Available online at www.sciencedirect.com

ScienceDirect

Lingua 175–176 (2016) 83–96

Lingua

www.elsevier.com/locate/lingua

Young children's early sensitivity to linguistic indications of speaker certainty in their selective word learning

Tomoko Matsui [a,*], Taeko Yamamoto [b], Yui Miura [c], Peter McCagg [d]

[a] Tokyo Gakugei University, Japan
[b] Meijigakuin University, Japan
[c] Kanazawa University, Japan
[d] Akita International University, Japan

Received 1 July 2015; received in revised form 16 October 2015; accepted 20 October 2015
Available online 25 November 2015

Abstract

In everyday conversation, both children and adults have an expectation that the speaker is telling the truth. In reality, however, this expectation is not always fulfilled, and both children and adults are equipped with a capacity for epistemic vigilance, i.e. a capacity to assess the speaker's trustworthiness in order to avoid being misinformed. The hearer's assessment of the speaker's trustworthiness is based on two criteria: his ability to provide true information and his benevolence toward the hearer. In two studies, we investigated how young children use these criteria, by focusing on two indicators of trustworthiness: linguistic expressions of speaker certainty, and personal familiarity. In the first study, both 3- and 4-year-olds were successful in distinguishing the degree of speaker certainty expressed by linguistic indicators and using it to assess the trustworthiness of the speaker. In the second study, children's ability to assess the speaker's trustworthiness on the basis of his attitude of certainty was further scrutinized. When pitted against personal familiarity, children's bias toward the certain speaker was modified in 5-year-olds but not 3 year-olds. The difference between the two age groups suggests that epistemic vigilance consists of a set of distinct components, with different developmental timelines.
© 2015 Elsevier B.V. All rights reserved.

Keywords: Trust; Epistemic vigilance; Selective learning; Certainty; Familiarity

1. Introduction

In verbal communication, it is essential for the hearer to be consistently vigilant toward the source of information in order to avoid being misinformed (Sperber et al., 2010). Often, the source of information is another human being, i.e. an informant, and a vigilant hearer should be good at assessing the trustworthiness or reliability of the informant.

According to a standard model of trust, two distinct types or dimensions of trust can be identified. One is often called cognition-based, or cognitive, trust and the other affect-based, or affective, trust (Lewis and Weigert, 1985; McAllister, 1995; Weber et al., 2005). According to Lewis and Weigert, cognitive trust is based on rational assessment of the trustworthiness of a person, while affective trust is based on emotional attachment to a person. By its nature, affective trust is more likely to be present in close interpersonal relationships. In verbal communication, cognitive trust is based on the

* Corresponding author at: Center for Research in International Education, Tokyo Gakugei University, 4-1-1 Nukuikita-machi, Koganei-shi, Tokyo 184-8501, Japan. Tel.: +81 422 336 6188.
E-mail address: matsui@u-gakugei.ac.jp (T. Matsui).

http://dx.doi.org/10.1016/j.lingua.2015.10.007
0024-3841/© 2015 Elsevier B.V. All rights reserved.

hearer's belief about the speaker's ability to provide accurate and reliable information, and affective trust is based primarily on the hearer's belief about the speaker's benevolence (Mayer et al., 1995).

Recent studies of children's ability to assess the trustworthiness of the speaker in the context of word learning have revealed that as young as 3 years of age, children show some ability to assess the reliability of the informant on the basis of his knowledgeability or accuracy (e.g. Clément et al., 2004; Koenig et al., 2004), although generally their performance was not as successful or consistent as that of 4- and 5-year-olds (Koenig and Harris, 2005; Pasquini et al., 2007). In addition, a few previous studies have revealed that 3-year-olds are quite competent both in learning a novel word from knowledgeable or certain informants and in not doing so from ignorant or uncertain informants (e.g. Birch et al., 2010; Jazwal and Malone, 2007; Sabbagh and Baldwin, 2001).

Within the standard dichotomy of interpersonal trust introduced above, children's trust of the informant on the basis of his knowledge, accuracy or confidence about the word-referent link is categorized as belonging to the dimension of cognitive trust. Young children's sensitivity to the other dimension of interpersonal trust, namely, affective trust, by contrast, has been relatively under-investigated so far (Landrum et al., 2013; Mascaro and Sperber, 2009; Xu et al., 2013). This is perhaps inevitable given that the nature and development of affective trust among adults has not yet been sufficiently examined (Dirks and Ferrin, 2002). The existing studies, however, suggest that preschool children generally trust a person with whom they have established a close relationship more than they trust a stranger (e.g. Corriveau and Harris, 2009). In other words, if a child hears a set of conflicting claims, one from an informant whom the child happens to believe is highly benevolent on the basis of his accumulated personal experience and the other from an informant whom the child has no idea whether he should trust or not, the child is more likely to accept the claim made by the informant with whom he has established a trusting relationship.

An interesting question then, from the viewpoint of pragmatic development, is this: how does a child react to a situation where the person the child trusts on the basis of her benevolence (affective trust) does not seem to be trustworthy in terms of her ability to provide reliable information (cognitive trust)? Previous studies suggest that 3-year-olds are willing to believe the statement from the informant who claims he has knowledge to support his claim (Sabbagh and Baldwin, 2001). However, the tasks in these studies involved two informants neither of whom had established long-term trust with the child participant in the past. It therefore remains to be tested whether a child trusts an informant who is more knowledgeable or confident about what he is talking about, even when the knowledgeable or confident informant is a stranger and the other less knowledgeable and less confident informant is someone whom the child knows to be highly benevolent.

The overall aim of the current study is to examine the early stage of epistemic vigilance by focusing on one particular cue to the informant's ability, namely, linguistic indications of speaker certainty. Our aim is two-fold. First, we will look more closely at how children's ability to understand linguistically encoded indications of speaker certainty develops. Children's sensitivity to linguistic expressions of the speaker's knowledgeability and confidence about his claim, for example, should improve their overall assessment of the speaker's trustworthiness. However, the nature and development of this sensitivity has been under-investigated so far and more research is urgently needed. Second, we will examine how children's sensitivity to linguistic expressions of speaker certainty interacts with personal familiarity. Following existing of models of interpersonal trust (Lewicki and Bunker, 1996; McAllister, 1995), we assume that both adults and children are likely to perceive benevolence in a person with whom they have a close interpersonal relationship. Our assumption is that children's sensitivity to linguistically encoded indications of reliability, as well as their perception of benevolence in the familiar speaker, develops as part of their competence in utterance interpretation, which typically involves fast, spontaneous and unconscious processing that is likely to be domain-specific (Sperber and Wilson, 1995, 2002). Our current study, therefore, can be seen as an investigation of children's developing competency in verbal communication.

2. Children's developing sensitivity to linguistic expressions of speaker certainty

Children's understanding of the speaker's attitude of certainty about the propositional content of his utterance has been investigated by only a few studies so far (e.g. Brosseau-Liard et al., 2014; Matsui et al., 2006, 2009). Of these, the studies conducted by Moore and his colleagues are probably the most widely known. Moore and his colleagues carried out a series of experimental studies which tested whether young children can adequately distinguish the semantic/pragmatic difference between word pairs such as *know* and *think* (Moore et al., 1989). In these experiments, children were asked to identify the location of a hidden object on the basis of two conflicting claims made by two different speakers. One claim was always preceded by an expression of speaker certainty (e.g. 'I know it's in the red box') and the other by an expression of speaker uncertainty (e.g. 'I think it's in the blue box'). Children were expected to trust the claim preceded by an expression of speaker certainty. The results of the experiments suggest that there is a threshold between 3- and 4-year-olds: 4-year-olds were capable of differentiating the degree of speaker certainty associated with each of the two verbs, while 3-year-olds were not. In another study, Moore and his colleagues included modal expressions such as *must* and *might* as one of the verbal clues, as in ''It might be in the blue box'' vs. ''It must be in the red box'' (Moore et al., 1990). They found that children's understanding of modal expressions correlated strongly with their understanding of mental verbs.

