Cognition 175 (2018) 69–76

Contents lists available at ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/cognit

Original Articles

Infants' understanding of the definite/indefinite article in a third-party communicative situation

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ARTICLE INFO

Keywords:
Infant cognition
Perspective-taking
Language comprehension
Social interactions

ABSTRACT

The present study examines how infants use their emergent perspective-taking and language comprehension abilities to make sense of interactions between two human agents. In the study, one agent (Agent1) could see only one of two identical balls on an apparatus because of a screen obstructing her view while the infant and another agent (Agent2) could see both balls. 19-month-old English-learning monolingual infants seemed to expect Agent2 to grasp the ball visible to Agent1 when she said to Agent2 "Give me *the* ball" but not when she said "Give me *a* ball." 14-month-olds appeared to accept that Agent2 could grasp either ball when Agent1 said "Give me *the* ball." Therefore, by 19 months of age, English-learning infants seem to attend to the specific linguistic units used, e.g., the definite article, to identify the referent of others' speech. Possible reasons in connection with language acquisition processes and/or environmental factors for the two age groups' respective failures with the definite and the indefinite articles are discussed.

1. Introduction

When we interact with other people, we use a coherent construct of mental states, including intentions, perceptions, and beliefs, to make sense of each other's behavior. Speech is also a very important, if not ubiquitous, part of social interactions. What we say conveys a great deal of information to our interaction partner, e.g., signals to him or her what we want. In cases in which speech is ambiguous (e.g., there are two potential choices when the speaker's verbal request is unclear), we also use our understanding of others' informational (or epistemic) states and perceptual experiences to determine the referent of the speech (e.g., Clark & Marshall, 1981; Sperber et al., 2011), although not always effectively (e.g., Keysar, Barr, Balin, & Brauner, 2000). Recent developmental research has discovered that even infants possess theory-of-mind understanding and also use it to make sense of social interactions when speech is involved. We review some of the evidence below.

There has been many reports suggesting that the understanding about others' mental states as causes for their behavior originates in infancy (for reviews, see Baillargeon, Scott, & Bian, 2016; Baillargeon et al., 2015). Particularly, infants seem to possess rudimentary perspective-taking skills, for example, they seem to recognize that others' perceptions can be different from their own.[1] For the purpose of the present research, we focus on situations in which others' visual perceptions are less complete than infants' own. Infants seem to consider others' incomplete perceptions when making sense of their intentional actions (for a review, see Luo & Baillargeon, 2010).

Numerous studies show that infants attribute to agents (i.e., entities that can perceive their environment and exert control over their actions, e.g., Luo & Choi, 2013) goals and dispositions (e.g., preferences) to predict and interpret their actions (e.g., Bíró & Leslie, 2007; Gergely, Nádasdy, Csibra, & Bíró, 1995; Hamlin, Ullman, Tenenbaum, Goodman, & Baker, 2013; Hernik & Southgate, 2012; Kuhlmeier, Wynn, & Bloom, 2003; Luo & Baillargeon, 2005; Luo & Beck, 2010; Luo, Hennefield, Mou, vanMarle, & Markson, 2017; Sommerville & Woodward, 2005; Song, Baillargeon, & Fisher, 2005; Woodward, 1998). In a study modeled after Woodward (1998), for example, Luo and Baillargeon (2005) found that 5-month-olds seemed to attribute to a nonhuman agent, a self-propelled box, a preference for object-A over object-B if the box

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[1] If we assume the connections between perceptions and knowledge, that is, seeing leads to knowing, not seeing leads to not knowing and in some cases holding outdated or wrong information, then infants' recognizing others' different perceptions suggests that they may also accept that other people can have perceptions or beliefs (or informational states) that are outdated or false. Recent data, although still controversial (e.g., Heyes, 2014), suggest that infants understand others' false perceptions (e.g., Song & Baillargeon, 2008) and false beliefs (for a review, see Baillargeon, Scott, & He, 2010). In fact, we argue that perspective-taking skills are central to the theory-of-mind understanding about others: we can "put ourselves in others' shoes" and realize that others' mental states such as goals, intentions, emotions, perceptions, and beliefs, can be different from our own.

https://doi.org/10.1016/j.cognition.2018.02.006
Received 20 September 2016; Received in revised form 17 January 2018; Accepted 6 February 2018

repeatedly approached and contacted A but not B. They expected the box agent to continue acting on this preference and responded with heightened interest when the agent changed its "mind" to approach object-B. In addition, if object-B was absent when the agent contacted object-A, infants seemed to realize that the agent did not have a preference. They no longer responded with heightened interest when the box agent contacted B after it was introduced. These results have been extended to younger, 3-month-old infants (Luo, 2011).

Infants also seem to take the agent's "perspectives" when interpreting the agent's actions in terms of goals and preferences. In various studies, Choi, Luo, and colleagues created situations in which one of the two options, e.g., object-B, was hidden from the agent, but not from the infant, while the agent approached object-A (e.g., Choi, Luo, & Baillargeon, 2017; Choi, Mou, & Luo, 2017; Luo & Baillargeon, 2007; Luo & Johnson, 2009). For example, object-B was behind a large screen or behind the agent's back and thus invisible to the agent (Luo & Baillargeon, 2007; Luo & Johnson, 2009). Infants aged 3–12.5 months seemed to view the situations from the agent's point of view; the agent could only see object-A and hence the situation was essentially a one-object condition to her in that A was the only option available. Although the agent approached object-A but not B, infants did not appear to interpret such actions as indicative of a preference, a response different than those from situations in which the agent performed the same actions with both objects A and B visible.

