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Children's Early Awareness of Comprehension as Evident in Their Spontaneous Corrections of Speech Errors

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A crucial human cognitive goal is to understand and to be understood. But understanding often takes active management. Two studies investigated early developmental processes of understanding management by focusing on young children's comprehension monitoring. We ask: When and how do young children actively monitor their comprehension of social-communicative interchanges and so seek to clarify and correct their own potential miscomprehension? Study 1 examined the parent–child conversations of 13 children studied longitudinally in everyday situations from the time the children were approximately 2 years through 3 years. Study 2 used a seminaturalistic situation in the laboratory to address these questions with more precision and control with 36 children aged 2–3 years.

Social transmission of information is one of the key ways in which both children and adults interact and children learn about the world. Potentially, these interactions manifest a crucial human cognitive goal: to understand and to be understood. Importantly, understanding often requires comprehension management—strategies or attempts to receive further information, to be alert for and attempt to correct misunderstandings. In the current research we ask: When and how do young children actively monitor their understanding of social-communicative interchanges in order to manage the social transmission of information and to clarify and correct their own potential miscomprehensions? A focus on comprehension monitoring and management as reflected in social exchanges of young children is both theoretically and methodologically motivated. Methodologically, social attempts to achieve comprehension—to understand information from others—are amenable to research with young children (who cannot easily reflect on, articulate, or rate their own inner states, such as states of comprehension). Theoretically, socially shaped understanding is developmentally formative—Vygotsky's work and contemporary research on "testimony" (Harris, 2012) both acknowledge the special importance of socially achieved understandings.

Two general accounts of early social-cognitive developments are particularly relevant here. Csibra and Gergeley (2009) have suggested that even infants are sensitive to pedagogy, that is, to others trying to teach or tell them something. For Csibra and Gergeley, this is the result of an innate set of cues pointing to pedagogical intent; very young children automatically utilize social signals, like direct eye contact and contingent, referential interactions, that cue them to accept information they receive from an informant (Csibra & Gergely, 2009). Alternatively, however, under the heading of "trust in testimony," Harris and others (Gelman, 2009; Harris, 2012) argue that young children are appropriately discriminative. They judge only some speakers emitting these cues, and only some information socially transmitted via such cues, as trustworthy.

Only the second of these positions presumes young children engage in active comprehension monitoring and management of speakers' messages. At the same time, the data adduced for these two

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positions typically apply to different ages—in the first case, infants and in the second case, 3-, 4-, and 5-year-old preschoolers. Examination of comprehension monitoring in toddlers can help illuminate these positions, their limits, and the nature of this crucial aspect of social-cognitive development. Some of these issues were taken up in an older, classic literature on comprehension monitoring but with notable lack of resolution when it came to very early development.

Comprehension Monitoring

By the time that children are 4 and 5 years old, they are well versed in managing comprehension in communicative situations, at least in several basic forms, as shown in that older literature on comprehension monitoring. Currently, comprehension monitoring research focuses almost exclusively on text processing in adults (e.g., Shiu & Chen, 2013; Weaver, Bryant, & Burns, 1995) and older elementary school children (e.g., Oakhill, Hartt, & Samols, 2005). However, earlier research on younger children's comprehension monitoring considered children's evaluation of spoken messages via experimental methods designed to elicit explicit evaluations as well as analyses of naturalistic conversations and interactions. Naturalistic studies demonstrated that even young toddlers produced the kinds of questions and reactions needed to clarify potential comprehension or communicative errors (Gallagher, 1981; Garvey, 1977; Spilton & Lee, 1977). Foreshadowing the natural pedagogy versus trust in testimony positions, some investigators advanced rich interpretations of such conversational data (as demonstrating valid and frequent comprehension monitoring by very young children), others argued the findings deserved only leaner interpretations. Thus, Markman (1981) argued that the youngest children did not mentally evaluate their comprehension of messages but simply commented when they were physically unable to comply.

Many experimental demonstrations seemed to support leaner interpretations for preschoolers and even elementary school children, because children did not discriminate between good (comprehensible, nonambiguous) messages versus poor ones on judgment tasks involving ratings or judgments of various messages (Beal & Flavell, 1982; Robinson & Robinson, 1977).

Crucially, however, almost all of the research with preschool children focused on referential ambiguity, which occurs when a message has several ambiguous referents—for example, "Look at the horse," when several horses are in view. Preschoolers generally did not react differently to ambiguous and unambiguous messages, simply choosing one of the potential referents, further suggesting young children systematically fail to monitor their comprehension. However, the overwhelming focus on ambiguity arguably led to an underestimate of preschoolers' monitoring.

To clarify some of this, Revelle, Wellman, and Karabenick (1985) gave preschool children several contrasting messages in natural-seeming situations and used children's contingent reactions to assess their comprehension monitoring and management. In the course of a play interaction within a room full of carefully composed objects, an adult interspersed the play episode with a series of requests, some of which were designed to be difficult for the child to understand or to execute. For example, in an *unintelligible* request, the adult said "bring me the [yawn]" obscuring the referent's name; in an impossible request, it was "bring me the refrigerator" for a real refrigerator that was clearly too big and heavy to move; in an *ambiguous* request, it was "bring me the cup" when there were four cups side by side in the room. Children's responses to these requests were compared with their responses to control requests that were easy to comprehend and comply with (e.g., "bring me the ball" when there was one ball present). Three-year-olds exhibited appropriate monitoring responses, for example saying things like "what?," "this one?," or "can't hear" for some target messages more than control ones. In particular, they did so for unintelligible or impossible messages. Even so, 3-year-olds systematically failed to monitor referential ambiguity. Four-year-olds displayed discriminative monitoring for all types of problems presented, but even for them referential ambiguity was especially difficult.