More recently, Sabbagh and Baldwin (2001) investigated whether young children learn words more readily from knowledgeable as opposed to ignorant speakers. Their experimental results suggest that both 3- and 4-year-olds are capable of understanding the speaker's confidence about word-referent links when this attitude is verbally expressed, as in 'I know this toy', or 'I don't know this toy'. The authors argue that for a child to learn the meaning of a new word, the child must be capable of judging if the speaker knows the word or not. Without this ability, the child would risk learning wrong word-referent links when the speaker is ignorant about the link.

Sabbagh and Baldwin's study is of particular interest here for two reasons. First, unlike the findings of Moore and his colleagues, Sabbagh and Baldwin's study indicates that 3-year-olds may have some sensitivity to speaker uncertainty. Moreover, the successful performances by 3-year-olds may be partly due to the use of the word-learning paradigm. In word-learning tasks, the child is expected to acquire general knowledge (e.g. a new word) while in other experimental tasks such as the hidden object task used in the studies by Moore and his colleagues, the child is required to process highly specific information but not to store it as part of long-term knowledge. In other words, word-learning tasks are unique in that they put the child in the familiar context of social learning. According to Csibra and Gergely (2009), children are sensitive to ostensive communicative signals from very early on, and use this sensitivity to acquire generic knowledge through social transmission. It is possible, therefore, that the child is more sensitive to the attitude of uncertainty expressed by an informant in the clear context of ostensive social learning. If so, the same paradigm should be effective in testing younger preschoolers' understanding of speaker certainty.

However, Sabbagh and Baldwin's stimuli consisted exclusively of either explicit statements of relevant knowledge or explicit denials of it, and they may not therefore have been adequate to tap children's understanding of degrees of speaker certainty. Thus, it seems worth investigating whether in the same word-learning situation, 3-year-olds show any sensitivity to more fine-tuned indications of speaker certainty. To summarize, existing studies investigating children's understanding of speaker certainty suggest that 4-year-olds are well capable of differentiating degrees of certainty. However, whether 3-year-olds can properly differentiate fine degrees of certainty remains unclear.

There is a variety of linguistic means for expressing the speaker's attitude of certainty about the propositional content of the utterance. For example, certainty can be expressed via open-class lexical items such as 'I know/bet', 'I think/guess', *definitely*, and *probably* or closed class items such as *may* and *must*, or the Japanese sentence-final particles *yo* (certain) and *kana* (uncertain). When lexical items such as ''I think'' or ''I suppose'' are used to express speaker certainty, they are generally called epistemic markers, or ''parentheticals'', i.e. linguistic items that lack a structural relation to the main utterance (Dehe and Kavalova, 2007). In other words, what is encoded by the expressions of speaker certainty is often considered to make no contribution to the truth-conditions of the basic-level proposition, i.e. the proposition expressed by the utterance. Rather, they are seen as making their own contribution to a higher-level proposition (Ifantidou, 2001; Itani, 1998; Matsui, 2000; Wilson and Sperber, 1993).

In the current study, we will test Japanese preschool children's understanding of speaker's attitude of certainty expressed by the two sentence-final particles, *yo* (certain) and *kana* (uncertain). Following previous studies, we assume that these sentence-final particles do not contribute to the truth-conditions of the basic proposition expressed by the utterance. Furthermore, adopting the relevance-theoretic distinction between conceptual vs. procedural encoding established by Diane Blakemore, we suggest that the two particles encode procedural information about speaker certainty.

Within the framework of relevance theory, grammaticalized items, including epistemic particles, are seen as encoding non-representational (procedural) information that facilitates the manipulation of representational (conceptual) information (Blakemore, 1987; Wilson and Sperber, 1993). The main function of procedural encoding is to guide the hearer through the inferential phrase of utterance comprehension, by making a particular range of assumptions more salient and accessible to the hearer (Blakemore, 2002; Wharton, 2003). We suggest that the main function of the two Japanese particles of speaker certainty is to facilitate the hearer's inferential construction of the particular propositional attitude intended by the speaker, by making the relevant epistemic state or attitude mentally more salient (see also Matsui, 2000). We also suggest, as a working hypothesis, that Japanese particles of speaker certainty and English parentheticals 'I know' and 'I think' are similar in that they both make no contribution to the truth-conditions of the basic level proposition, but they are also quite different from each other in that the former encode procedural information and the latter conceptual information.

Naturalistic studies on the acquisition of Japanese sentence-final particles suggest that children start using the two particles of speaker certainty *yo* and *kana* relatively early. For instance, according to Shirai et al. (1999), the earliest use of *yo* occurs at around 18 months, and the onset of *kana* follows between 24 and 30 months. The findings suggest that by 3 years of age, Japanese children's understanding of these epistemic particles should be well established, and a study by Matsui et al. (2006) confirmed this. Adopting the method used by Moore and his colleagues, they tested 3- to 6-year-old Japanese children to see if they trust the informant who is more certain about the location of the target object more than they trust the informant who is less certain about it. They found that 3-year-olds trusted the informant who used the particle *yo* (certain) in stating the location of the object more than they trusted the informant who used the particle *kana* (uncertain).

These previous studies suggest that Japanese children understand the meaning of the two epistemic particles by 3 years of age and can use the knowledge effectively to distinguish between a speaker who is confident about his statement

and one who is not. However, no study has ever investigated whether the same children avoid learning from an uncertain informant who uses the particle *kana* (uncertain). A vigilant learner, for example, should be able to avoid learning a new word from an informant who is uncertain about the word-referent link, as the information provided by the uncertain speaker is likely to be false. The current study was designed to investigate whether Japanese 3- and 4-year-olds are not only willing to learn from a speaker who is confident about the word-referent links but are also vigilant enough to avoid learning from an uncertain speaker.

3. Study 1

Past studies of children's understanding of uncertainty generally suggest that the ability to differentiate degrees of speaker certainty becomes fully functional by 4 years of age. Sabbagh and Baldwin's study indicates that English-speaking 3-year-olds are also capable of understanding the speaker's confidence about word-referent links when they are explicitly told whether the speaker does or does not have knowledge about the target object. However, the question of whether the same children understand the informant's attitude of uncertainty toward his claim when it is communicated only by linguistic markers of propositional attitude such as particles or modal adverbs (e.g., *maybe*) has not yet been answered.

Given that in Sabbagh and Baldwin's study, English-speaking 3-year-olds were reluctant to assign labels when speakers signaled strong uncertainty about a particular word-referent link, we decided to adapt their experimental procedure to test Japanese children's understanding of speaker uncertainty. We altered the stimuli so that they included no explicit statements about speaker knowledge, and the only difference between the two conditions was in the use of overt expressions to mark the speaker's attitude of certainty/uncertainty. We were interested in young children's understanding of the propositional attitude of certainty/uncertainty, as distinct from their understanding of propositional content, and in our view, an explicit statement of knowing or not knowing something (e.g. 'I know/don't know the name of this toy') is a matter of propositional content. Our expectation here was that the change of stimuli might influence children's performance: for example, children may not sense an attitude of uncertainty when they do not hear an explicit statement that the speaker does not know the right link between the label and the object.

4. Method

4.1. Participants

Fifty-six children from two age groups participated: twenty-eight 3-year-olds (range: 3.0–3.11 (M = 3.6), 14 male) and 28 4-year-olds (range: 4.0–4.11 (M = 4.5), 14 male). The number and the mean ages of participants across conditions were the same. Participants were recruited from three nursery schools in cities in east Japan. All the nursery schools recruit children from a broad socioeconomic range.

