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Mental vocabulary and markers of uncertainty in childhood and preadolescence

Alda Maria Scopesi
University of Genoa

Anna Maria Rosso
University of Genoa

Paola Viterbori
University of Genoa

Erika Panchieri
University of Genoa

Abstract
From middle childhood through adolescence, a growing awareness of interpretive activities in the construction of knowledge and belief occurs. Children progressively realize that cognitive activities are highly inferential and, consequently, uncertain. The present study moves from the hypothesis that a developmental progression of the understanding of the relative certainty of mental processes across late childhood and preadolescence is reflected in the use of mental terms. In particular, the present study analyses the production of two cognitive verbs (*think* and *know*) and of markers of uncertainty in an autobiographical narrative. The results confirm an increase in the use of *think* and of markers of uncertainty in children aged 8 to 12, suggesting a major change in children's appreciation of subjectivity. The production of these mental terms was not associated with general verbal ability. Gender differences in their use were marginal and, when present, favored girls.

Keywords: mental state talk, middle childhood, preadolescence

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In research on Theory of Mind (ToM), many studies underline the crucial role of children's linguistic competence in promoting the ability to understand mental states (e.g., Antonietti, Liverta Sempio, Marchetti, & Astington, 2006; Astington, 2001; Harris, De Rosnay, & Pons, 2011; Milligan, Astington, & Dack, 2007). Full mentalization involves strong linguistic competence, which is relevant to being able to modulate and express internal states of mind. A growing corpus of research findings has documented associations between children's developing capacities for representing and reasoning with mental states and semantic aspects, particularly words referring to inner states (for reviews, see Carpendale & Lewis, 2004; Symons, 2004). Indeed, an appropriate use of words such as *believe*, *will, being happy*, *guilty* or *ashamed* indicates that a child has not only linguistic abilities but also a precise knowledge of mental life. The mastery of words referring to inner states, such as beliefs, emotions and desires, indeed implies that a child understands that human beings may have different psychological states and are capable of representing them and using them to understand the behaviour of others. Many studies have explored the emergence of mental state talk and its development in infancy (Bartsch & Wellman, 1995; Bretherton & Beeghly, 1982; Hughes & Dunn,1997; Ruffman, Slade, & Crowe, 2002; Shatz, Wellman, & Silber, 1983; Wellman, 2002). Within mental state talk, a particularly interesting class of words is represented by the *belief predicates*, including items such as *think, believe, remember* and *know*. According to Papafragou, Cassidy, & Gleitman (2007, 126) "these items differ in their semantic-conceptual properties and in their typical learning signatures from most other words in several ways: they do not refer to perceptually transparent properties of the reference world; they are quite insalient as interpretations of the gist of scenes; they appear frequently in maternal speech to babies and yet occur in the child's own speech comparatively late; the concepts that they encode are evidently quite complex or abstract; and they are hard to identify from context even by adults who understand the meanings." In preschoolers, mental verb input (i.e., adult input with *think, know* and *remember*) significantly influences children's understanding of false belief. An experiment by Howard Gola (2012) demonstrated that mental verb utterances about other people, even when not directed towards children, scaffold children's attention to differing perspectives, thus more efficiently promoting certain aspects of their ToM development.

The first studies of children's use of cognitive verbs have identified a distinction between semantic and pragmatic use. Expressions such as "I know" or "I

think so" are often used idiomatically: in these cases, the term is used to capture attention or as an automatic insert, and the literal internal state meaning of the verb does not contribute directly to the intended meaning of the utterance (Shatz, Wellman, & Silber, 1983). More recently, Hall and his colleagues (Booth & Hall, 1994; Frank & Hall, 1991) analyzed the polysemic nature of cognitive verbs such as *know* and *think* and proposed that their different meanings are acquired according to a six-level processing hierarchy that organizes the meaning of cognitive verbs from the least abstract and difficult to the most abstract and difficult from a conceptual perspective. Specifically, the range of uses varies from the lower levels of perception, recognition, recall, and understanding to the higher levels of metacognition and evaluation. For example, between 10 and 15 years of age, *know* and *think* are also used at more abstract levels (e.g., *to know* as a belief or attitude regarding the truth of a statement or as an anticipation of a future event). The different qualities of the use of cognitive verbs are connected to the development of children's understanding of cognitive activities.