Although clarifying the development of comprehension monitoring in part, these studies fail to clarify the development of comprehension monitoring in the early formative age ranges that naturalistic studies had hoped to address. Several of the studies do, however, validate a method that could be used with still younger children, a "reaction method" examining children's reaction to problematic messages in controlled but seminaturalistic communicative situations. The essential idea is that, if/when young children seek understanding (rather than merely action success or responding automatically to pedagogical cues), they will monitor their understanding and react to attempt to clarify or repair possible misunderstandings.

The Current Research

The current research revisits questions about the early development of comprehension monitoring. Requests are a limited form of communicative exchange, so in two studies we primarily focus on declarative naming, with some comparison to requests as well in Study 2. Anomalous requests ("Bring me the refrigerator") have their parallels in misnamings, deliberate or accidental references to X as Y. Children's reactions to misnamings prove to be a revealing way to examine the early development of their comprehension monitoring and management.

Study 1

In a preliminary study, we examined young children's reaction to misnamings in naturally occurring conversations with adults (mostly their parents). So, we considered conversations like this:

Adult: That's a truck.

Child: A car.

One methodological difficulty becomes immediately apparent: Did the parent misname here? (Is the interchange even about naming rather than preference or compliance?) In an experimental situation this can be known and controlled (the adult purposefully calls a car a truck), but it is not so obvious what an adult–child interchange is about by recourse to conversation alone in everyday parent–child exchanges. So, perhaps the child's reaction above concerns comprehension management ("That's not a truck"), or perhaps it concerns attention management ("Not that truck mom, this car"), or other possibilities. We dealt with this interpretive difficulty in two ways. In Study 2, we collected experimental data via a reaction method. But in this initial study, to gain preliminary insights from naturally occurring parent–child conversations, our approach was to seek further clarity by utilizing more extended conversational sequences. Social communicative interchanges intuitively encompass three steps: (a) one person's initial communication (e.g., adult says, "that's a truck"); (b) a response to that by the listener (e.g., the child says, "it's a car," possibly remarking on a misnaming); and (c) the initial person's reaction to this response. The third component, (c), can (at times) inform us about the prior ones. For example, if the adult says, "Oh you're right" (in c), that provides evidence that the child was catching something like a misnaming in their utterance in (b). In addition, more generally, examining adult–child naturally occurring conversations helped inform our generation of a seminaturalistic experimental setting and stimuli for Study 2.

Study 1 examined parent–child conversations for young children studied longitudinally in everyday situations from the time the children were approximately 2;0 years through 3;6 years. Our focus was instances of apparent adult naming of objects (step a above), and then the further steps (b) and (c) of the conversations.

Method

Participants

We examined adult–child conversations from longitudinal transcripts of 13 children from the CHILDES database (MacWhinney & Snow, 1990). The CHILDES database contains (among other things) samples of children's everyday conversations with mothers, fathers, siblings, and experimenters in everyday situations at home. As outlined in Table 1, the conversations we examined were recorded every 1, 2, or 3 weeks over several months or years, and for 20 min, 30 min, or 1, 2, or 4 hr per session depending on the child. Also shown in that table is the total number of child utterances included in the transcripts we used. As can be seen, the varying sampling intervals and sessions plus the varying verbosity of the children meant that children provided widely different numbers of utterances for further coding.

These 13 children were selected from the larger CHILDES database because their transcripts included the age range from 2 to 3 years and 6 months; each had at least 50 conversations matching our search criteria (see below, but in essence we searched for conversations that included adults' naming statements); the transcripts were recorded in naturalistic settings rather than structured tasks (e.g., story book reading tasks). These transcripts were of audio recordings and thus provide no information about nonverbal responses, such as where the parties were looking or (possibly) pointing when they made their utterances.

As shown in Table 1, these children vary on gender (nine boys and four girls), ethnicity (one African American), and family social economic status (children from academic, nonacademic, and middle-class or working-class families). But they do so unsystematically.

Table 1
Subject and Sample Descriptions

Child	Contributor	Collected procedure	No. of transcripts	Age range	Demographics	1:1 Conversation partner	No. of total conversations	No. (%) of valid conversations
Abe	Kuczaj (1977)	0.5 or 1 hr a week	105	2;4–3;5	White male; graduate student family	Mother, father	185	97 (52.4)
Adam	Brown (1973)	1 or 2 hr every 2 weeks	32	2;3–3;5	African American male; middle class	Mother, researcher	285	213 (74.7)
Jillian	Weist and Zevenbergen (2008)	0.5 hr every 2 weeks	22	2;1–2;10	White female; middle-class professional	Mother, researcher	90	41 (45.6)
Jimmy	Demetras (1987)	20 min every 2 weeks	26	2;2–2;9	White male; working class	Mother, father	50	33 (66.0)
Matty	Weist and Zevenbergen (2008)	0.5 hr every 2 weeks	27	2;3–3;5	White male; middle-class professional	Mother	133	61 (45.9)
Naomi	Sachs (1983)	Multiple short episodes every 2 weeks	55	2;0–3;5	White female; college professor family	Mother	72	50 (69.4)
Nina	Suppes (1974)	1 hr every week	49	2;0–3;3	White female; middle-class professional	Mother	726	468 (64.5)
Peter	Bloom, Hood, and Lightbown (1974)	4 hr every 3 weeks	15	2;0–3;1	White male; upper middle class	Mother, father, researcher	429	249 (58.0)
Roman	Weist and Zevenbergen (2008)	0.5 hr every 2 weeks	24	2;2–3;5	White male; middle-class professional	Researcher	51	40 (78.4)
Ross	MacWhinney (1995)	Multiple short episodes every 2–3 weeks	81	2;4–3;5	White male; college professor family	Researcher	101	47 (46.5)
Sarah	Brown (1973)	0.5 hr once or twice a week	63	2;3–3;5	White female; working class	Mother	212	128 (60.4)
Shem	Clark (1979)	1 hr once a week	47	2;2–3;2	White male; middle to upper middle class	Mother, researcher	368	244 (66.3)
Trevor	Demetras (1987)	Multiple short episodes a month every 2–3 months	21	2;0–3;3	White male; working class	Father	80	36 (45.0)

Note. Total: 13 children, 2,782 utterances; among these, 61.4% (1,707 utterances) were coded for Steps 2 and possibly 3, and so included in further analyses.