In the studies reviewed above, there is only one agent involved, human or nonhuman. The human agent either does not talk to the infant at all (Luo & Baillargeon, 2007) or talks simply to get the infant's attention (Woodward, 2003) or to indicate her goal object (Phillips & Wellman, 2005; Song, Baillargeon, & Fisher, 2014). Recently, an interesting line of research has found that infants also seem to understand that speech can convey information about agents' intentions, e.g., goals or preferences, in interactions between two agents (Martin, Onishi, & Vouloumanos, 2012; Vouloumanos, Martin, & Onishi, 2014; Vouloumanos, Onishi, & Pogue, 2012). For example, 12-month-olds (Martin et al., 2012) first watched an experimenter (E1) demonstrate her preference between two toys by grasping toy-A but not toy-B three times. During the test trial, the toys became out of the experimenter's reach. She thus turned to her interaction partner (E2), who did not witness her previous choices between toy-A and toy-B, and uttered a pseudo-word "koba." E2 then reached for one of the two toys. Infants looked reliably longer when E2 reached for toy-B than when she reached for toy-A, E1's preferred toy. These positive results were not found when E1 simply coughed, said "ooh," or did not say anything to E2. Together, these and control results suggest that infants realize that E1's speech, but not non-speech vocalization, could signal to E2 what she wanted between the two options, even before they grasped the meaning of the word used by E1. Such results have been extended to younger, 6-month-old infants (Vouloumanos et al., 2014).

Therefore, by the end of the first year of life, infants appear to recognize that others do not always see what they can see, and that speech is indicative of others' intent. In Martin et al. (2012), the research question explored infants' understanding of the communicative function of speech and hence the speaker and the infant held the *same* perceptions of the scene. There has also been ample evidence from action tasks suggesting that when the speaker's perceptual experiences are *different* from the infant's own, infants use their perspective-taking skills to identify what the agent's speech refers to. In one line of research (e.g., Moll, Carpenter, & Tomasello, 2007; Moll & Tomasello, 2007; Tomasello & Haberl, 2003), the referent of the agent's speech remains visible to infants (for similar results with the agent *pointing* to indicate her target, see e.g., Liebal, Behne, Carpenter, & Tomasello, 2009). For example, 14-month-olds first played with two objects with one agent, agent-A. They then played with a third object with another agent, agent-B, when agent-A was absent. Next, agent-B put all three objects in a tray. When agent-A returned, looked at the tray, and requested "Oh, look! Look there! Look at that there! Give it to me, please!" (Moll & Tomasello, 2007, p. 312), infants chose the third object for her, suggesting that they tracked which objects agent-A had and had not seen before and knew what she was asking for.

In another line of research, the referent of the agent's speech is even hidden from view (Ganea & Saylor, 2007; Saylor & Ganea, 2007; Saylor, Ganea, & Vázquez, 2011). For example, 14-month-olds (Saylor & Ganea, 2007) played with agent-A with a red ball for one minute during which the agent claimed it was her ball and mentioned "ball" for the total of seven times. Agent-A then put it in a yellow bucket. The same sequence was repeated with agent-B and her ball, a blue one. During test, one of the agents sat in front of the two buckets and asked "Where is *the* ball?" Infants were able to choose the red ball for agent-A but the blue one for agent-B (counterbalanced). These and control results suggest that infants can keep track of others' experiences to determine the absent referent of their speech. Interestingly, slightly younger, 13-month-old infants failed in similar tasks unless the agent asked, "Where is *my* ball?" (Saylor et al., 2011). This comparison hints at the role specific units of speech play in how infants identify the referent of others' speech.

1.1. The present research

In summary, at least at the beginning of the second year, infants can use both their language comprehension and perspective-taking skills to make sense of social interactions. On the basis of these findings, the present research aimed to examine how refined infants' language comprehension skills could be by introducing into an agent's speech the distinction between the definite article (*the*) and the indefinite article (*a*) in English. In addition, in the studies reviewed above, the two or three objects among which infants have to find the referent of the agent's speech have different features, at least in color. In the present task, the two options to choose from were identical. Specifically, one human agent (Agent1) could only see one of two identical balls on an apparatus because of a large screen obstructing her view while another agent (Agent2) and the infant could see both balls. Agent1 said to Agent2 twice "Give me *the* ball" or "Give me *a* ball." Given that the definite article usually denotes an object that the speaker and the listener both know about (e.g., Ariel, 1988; Chafe, 1976; Gundel, Hedberg, & Zacharski, 1993; Onishi & Murphy, 2002; Schmerse, Lieven, & Tomasello, 2015), Agent1 should be referring to the ball visible to her when she used "*the*" but not "*a*." To succeed, infants not only had to consider the agent's less complete perceptions from their own, they also had to rely on the article the agent used in her speech to make appropriate predictions.

Previous research suggests that English-learning toddlers have some understanding about articles (e.g., Petretic & Tweney, 1977; Shipley, Smith, & Gleitman, 1969). For example, two-year-olds were sensitive to the presence of the definite article "*the*" in a sentence. They performed the best when told to "Find *the* bird" in a picture book than when they heard "Find bird," "Find *was* bird," or "Find *gub* bird" (e.g., Gerken & McIntosh, 1993). Also, 17- to 24-month-olds have been found to respond differently to a novel noun with or without an article in front of it (e.g., Gelman & Taylor, 1984; Katz, Baker, & Macnamara, 1974). If hearing "This is Zav" or "This is *a* zav," 17-month-olds considered "zav" a proper name in the first case but a common noun in the second case (Katz et al., 1974).