By late childhood, children begin to organize their knowledge of cognitive activities in terms of similarities between the characteristics and functions of different cognitive processes. Schwanenflugel, Fabricius, and Noyes (1996) evaluated the ability of children and adults to rate the similarities in pairs of cognitive verbs (e.g., *know, think, understand, guess, explain*) in terms of how the mind is used in the activities that are referenced by each verb. The multidimensional scaling analyses of similarity ratings by children and adults revealed two major dimensions: information processing and certainty. The information processing of mental activities was organized along a continuum and ranged from the perceptual processing of input (e.g., *hear, attend, notice*) to the production of output (e.g., *decide, invent*), with processes that mediate between the two located near the middle of the dimension (e.g., *think, memorize*). The certainty dimension ranged from verbs implying high certainty at one end (e.g., *know, memorize, understand*) to those indicating low certainty at the opposite end (e.g., *guess*). Both dimensions were present in the multidimensional scaling analyses for 8- to 10-year-old children as well as for adults, but the relative weights of these aspects changed with age; children emphasized information processing more than certainty, whereas adults weighted certainty more heavily than did children. These data indicate that beginning in late childhood, there is a growing awareness of inferential and interpretative activities and a parallel realization that cognitive processes differ in certainty: some activities are highly inferential and are produced on the basis of less certain information.

With regard to the understanding of inferential activities, a few studies have highlighted that during middle childhood, children are able to differentiate inferential reasoning from cognitive processes, such as perception and guessing, and that

they begin to distinguish between different patterns of reasoning (Pillow, 2002). Specifically, deduction, induction and guessing are based on different patterns of informational input and differ in the certainty or strength of conclusions that they produce. Beginning in kindergarten and first grade, children were observed as rating deductions as more certain than weak deductions or informed guesses; third- and fourth-grade children and adults could differentiate strong inductions, weak inductions, and informed guesses from pure guesses; and only third-graders and adults rated the strong induction as significantly more certain than the weak induction (Pillow, Pearson, Hecht, & Bremer, 2010).

The development of the understanding of the use of lexical items to express different levels of certainty has also been explored by Moore and colleagues (Moore, Bryant, & Furrow, 1989; Moore & Furrow, 1991; Moore, Pure, & Furrow, 1990). Children from preschool age to middle childhood develop the ability to distinguish among different levels of certainty expressed by certain cognitive verbs (e.g., *know, think, guess*), modal verbs (e.g., *must, might, could*) or modal adjuncts (e.g., *probably, possibly, maybe*). Other changes in the organization of cognitive verb extensions occur during the elementary school years. During this period, children learn that various cognitive verbs that reflect and manage cognitive uncertainty (e.g., *estimate, guess, reason, think, question*) can be applied to similar contexts. Furthermore, these verbs may be similar or different with respect to how they are applied within the same contexts (Schwanenflugel, Henderson, & Fabricius, 1998).

The evaluation of certainty is relevant in grasping not only the development of reasoning abilities but also the development of social cognition and of the self-concept. The awareness of the opacity of mental states and of the possibility of value errors is a major component of social cognition abilities. During their lives, all individuals learn that they are not always able to interpret the feelings, intentions and beliefs of others, and they realize that the understanding of their own mental states can also be difficult. People frequently tend to attribute more desired mental states to themselves and to other people. Furthermore, during their life span, individuals realize that internal states may be screened and that their insight is therefore partial and limited (Fonagy, 2006). For example, it is often impossible to determine whether a person is actually as peaceful as he appears or whether he is masking his sadness because he cannot cope with it or because he does not want to communicate and share his feelings with other people. In this sense, uncertainty regarding the knowledge of mental states has a positive connotation because it indicates both a relevant interactive competence and the perception of the Self as an individuated person with specific confines and awareness of its own limits. According to the psychoanalytic perspective, this capacity indicates the completion of the separation-individuation process, which is fulfilled during adolescence (Blos,

1962, 1979). During this period, these processes occur concurrently with, and are linked to, cognitive changes, such as the understanding of the concepts of possibility and logical necessity (Piéraut-Le Bonniec, 1980).

The capacity to reason in terms of logical truth – and not only in terms of factual truth – involves the capability to discriminate between different aspects of a situation, selecting the most relevant elements and considering them adequately; the ability of adolescents to assess their own knowledge is proven by explicit reference to decision-making processes and to uncertainty. In particular, the use of terms that refer to uncertainty can signal one's awareness of the opacity of mental states and can be regarded as an indicator of mentalization ability (Howard, Mayeux, & Naigles, 2008).

In general, in the vast body of research on mental state talk, several studies have addressed the relationship between this aspect and the development of complex patterns of reasoning that imply awareness of the certainty/uncertainty dimension and inferential processes. Nevertheless, few studies have analyzed these aspects according to individual variables, particularly in the later ages, such as late childhood and preadolescence.