Procedure

The 13 children's transcripts that matched the age range of 2;0–3;6 were searched for all adults' utterances containing the following target phrases intended to capture simple cases of adult (mostly parent) object naming: (a) "it's a __," (b) "that's a __," (c) "these are __," (d) "those are __," (e) "this is a __." This yielded 2,782 utterances for initial consideration. These target phrases do not, of course, capture all instances of parental naming but capture many. Furthermore, identifying utterances using those phrases includes parental talk that is not object naming (e.g., "that's a good idea" referring to nonobjects; "that's a pretty box" referring to an attribute of an object not its name). All statements that were not clear-cut instances of object naming (e.g., "that's a good idea") were excluded from further analysis. Adult utterances that were interrupted, unintelligible, or directed to another person (not to target child) were likewise excluded.

Phrases that were repeated in a same conversational turn were coded only once. The final sample consisted of 1,707 adult statements followed by a child response and then a further adult response; these varied by parent–child pair as shown in Table 1.

Coding

After being identified by computer search as containing the target adult phrases, each candidate conversational sequence was coded only if it minimally contained two steps: the initial adult naming statement (step a above) and the child's response (step b). If the child (in step b) disagreed with the adult statement or questioned the name, the adult's reaction to the child's response was also coded in a third step (c). All coding was conducted by examining each conversation within four utterances before the first step and the four utterances after the third step, and still more utterances as needed, to allow the coders to understand the conversational context.

Adult statements. The adult statements were initially coded into one of the five types of naming phrases mentioned above. Inspection showed that patterns of child response were essentially the same for all these adult naming phrases, so analyses collapsed all these variations in a simple category of an adult naming.

Child responses. The child's responses to the adult's naming were initially coded into one of several categories, including (1) the child disagrees with the adult name (e.g., mom says "it's a truck," child says "no" or "it's a car"), (2) the child asks a name-related question for confirmation (e.g., a doubtful question: "a truck?"), (3) the child agrees with the adult's name (by saying "yes" or repeating the name, etc.), (4) the child provides a follow-up statement or asks a follow-up question, apparently agreeing with the name (e.g., "that's a nice truck," "is that a dump truck?"), and (5) other, the child provides no response or switches to a new topic, or provides an uncodable response (e.g., "la la"). For analyses, we collapsed 1 and 2 as indicating disagreements and 3 and 4 as indicating agreement with the adult's name. The purpose of the initially extensive categories was to help coders have a comprehensive list of all possible responses to aid reliability.

Adult reactions. The adult's reaction to the child's response was coded into one of several categories (and subcategories) that followed up (or failed to follow-up) on the child's response, given that the child's response in step b was coded as a 1, 2, 3, or 4 as outlined above (in essence the child either agreed or disagreed with the adult's naming in step a). Given our focus on child reaction to potential misnamings, our coding here had only three categories: (a) confirmed misname—adult's response confirmed the child had apparently detected a misnaming at least from the child's point of view, including adopting the child's name (e.g., "oh, a car"), (b) following up the child's name in a question ("you think that's a car?") or statement ("a really big car"), (c) restated name ("that's a truck," "no, truck") or other (changing the topic, no response, etc.).

Reliability

Intercoder reliability was assessed using randomly selected samples of 20% of the total conversations but taken from the four children with the largest number. Two reliability coders from a pool of three coders independently coded each reliability sample. For all codes, there was 92%–99% agreement, with kappas ranging from .62 to .98. All of the kappas fall within "substantial" (.61–.80) levels of interrater reliability, and 71% of them fall within "near perfect" (.81 and above) levels (Landis & Koch, 1977).

Results

Overall, mothers were the adult speakers in 58.2% of these conversations, in 10.2% it was

fathers, and 31.5% of the time it was some other nonparental adult. Descriptively, within the 2,782 conversations (see Table 1) that used the adult target phrases, 1,707 conversations or 61.4% were judged to include instances of adult object naming. The frequencies ranged from 50 for the adult–child pair contributing the fewest instances to the sample (1.8% of the total) to 726 for a different pair who contributed the most (26.1%). To reiterate, these figures inevitably miss some instances of adult naming but include a large sample (1,707) for analyses.

In 829 conversations (or 48.6% of the time), the child's response was a 3 or 4 as outlined in the description of coding; that is, essentially the child directly or indirectly agreed with the adult's name. In 733 conversations (42.9% of the time), the child made no response or changed the topic. Yet in 145 conversations (8.5% of the time), the child provided a reaction potentially indicating detection of a misnaming, a response coded as a 1 or a 2. All children except one child did so on at least 6% of the adult namings they received (range from 6.2% to 25%; $M = 9.4\%$, $SD = 6.2\%$). Critically, for 32.4% of these instances of potential misnaming, the adult's further reaction seemed to confirm that a misnaming had been detected by the child (at least from the child's point of view). That is, the adult agreed with or accepted the child's alternative name.

Child age did not correlate with the proportion of children's awareness of potential misnamings (% occurrences of categories 1, disagree, and 2, question for confirmation, combined for each child)—$r(137) = -.09$, $p = .31$—nor did it do so for detected misnamings confirmed by subsequent adult response—$r(68) = -.15$, $p = .21$. That is, misnaming detection occurred even in the children's youngest transcripts.