4.2. Design and procedure

In a between subjects design, children were randomly assigned to one of two experimental conditions: (1) certain speaker condition and (2) uncertain speaker condition. The only difference between the two conditions was the sentence-final particles used by the experimenter to introduce each set of three toys and the name of the target toy to the participants. In the certain speaker condition, the Japanese particle (*da*)*yo* (equivalent to English adverbial *sure*) was used; in the uncertain speaker condition *kana* (equivalent to English *maybe*) was used. The particle *(da)yo* (the combination of the Japanese copula *da* and the sentence-final particle *yo* that indicates speaker certainty) was chosen as the acquisition period of the particles more or less coincides with that of *kana*, and it has the same number of syllables as *kana*.

Children participated in two trials. The central materials were two sets of three colorful novel toy objects which did not fit neatly into known named toy categories. Two hand puppets, Mickey and Donald, always introduced the same set of toys; the target toy in Mickey's set was always named *mappi*, and the target toy in Donald's set was named *toma*.

In both conditions, participants were introduced to a puppet (Mickey or Donald) who quickly excused himself to go and play outside with Minnie (Mouse), but before leaving gave the child participant permission to play with his toys while he was away. Once the puppet had gone, the experimenter suggested that they play with the toys. The first critical experimental manipulation started when the experimenter showed how to play with the toys. In the certain speaker condition, the experimenter communicated her confidence about how to play with each toy by using the sentence-final particle *(da)yo* (*sure*) (e.g. ''This is how you play with this toy, for sure'') In the uncertain speaker condition, the experimenter's uncertainty about how to use each toy was expressed by the particle *kana (maybe)* (e.g. ''This is how you play with this toy, maybe''). This activity ended when a phone rang, and the child started listening to a recorded message from Mickey (or Donald) asking for someone to send him their *mappi* or *toma*. To check each child's understanding, the

experimenter asked the child to repeat the message. The second critical experimental manipulation began when the experimenter named the target object. In the certain speaker condition, the experimenter named the toy using the particle *(da)yo* (e.g. This is toma, for sure). In the uncertain speaker condition, the toy was named using the particle *kana* (e.g. This is toma, maybe). The child then was asked to take the target toy to the mailbox so that Mickey/Donald could play with it. Having put the target toy to the mailbox, the child was also asked to put the distractor toys there. In this way, the amount of the experimenter's physical contact with all the toys was controlled.

Next, the experimenter suggested that they look at Mickey's/Donald's photo album and see how many of the pictures they could name. Each album contained 6 photographs of familiar objects, 6 unfamiliar and non-presented objects, and 2 photographs of each of the novel objects presented earlier. The photo albums offered each child 2 opportunities to name the novel objects. Immediately after the second trial, children were given a comprehension test by asking them to identify the named novel objects (*mappi* and *toma*) from among all six toys used across both trials displayed randomly on the table.

5. Results and discussion

Table 1 shows the average number of correct responses of each age group for both Production and Comprehension tests. For the Production test, scores represent the number (standard deviation) of times children successfully produced the name of the target toy. A two-way ANOVA with Age (3, 4) and Condition (certain, uncertain) was calculated for the number of correct replies in the Production test (maximum score = 4). We found a main effect of Condition ($F(1,52) = 10.708$, $p = .002$, $\eta^2 = .171$). Children in the certain speaker condition ($M = 1.07$, $SD = 1.51$) performed better than children in the uncertain speaker condition ($M = .11$, $SD = .31$). We found no main effect of Age group ($F(1,52) = .720$, $p = .400$, $\eta^2 = .014$) and no interaction between Age and Condition ($F(1,52) = .367$, $p = .547$, $\eta^2 = .007$). The results indicate that children successfully learned a novel word when the speaker was highly confident about the word-referent links, while they did not do so when the speaker was rather uncertain about them.

For the Comprehension test, the average number of correct responses (standard deviation) of each age group is also shown in Table 1. A two-way ANOVA with Age and Condition based on the number of correct replies (maximum score = 2) revealed a significant main effect for condition ($F(1,52) = 55.008$, $p < .001$, $\eta^2 = .514$). Children in the certain speaker condition ($M = 1.54$, $SD = .507$) performed better than children in the uncertain speaker condition ($M = .39$, $SD = .628$). We found no main effect of Age group ($F(1,52) = .860$, $p = .358$, $\eta^2 = .016$) and no effect of interaction between Age and Condition ($F(1,52) = .215$, $p = .645$, $\eta^2 = .004$). Children's performance in the Comprehension test was also compared to chance (16 percent) by a *t*-test and the results are shown in Table 1. In the certain speaker condition, both 3- and 4-year-olds performed well above chance in the comprehension test, while in the uncertain speaker condition, their performance was at or close to chance.

To summarize, the main finding of the study was that 3- and 4-year-olds were successful both in learning a novel word when the speaker was confident about the word-referent links and in not doing so when the speaker was uncertain about them. The finding indicates that both 3- and 4-year-olds understand the speaker's attitude of certainty about his statement expressed by the sentence-final particles and used the information to decide whether they should learn the novel word introduced by the speaker or not. Furthermore, the finding that they could assess the speaker's varying degree of certainty about the statement even when the attitude is not communicated explicitly (by using the expression ''I don't know about it''), but implicitly or procedurally by use of the sentence-final particles, suggests that young children may also understand a wide variety of implicit expressions of speaker certainty, for example, facial expressions, eye-gaze, posture, and tone of voice (Brosseau-Liard et al., 2014; Brosseau-Liard and Poulin-Dubois, 2014)

On the other hand, studies by Moore and his colleagues suggest that 3-year-olds are not capable of understanding the speaker's attitude expressed by parenthetical verbs such as 'I think' and 'I know', or modal expressions such as *may* and

Table 1
Average number of correct responses of each age group in each condition in Study 1. Scores represent the number (standard deviation) of times children chose to learn from the speaker who expressed certainty about the word-referent link.

	3-year-olds			4-year-olds		
	Mean scores	SD	*t*(13)	Mean scores	SD	*t*(13)
Certain speaker condition						
Production test (maximum = 4)	1.29	1.68		.86	1.35	
Comprehension test (maximum = 2)	1.57	1.57	9.04***	1.5	.52	8.44***
Uncertain speaker condition						
Production test (maximum = 4)	.14	.36		.07	.26	
Comprehension test (maximum = 2)	.50	.76	.84	.29	.47	−.35

Note. ***$p < .001$.

must. Matsui et al. (2006) also demonstrated that Japanese 3-year-olds, who understood speaker certainty when expressed by the two sentence-final particles, were not capable of differentiating the certain speaker from the uncertain speaker on the basis of a pair of parenthetical verbs 'I know' and 'I think'. These findings suggest that although 3-year-olds are capable of understanding the speaker's attitude of certainty, some linguistic expressions are easier for them than others. On this point, Matsui and Miura (2009) suggest that both frequency of input and the particular linguistic form used are likely to determine the timing of children's semantic/pragmatic understanding of linguistic expressions of speaker certainty. If our hypothesis that Japanese sentence-final particles encode procedural information and parenthetical verbs encode conceptual information is correct, the current study, together with the previous studies just mentioned, suggest that children seem to understand procedurally encoded indications of speaker certainty earlier than the conceptual equivalent.

The current study has demonstrated that by 3 years of age, children understand the speaker's attitude of certainty and are able to apply this understanding to their selective learning. However, as discussed earlier, vigilance toward an informant has not only an epistemic dimension but also a moral or affective dimension. Previous research suggests that children's vigilance toward the moral or affective dimension of the trustworthiness of an informant develops quite early, during the infantile and toddler periods (e.g. Hamlin et al., 2007; Kuhlmeier et al., 2003). Recent studies suggest that by 3 years of age, children's trust is biased toward a familiar adult rather than an unfamiliar counterpart (e.g. Corriveau and Harris, 2009). Thus, if children are sensitive to both personal familiarity and speaker certainty by 3 years of age, it is of great interest to consider which of the two bases young children prioritize in assessing the informant's trustworthiness. The second study was designed to investigate this question.