Although children are sensitive to the absence or presence of "*the*" and "*a*" in noun phrases, their production and comprehension of these articles are not yet precise. Between 2 and 5.5 years of age, while children correctly use "*the*" to refer to entities already mentioned in discourse, they use both "*a*" and "*the*" to refer to a newly introduced entity (Karmiloff-Smith, 1981; Maratsos, 1974; Rozendaal & Baker, 2008; Schaeffer & Matthewson, 2005; Schafer & De Villiers, 2000; Wexler, 2011). In comprehension tasks, children correctly understand the determinedness of "*the*" but remain uncertain about "*a*." They seem to accept that it can refer to new as well as old entities in discourse (Van

Hout, Harrigan, & de Villiers, 2009, 2010). For instance, if being told "Stacey has an orange sweater. She knows that orange is John's favorite color, so she lets him wear the orange sweater!" (p. 1985) children, 3.5- to 5-year-olds, correctly picked the *same* item as the one already mentioned 87% of the time in a picture depicting the story. By contrast, after being told "John sees his teacher with a piece of cake. He asks her if he can have a piece of cake," (p. 1985) children chose an item *different* from the one already mentioned (the teacher's cake) only 41% of the time (Van Hout et al., 2010). Consistent with these findings, a recent study with German monolingual children (Schmerse et al., 2015) found that 3-year-olds successfully picked the one object they had used with an experimenter (e.g., a pan in washing up) out of three similar objects from the same category (e.g., three pans differing in size), when the experimenter said "She (a puppet) wants an egg! I have to go and get one, but we also need *the* pan. Can you go and get *the* pan?" (p. 7). They also correctly picked any of the three pans when "*a*" was used, presumably because there was no item singled out in the same fashion (i.e., the teacher has already got *a* piece of cake) as in Van Hout et al. (2010).

In these tasks with preschoolers, the child has to infer in discourse why the speaker uses the definite or indefinite noun phrases. Children correctly understand that the speaker picks the definite noun phrase for a unique referent, but because of their "pragmatic immaturity" (p. 1989; Van Hout et al., 2010), they have difficulty grasping the reasons behind the speaker's choice of "*a*," that is, since she did not use "*the*," she must have meant any of the items. In the present task, the speaker Agent1 only uttered the same sentence twice to Agent2 "Give me *the/a* ball." Hence, there was no need to track the use of articles in more than one sentences, as in Van Hout et al. (2010). In addition, similar to previous studies (e.g., Luo & Baillargeon, 2007; Martin et al., 2012), we used a looking-time task in which infants watched Agent2 grasp either of the two balls after Agent1's request, instead of them having to choose a ball for Agent1, as in Schmerse et al. (2015). This is because in the past several decades, studies using the looking-time method have yielded numerous reports on infants' understanding of physical objects and events as well as their theory-of-mind understanding about agents (for reviews, see e.g., Baillargeon, Li, Gertner, & Wu, 2011; Baillargeon et al., 2015), demonstrating infants' cognitive competencies earlier than those from tasks in which infants or young children are required to act on objects or answer questions. Therefore, we believed that success could be found before preschool years in the present task and chose an age group in the late second year of life, 19-month-olds.

Based on the findings described above (e.g., Schmerse et al., 2015; Van Hout et al., 2010), we expected that 19-month-old English-learning monolingual infants would predict that "*the*" ball referred to the ball Agent1 could see and that they would hold no clear predictions about the referent of "*a*" ball. A younger age group, 14-month-olds, was included to provide age comparisons. In an action task similar to the present study (Liberman, Woodward, Keysar, & Kinzler, 2017), 14- to 17-month-old infants who were only exposed to English failed to give a speaker the toy she could see, out of two identical ones, when she said "Ooh, *a* X! I see *the* X! Can you give me *the* X?" (pp. 5–6). Similarly, we expected that the 14-month-old monolingual infants in the present task should fail to understand that Agent1 wanted the ball she could see when she said to Agent2 "Give me *the* ball."

2. Experiment

In the experiment, 19-month-old English-learning monolingual infants were randomly assigned to one of two conditions, a definite-article or an indefinite-article condition (see Fig. 1). In addition, 14-month-old English-learning monolingual infants were tested in the definite-article condition only. Infants in all three conditions first received a familiarization trial in which they watched a static scene with two identical tennis balls on the apparatus and a large screen behind one of the balls. During the test trials, two agents were present. One agent (Agent1), a native English speaker, sat across the apparatus from the infant and the other agent (Agent2) sat by the right side window of the apparatus. Both the infant and Agent2 could see the two balls while the screen hid one of them from Agent1. In the definite-article condition, Agent1 looked at Agent2 and said, "Give me *the* ball" twice. In the indefinite-article condition, Agent1 said to Agent2 "Give me *a* ball" twice. Agent2 then reached for and grasped the ball in front of the screen and thus hidden from Agent1 (hidden-ball event) or the ball visible to her (visible-ball event).