Discussion

As expected (from the nature of human fallibility alone), adults do misname objects for their young children. More focally, even children who have just attained their second birthdays at times detect these misnamings and attempt to correct them.

Naturalistic recordings of children's communicative interactions however do not allow control of the exchanges surrounding the child's reactions and so cannot tell us if such comprehension monitoring is frequent or extremely rare, just that it exists as early as in toddlerhood. In this and other ways, naturally occurring conversations are difficult to rigorously interpret. For example, they are unlikely to include closely contrasting objects X and Y, or closely contrasting situations for comparison, or unlikely to provide evidence that the child actually knew (or did not know) the named object. Moreover, perhaps (and sometimes, surely) the adult (e.g., parent) in some way prompts the child to make his or her reactions. Of course, with only 47 misnamings plausibly confirmed by the adult, we were unable to look deeply into young children's comprehension monitoring or management. Experimental control of situations and names are needed to overcome these interpretive difficulties.

Study 2

In Study 2, we experimentally contrasted correct and incorrect namings provided to young children and examined their reactions. One set of four studies by Koenig and Echols (2003) with infants sets the stage for this endeavor. Koenig and Echols examined how 16-month-olds reacted to either true or false labeling of common objects. Primarily, they observed infants' gaze to attempt to shed light on whether the infants understood that fundamental mislabeling might have occurred. Their initial, basic finding (their Study 1) revealed that infants presented with false labeling looked significantly longer to the human speaker (rather than the object labeled) than did infants who were presented with correct labeling statements, suggesting that infants were detecting false labels. In three subsequent studies they found that infants did not exhibit this pattern if the labels emanated from an audio speaker (not a person) or if the person saying the label was turned away from the objects and looking elsewhere. At the least, these data show that even for such young children, naming (and misnaming) is of interest for the case of an intentional speaker apparently labeling deliberately.

At the same time, from infant looking alone (e.g., looking to an attentive human labeler for misnamings, but looking to the object for correct namings), it is not clear that children did much more than simply notice a discrepancy between the name spoken and their own name for the object. A name–object discrepancy, given that it was delivered by an attentive, "pedagogical" adult (and not a recording machine or an adult not even looking at the object or child), in itself might have elicited looking to the speaker, with or without the child sensing the name was communicatively incorrect. Intriguingly, in a final analysis conducted across all their four studies, Koenig and Echols (2003) reported that some of these infants did at times verbally comment on the

objects and names. Of the 64 infants who heard correct namings (12 correct namings each in that between-subjects condition) across the four studies, 29 (45%) said a name themselves on at least one of their 12 trials, and all of these repeated the object name used by the adult—consistent with both what the infant saw and what they heard. For the 64 who heard misnamings, however, 33 (52%) produced at least one label on at least one of their 12 trials, and 31 of these "correctively labeled," stating the correct rather than false name for the focal object at least once. These suggestive corrections point to studies with slightly older children who can talk (and thus have the ability to say conversationally, in some fashion, that the name was wrong or to query the speaker about what they meant) in order to better reveal young children's emerging comprehension monitoring and management.

In Study 2, we used a seminaturalistic situation in the laboratory to examine young children's comprehension management reactions. We included children from 2 to 3+ years, both to fill in a gap in the literature (examining toddlers who are in between the infants and preschoolers studied in other research) and to clarify the initial verbal data provided by Koenig and Echols (albeit in our case with young toddlers rather than old infants). Primarily we focused on naming events—naming and misnaming.

To be clear, our focus is not language acquisition but social cognition: Understanding misnaming involves knowing not only that a word failed to label an object but that a person also failed to refer correctly to that object. Furthermore, to achieve increased clarity requires commenting on, questioning, or otherwise managing the misnaming. For comparison purposes (and to begin to extend the Revelle et al., 1985, data to younger children), we also included some carefully targeted adult requests for objects—straightforward requests and, focally, anomalous requests.

Method

Participants

Thirty-six normally developing children (17 male) ages 2–3.5 years old participated (M_{age} = 31 months, range = 25–41 months). Children came from a small midwestern university city and surrounding smaller towns where most families were middle class. By parental report, 32 children were Caucasian and 4 were African American, multiracial, Latino, or Asian. All children spoke English as their only language or fluently as one of two languages. By parental report, 17% of mothers were occupied caring for children and families at home, 47% were from families of professionals (doctors, lawyers, teachers, researchers), and 10% from blue-collar families.

Children and parents were contacted because they were on a potential participant list obtained initially from birth records at one of the area's two primary birthing hospitals. They agreed to come to a university laboratory for the study, where the parent received free parking and $10, regardless of if they then consented to have their child participate (100% of those that came to the laboratory consented to participation). The data were collected between May 2015 and January 2016.

Procedures

After consenting to participate at the laboratory, parents (mothers, with a rare father as an exception) received a vocabulary checklist to report their child's familiarity with different words. Then child and parent were brought to a small room where various toys and objects were arranged on two toddler-size tables. Parents were seated doing paperwork in the corner of the room to help ensure the child's comfort. Parents were told they could encourage their child to play with the toys but not to name any toys or objects specifically. Once the child engaged in play comfortably, the adult experimenter followed a script for the misnaming of some objects and correct naming of others, as well as several anomalous and straightforward requests. For namings and misnamings, the adult got the child's attention, pointed to or held an object and said "this is a X." For requests, she got the child's attention and said the request. Target items (named and misnamed, straightforward and anomalous) were mentioned using a neutral voice and a neutral expression. All children received the same target items, but in one of two different orders with the specific order for each child randomly assigned before the start of the session.

