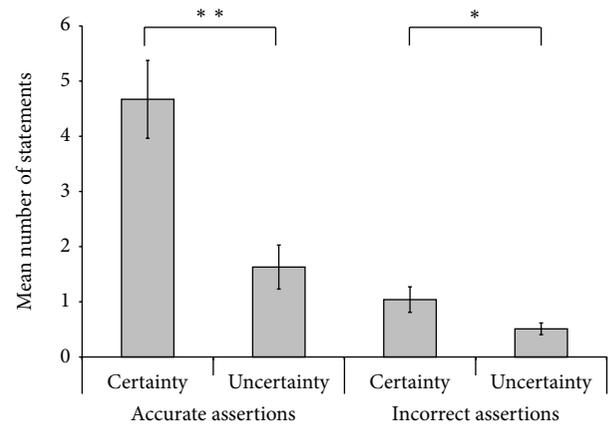


FIGURE 1: Mean number of accurate and incorrect assertions of domain knowledge expressed with certainty and uncertainty. *Note:* * $P < 0.05$; ** $P < 0.01$.

Although mothers projected confidence, it remained unclear whether this apparent confidence was well founded. To address whether mothers successfully calibrated their knowledge, we calculated the number of accurate assertions of domain knowledge expressed with certainty versus uncertainty. If mothers successfully calibrated their knowledge, we would expect accurate assertions to be expressed with certainty. A paired t -test confirms that this was the case. Mothers were significantly more likely to express accurate information with certainty ($M = 4.67, SD = 4.94$) than uncertainty ($M = 1.63, SD = 2.79$), $t(48) = 4.44, P < 0.0005$, two-tailed, Cohen’s $d = 0.68$ (see Figure 1). This suggests that mothers were largely successful at calibrating their domain knowledge when it was accurate.

We also calculated the number of incorrect assertions of domain knowledge expressed with certainty versus uncertainty. If mothers were truly successful at calibrating their knowledge, we would expect incorrect statements to be expressed with uncertainty. This, however, was not the case. In fact, mothers were significantly more likely to express incorrect statements with certainty ($M = 1.04, SD = 1.62$) than uncertainty ($M = 0.51, SD = 0.74$), $t(48) = 2.17, P = 0.035$, two-tailed, Cohen’s $d = 0.34$. While mothers projected confidence when their knowledge was accurate, they also seemed confident when conveying information that was incorrect. Mothers thus appeared to be overconfident in their own knowledge during book-reading interactions with their kindergartners.

Finally, we examined the relationship between maternal education and successful knowledge calibration. Level of education was not significantly correlated with mothers’ overall projected confidence ($r = 0.08, P = 0.595$). Furthermore, maternal education was not significantly related to certainty when conveying accurate ($r = 0.10, P = 0.517$) or incorrect ($r = -0.01, P = 0.955$) assertions of domain knowledge. Although more knowledgeable individuals tend to be better calibrated and less overconfident in their knowledge [42], these results suggest that, across educational backgrounds, mothers tended to overestimate their domain knowledge when discussing books with their children.

TABLE 1: Hierarchical regression analysis of mothers' successful knowledge calibration predicting their children's vocabulary knowledge ($n = 49$ dyads).

Step	B^a	Standard error	t -value	P value	sr^{2b}
Step 1					
Maternal education	3.15	1.35	2.33	0.027	0.16
Step 2					
Maternal education	3.77	1.20	3.15	0.004	0.22
Proportion of accurate assertions expressed with certainty	16.14	5.98	2.70	0.012	0.16
Proportion of incorrect assertions expressed with uncertainty	11.52	4.65	2.48	0.020	0.14

^aUnstandardized regression coefficient.

^bSquared semipartial correlation.

3.3. Does Successful Knowledge Calibration Predict Language Outcomes? Children's PPVT ($M = 106.82$, $SD = 13.69$) and LWS ($M = 24.10$, $SD = 7.10$) scores were positively correlated, $r = 0.64$, $P < 0.0005$. A series of fixed-order hierarchical regressions tested whether mothers' knowledge calibration during the book-reading activity explained variance in children's vocabulary knowledge and listening comprehension.