In the definite-article condition, if 19-month-old infants understood that Agent1 was referring to the ball visible to her when she spoke to Agent2, then they should expect Agent2 to reach for it and hence respond with heightened interest when Agent2 grasped the ball hidden from Agent1 instead. Infants should thus look reliably longer at the hidden-ball than at the visible-ball event during the test trials. By contrast, we reasoned that unlike 19-month-olds, younger, 14-month-old infants should not yet be sensitive to the function of the definite article in English, as in Liberman et al. (2017). They should therefore not differentiate between the hidden-ball and visible-ball events. On the other hand, 19-month-old infants might have no prediction about which ball the indefinite noun phrase "*a* ball" specified. They might therefore accept that Agent2 could reach for either of the two balls and look similar amounts of time at the two test events.

2.1. Method

2.1.1. Participants

Participants were 48 monolingual English-speaking infants, 21 male and 27 female, at two different ages: thirty-two 19-month-olds (range: 17 months, 28 days to 20 months, 0 day; M = 18 months, 28 days) and sixteen 14-month-olds (range: 13 months, 21 days to 14 months, 27 days; M = 14 months, 13 days). Sixteen older infants, 8 male, were randomly assigned to the definite-article condition (M = 18 months, 27 days), and the rest to the indefinite-article condition, 5 male (M = 18 months, 28 days). The 14-month-old infants only participated in the definite-article condition. Another 28 infants were tested but excluded because of differences in test looking times more than 2 *SD*s from the mean of the condition[2] (n = 8; 4 in the indefinite-article condition) (e.g., Luo et al., 2017; Luo, Kaufman, & Baillargeon, 2009), parental interference (n = 7; 3 in the indefinite-article condition), being exposed regularly to a language other than English based on parental input (n = 5; 2 in the indefinite-article condition), maximum looking times allowed (60 s) in both test trials (n = 3; 2 in the indefinite-article condition) (e.g., Choi & Luo, 2015; Scott & Baillargeon, 2013), observer errors (n = 3), fussiness (n = 1), or the infant getting onto the apparatus to touch one ball and Agent2's hand during one of the test trials (n = 1).[3] These exclusion criteria were consistent with common

[2] When detecting outliers, we first get the group of infants and treat the large difference numbers as "suspects." After calculating the mean and *SD* of the remaining infants' numbers, if the suspect remains outside the 2 *SD*s range, it is an outlier and will be replaced; if not, it is put back into the group. Each "suspect" and replacement is checked systematically as such.

[3] Two factors contributed to the relatively large number of infants who were tested but excluded. The first had to do with the number of infants regularly exposed to more than English based on parental reports. The second had to do with the number of parents who interfered, for example, by talking to their infant during the experiment. One possible reason was the following. For 59 of the 76 infants tested, we administered an action task after the looking-time task in which Agent1 said to the infant "Give me *a/the* ball" without Agent2 present (This was a less than optimal design since it was unclear how the looking-time task might have affected infants' performance in the action task. Therefore, the action task results are not included in the main results). The parent was told to close their eyes during the action task but repeat after Agent1 to encourage their infant to act, e.g., by reaching for a ball. Several parents thus got confused and also repeated after Agent1 during the looking-time task. The ratio of the infants excluded for other reasons to those included (16:48) was similar to that of previous studies measuring visual attention of infants at comparable ages (9:28, 12:36, or 23:32; Senju, Southgate, Snape, Leonard, & Csibra, 2011; Sodian, Thoermer, & Metz, 2007; Song, Onishi, Baillargeon, & Fisher, 2008).

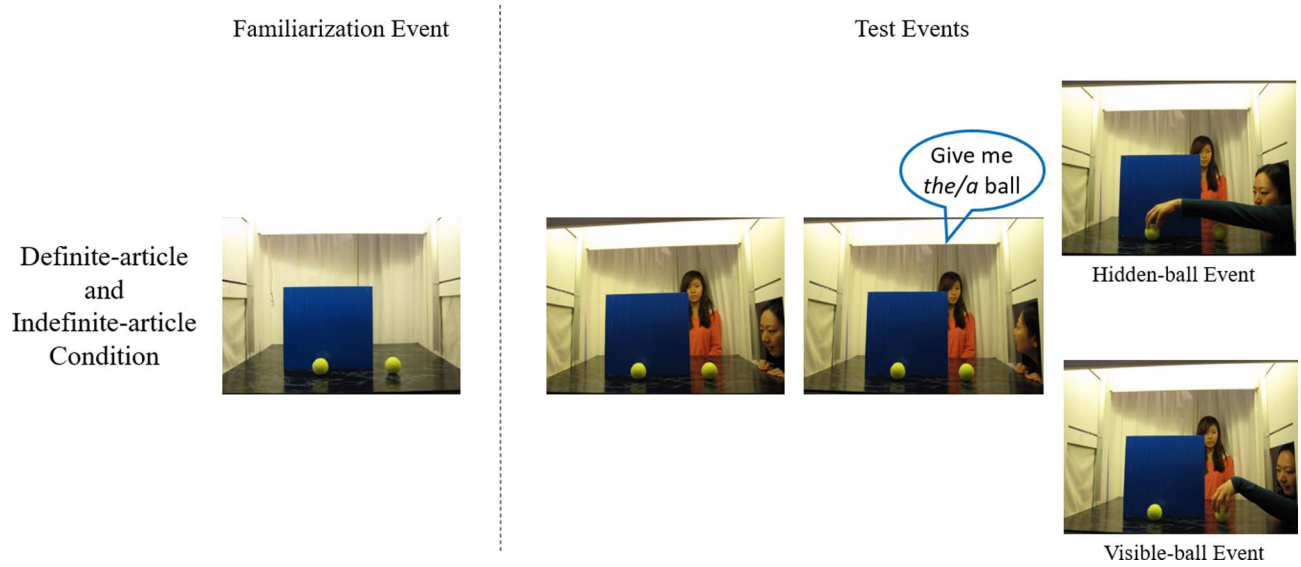

Fig. 1. Photographs of the familiarization and test events (with the screen behind the ball on the left) shown in the definite-article and the indefinite-article conditions.

practices in the field (Eason, Hamlin, & Sommerville, 2017).