Besides the target items, the child and adult experimenter interacted with the various other objects and with each other in a natural-seeming adult–child play interaction. Sessions lasted approximately 10 min and were videotaped throughout. Except for the target items, the total amount of adult–child talk, and topics talked of, could vary per child depending on each child's interests, temperament, and so forth. Within these adult–child interactions, four examples of "misnaming" and

seven examples of correct naming were presented to the child more or less evenly spaced throughout the 10-min session with the aim of helping the session seem normal and not generally odd or peculiar. The objects for naming were a small ball, book, cup, doll, spoon, shoe, toy car, dog, cat, and frog. After each of the four target misnamings, and after giving the child time to spontaneously react and comment, the adult proceeded to ask "Is that right, is that (e.g.) a dog?" to potentially supplement the child's online reactions.

In the course of the interactions, the adult provided a modicum of ordinary requests and directives to the child (e.g., "you sit here," "look at this," "leave your shoes on," etc.). The child also received six (or sometimes five) scripted requests directed to an array of objects in the room. For example, "Bring me the car." Of these, four were anomalous requests, "Bring me the toma" (unknown object); "Bring me the *cough*" (inaudible); and two impossible items, "Bring me the towel" (which was surreptitiously tacked to the table) and "Bring me the clock" (which was attached to the wall above the child's reach). Straightforward request objects were a car and a book, readily available among the toys on one of the two tables.

Table 2
Categories for Coding Children's Responses in Study 2

Response category	Examples
Child response to a misname	
1. Corrective	Says "That's not a _____. That's a ____."
2. Disagree	Says "No."
3. Agree	Says "Yes," "Dog" (repeating adult label)
4. What/ask	Says "What?" or "Huh?"
5. Nothing/ignore	Does not acknowledge name
Child response to a correct name	
1. Agree	Says, for example, "Yes," "Frog," "Ribbit Ribbit"
2. Disagree	Says "No."
3. Corrective	Says "That's not a _____. That's a ____."
4. What/ask	Says "What?" or "Huh?"
5. Nothing/ignore	Does not acknowledge name
Child response to an anomalous request	
1. Unable	Expresses inability: "High" or "It's stuck"
2. Noncomply	Says "no" to request
3. Alternative	Brings other object
4. Asking/what	Says "What?" "This?" "Dog?"
5. Nothing/ignore	Does not acknowledge request
Child response to a normal request	
1. Comply	Brings object
2. Noncomply	Says "no" to request
3. Alternative	Brings other object
4. Asking/what	Says "What?" "This?" "Dog?"
5. Nothing/ignore	Does not acknowledge request

Measures

The sessions were coded from the videos separately by the adult experimenter and a research assistant. Interrater reliability, established on approximately half the subjects, was 90.6%. Once interrater reliability was established, the two coders each coded essentially half of the remaining videos separately.

Misnaming. The child's responses to each of the experimenter's misnaming and correct-naming statements were coded based on the global coding system outlined in Table 2. As one example, for the misnaming condition, for a child's response to be coded as a "corrective," the child had to correct the adult and provide the appropriate name for the misnamed object or give the experimenter the correct object, which would be located on the tables with toys. Thus, an illustrative "corrective" response would be if the child said, "Not a dog. It's a frog" when the experimenter pointed to and misnamed the frog as a "dog" or if the child brought the experimenter the toy dog.

Table 2 also outlines the coded responses for correct names. Focally, for example, a child's response would be coded as "agree" if the adult correctly says "That's a spoon" when holding a spoon, and the child responded "yes" or repeated the name, such as saying "spoon." In principle, just as in misnaming a child could disagree or provide a corrective for correct namings too. Or they could agree with a misnaming (e.g., repeating or saying yes to a misname) just as for a correct naming.

For the purpose of analysis, we termed "corrective," "disagree," and "what/ask?" responses for the misname condition as "appropriate to misnaming" responses, responses that indicated the child detected the misname and thus was monitoring his or her comprehension. For comparison, we tallied the same three responses—corrective, disagree, and what/ask?—as "appropriate to misnaming" responses for the correct names too, although they were of course not appropriate for a correct name. Thus, we compared these same two categories of responses (those composing "appropriate for misnaming") across the two conditions.

Anomalous requests. Table 2 also displays the coding categories utilized for the requests. In order to be conservative, for the anomalous requests, only responses of either "unable" or "asking" were considered "appropriate to anomalous requests" for our analyses. For comparison, these same responses

were scored as "appropriate to anomalous requests" for the control, comparison items as well.

Results

Misnaming

Figure 1 outlines the focal data. For the misnamed target objects, 118 (83%) of 143 of the children's responses were either "corrective," "disagree," or "what/ask?"; that is, they appropriately detected and commented on the misnaming. Of course, children might, for whatever reasons, provide many of the same sorts of reactions to ordinary correctly named objects. For the correctly named control items, however, only 15 (6%) of 242 items received the response appropriate for a misnamed object. Instead of correcting or denying the correctly named objects, children agreed with the name, repeated the name the adult provided, or often (138, or 57% of the time) did nothing but continued with the play interaction.

Statistical tests of these data were straightforward. A *t* test comparing "appropriate to misnaming" reactions for the misnamed versus correctly named target objects was $t(35) = 17.96$, $p < .0001$, $d = 3.98$, 95% CIs [.68, .85]. Nonparametrically, all 36 children provided at least one reaction appropriate to the misnamed items. In contrast, only seven children ever did so for the correctly named items (four children doing so on only one of the seven correctly named objects). This contrast was significant, $\chi^2(1) = 27.03$, $p < .0001$. Age made little difference to this appropriate responding: The older half of our children responded appropriately to 90% of the misnamed items and the younger half responded appropriately to 75%.