We first tested whether maternal knowledge calibration explained variance in children's receptive vocabulary knowledge. We predicted that knowledge calibration accuracy would positively predict children's vocabulary knowledge. In other words, successful knowledge calibration (i.e., relatively greater proportions of accurate assertions expressed with certainty than uncertainty and incorrect assertions expressed with uncertainty than certainty) was expected to be associated with higher PPVT scores, whereas poor knowledge calibration (i.e., relatively greater proportions of accurate assertions expressed with uncertainty than certainty and incorrect assertions expressed with certainty than uncertainty) was expected to be associated with lower PPVT scores.

Because we were interested in the role of knowledge calibration over and beyond the effects of maternal education, we controlled for education by entering it at the first step of the regression. Consistent with previous research [43], maternal education accounted for 15.8% of the variance in PPVT scores, $F(1, 29) = 5.45$, $P = 0.027$. The proportion of accurate assertions expressed with certainty and proportion of incorrect assertions expressed with uncertainty were then entered at the second step. Together, these two knowledge calibration variables accounted for 24.7% of the variance in children's PPVT scores, $F(2, 27) = 5.59$, $P = 0.009$, after controlling for maternal education.

As shown in Table 1, the proportions of accurate assertions expressed with certainty and incorrect assertions expressed with uncertainty were significant positive predictors of children's PPVT scores. As we hypothesized, mothers' knowledge calibration accuracy was positively associated with their children's vocabulary outcomes. Consistent with previous research, maternal education also significantly predicted children's vocabulary, such that higher levels of education were associated with greater PPVT scores. However, knowledge calibration was a significant positive predictor even after controlling for maternal education.

Additionally, the sum of the squared semipartial correlations (sr^2) for the two knowledge calibration variables

exceeded the amount of variance explained at Step 2, suggesting a suppression effect. Under conditions of suppression, the sum of sr^2 values for two correlated variables must exceed R^2 [44]. This apparent suppression effect suggests that knowledge calibration accuracy may help separate the variance in children's vocabulary knowledge that is explained by how information was conveyed from the variance explained by mothers' general knowledge (i.e., maternal education).

We next tested whether maternal knowledge calibration explained variance in children's listening comprehension abilities. We predicted that knowledge calibration accuracy would positively predict children's LWS scores, such that successful calibration would be associated with stronger listening comprehension outcomes and poor knowledge calibration would be associated with weaker outcomes. As in the previous regression, we controlled for maternal education by entering it at the first step. Maternal education accounted for 8.2% of the variance in LWS scores, $F(1, 29) = 2.60$, $P = 0.118$. The proportion of accurate assertions expressed with certainty and proportion of incorrect assertions expressed with uncertainty were then entered at the second step. These two knowledge calibration variables together accounted for 31.6% of the variance in LWS scores, $F(2, 27) = 7.10$, $P = 0.003$, after controlling for maternal education.

As Table 2 shows, the hierarchical regression for listening comprehension revealed a similar pattern to vocabulary knowledge. Consistent with our hypothesis, the proportions of accurate assertions expressed with certainty and incorrect assertions expressed with uncertainty positively predicted children's LWS scores. This suggests that mothers' knowledge calibration accuracy may be positively associated with children's comprehension outcomes. Interestingly, while maternal education did not significantly predict children's listening comprehension at Step 1, it did have a positive significant regression weight after the knowledge calibration variables were included in the regression. Furthermore, the sum of sr^2 values for the two knowledge calibration variables exceeded the variance explained at Step 2. Together, these results indicate a suppression effect [44, 45]. This suggests that knowledge calibration may help separate the variance in children's listening comprehension skills explained by how information was conveyed from the variance explained by mothers' general knowledge (i.e., maternal education).

Taken together, these results suggest that mothers' knowledge calibration accuracy was positively associated with

TABLE 2: Hierarchical regression analysis of mothers' knowledge calibration predicting their children's listening comprehension ($n = 49$ dyads).