2.1.2. Apparatus

The apparatus consisted of a wooden display box (106 cm high × 104 cm wide × 61 cm deep) mounted 76 cm above the room floor. The infant sat on a parent's lap and faced an opening (56 cm high × 102 cm wide) in the front of the apparatus. Between trials, a curtain consisting of a muslin-covered frame (61 cm high × 104 cm wide) was lowered in front of the opening. The side walls of the apparatus were painted white, and the floor was made of foam board and covered with black granite patterned contact paper. Agent1, wearing a pink shirt, sat behind the floor during the test trials. A large white cloth curtain covered the area behind her. A rectangular muslin-covered window (31.5 cm high × 30.5 cm wide) was created in the right side wall. Agent2, wearing a green shirt, sat by this window during the test trials.

Two tennis balls were used, each 6.5 cm in diameter. The screen, 35.5 cm high and 39.5 cm wide, was made of form board and covered with blue contact paper. It stood about 3 cm behind one of the balls. Half of the infants saw the screen behind the right ball and the rest saw it behind the left ball throughout the experiment. During the test trials, Agent1 sat centered behind the ball visible to her, about 58 cm from it. The ball was out of her reach.

The apparatus is also equipped with two video cameras. One records the events being shown on the apparatus, whereas the other records the infant. The input from the two cameras can be monitored online and checked offline to ensure proper testing. A metronome that beat softly once per second was used to help agents adhere to the scripts.

2.1.3. Procedure

To determine an infant's vocabulary, the parent filled out the MacArthur Communicative Development Inventories (MCDIs; Fenson et al., 2000) before the experiment began (e.g., Fisher, Klingler, & Song, 2006; Yuan & Fisher, 2009). MCDIs are widely used parental reports for assessing communicative skills in infants and toddlers. Parents of the 19-month-olds received the Level II short form MCDIs (Form A, for 16- to 30-month-olds) with 100 words listed and checked how many of them the infant could *produce*. Parents of the 14-month-olds received the Level I short form MCDIs (Form A, for 8- to 18-month-olds) with 89 words listed and checked how many of them the infant could *understand* (e.g., Sauer, Levine, & Goldin-Meadow, 2010).

During the experiment, the infant sat on the parent's lap in front of the apparatus. Parents were instructed to close their eyes during the test trials and not interact with the infants. After being seated in front of the apparatus, infants were greeted by the two agents, one at a time. Two naïve observers monitored the infant's looking behavior by viewing the infant through peepholes in large cloth-covered frames on either side of the apparatus. Each observer held a controller linked to a computer software (Baillargeon & Barrett, 2005) and pressed the button when the infant looked at the event. Looking times recorded by the primary observer were used. For 17 of the 48 infants, only the primary observer was present. Interobserver agreement for the remaining 31 infants averaged 88% per trial per infant.

The infants were tested with a procedure that consisted of a familiarization trial and two test trials. In the *definite-article* condition, during the *familiarization* trial, infants saw a static scene with the two balls and the blue screen behind one of them. Whether the screen was behind the left or the right ball was counterbalanced across infants, and the position of the screen did not change from the familiarization to the test trials. The familiarization trial ended when the infant looked away for 2 consecutive seconds after having looked for at least 6 cumulative seconds, or looked for 60 cumulative seconds.

Next, infants received two *test* trials alternating between the hidden-ball and the visible-ball events. Each event consisted of a 12-s interaction sequence and a main trial; looking times were computed separately. To start, the infant looked at the scene with the two agents, the two balls, and the screen for 2 consecutive seconds, during which Agent1 looked at the edge of the screen next to the visible ball and Agent2 looked ahead at the two balls (From Agent2's position, she could see Agent1, the screen, and the two balls, regardless of the position of the screen). Next, the interaction sequence began. The agents first paused for 2 s. They then turned to look at each other (1 s). Agent1 said to Agent2 "Give me *the* ball" (2 s), paused (1 s), and said it again (2 s). After a 1-s pause, Agent2 turned to look straight ahead at the two balls (2 s), reached for and grasped one of them and paused (1 s). For the main trial, infants watched this paused scene until they looked away for 2 consecutive seconds after having looked for at least 5 cumulative seconds, or looked for 60 cumulative seconds.

The *indefinite-article* condition was similar to the definite-article condition with only one exception: Agent1 said "Give me *a* ball" twice to Agent2 during the interaction sequence of the test trials. Across the three conditions, half of the infants, 11 male, saw the hidden-ball event first during the test trials, and the remainder saw the visible-ball event first.