After each naming item, children were asked, "Is that right; is it an X?" Often children did not respond to the question, but 63.6% of the time for misnamed items children asserted it was not. This occurred on only 8.3% of correct namings, $t(35) = 7.90$, $p < .0001$. Moreover, for correctly named items, 46.7% of the time children asserted that "yes" what the adult said was right. This occurred only 1.3% of the time for misnamings.

The "appropriate to misnaming" data in Figure 1 include essentially children's spontaneous "correctives," "disagrees," or "whats?" in 3–4 s after the misnaming (or correct naming) occurred. A few

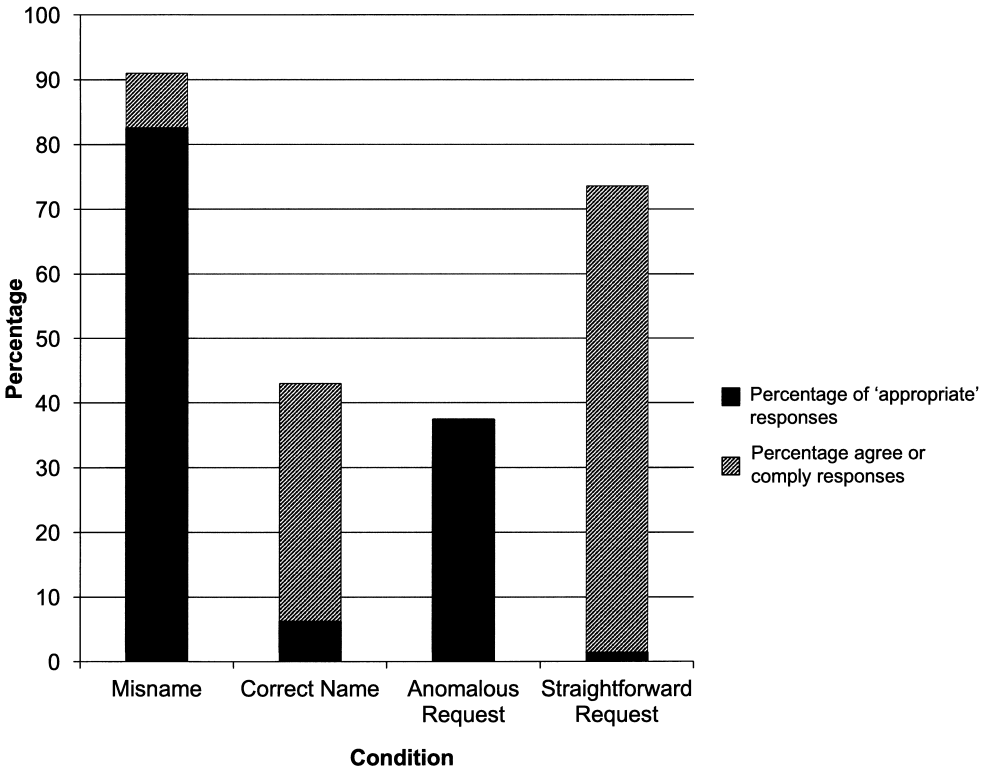

Figure 1. Percentage of child responses to correct versus misnaming utterances, and to straightforward versus anomalous requests. "Appropriate" responses mean responses appropriate to *misnamings* for the two naming conditions, and mean responses appropriate to *anomalous requests* for the request conditions, as detailed in the text.

children who did nothing in that interval but said "no" to the "Is that right?" question that then followed were also included as disagreeing and thus they were credited as responding "appropriate to misnaming." Nine children's disagrees were of this form for one or two of their four misnaming trials, and one child's only disagrees came in response to that question (on 3 of his 4 misnamed items). These inclusions had only a minor effect on the data. When those responses are removed, then the "appropriate to misnaming" data shown in Figure 1, declines from 83% to 75%. A *t* test comparing "appropriate to misnaming" reactions for the misnamed versus correctly named target objects remains highly significant, $t(35) = 13.55$, $p < .0001$, $d = 3.03$, 95% CIs [.58, .79]. With this rescoring, 35 of 36 children provided at least one reaction appropriate to the misnamed items. In contrast, only seven children ever did so for the correctly named items, $\chi^2(1) = 26.04$, $p < .0001$.

In addition to verbal responses—"correctives," "disagrees," and "whats?"—children could respond to the misnaming event with gestures or actions that would be appropriate. Here we coded from the videotapes two actions that seemed particularly appropriate and were easy to code when definitely exhibited: shaking the head "no" to disagree with the misnaming ("shakes head") and "looks around" (as if to search for the labeled object instead of the one actually referred to). Of the 118 responses tallied as appropriate to misnaming for the misnamed items (as shown in Figure 1), there were 19 that included these definite gestures (16.1% of those 118); 12 were "shakes head" and 7 were "looks around." Only four such responses (all "looks around") were given without some accompanying "appropriate to misnaming" verbalization. In short, at this age, the vast majority of children's appropriate responding was verbal (83%) or included a verbal comment (96.6%).

We chose objects to name for which other research (e.g., research with the McArthur Communicative Development Inventory) has shown that children know the names. But we also asked parents to report for their child on a parent checklist. As expected, parents reported that their children knew the names of the items 96.9% of the time.

Anomalous Requests

For the anomalous requests, 54 (38%) of the 144 responses were either "unable" or "asking," that is, "appropriate to anomalous requests." In contrast, for the straightforward requests, most children (40 of the 55 requests) brought the object and only one said "no" (noncomply in Table 2) with that response conservatively plotted as "appropriate to anomalous request" in Figure 1. A paired samples *t* test of these request data yielded, $t(35) = 6.27$, $p < .0001$, $d = 1.55$, 95% CIs [.24, .48]. Additionally, for 28 (19.4%) of the anomalous requests children brought an alternative object to the one requested, this occurred only once for straightforward requests.