Our research aims were the following:

1. We aimed to study children from 8 to 12 years in their different uses of two cognitive verbs (*know* and *think*) that imply different levels of certainty and of other mental words (i.e., uncertain cognitive verbs, modal adverbs, modal verbs, and modal adjectives) that refer to uncertain situations or contexts. In particular, we hypothesized that we would find a significant increase in uncertainty-related language, especially in preadolescents;
2. We aimed to analyze the relationship between mental state talk and verbal ability. Based upon the literature in this field, we hypothesized that a link does not exist between verbal ability and mental state talk in late childhood and preadolescence, in contrast to previous developmental phases (O'Connor & Hirsch, 1999);
3. We aimed to verify whether gender differences can be detected in the use of cognitive verbs and markers of uncertainty. Concerning this aim, we did not formulate precise hypotheses, because of the inconsistency of the data from previous studies. In fact, some data support the existence of gender differences (Bosacki & Astington, 1999) whereas other findings do not (O'Connor & Hirsch, 1999).

Methods

Participants

The sample included 138 children, 61 females and 77 males, ranging in age from 8 to 13 years old. Children were divided into four age groups: group 1 comprised 27 children attending the third grade of primary school (41% male; mean age in months±SD: 103±3.3); group 2 comprised 40 children attending the fourth grade (57% male; mean age in months±SD: 114.3±3.1); group 3 comprised 26 children attending the fifth grade (61% male; mean age in months±SD: 125.7±3.8); group 4 comprised 45 children attending the second year of junior secondary school (60% male; mean age in months±SD: 148.2±2.3). Children in the first three groups were recruited from the same primary school; the last group of children was recruited from two different junior secondary schools. All the schools were located in a central district of Genoa and served families from the middle and working classes. All the participants were native Italians and no child suffered from a learning disorder or other psychological disorder. The verbal IQ of the children ranged from 86 to 148 (mean±SD: 117.4±13.4).

Measures

The Child Attachment Interview (CAI) (Shmueli-Goetz, Target, Fonagy, & Datta, 2000) was administered to children. This instrument was used only to evaluate the frequency and quality of the mental state talk in the context of an autobiographical narrative. According to Bruner, autobiographical narratives allow human beings to give sense to their experiences. When narrating, we make efforts to understand ourselves and others largely on the basis of plausible interpretations and interplay of the minds of ourselves and of others. In this sense, narratives are means of analyzing developmentally advanced references to mental states and mentalizing processes.

The CAI is a semi-structured interview that was specifically developed to assess state of mind with respect to attachment in childhood and early adolescence. Children are invited to describe their relationships with their primary caregivers and to answer a series of questions addressing areas that include times of conflict, distress, illness, hurt, separation and loss. All of the CAIs were videotaped and then transcribed verbatim. For each CAI protocol, we counted the total number of words produced; the number of terms referring to emotional (e.g., *adore*, *appreciate*, *envy*, *get angry*), cognitive (e.g., *analyze*, *be aware*, *understand*, *change one's mind*) and voli-

tional lexicon (e.g., *desire*, *feel like*, *prevent*) in addition to the number of words related to skills (e.g., *be able*, *succeed*, *ability*) and the number of markers of uncertainty. Within cognitive terms, *think* and *know* were counted separately and classified based on their type of use: genuine, conversational and metacognitive (Booth & Hall, 1994). Genuine use occurs when a cognitive word contributes directly to the intended meaning of an utterance (e.g., "He knows the answer"), conversational use contributes only indirectly as a conversational device (e.g., "You know, I must go now"), and metacognitive use requires the speaker to indicate awareness of mental acts (e.g., "I would like to know more than I do").

Markers of uncertainty included uncertain cognitive verbs (e.g., *believe, suppose*), modal adverbs (e.g., *perhaps*), modal verbs (e.g., *should*) and modal adjectives (e.g., *probable, possible, likely*). The use of words that express likelihood, such as markers of uncertainty, indicates awareness of the opacity of mental states and can be considered an indirect sign of mentalizing ability. For the purpose of this study, only markers of uncertainty and the cognitive verbs *think* and *know* were considered.

Verbal ability was evaluated by administering the verbal scale of the WISC-III (1991), which has been considered a valid proxy of language skills (Smith, Smith, & Dobbs, 1991; Smith, Smith, Taylor, & Hobby, 2005; Sparks, Ganschow, & Thomas, 1996).

Statistical analysis

Descriptive statistics (mean, SD, range, kurtosis and skewness) were calculated for the number of occurrences for *think*, *know* and *markers of uncertainty* and for the same variables divided by the square root of the total number of words produced in the narratives. The square root has a mitigating effect of the impact of the length of narratives; this transformation allows for adjustment of the number of cognitive verbs and *markers of uncertainty* according to the total number of words, so that we can compare the occurrences of these terms among children with narrative productions of different lengths (Rizzi, 1995).

The Shapiro-Wilk test was performed to test for normality. Because the data were not normally distributed, non-parametric statistics were used for the subsequent analyses.

The Kruskal-Wallis test was used to compare age groups on the production of *think*, *know* and *markers of uncertainty* (number of occurrences and corrected number of occurrences). A Mann-Whitney test with Bonferroni correction was used for post-hoc comparisons.