6. Study 2

Two existing studies have investigated children's sensitivity to personal familiarity within the word-learning paradigm. Corriveau and Harris (2009) investigated how children assess and compare the trustworthiness of two informants who crucially differ from each other in two respects: personal familiarity (someone the child has had a close relationship with vs. someone the child has had no previous relationship with) and accuracy (someone who has accurate knowledge about familiar objects vs. someone who does not). They found that children from 3 age groups (3-, 4-, and 5-year olds) had a basic preference for asking the familiar person (familiar teacher) rather than the unfamiliar counterpart (unfamiliar teacher) the name of a novel toy. The effect of interaction between familiarity and accuracy, however, differed considerably between 3-year-olds and 5-year-olds. For instance, among children who witnessed that the familiar person was less accurate than the unfamiliar person about a set of known objects, 3-year-olds tended to persist in trusting the familiar person, while 5-year-olds trusted the accurate, but unfamiliar, person more. On the other hand, among children who observed that the familiar person was more accurate than the unfamiliar person about the names of known objects, 5-year-olds intensified their trust in the familiar person, while 3-year-olds did not do so. Thus, 5-year-olds demonstrated a more sophisticated ability to modulate their trust on the basis of the evidence provided.

In another study, Corriveau and her colleagues investigated the effect of interaction between personal familiarity and acceptability of the claims (Corriveau et al., 2009). The familiar person in this study was the child's mother and the unfamiliar person was a stranger (one of the research team). They found that when the two informants provided conflicting, but equally acceptable claims on the basis of perceptual evidence (e.g. a picture of an animal hybrid which was 50% horse and 50% cow), 5-year-olds generally accepted the mother's claims over those of the stranger. When the stranger's claims seemed more acceptable on the basis of evidence (e.g. an animal hybrid which was 75% bird and 25% fish), however, children preferred her claims over those of the mother. The tendency was particularly evident among children who had a secure attachment with the mother. Here again, it was demonstrated that by 5 years of age, children can flexibly modulate their trust on the basis of available clues. However, 3-year-olds were not included in this study, and so the question of whether they would perform in the same way as 5-year-olds remains to be tested.

To date, no study has investigated the effect of interaction between personal familiarity and the informant's epistemic attitude (e.g. certainty/uncertainty) toward the content of the statement. Study 2 was designed to address this question by comparing the performance of 3- and 5-year-olds. In Study 1, 3-year-olds were found to be well capable of detecting the degree of speaker certainty communicated by the linguistic expressions and of using this information to decide whether they should or should not learn a new word from the speaker. The two previous studies reviewed above, on the other hand, suggest that preschool children have a basic affective trust toward a familiar person and as a result, prefer to learn from the familiar person rather than an unfamiliar counterpart. In Study 2, therefore, we predicted that both 3- and 5-year-olds would generally prefer to learn from a familiar person rather than a stranger. We also predicted that preference for the familiar person should be intensified in 5-year-olds, but not in 3-year-olds, when the familiar person expresses confidence about her own claim by linguistic means while the stranger expresses uncertainty. In addition, the question of how children will react when the familiar person expresses uncertainty and the stranger expresses certainty about their respective claims is of particular interest here. Corriveau and Harris (2009) found that 3-year-olds tend to persist in their basic trust for

a familiar person even after they have witnessed her not being accurate about the known names of familiar objects. Based on this finding, in Study 2 we hypothesized that 3-year-olds are likely to persist in preferring to trust the claim made by the familiar person even when she expresses uncertainty about it, whereas 5-year-olds will opt for dismissing the familiar person's claim when they perceive her uncertainty.

7. Method

7.1. Participants

Fifty-four Japanese-speaking children from two age groups participated: twenty-six 3-year-olds (range: 3.0–3.10 (*M* = 3.3), 14 male) and 28 5-year-olds (range: 5.1–5.11 (*M* = 5.4), 14 male). Two additional children (3-year-olds) were recruited but were excluded from the study as they did not satisfy the inclusion criterion of passing the certainty control task (see below). Participants were randomly assigned to the two conditions and their number and mean ages were the same across the conditions. They were recruited from four nursery schools in cities in east Japan. All the nursery schools recruit children from a broad socioeconomic range.

7.2. Design and procedure

Two different types of social cues to speaker trustworthiness were used: linguistic indications of speaker certainty (certain vs. uncertain) and personal familiarity (a familiar person vs. a stranger). For the linguistic indication of certainty, as in Study 1, the two Japanese sentence-final particles *(da)yo* (certain) and *kana* (uncertain) were used. For the personal familiarity clue, the mother of each child participant was chosen to serve as a familiar person in the experiment.

Each child participant was to learn a series of novel words from two adults (mother vs. stranger). For each novel word, a pair of novel objects was shown as candidate referents. Each adult indicated a different toy as the referent of the novel word, and thus they provided conflicting information. The child's task was to choose one of the two objects as the referent of the novel word. On the basis of previous studies, it was expected that by default, children would trust the person expressing certainty more than the person expressing uncertainty, and trust the mother more often than a stranger. In addition, we hypothesized that when the familiar person, the mother, is more certain about the name-referent link than the stranger, the child's trust in the mother should be intensified. We also hypothesized that when the mother is less certain about the name-referent link than the stranger, 5-year-olds will be more willing to dismiss the mother's claim than 3-year-olds.

Both the child and the mother were invited to participate in the tasks in a quiet room in the university laboratory. Each child participated in two word-learning tasks: one was the Familiarity Task (3 trials) and the other was the Certainty Task (6 trials), and the order of the tasks was counterbalanced. In the Familiarity Task, both the mother and the stranger were equally certain about the name of a novel object and made conflicting claims about the name-referent link. Here we expected that the mother would be the generally preferred informant and children should learn from the mother more often than from the stranger. In the Certainty Task, on the other hand, the two adults expressed different degrees of certainty toward their own statement about the name-referent link. In the mother-certain condition (3 trials), the mother of the child was certain while the second experimenter was uncertain, and vice versa in the stranger-certain condition (3 trials). Again the claims were in conflict, and the child had to rely on one or other of the informants to learn the novel name. Here the child was expected to learn from the adult who expressed certainty about the name-referent link, and not from the adult who expressed uncertainty about it.

In both tasks, the first experimenter sat on one side of a table and the child, the child's mother and the second experimenter, who played the role of an adult female stranger, sat on the other side with the child in the center. The experimenter asked the child to look at the two women and to say if he knows them. All the children confirmed that they knew the mother but didn't know the second experimenter who played the role of stranger to the child. Each trial began when the first experimenter put 2 novel objects on the table. After the experimenter and the child played with each object, the experimenter told the child, ''Listen, only one of these is called *Toma* (one of the novel names) but we don't know which one. Let's ask your mother and the other woman which one is *Toma.* I will ask them one by one, so listen carefully to what they say. I will ask you later which one is *Toma*.'' Then the experimenter asked the mother and the second experimenter one by one which of the two objects was *Toma*; the order in which they were asked was counterbalanced within participants. The mother and the second experimenter one by one picked up one of the two objects and showed it to the child saying ''*Toma* is this one. This one is *Toma*''. Having heard what the two informants told him, the child was asked to point at *Toma*.

Prior to the two experimental tasks, children participated in control tasks involving two informants (two puppets) who were both strangers to the child. In the control task for the Familiarity condition (3 trials), a child heard conflicting statements from two informants who are equally certain about the name-referent link. It was expected that a child should have no bias toward trusting one informant better than the other. In the control task for the Certainty Task (3 trials), one informant was certain and the other was uncertain about the name-referent link. The combination of the puppet and

attitude of certainty/uncertainty was counterbalanced across the participants. Here, we expected that the child should prefer the informant who is certain about the name-referent link over the informant who is uncertain about it. The Certainty Control Task also played the role of pre-test: children who chose the uncertain speaker more frequently than the certain speaker in the Certainty Control Task were excluded from participating in the experimental tasks.