Step	B^a	Standard error	t -value	P value	sr^{2b}
Step 1					
Maternal education	1.21	0.75	1.61	0.118	0.08
Step 2					
Maternal education	1.59	0.64	2.47	0.020	0.14
Proportion of accurate assertions expressed with certainty	9.71	3.22	3.02	0.005	0.20
Proportion of incorrect assertions expressed with uncertainty	7.04	2.50	2.82	0.009	0.18

^aUnstandardized regression coefficient.

^bSquared semipartial correlation.

children's oral language development. Mothers who were able to successfully calibrate their assertions of domain knowledge tended to have children with stronger vocabulary knowledge and listening comprehension skills. However, because knowledge calibration was calculated proportionally, the inverse relationship also held: mothers who were poorly calibrated tended to have children with more limited vocabulary knowledge and listening comprehension skills. Importantly, these predictive relationships held over and above the effects of maternal education.

4. Discussion

Although it is well established that knowledge is an important foundation for young children's oral language development [24, 25], research is only beginning to address the sources of that knowledge. While personal experience is one potential source, children must have the opportunity to explore the objects or entities in question and the necessary expertise to interpret their observations. If children were limited to learning on the basis of their own experience, they would be unlikely to learn, for instance, that whales are mammals rather than fish, or that dinosaurs once roamed the earth. An alternative, and potentially more efficient, method for acquiring domain knowledge is to take advantage of another person's knowledge or expertise. The willingness to accept another person's testimony is essential for the transmission of culturally-acquired knowledge [1, 2] and allows learners to make subsequent inferences that are different than those that can be made on the basis of direct observation.

Previous research suggests that young children may view their mothers as particularly reliable sources of information, especially if she projects confidence [7, 13, 14]. However, adults are notoriously poor at accurately calibrating their own knowledge, which may result in overconfidence about what they actually know [19, 20]. In the present study, we found that mothers appeared to overestimate their own knowledge during content-related discussions with their children. When conversing with their kindergartners, mothers were more likely to express their assertions with certainty, regardless of the information's accuracy. If children do indeed privilege maternal confidence, this may profoundly impact their learning, depending on the accuracy of the information being conveyed. We found that mothers' knowledge calibration

accuracy positively predicted their children's oral language development. Successful knowledge calibration (accurate assertions expressed with certainty and incorrect assertions expressed with uncertainty) was associated with *higher* vocabulary and listening comprehension scores. By contrast, poor knowledge calibration (accurate assertions expressed with uncertainty and incorrect assertions expressed with certainty) was associated with *lower* vocabulary and listening comprehension scores.

It is perhaps unsurprising that incorrect assertions expressed with certainty were associated with weaker vocabulary and listening comprehension scores. After all, a confident but unreliable informant is a poor source of information, particularly if her lack of knowledge remains unknown to the listener. To avoid unintentionally providing children with erroneous information, one possible strategy would be to modulate all content-related assertions with uncertainty. Yet our results suggest that such hedges may not always be beneficial; accurate assertions stated with uncertainty were also associated with poorer child outcomes. If children privilege confidence, it is possible that they may discount or even disregard statements expressed with uncertainty. In cases where such statements convey accurate information, children could miss important opportunities for building their knowledge base.

Although a growing body of evidence suggests that young children are sensitive to the reliability of information sources, the tendency has been to focus solely on proximal outcomes, such as children's willingness to learn new words from reliable and unreliable informants. Yet, as Gelman [8] has argued, the testimony provided by trusted informants may influence children's conceptual development more broadly. The current study is unique in that it examined how mothers' ability to calibrate their own knowledge during a representative book-reading interaction predicts their children's general oral language comprehension (i.e., receptive vocabulary knowledge, listening comprehension skills) and, by extension, how maternal testimony may be an important contributor to children's knowledge base and language development. The extent to which children may have acquired and retained the specific domain-related content conveyed during these discussions, however, remains an open question.