Infants were attentive during the 12-s interaction sequence of the test trials (range: 8.4 to 12 *s*; $M = 11.8$, $SD = 0.6$). The 19-month-old

infants' productive vocabularies (from 31 of the 32 infants) ranged from 4 to 92, *Median* = 22. The 14-month-old infants' comprehensive vocabularies (from all 16 infants) ranged from 8 to 75, *Median* = 22. Whether infants' productive or comprehensive vocabulary was above or below the median, however, did not interact with infants' looking time at the test events in each condition (19-month-olds in the definite-article condition: $F(1, 14) = 0.34$, $p > .250$; 19-month-olds in the indefinite-article condition: $F(1, 13) = 0.12$, $p > .250$; 14-month-olds in the definite-article condition: $F(1, 14) = 1.52$, $p = .238$). This factor was thus excluded from the main analyses.

2.2. Results

Infants' looking times during the *familiarization* trial were first analyzed by a single-factor analysis of variance (ANOVA) with condition (definite-article, indefinite-article, young definite-article) as a between-subjects factor. The main effect of Condition was not significant, $F(2, 45) = 1.59$, $p = .215$, $\eta^2_{partial} = 0.066$, suggesting that infants in the three conditions looked about the same amounts of time during the familiarization trial (definite-article: $M = 16.9$, $SD = 11.2$; indefinite-article: $M = 15.0$, $SD = 6.7$; young definite-article: $M = 20.7$, $SD = 9.4$). When the looking times were analyzed by a 3 × 2 × 2 × 2 ANOVA with condition (definite-article, indefinite-article, or young definite-article), order (hidden- or visible-ball test event first), sex (male or female), screen position (left or right) as between-subjects factors, no effect involving condition was significant, $Fs(2, 24) < 2.32$, $p > .120$. There was, however, a significant Order x Sex interaction, $F(1, 24) = 7.51$, $p = .011$, $\eta^2_{partial} = 0.238$. This effect did not involve condition and hence was not discussed.

Infants' main-trial looking times in the two *test* trials (see Fig. 2) were analyzed using a 3 × 2 × 2 × 2 × 2 ANOVA with condition (definite-article, indefinite-article, or young definite-article), order (hidden- or visible-ball event first), sex (male or female), screen position (left or right) as between-subjects factors and event (hidden-ball or visible-ball) as a within-subject factor. The analysis yielded a significant Condition × Event interaction, $F(2, 24) = 4.11$, $p = .029$, $\eta^2_{partial} = 0.255$. Planned comparisons reveal that the 19-month-old infants in the definite-article condition looked reliably longer at the hidden-ball ($M = 35.3$ s, $SD = 20.2$) than at the visible-ball event ($M = 27.3$ s, $SD = 15.0$), $F(1, 24) = 4.65$, $p = .041$, Cohen's $d = 0.520$, whereas the 19-month-olds in the indefinite-article condition did not look significantly differently at the two events (hidden-ball event: $M = 28.6$, $SD = 15.8$; visible-ball event: $M = 33.9$, $SD = 15.6$, $F(1, 24) = 2.02$, $p = .168$, $d = -0.298$). In addition, the 14-month-old infants in the definite-article condition looked about similar amounts of time at the two events (hidden-ball event: $M = 26.6$, $SD = 14.6$; visible-ball event: $M = 28.5$, $SD = 17.1$, $F(1, 24) = 0.27$, $p > .250$, $d = -0.128$). Examination of individual infants' looking patterns confirmed the differences among the three conditions. Eleven of the sixteen 19-month-old infants in the definite-article condition looked longer at the hidden-ball than at the visible-ball event, whereas only 4 of the sixteen 19-month-old infants in the indefinite-article condition and nine of the sixteen 14-month-olds in the definite-article condition did so, $\chi^2(2, N = 48) = 6.50$, $p = .039$, $\phi = 0.368$ (Preacher, 2001). The 19-month-olds' response patterns were also significantly different in the definite-article and the indefinite-article conditions, $\chi^2(1, N = 32) = 6.15$, $p = .013$, $\phi = 0.438$ (Preacher, 2001).

The analyses also yielded a significant Order × Event interaction, $F(1, 24) = 7.37$, $p = .012$, $\eta^2_{partial} = 0.235$. This was because similar to previous infant studies (e.g., Baillargeon, 1987; Duh & Wang, 2014; Gergely et al., 1995), across the three conditions, infants who received the hidden-ball trial first looked reliably longer at the event ($M = 34.2$, $SD = 16.3$) than at the visible-ball event ($M = 27.5$, $SD = 15.8$), $F(1, 24) = 4.90$, $p = .037$, whereas those who received the visible-ball trial first did the reverse (hidden-ball event: $M = 26.2$, $SD = 17.2$; visible-ball event: $M = 32.3$, $SD = 15.9$), $F(1, 24) = 4.16$, $p = .053$. This interaction, however, did not involve condition ($F(2, 24) = 0.72$, $p > .250$) and simply reflected infants' interest in the first test trial they received. These trends were apparent in the two conditions yielding negative results. Interestingly, in the definite-article condition with 19-month-olds, infants looked about similar amounts of time during the first test trial, regardless of whether they watched the hidden-ball ($M = 32.9$, $SD = 19.2$) or the visible-ball event ($M = 32.1$, $SD = 18.2$), $F(1, 24) = 0.02$, $p > .250$. They, however, looked reliably longer at the hidden-ball ($M = 37.7$, $SD = 22.3$) than at the visible-ball event ($M = 22.6$, $SD = 10.2$) during the second test trial, $F(1, 24) = 8.41$, $p = .008$. Importantly, infants in this condition looked longer at the hidden-ball than at the visible-ball event, regardless of order. Finally, the analyses also revealed a significant Condition × Event × Sex × Screen Position interaction, $F(2, 24) = 3.91$,