8. Results and discussion

8.1. Certainty task

The average numbers of correct responses for each age group in each condition are shown in Table 2. The scores represent the number (standard deviation) of times children chose to learn from the speaker who is certain about the word-referent link. They are compared to chance (50 percent) by a *t*-test. In both the Certainty Task and the Certainty Control Task, 3- and 5-year-olds performed above chance in choosing the object referred to by the certain informant over that referred to by the uncertain informant in all 3 conditions. When the certain speaker was the stranger and the uncertain speaker was the mother, however, 5-year-olds' correct responses were closer to chance than in the other two conditions. This suggests that 5-year-olds, but not 3-year-olds, were not as ready to trust a certain stranger over the uncertain mother as they were to trust the certain mother over an uncertain stranger.

To confirm the conclusion, a two-way mixed ANOVA with Age (3, 5) as the between-subjects variable and Condition (mother-certain, stranger-certain, control) as the within-subjects variable was calculated for the proportion of correct replies. We found a main effect of Condition ($F(2,104) = 21.687$, $p < .001$, $\eta^2 = .294$). Children in the mother-certain condition ($M = 2.81$, $SD = .39$) performed better than children in the stranger-certain condition ($M = 2.15$, $SD = .76$). Children in the control condition ($M = 2.67$, $SD = .48$) also performed better than children in the stranger-certain condition. A Bonferroni post hoc test revealed that children learned from the certain speaker significantly fewer times in the stranger-certain condition than the mother-certain and the control conditions ($p < .001$, $p = .001$, respectively). We also found an effect of interaction between Age and Condition ($F(2,104) = 7.490$, $p = .002$, $\eta^2 = .126$). A Bonferroni post hoc test revealed that 5-year-olds learned from the certain speaker significantly less often in the stranger-certain condition than the other two conditions ($p < .001$), while the performance of 3-year-olds did not differ significantly across conditions. Furthermore, according to a Bonferroni analysis, the performance of 5-year-olds was significantly different from the performance of 3-year-olds in the stranger-certain condition ($p = .003$), but not in the other two conditions. No main effect of Age group was found ($F(1,52) = 2.644$, $p = .110$, $\eta^2 = .048$), however. Thus, the conclusion was confirmed that the number of times on average 5-year-olds chose the certain speaker in the stranger-certain condition was significantly lower than that of 3-year-olds in the same condition. The performance of 5-year-olds in the stranger-certain condition was also significantly different from their own performance, as well as that of 3-year-olds, in the other two conditions.

8.2. Familiarity task

Table 2 shows the average number of 'correct' responses for each age group in each condition. For the experimental conditions, the scores represent the number (standard deviation) of times children chose to learn from the familiar person

Table 2
Average numbers of correct responses for each age group in each condition obtained in Study 2. In the Certainty Task, the scores represent the number (standard deviation) of times children chose to learn from the speaker who expressed certainty about the word-referent link. In the Familiarity Task, for the experimental conditions, the scores represent the number (standard deviation) of times children chose to learn from the familiar person (the mother), while for the control condition where both informants were strangers, scores represent the number of times children chose to learn from one of the strangers who was on average trusted more frequently than the other.

	3-year-olds			4-year-olds		
	Mean scores	*SD*	*t*(25)	Mean scores	*SD*	*t*(27)
Certainty task						
Mother is certain (maximum = 3)	2.77	0.43	15.06***	2.86	0.36	20.15***
Stranger is certain (maximum = 3)	2.46	0.65	7.58***	1.86	0.75	2.5*
Control (maximum = 3)	2.61	0.49	11.46***	2.71	0.46	13.97***
Familiarity task						
Mother vs. stranger (maximum = 3)	1.73	0.87	1.35	2.5	0.51	10.39***
Control (maximum = 3)	1.58	0.76	0.52	1.53	0.64	0.3

Note. *$p < .05$, ***$p < .001$.

(the mother). For the control condition where both informants were strangers, the scores represent the number of times children chose to learn from one of the strangers who was on average trusted more frequently than the other. In this task, as both informants were equally certain about their claims, we expected that children's performance would be at or close to chance unless there was some pre-existing bias toward one or other of them. We also predicted that one potential pre-existing bias children may have toward trusting an informant is based on personal familiarity.

The results demonstrated that the performance of 3-year-olds was at chance in both the experimental and the control conditions. This indicates that they had no particular bias toward either of the two informants, not only when they were both strangers, but also when one of the informants was their mother. The performance of 5-year-olds, by contrast, was different between the two conditions: in the control condition, where two strangers made conflicting claims, their performance was at chance, while in the experimental condition, where one of the informants was the mother and the other a stranger, their performance was far from chance. This finding suggests that 5-year-olds, but not 3-year-olds, kept their pre-existing bias toward the mother rather than the stranger when both expressed certainty about the word-referent link.

In order to confirm the findings, we conducted a two-way mixed ANOVA with Age (3, 5) as the between-subjects variable and Condition (mother-stranger, control) as the within-subjects variable. We found a main effect of Condition ($F(1,52) = 18.128$, $p < .001$, $\eta^2 = .258$). Children's performance in the mother-stranger condition ($M = 2.13$, $SD = .80$) was more biased toward the 'correct' choice (mother) than in the control condition ($M = 1.56$, $SD = .69$). An interaction between Age and Condition ($F(1,52) = 9.523$, $p = .003$, $\eta^2 = .155$) was also found. A Bonferroni post hoc test revealed that the performance of 5-year-olds differed significantly from that of 3-year-olds in the mother-stranger condition ($p < .001$). In addition, a main effect of Age group ($F(1,52) = 6.817$, $p = .012$, $\eta^2 = .116$) was found. Overall, 5-year-olds ($M = 2.02$; $SD = .09$) scored significantly better than 3-year-olds ($M = 1.65$; $SD = .10$).

The overall results of Study 2 suggest that the relative weightings of linguistic expressions of speaker certainty within an overall assessment of the trustworthiness of the speaker vary between 3- and 5-year-olds. The difference was particularly clear in two cases: when the familiar person (the mother) was uncertain and the stranger was certain about the particular word-referent links (Certainty Task) and when both the familiar person and the stranger were equally certain about them (Familiarity Task). In both cases, the 5-year-olds' preference to learn from the familiar person over the stranger was stronger than that of 3-year-olds. Unlike 5-year-olds, 3-year-olds did not appear to have a strong preference for the familiar person. Rather, for 3-year-olds, speaker certainty seems to be a more salient clue in assessing the trustworthiness of the speaker than personal familiarity.

These findings suggest that, contrary to our prediction, the informant's familiarity is not always the ultimate basis for young children's assessment of the trustworthiness of informants. Also contrary to our prediction, affective trust did not seem stronger in younger than in older preschool children. When an informant who is highly familiar to a child expressed uncertainty about her own statement, 3-year-olds were more likely to dismiss the familiar person's claim than 5-year-olds.

9. General discussion

We will summarize the main findings of the two studies and consider their possible implications here. The results of Study 1 strongly suggest that by 3 years of age, Japanese children understand what is encoded by each of the two sentence-final particles of speaker certainty and use the information to assess the trustworthiness of the speaker[1]. When the speaker consistently expressed her certainty about particular word-referent links, both 3- and 4-year-olds learned novel words from her. When the speaker consistently expressed her uncertainty about them, by contrast, the majority of both 3- and 4-year-olds did not learn novel words from her. Existing studies investigating preschool children's trust on the basis of the informant's ability to provide reliable information (cognitive trust) have demonstrated that adult-like assessment of the informant's trustworthiness on the basis of her accuracy and knowledgeability develops between 3 and 5 years of age (Koenig and Harris, 2005; Pasquini et al., 2007). The present study adds new evidence to the conclusions of existing studies, showing that 3-year-olds are also well capable of assessing the trustworthiness of an informant on the basis of her attitude of certainty about her own statement.