Two anomalous request items were specially constructed to be able to address suspicions like that of Markman (1981) that young children process requests simply by attempting to fulfill them and only comment if they are unable (engaging in action monitoring instead of comprehension monitoring). This cannot account for 3- and 4-year-olds responses in Revelle et al. (1985) but potentially could account for the responses of the younger children examined in Study 2. For the towel request (where the towel was surreptitiously tacked to the table), children could only appropriately comment on their inability (and thus the anomalousness of the request) after trying to bring it. For the clock item (where the clock was high on the wall), however, children could monitor and comment ahead of any attempt to retrieve it. Thus, for these items we closely examined the timing of children's comments and actions: 17 children commented by questioning the request ("e.g., clock?") or verbally refusing ("no") *before* trying (pantomiming trying) to reach the clock; only 6 questioned or verbally refused the request to bring the towel before attempting to bring it and finding it could not be moved: binomial test, $z = 3.04$, $p < .003$. In other words, on average, these young children were monitoring their comprehension (not simply reacting to failed actions) for the clock requests, and presumably for others as well.

Discussion

These results straightforwardly demonstrate that children as young as 2 years have an understanding of the appropriate naming of objects and, more focally, monitor the speech of others to detect and correct misnamings. As demonstrated in the high percentage (83%, see Figure 1) of "corrective," "disagree," and "what?" responses for misnaming, the children freely expressed that they understood a speaker had misnamed an object. Note that children were not just responding indiscriminately, because despite equal opportunities to do so children rarely "corrected" or "disagreed" when they received a

correct name. In total, very young children have begun to monitor and manage their comprehension in the case of naming of common objects.

A priori it could be argued that children's comprehension monitoring abilities might be first developed and revealed in their reaction to misnaming, because young children are so busy learning names for objects. However, we provide evidence that they monitor and manage their comprehension for simple requests as well. Using reactions methods similar to ours with still younger children might show an advantage for naming over requesting, but might not. Some have argued that with regard to children's own productions, protoimperative points precede pro-to-declarative ones. But this is contentious, and regardless there is no good reason to suspect that such production data would parallel comprehension data in this realm. Figure 1 might give the impression that children are more likely to spot misnamings than anomalous requests, but a convincing argument to that effect is not possible given our data because of the many differences in the utterances themselves and the response demands for children in reacting appropriately as we have defined such reactions. What can be said confidently, given the variety of objects, names, and requests we used, as well as the variety of reactions we coded, is that very young children monitor and manage their comprehension in an impressive variety of conversational ways.

Our method in this study was importantly quasi-experimental—using carefully created experimental contrasts—but also naturalistic in that these contrasts were embedded within natural situations that provoke everyday reactions. Experimental methods, such as those for examining understanding in adults and older children, also carefully contrast several conditions but typically measure cognitive preferences by directly asking for explicit evaluations using ratings or forced-choice tasks (e.g., a passage rated as "good" or "bad," or an explanation rated for "simplicity"). Whereas preschool and elementary school children can be tested with such methods, very young children fail to validly employ such explicit evaluations and ratings. In our own data, when children were explicitly asked if what the adult had said was right (e.g., "that's a dog"), children asserted it was correct for only 47% of the correctly named items. Appropriately, this was significantly more than they ever asserted a false name was correct (which occurred only 1% of the time) but nonetheless shows how often young children can fail to respond to even such straightforward requests for an explicit judgment. At the same time, children's reactive responding was clearly more explicitly informative than the simple eye gaze measures used with infants. Other examples of what we have termed reaction methods used with very young children (to address other questions) include those by Kemler Nelson, Egan, and Holt (2004); Meltzoff, Waismeyer, and Gopnik (2012); and Grosse, Behne, Carpenter, and Tomasello (2010).

General Discussion

Using naturalistic (Study 1) and controlled quasi-naturalistic (Study 2) methods, we demonstrate that very young children who have just attained their second birthdays detect communicative breakdowns of understanding and attempt to correct them. These data establish a very early emergence of abilities and proclivities to actively monitor and manage one's comprehension, and Study 2 establishes a method for measuring those abilities in very young children.

Recall the two general accounts of early social-cognitive developments outlined in the Introduction: (a) Very young children automatically utilize social signals, like direct eye contact and contingent, referential interactions, to accept the information they receive from an informant because those provide innate cues pointing to pedagogical intent (Csibra & Gergely, 2009). (b) Alternatively, however, young children are appropriately discriminative at least by the ages studied via "trust in testimony" paradigms (Harris, 2012). The second position, but not the first, presumes young children engage in active comprehension monitoring and management of speakers' messages. Our findings support the second overall account and do so by bridging the gap in ages manifest across most earlier studies, where the natural pedagogy studies typically research infants and the "trust" studies typically research 3-, 4-, and 5-year-olds.

Establishing the early emergence of abilities and proclivities to actively monitor and manage one's comprehension is an important step, but the details of that early emergence and its importance in children's further cognitive growth remain to be explored. For example, what about still younger children, infants? Consider further the Koenig and Echols (2003) research with 16-month-olds, where they post hoc examined children's spontaneous comments. Although overall children were as likely to say a name in the true naming and false naming

conditions (45% and 52% of infants did so at least once across the 12 namings they heard), in their Study 1 where children saw a live adult look at and label (or mislabel) the objects, 15 of 16 children's spontaneously correctly named the object (again at least once over 12 trials). Although these data are notably sparser, and corrective naming much less frequent than in ours, their methods were also arguably less naturalistic and less child friendly than our free play-based method. In this way, their data suggest that our methods could be extended to still younger children to good effect. Doing so might help reveal the earliest emergence of such comprehension monitoring and management.