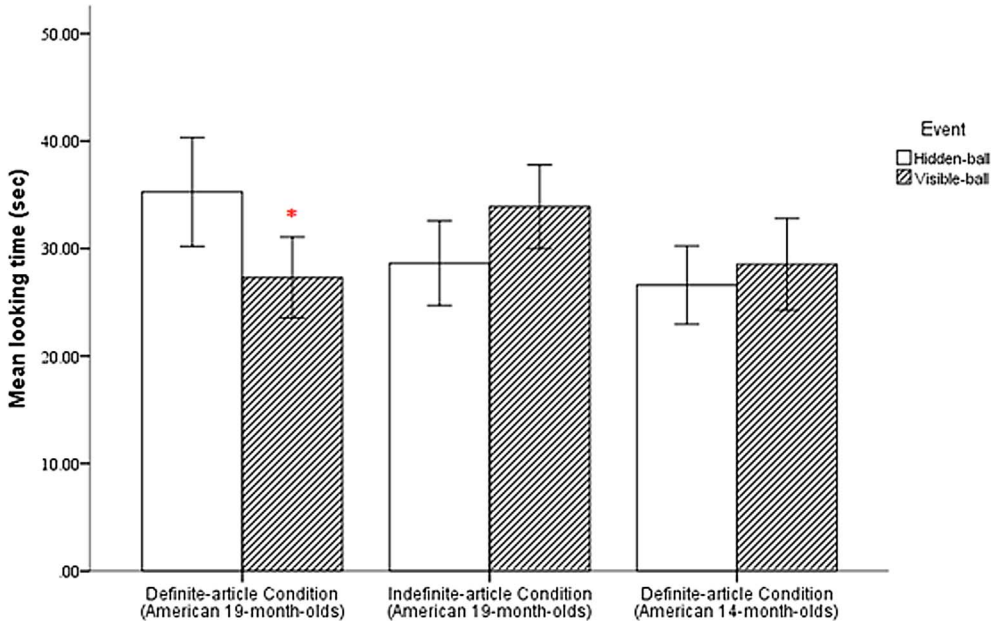

Fig. 2. Mean looking times of the infants in the three conditions during the test trials. Error bars represent standard errors. An asterisk (*) indicates a statistically significant difference ($p < .05$) between infants' mean looking times at the two test events.

$p = .034$, $\eta^2_{partial} = 0.246$. Given the small number of infants in each cell, these results did not warrant further discussion.

3. Discussion

In the present task, Agent1 could only see one of the two balls on the apparatus because of the screen obstructing her view. When she said to Agent2 "Give me *the* ball," 19-month-old infants seemed to expect Agent2 to reach for the ball visible to Agent1 and hence responded with heightened interest to the hidden-ball test event. These positive results extend reports on preschoolers' correct understanding of the definite article (e.g., Schmerse et al., 2015; Van Hout et al., 2010) to younger, 19-month-olds. Schmerse et al. (2015), however, did not find success in their 2.5-year-old group. Besides differences between the tasks such as the number of options to choose from (2 or 3), whether the options were identical or highly similar, or whether all the options were visible to the speaker, one possible reason for our 19-month-olds' success, as described in the Introduction, might be the use of a looking-time as opposed to an action task. Therefore, the present definite-article condition results suggest that by 19 months of age, English-learning infants seem to understand that the definite article "*the*" refers to an entity a speaker and a listener both can see, at least when infants are tested by implicit measures such as the looking-time method.

By contrast, in the indefinite-article condition, when Agent1 said "Give me *a* ball," 19-month-old infants appeared to have no clear prediction on the referent of her speech and hence responded similarly when Agent2 reached for either of the two balls. This is similar to the German monolingual toddlers' responses when hearing "Can you get *a* pan" (Schmerse et al., 2015). Given the previous reports on preschoolers' difficulties understanding the use of the indefinite article in discourse (e.g., Van Hout et al., 2010), we doubt that our 19-month-olds grasped the non-determinedness of "*a*." In fact, they tended to look shorter at the hidden-ball than at the visible-ball event during the test trials. We suspect that the indefinite-article condition, while serving as a control to the definite-article condition, might present a puzzling case to infants. Since Agent1 could not see the ball hidden from her by the screen, did some infants expect Agent2 to notify her of the presence of the ball by reaching for it? It is even possible[4] that infants might have assumed that Agent1's perceptions were irrelevant in the situation because it is similar to everyday life when infants regularly hear a great deal of indefinite noun phrases calling their attention to various objects in the surroundings (e.g., "*a* bird!" "*a* car!"). In fact, to adults, the use of "*a*" by Agent1 when she can only see one ball seems pragmatically inappropriate, unless she already knows there are more than one ball in the situation and hence has reasons not to use "*the*." Such reasoning about the choice of articles by a speaker involves scalar implicature understanding. For instance, to understand that a speaker's choice of "*some*" over a more informative "*all*" implies that it's "*not all*." (Noveck, 2001) Preschool age children do not yet grasp these implicates (Chierchia, Guasti, Gualmini, Meroni, & Crain, 2004; Noveck, 2001; Papafragou, 2006; Papafragou & Musolino, 2003; Pouscoulous, Noveck, Politzer, & Bastide, 2007). Similarly, they do not yet understand that a speaker's choice of the indefinite article "*a*" over the more informative "*the*" implies she is introducing a new entity into the conversation (Van Hout et al., 2010), or she is *not* referring to a specific referent.