The results of Study 1 also confirm the earlier claim by Matsui et al. (2006) that by 3-years of age, children are generally well capable of understanding and differentiating the speaker's degree of certainty about the propositional content of the

[1] Considered in isolation, the children's performance in Study 2 might conceivably have been based on their understanding of only one of the two particles, rather than both. However, the results of Study 1 strongly indicate that the children understood what is encoded by each of the two sentence-final particles. In the certain speaker condition, a group of children were willing to learn the novel word on the basis of their understanding of the particle of certainty alone; in the uncertain speaker condition, another group of children were reluctant to learn novel words on the basis of their understanding of the particle of uncertainty alone. In other words, the children's degree of willingness to learn the novel words in Study 1 depended on their understanding of each of the two particles. So we believe that we have sufficient evidence to support the claim that by 3 years of age, Japanese children understand what is encoded by each of the two sentence-final particles.

utterance. However, studies by both Matsui and her colleagues and Moore and his colleagues have demonstrated that when the same propositional attitude of certainty/uncertainty is expressed by parentheticals such as 'I think' and 'I know', 3-year-olds are not as capable of understanding the same attitude.

Why does 3-year-olds' understanding of the speaker's propositional attitude of certainty vary depending on the form of linguistic expression used to communicate the attitude? We do not have a full-fledged answer yet, but would like to suggest the following, based on Blakemore's distinction between conceptual and procedural encoding: there are two different but related routes to understanding a speaker's attitude of certainty expressed by linguistic means, and for 3-year-olds, only one route is accessible. One of the two routes is representational, and we suggest that this route to understanding a linguistically expressed attitude of certainty is not accessible to 3-year-olds. Understanding mental verbs such as 'I believe', 'I know', and 'I suspect' requires a type of metarepresentational ability that is widely believed to become functional sometime between 4 and 5 years of age (Bartsch and Wellman, 1995; de Villiers, 2007; Matsui et al., 2006). As Moore and his colleagues and Matsui and her colleagues found, children's understanding of parenthetical expressions of speaker certainty such as 'I think' and 'I know' coincides with their understanding of mental verbs. Both studies demonstrated that children's understanding of parenthetical expressions of speaker certainty correlated strongly with performance in the false belief tasks that have been widely used to test children's representational understanding of others' beliefs in the past 30 years. These findings suggest that in order to understand what is encoded by parenthetical expressions such as 'I think' and 'I know', the type of first-order metarepresentational ability that begins to be functional around 5 years of age is required. If so, then children younger than 5 should find the same parenthetical expressions very difficult, if not impossible, to understand.

The second route, we suggest, is procedural. Within the relevance-theoretic framework, grammaticalized items, including Japanese sentence-final particles, are taken to encode procedural information that guides the hearer's inferential comprehension process by making certain (sets of) interpretations more salient or accessible to the hearer. Within this framework, we suggest that the main function of the Japanese particles of speaker certainty/uncertainty is something like this: they make a range of information highly accessible or salient to the speaker, thus helping him to decide whether he should believe what the speaker says or not. For example, having heard the particle *yo* (certain), the following type of information may become highly salient:

(a) that the speaker is confident about what he describes.
(b) that the speaker is knowledgeable about what he describes.
(c) that the speaker strongly believes that the hearer should believe what he says.

This type of information should help the hearer to assess the trustworthiness of the speaker. Which information is actually accessed by the hearer in the course of the comprehension process may vary depending on the hearer's circumstances (e.g. age, ability) and the communicative context (e.g. topic of conversation, relation between the speaker and the hearer). For instance, 3-year-olds, who do not have a sophisticated metarepresentational capacity but who do have an intuitive understanding of knowledge, may infer (a) and (b) but not (c). Indeed, the possibility that understanding the attitude of speaker certainty expressed by grammaticalized particles does not involve a sophisticated metarepresentational ability was suggested by Matsui et al. (2006). They demonstrated that Japanese 3-year-olds who successfully understood what was encoded by the two particles of certainty *yo* (certain) and *kana* (uncertain) were not as successful in false belief tasks which do require the first-order metarepresentational ability described above. These results strongly indicate that understanding the speaker's propositional attitude does not always involve a sophisticated metarepresentational ability. Rather, it is likely that when a particular propositional attitude is expressed in the form of a procedure (i.e. as a clue to the hearer's inferential comprehension of the appropriate attitude), as in the case of grammaticalized linguistic expressions, facial expressions or tone of voice, the interpretation process is quite different from the one used when it is expressed in the form of a concept, by linguistic expressions such as 'I believe/doubt that', 'definitely' and 'possibly', for instance.

An important question here is what enables 3-year-olds, who lack the required type of first-order metarepresentational ability to comprehend the speaker's attitude of certainty when it is communicated via a procedural indication of the speaker's knowledge or level of confidence, as in (a) and (b) above. The nature of procedural encoding and decoding is still under discussion (Wilson, 2011), but here we suggest that understanding what is encoded by Japanese particles of speaker certainty, for instance, is guided by children's more general capacity for epistemic vigilance. Sperber and his colleagues (2010) claim that epistemic vigilance in humans consists of a set of modular mechanisms that enable hearers to assess the reliability of both the speaker and the communicated information itself in order to avoid being misinformed. It has been suggested that epistemic vigilance has at least 3 functionally and developmentally distinct components: the moral, epistemic and mind-reading components (Mascaro and Sperber, 2009). If this is the case, it is reasonable to hypothesize that children's early sensitivity to Japanese particles of speaker certainty forms part of the epistemic component of epistemic vigilance, which may function without requiring sophisticated metarepresentational ability.

Procedural encoding and decoding by its nature requires at least some intuitive understanding of the equivalent concepts: for example, in order for Japanese children to understand the particles of speaker certainty *yo* and *kana*, at least an intuitive understanding of certainty and uncertainty is required. This level of intuitive understanding of mental states may be similar to what Dennett called 'sub-personal' level, as opposed to personal level, psychology (Dennett, 1969; Drayson, 2012). An important feature of sub-personal processes is that, while personal-level processes can be the target of conscious reflection, sub-personal ones cannot. If the personal vs. sub-personal distinction is on the right track to explain Japanese 3-year-olds' intuitive understanding of speaker certainty, it predicts that even if they can distinguish a certain speaker from an uncertain speaker on the basis of the particle used, they may not be able to explain how they made the distinction, as doing so requires conscious reflection on the process. In fact, this possibility was confirmed by Matsui and Miura (2009). They report that in a hidden object task, children between 3 and 5 generally trusted the informant who used the particle *yo* (certain) more than the one who used the particle *kana* (uncertain). When asked to explain their choices, however, only older children (4.5–5.11) managed to explain why they did so by referring to the utterances and particles used. This finding indicates that 3-year-olds did not have reflective or fully conceptual understanding of speaker certainty, and supports the view that their understanding was at the sub-personal level.

It is worth noting here that we are not claiming that children generally understand procedural encoding and decoding earlier than their representational counterparts. The Japanese 3-year-olds, who are well capable of distinguishing what is encoded by the sentence-final particles *yo* and *kana*, do not understand what is encoded by another Japanese sentence-final particle, *tte* (Matsui et al., 2006). This particle encodes procedural information about the source of the information provided, indicating that what the speaker is communicating is derived by hearsay. Although children start using this particle relatively early, comprehension of what it encodes starts developing much later, around 6 years of age. This can be explained by previous findings that the distinction between direct (e.g. eye-witness) vs. indirect evidence (by hearsay) seems to be acquired relatively late in development (Fitneva and Matsui, 2009; Matsui and Yamamoto, 2013). Thus, it seems that children can understand certain types of procedural information (e.g. speaker certainty) relatively early as long as an intuitive, sub-personal grasp of the equivalent concept is already possible for them. This, in turn, suggests that the development of epistemic vigilance is gradual. Within the modular account of epistemic vigilance, it seems reasonable to assume that each of a set of modular systems develops at a different time.