In this study, we specifically focused our examination on mothers' assertions of their own domain knowledge; children's requests for and contributions to this knowledge

were beyond the bounds of our inquiry. Yet learning is often a socially mediated process [46], and one of the primary functions of shared book reading may be the co-construction of meaning through parent-child conversations [47]. Given this, children's explicit requests for content-related information may play an important role in the learning process. Asking questions, for example, may help children encounter targeted domain knowledge when they are especially receptive to it [48]. When children are actively seeking to fill gaps in their knowledge, however, their tendency to privilege perceived confidence may make them particularly vulnerable to poorly calibrated responses, such as incorrect information expressed with certainty. This, in turn, may have lasting implications, particularly given that the reevaluation and restructuring of erroneous knowledge are usually achieved in a slow and gradual fashion [49]. Future research is thus needed to fully address the relationship between maternal knowledge calibration and children's active knowledge seeking and evaluation.

Although we found that mothers tended to project confidence when making content-related assertions, there was considerable variability in successful knowledge calibration across individuals. One potential source of variability could be maternal education. According to previous research, level of education is positively related to domain knowledge [41], and more knowledgeable individuals tend to be better calibrated and less overconfident in their knowledge [42]. In our study, however, mothers infrequently discussed content-related information, and when they did, they tended to do so with certainty, regardless of their educational background. Furthermore, we found that knowledge calibration was a significant predictor of children's vocabulary knowledge and listening comprehension skills even after controlling for maternal education. Although maternal education may be related to differences in the overall amount of linguistic input mothers provide for their children [43, 50], it is possible that children from lower-SES backgrounds experience content-related discussions comparable to their more socioeconomically advantaged peers when they engage in shared book reading.

Alternatively, children across socioeconomic backgrounds may experience comparably low levels of content-related conversation during book-reading interactions. In our study, just 6.41% of all maternal utterances conveyed domain knowledge. This was despite specifically selecting a book-reading task that would draw on general domain knowledge and encourage knowledge-building discussions [31, 33]. Content-rich discussions may occur even less frequently in other contexts, such as discussing fictional storybooks. If this is the case, each assertion of domain knowledge may be especially valuable, and successful maternal knowledge calibration may be particularly crucial.

In a recent paper, Jaswal [51] reported that young children with larger vocabularies were more likely to accept an informant's assertion that an entity looking like a member of one category (e.g., whales look like fish) is actually a member of a different category (e.g., whales are actually mammals). Our study suggests that the relationship between children's oral language skills and their willingness to accept what other

people tell them may in fact be bidirectional. Moreover, the nature of this relationship may be particularly influenced by mothers' (or other trusted informants') knowledge calibration and projected confidence. It is possible, for instance, that children who extend their trust to well-calibrated mothers may evince greater background knowledge and language skills relative to children who extend their trust to poorly calibrated mothers.

5. Conclusions

Mothers may convey important information to their children during their everyday conversations, and the content of these conversations may help build children's general knowledge and encourage their language development. The current study, however, suggests that knowledge calibration may be a critical factor in the successful transmission of knowledge from mothers to their children. For successful teaching (and learning) to occur, it is important to know what you know and what you do not know.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Acknowledgments

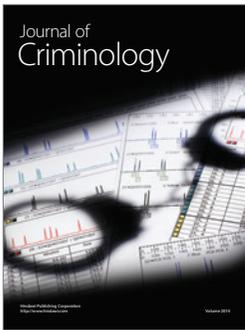
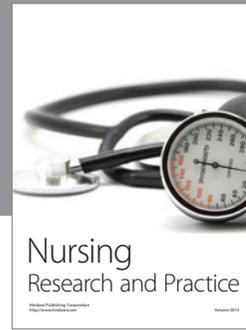
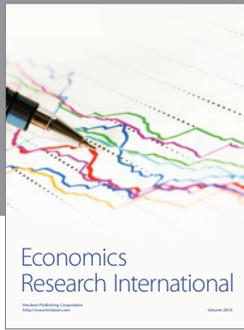
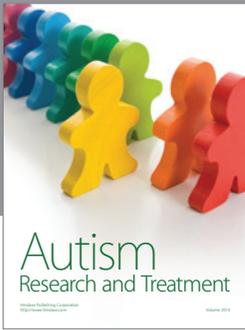
The authors gratefully acknowledge funding from the Institute of Education Sciences (Grants R305A090013 and R305A110038). Many thanks are due to Gabrielle Desano and Robyn Lachman for help with transcription and coding, and to the families who participated in this research.

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