Lastly, the 14-month-old infants did not differentiate between the hidden-ball and the visible-ball events as shown by their looking behavior in the definite-article condition. There are at least two possible explanations, not mutually exclusive, for their failure. The first explanation centers on the younger infants' language comprehension skills. Unlike the 19-month-olds, they did not yet understand the determinedness of "*the*" and assumed either of the two balls would suffice. If so, the utterance "Give me *a* ball" and an ungrammatical one "Give me ball" would yield negative results as well albeit for different reasons; the former because infants might have assumed "*a*" was just another article like "*the*" while the latter because infants could have been confused by the omission of an article in the sentence. The positive results obtained by Saylor et al. (2011) suggest that a pronoun such as "*my*" or "*that*" might work. This is because pronouns are even more informative than definite noun phrases (Gundel et al., 1993; Van Hout et al., 2010). Therefore, it is possible that 14-month-olds already expect "*that* ball" to refer to the ball the speaker, Agent1, can see while they are still unsure about the referent of "*the* ball." Future research will examine these possibilities.

The second explanation lies in 14-month-old infants' perspective-taking skills. The evidence reviewed in the Introduction suggests that infants around this age should be aware of Agent1's less complete perceptions than their own. Nevertheless, as in the current task, Liberman et al. (2017) obtained negative results with 14- to 17-month-old American monolingual infants in a similar action task. Liberman et al. (2017), however, found success in infants regularly exposed to a language other than English, regardless of what language(s) and how much exposure infants had. Liberman et al. (2017) therefore contend that executive functioning benefits usually found in bilingual infants (e.g., Kovács & Mehler, 2009a, 2009b) cannot fully explain their results. Instead, they offer an explanation focusing on the socio-cognitive experiences afforded by a multilingual environment, which makes infants more aware of others' different informational states. If this is the case, we might also find success in the present task with 14-month-old infants who are regularly exposed to more than English (all five infants excluded for this reason were 19-month-olds).

Therefore, the present task with the requirement on understanding the determinedness of "*the*" was challenging to 14-month-old monolingual infants with perspective-taking limitations. In Liberman et al. (2017), 14- to 17-month-old monolingual infants did as well as their peers from multilingual environments when the experimenter asked, "Give me *the* x" (e.g., the banana) with two different choices present, e.g., a banana and a phone. In previous research (e.g., Moll & Tomasello, 2007; Saylor & Ganea, 2007; Saylor et al., 2011; Schmerse et al., 2015), the options infants or children needed to choose from differed at least in size or color. Therefore, 14-month-old monolingual infants might succeed in the present task if the two balls had differed, for instance, in size or color.

Finally, the current study is framed around infants' perspective-taking skills in that they seemed to understand Agent1's less complete perceptions: she could only see one of the two balls on the apparatus. A low-level account for the whole set of results is that Agent1 was associated with the visible ball by her position (she always sat behind the visible ball) and her line of sight. When she said, "*the* ball" in the definite-article condition, 19-month-olds identified the visible ball as her referent and hence responded with heightened interest to the hidden-ball event. In the other two conditions, the association between Agent1 and the visible ball remained the same. Her speech, however, failed to enable infants to make predictions. We consider this association-based account as compatible with our perspective-based account in that such an agent-object association was an inherent part of Agent1's perception because of the experimental setup to ensure that she could see one ball. In future research, one way to disentangle these two factors is to remove the screen or replace it with a transparent screen, as in Luo and Baillargeon (2007), so that Agent1 could see both balls although the association between her and the ball closer to her was somewhat intact. If Agent1 said "Give me *the* ball," her speech should be viewed by infants as unspecified because the two balls were identical and there was no information about her preference, unlike in Martin et al. (2012). Therefore, infants should be unclear about which of the two balls Agent1 referred to. Such negative results would thus clarify that the association alone was not responsible for infants' specific expectations in the current study. Rather, infants consider Agent1's less complete perception as well as her speech to make predictions.

[4] We thank an anonymous reviewer for this and other helpful suggestions.

3.1. Concluding remarks

The present study suggests that when watching two agents interact, infants could use their emergent perspective-taking and language comprehension abilities to make appropriate predictions. Previous results (e.g., Moll & Tomasello, 2007; Saylor & Ganea, 2007; Saylor et al., 2011) have shown that infants in the second year of life can track others' perceptual experiences to identify the referent of their speech. We extend these results by demonstrating that by 19 months of age, infants are also attentive to the specific units, i.e., articles, used in others' speech. Particularly, infants appeared to have understood that an agent, Agent1, used "*the* ball" to signal the ball she could see when only Agent2 could see there were actually two identical balls on the apparatus. Infants were unsure of the referent of Agent1's speech when she used "*a* ball," possibly due to their limited understanding about the indefinite article. Likewise, 14-month-old infants failed to generate predictions about what Agent1 wanted when she said, "Give me *the* ball." Their failure might lie in limits in their understanding about the definite article and/or their use of perspective-taking skills.

Acknowledgments

We thank the University of Missouri Infant Cognition Laboratory for their help with data collection, the infants and parents who participated in the research, and three anonymous reviewers for very useful comments.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.cognition.2018.02.006.

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