Furthermore, in the light of Dennett's distinction between personal and sub-personal level psychology, it is possible that modular epistemic vigilance mechanisms as a whole function at a sub-personal rather than a personal level. Recent studies suggest that procedural indications of speaker certainty by non-verbal means, such as facial expressions and gestures, may be understood by children around 2 years of age (Brosseau-Liard and Poulin-Dubois, 2014; Harris and Lane, 2014). This early understanding of non-verbal cues to speaker certainty is also likely to be part of the epistemic component of epistemic vigilance. Infants and toddlers are also good at evaluating degrees of benevolence in others (Hamlin et al., 2007; Kuhlmeier et al., 2003). Children's early understanding of benevolence and epistemic states as demonstrated in these studies is likely to be the product of sub-personal psychology in Dennett's sense. More research is needed to confirm this possibility.

It is important to emphasize here that both children and adults understand the speaker's confidence or uncertainty about the information being conveyed in the context of ostensive communication. As adults, as soon as we recognize an attempt at ostensive communication in others, we automatically start to construct an interpretation which includes information about the communicator's intentions, attitudes and beliefs (Sperber and Wilson, 1995). Our sensitivity to ostensive acts also plays an important role in the acquisition of generic knowledge, as recognizing a communicative act, together with an expectation that the communicator is benevolent, is usually enough for the recipient to interpret the communicated information and accept it as true (Csibra and Gergely, 2009). Sensitivity to ostensive acts and the expectation of epistemic benevolence are known to be present very early, since infants are capable of using them to learn new information as early as 6-months (Senju and Csibra, 2008). Epistemic vigilance is then essential in order to screen out mistakes or misinformation and prevent the hearer from accepting them.

The existing studies mentioned earlier suggest that children start screening out socially transmitted information around 2 years of age. A recent study, however, revealed that infants' statistical learning of the informant's likelihood of providing reliable new information begins much earlier, around 8 months (Tummeltshammer et al., 2014). Should this be seen as evidence of an even earlier capacity for epistemic vigilance in children? Generally, infants are known to be very good statistical learners in a variety of non-social domains, and whether this general ability should be considered as a part of epistemic vigilance may be controversial for the following reason: infants' sensitivity to statistical regularity in tracking an informant's reliability does not necessarily involve a deeper understanding of communicative intentions. Nonetheless, statistics is a useful tool for assessing observation-based evidence, and it is possible that the mechanisms for epistemic vigilance use this tool as soon as it becomes available to the cognitive system.

Let us now move on to consider the results of Study 2. In Study 2, children's sensitivity to linguistically expressed speaker certainty (a type of cognitive trust) was pitted against personal familiarity (a type of affective trust). We obtained two main findings. First, in the Certainty task, relative to the control condition, the 5-year-olds' bias toward the certain

speaker was reduced in the stranger-certain condition, while the 3-year-olds' bias was unaltered. Second, in the Familiarity task, relative to the control condition, 5-year-olds showed a robust bias toward the familiar adult in the experimental condition, while 3-year-olds did not. The findings indicate that 5-year-olds are sensitive to both clues to trustworthiness, and as a result, alter the relative weightings of the two clues depending on the speaker's overall characteristics. By contrast, 3-year-oldsappeared to be sensitive only to speaker certainty.

Thus, the findings of Study 2 suggest that, contrary to our prediction, familiarity is not always the ultimate basis for young children's assessment of the trustworthiness of informants. Also contrary to our prediction, affective trust did not seem stronger in younger than in older preschool children. When an informant who is highly familiar to a child expressed uncertainty about her own statement, 3-year-olds were more likely to dismiss the familiar person's claim than 5-year-olds. This finding is rather unexpected given the results reported in Corriveau and Harris (2009). They found that 5-year-olds, but not 3-year-olds, were sensitive both to past accuracy (cognitive trust) and personal familiarity (affective trust) of the informant, and their bias toward the familiar person was intensified when she was perceived as accurate and reduced when she was perceived as inaccurate. In other words, for 5-year-olds, past accuracy (a type of cognitive trust) was a more reliable clue than personal familiarity (a type of affective trust).

The difference between the findings reported in Corriveau and Harris and those in the current study suggest the following 3 possibilities. First, among a wide range of clues related to cognitive trust, speaker certainty is easier for 3-year-olds to understand than past accuracy. This partly explains why 3-year-olds in the current study consistently preferred to learn from the certain speaker while 3-year-olds in Corriveau and Harris's study did not consistently show a strong preference for the accurate informant. This possibility is also supported by previous findings that 3-year-olds are less sensitive to the degree of accuracy of their informants than 4-year-olds (Clément et al., 2004; Koenig et al., 2004; Koenig and Harris, 2005; Pasquini et al., 2007).

Second, once children become sensitive to the informant's accuracy in assessing his trustworthiness, it may remain a more reliable clue than speaker certainty for children in assessing overall trustworthiness. This partly explains the difference between the performance of 5-year-olds in the two studies. Past accuracy is intuitively a more reliable clue than certainty, because someone's past accuracy is evidence for the conclusion that this person is generally accurate and is going to be accurate in the future. By contrast, what can be concluded by observing someone who is certain or uncertain about something is more limited. For one thing, a person who is very certain about something may turn out to be wrong. Likewise, a person who is uncertain about something may still turn out to be right. A recent study confirms the possibility by demonstrating that children come to prioritize past accuracy over the attitude of certainty around 5 years of age (Brosseau-Liard et al., 2014).

Third, personal familiarity is generally a reliable clue for young children in assessing the trustworthiness of an informant, but its reliability is relative to other clues provided more or less at the same time. When pitted against potentially stronger cognitive clues such as past accuracy, children who are sensitive to both clues weigh the cognitive clue more than the affective clue; by contrast, when pitted against a potentially weaker cognitive clues such as speaker certainty, the same children are likely to weigh the affective clue more than the cognitive clue. Again this partly explains the difference between the performance of 5-year-olds in the two studies, but future investigation is needed to test this possibility directly. Currently, much less is known about children's understanding of affective trust in general than is known about cognitive trust in the context of overall assessment of the trustworthiness of an informant. More research is needed in this domain.

Let us note here that in Study 2, we were interested in finding out how children in the two age groups differ in the way they prioritize a particular clue that indicates the speaker's level of trustworthiness in relation to the other available clues. The study was therefore not designed to address the issue of potential individual differences in the emotional relation between a child and the mother. According to Corriveau and her colleagues (2009), however, the strength of children's affective trust for their mothers may vary depending on what kind of emotional bonding or attachment the pair has established previously. Also according to one model of affective trust among adults, attribution of trustworthiness is likely to be affected by an individual's feelings of dependence and their desire to believe that the informant is trustworthy (Weber et al., 2005). The current study demonstrated that there was a clear age difference in whether children prioritize their affective trust for the mother over a particular type of cognitive trust (speaker certainty) or vice versa. The question of how individual differences in mother-child relationships influence the general pattern of priority demonstrated in the age groups investigated in Study 2 is certainly an important issue to address in future research.

Acknowledgements

We have deeply benefited from stimulating discussions with Deirdre Wilson and Michiko Takeuchi. We are grateful to anonymous reviewers for their helpful and constructive comments. We thank the children and parents who participated in the study. This research was partly financed by JSPS Grants-in-aid for scientific research #24402043 and #15H03450 to Tomoko Matsui.

References

Bartsch, K., Wellman, H.M., 1995. Children Talk About the Mind. Oxford Press, New York.

Birch, S.A.J., Akmal, N., Frampton, K.L., 2010. Two-year-olds are vigilant of others' nonverbal cues to credibility. Dev. Sci. 13, 363–369.

Blakemore, D., 1987. Semantic Constraints on Relevance. Blackwell, Oxford.

Blakemore, D., 2002. Relevance and Linguistic Meaning: The Semantics and Pragmatics of Discourse Markers. Cambridge University Press, Cambridge.

Brosseau-Liard, P.E., Poulin-Dubois, D., 2014. Sensitivity to confidence cues increases during the second year of life. Infancy 19, 461–475.