Relatedly, we unexpectedly found no strong evidence of developmental change within toddlerhood. Both the youngest children and those a year and a half older routinely monitored and managed their understanding in these social-communicative situations. Given the impressive performance of children only 24 months of age, this too suggests that future research could potentially use our methods with still younger children.

Additionally, it now seems timely to ask: How frequently and widely do very young children monitor and attempt to manage their comprehension of the communicative information that surrounds them? In advance of further research, we suspect that young children do so in a wider set of circumstances for a wider variety of miscommunications than we deployed. One prior study that used a reaction method and provides data on children's spontaneous corrections of false namings sheds light on this issue.

In a complex study designed to examine children's use of negation, Pea (1982) presented children numerous sentences that included true and false namings. Half of these were namings of the sort we used, but half were hybrid naming plus requests (e.g., "show me the ball" while the experimenter pointed directly to a car). In Pea's test situation, the adult and child sat across from each other at a table and the adult pointed and then labeled 48 items one by one. Given the testing situation and total number of sentences, children often failed to respond at all; indeed, 18-month-olds failed to respond on 54% of their sentences, making their data essentially uninterpretable. Thirty children aged 24–40 months, however, responded in some form or another on 84% of their trials, and they provided an explicit negation (e.g. "no" or more complexly "that's not a ball") on 49% of their misnamed items. In contrast, they provided an explicit negation on only 5% of the correct-naming items they received. Clearly, Pea's situation was more demanding and less child friendly than ours, and his measure of verbal negation narrower than our measure of explicit disagreement. Thus, as shown in Figure 1, our young children appropriately responded to misnamings on more than 80% of their trials. Nonetheless, if construed as indicating comprehension monitoring (rather than just logical negation), his data also show that very young children are monitoring and managing their comprehension. Indeed, they do so in his case even when the circumstances are relatively more challenging and less engaging than in ours.

Findings from somewhat older children's "trust in testimony" (e.g., Harris, 2012) show that young children are monitoring and reacting to the accuracy of speakers in several additional fashions. In particular, 3- and 4-year-old children track speakers who have been consistently accurate or consistently inaccurate for several prior namings and then differentially learn new names from the former not the latter. These data show that by the time they are preschoolers, children not only monitor and manage their own comprehension, but they also use that monitoring to manage further learning. Only a few recent studies have begun to assess if speaker accuracy influences the word learning of still younger children, infants and toddlers (Brooker & Poulin-Dubois, 2013; Koenig & Woodward, 2010; Krogh-Jespersen & Echols, 2012). Koenig and Woodward's (2010) series of three studies exemplify what has been found. In that research, 24-month-olds interacted with either an adult who first labeled three common objects accurately or instead inaccurately. Then that speaker trained and tested children's learning of a new word–object link. The training and test involved both provision of a word for a novel object ("first label") or a new label for a familiar object ("second label," because the child already knew one name for the object). These young children learned novel object names ("first label") equally from both accurate and inaccurate speakers (learning the label for the novel object about 70%–80% of the time in both cases). However, they often attenuated their learning of "second labels" from speakers who were inaccurate on the earlier common object names. They still learned those new "second labels" from the inaccurate labelers (50%–60% of the time), but this was typically less than the percentage of time they learned "second labels" from the accurate labelers. (However, this first versus second label difference does

not appear in some other studies with infants see Brooker & Poulin-Dubois, 2013.)

Future studies would do well to examine additional factors that could illuminate the development of comprehension monitoring across early childhood and beyond. Gesture could potentially be one such factor. The fact that gesture does not add anything to children's monitoring of comprehension in our data is interesting. It might be a more important factor for still younger children, however, whose verbal competences are still more limited than those of 2-year-olds. Such a trend would help illuminate the contribution of increasing language skill—which develops notably in the preschool years—to the development of early comprehension monitoring and management. Perhaps one developmental trend would be a diminution of the use of gesture in situations presenting comprehension anomalies. At the same time, however, gesture is known to provide an indicator of comprehension struggles in still older children as well as provide a mechanism for developmental change (see the work of Goldin-Meadow, 2015).

Executive functioning is another factor that itself develops and given its extended developmental trajectory could contribute to the development of comprehension management skills in early development and beyond. With regard to early development specifically, between the ages of 3 and 5 years, children show dramatic improvement in the use of executive control to achieve cognitive, emotional, and action goals (Diamond, 2013). Executive functioning often involves overriding a dominant response tendency, and it is plausible that detecting inconsistencies between what is known and what someone else says requires just this; that is, active comprehension monitoring (as opposed to automatic responding to pedagogical cues) seems to require one to inhibit a default tendency to accept information as true and coherent. Intriguingly, children with lower levels of inhibitory control have difficulty ignoring misleading testimony (Jaswal et al., 2014). Recent research by Doebel, Rowell, and Koenig (2016) shows that detecting simple logical inconsistencies in speakers' statements (e.g., "I saw a ball today that was the biggest ball ever; it was the smallest ball ever") improved from 3 to 5 years. Moreover, executive function (plus working memory) predicted inconsistency detection. By hypothesis, executive functions could help shape and predict further developments in comprehension monitoring as well, and our results set the stage for such future research.

Much remains to be known about how young children track the accuracy of speakers over time and how that may influence their learning. Given our findings, several questions are now ripe for systematic investigation. These include, at the least, (a) when and in what circumstances very young children's comprehension monitoring originates, (b) whether and when very young children's comprehension monitoring is deployed in the service of actively managing learning, (c) how early comprehension monitoring expands and develops, and (d) what factors predict and shape its early origins plus its extended development.

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