Brosseau-Liard, P., Cassels, T., Birch, S., 2014. You seem certain but you were wrong before: developmental change in preschoolers' relative trust in accurate versus confident speakers. PLOS ONE 9 (9), e108308.

Clément, F., Koenig, M., Harris, P., 2004. The ontogeny of trust. Mind Lang. 19, 360–379.

Corriveau, K., Harris, P., 2009. Preschoolers continue to trust a more accurate informant 1 week after exposure to accuracy information. Dev. Sci. 12, 188–193.

Corriveau, K.H., Harris, P.L., Meins, E., Ferneyhough, C., Arnott, B., Elliott, L., Liddle, B., Hearn, A., Vittorini, L., de Rosnay, M., 2009. Young children's trust in their mother's claims: longitudinal links with attachment security in infancy. Child Dev. 80, 750–761.

Csibra, G., Gergely, G., 2009. Natural pedagogy. Trends Cogn. Sci. 13, 148–153.

de Villiers, J., 2007. The interface of language and theory of mind. Lingua 117, 1858–1878.

Dehe, N., Kavalova, Y. (Eds.), 2007. Parentheticals. John Benjamins, Amsterdam.

Dennett, D.C., 1969. Content and Consciousness. Routledge and Kegan Paul.

Dirks, K.T., Ferrin, D.L., 2002. Trust in leadership: meta-analytic findings and implications for organizational research. J. Appl. Psychol. 87, 611–628.

Drayson, Z., 2012. The uses and abuses of the personal/subpersonal distinction. Philos. Perspect. 26, 1–18.

Fitneva, S., Matsui, T. (Eds.), 2009. Evidentiality: A Window into Language and Cognitive Development, New Directions for Child and Adolescent Development, vol. 125. Jossey-Bass, San Francisco, CA.

Hamlin, J.K., Wynn, K., Bloom, P., 2007. Social evaluation by preverbal infants. Nature 450, 557–559.

Harris, P.L., Lane, J., 2014. Infants understand how testimony works. Topoi 33, 443–458.

Ifantidou, E., 2001. Evidentials and Relevance. John Benjamins, Amsterdam.

Itani, R., 1998. A relevance-based analysis of hearsay particles: with special reference to Japanese sentence-final particle TTE. In: Carston, R., Uchida, S. (Eds.), Relevance Theory: Applications and Implications. John Benjamins, Amsterdam, pp. 47–68.

Jazwal, V.K., Malone, L.S., 2007. Turning believers into skeptics: 3-year-olds' sensitivity to cues to speaker credibility. J. Cognit. Dev. 8, 263–283.

Koenig, M., Harris, P.L., 2005. Preschoolers mistrust ignorant and inaccurate speakers. Child Dev. 76, 1261–1277.

Koenig, M., Clement, F., Harris, P.L., 2004. Trust in testimony: children's use of true and false statements. Psychol. Sci. 10, 694–698.

Kuhlmeier, V., Wynn, K., Bloom, P., 2003. Attribution of dispositional states by12-month-olds. Psychol. Sci. 14, 402–408.

Landrum, A.R., Mills, C.M., Johnston, A.M., 2013. When do children trust the expert? Benevolence information influences children's trust more than expertise. Dev. Sci. 16, 622–638.

Lewicki, R.J., Bunker, B.B., 1996. Developing and maintaining trust in work relationships. In: Kramer, R.M., Tyler, T.R. (Eds.), Trust in Organizations: Frontiers of Theory and Research. SAGE, Thousand Oaks, CA.

Lewis, J.D., Weigert, A., 1985. Trust as a social reality. Soc. Forces 63, 967–985.

Mascaro, O., Sperber, D., 2009. The moral, epistemic and mindreading components of children's vigilance towards deception. Cognition 112, 367–380.

Matsui, T., 2000. Linguistic encoding of the guarantee of relevance: Japanese sentence-final particle *yo*. In: Andersen, G., Fretheim, T. (Eds.), Pragmatic Markers and Propositional Attitude. John Benjamins, Amsterdam, pp. 145–172.

Matsui, T., Miura, Y., 2009. Children's understanding of certainty and evidentiality: advantage of grammaticalised forms over lexical alternatives. In: Fitneva, S., Matsui, T. (Eds.), Evidentiality: A Window into Language and Cognitive Development. Wiley, San Francisco, CA, pp. 49–62.

Matsui, T., Yamamoto, T., 2013. Developing sensitivity to the sources of information: early use of the Japanese quotative particles *tte* and *to* in mother–child conversation. J. Pragmat. 59, 5–25.

Matsui, T., Yamamoto, T., McCagg, P., 2006. On the role of language in children's early understanding of others as epistemic beings. Cognit. Dev. 21, 158–173.

Matsui, T., Rakoczy, H., Miura, Y., Tomasello, M., 2009. Understanding of speaker certainty and false-belief reasoning: a comparison of Japanese and German preschoolers. Dev. Sci. 12, 602–613.

Mayer, R.C., Davis, J.H., Schoorman, F.D., 1995. An integrative model of organizational trust. Acad. Manage. Rev. 20, 709–734.

McAllister, D., 1995. Affect-based and cognition-based trust as foundations for interpersonal cooperation in organizations. Acad. Manage. J. 38, 24–59.

Moore, C., Bryant, D., Furrow, D., 1989. Mental terms and the development of certainty. Child Dev. 60, 167–171.

Moore, C., Pure, K., Furrow, D., 1990. Children's understanding of the modal expression of speaker certainty and uncertainty and its relation to the development to the development of a representational theory of mind. Child Dev. 61, 722–730.

Pasquini, E.S., Corriveau, K., Koenig, M., Harris, P.L., 2007. Preschoolers monitor the relative accuracy of informants. Dev. Psychol. 43, 1216–1226.

Sabbagh, M.A., Baldwin, D.A., 2001. Learning words from knowledgeable versus ignorant speakers: links between preschoolers' theory of mind and semantic development. Child Dev. 72, 1054–1070.

Senju, A., Csibra, G., 2008. Gaze following in human infants depends on communicative signals. Curr. Biol. 18, 668–671.

Shirai, J., Shirai, H., Furuta, Y., 1999. Acquisition of sentence-final particles in Japanese. In: Perkins, M., Howard, S. (Eds.), New Directions in Language Development and Disorders. Plenum Press, New York, pp. 243–250.

Sperber, D., Wilson, D., 1995. Relevance: Communication and Cognition, 2nd ed. Blackwell, Oxford.

Sperber, D., Wilson, D., 2002. Pragmatics, modularity and mindreading. Mind Lang. 17, 3–23.

Sperber, D., Clément, F., Heintz, C., Mascaro, O., Mercier, H., Origgi, G., Wilson, D., 2010. Epistemic vigilance. Mind Lang. 25, 359–393.
Tummeltshammer, K.S., Wu, R., Sobel, D.M., Natasha, Z., Kirkham, N.Z., 2014. Infants track the reliability of potential informants. Psychol. Sci. 25, 1730–1738.
Weber, J.M., Malhotra, D., Murnighan, J.K., 2005. Normal acts of irrational trust: motivated attributions and the trust development process. In: Kramer, R.M., Staw, B.M. (Eds.), Research in Organizational Behavior. JAI, Greenwich, CT, pp. 77–103.
Wharton, T., 2003. Interjections, language and the 'showing-saying' continuum. Pragmat. Cognit. 11, 39–91.
Wilson, D., 2011. The conceptual–procedural distinction: past, present and future. In: Escandell-Vidal, V., Leonetti, M., Ahern, A. (Eds.), Procedural Meaning: Problems and Perspectives. Emerald Group Publishing Limited, Binley, pp. 3–31.
Wilson, D., Sperber, D., 1993. Linguistic form and relevance. Lingua 90, 1–25.
Xu, F., Evans, A.D., Li, C., Li, Q., Heyman, G., Lee, K., 2013. The role of honesty and benevolence in children's judgments of trustworthiness. Int. J. Behav. Dev. 37, 257–265.