Correlation between markers of uncertainty, cognitive verbs and verbal IQ were calculated using Spearman's correlation for each age level and for the whole sample.

Gender differences in the production of both cognitive verbs and markers of uncertainty (number of occurrences and corrected number of occurrences) were analyzed using a Mann-Whitney test for each age level.

Results

The total number of words produced by children in their narratives ranged from 303 to 5363 (M = 2024.5, SD = 987.31) without any significant differences between the four age levels. The distributions of *know* and *think* and of *markers of uncertainty* in the whole sample are reported in table 1.

Table 1: *Children's production of cognitive terms and markers of uncertainty in CAI narratives.*

	mean±SD	range	Skewness	kurtosis
Know	6.7±6.28	0-40	2.51	8.65
Know (corrected)[1]	.14±.12	0-.67	2.13	5.82
Think	3.15±3.57	0-18	2.04	4.77
Think (corrected)[1]	.06±.07	0-.31	1.48	2.23
Markers of uncertainty	17.65±15.17	2-89	1.91	4.95
Markers of uncertainty (corrected)[1]	.38±.29	.04-1.54	1.66	3.35

[1] NOTE: corrected variables were calculated by dividing the number of occurrences by the square root of the total number of words produced in the narrative.

The use of know and think

Most children (from 90% to 97% across the four age groups) used the verb *know* in a genuine way at least once. The conversational use was less frequent (from 23% to 38% across the four age groups). However, no significant differences were found between the age groups in the mean occurrences of *know* (see Figure 1), even when corrected for the total number of words produced in the narratives.

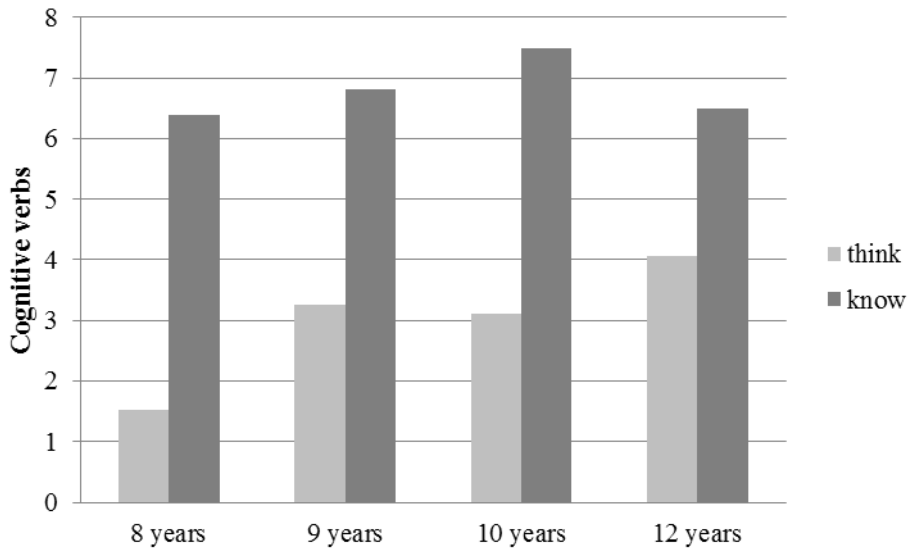

Figure 1. Mean number of occurrences of think and know across the four age groups.

The percentage of children producing the verb *think* in a genuine way increased significantly across the four age groups from 50% at age 8 to 82% at age 12 (χ^2 (3) = 16.4; p <. 01). Additionally, the percentage of children using the word *think* in a conversational manner increased (from 8% at age 8 to 17% at age 12), though not significantly. Few children used both cognitive verbs in a metacognitive manner (8% for *know* and 16% for *think*), and there were no significant differences between the age groups.

A Kruskall-Wallis test revealed a significant effect of age group on the occurrence of the cognitive verb *think* (χ^2 (3) = 9.13; p =. 028), which increased from a mean of 1.5 at age 8 to a mean of 4.1 at age 12 (see Figure 1). The differences in its production between the four age groups were also present when comparing the occurrence of the verb corrected for the total number of words produced by each child (χ^2 (3) = 8.55; p= .036). A post-hoc Mann-Whitney test with Bonferroni correction showed a significant difference between third grade children (group 1) and junior secondary school children (group 4) for both corrected (Z = -2.95; p < .05) and non-corrected occurrences (Z = -2.94; p < .05).

Markers of uncertainty

Nearly all of the children (from 93% to 100% across the four age groups) used at least one marker of uncertainty in their narratives. A Kruskall-Wallis test revealed a significant effect of age group (χ^2 (3) = 11.27; p = .010) on the occurrence of *markers of uncertainty* that indicated an increase in the number of markers of uncertainty produced by children, from a mean occurrence of 14.7 at age 8 to 22.8 at age 12 (see Figure 2).

The differences in the production of markers of uncertainty between the four age groups was also present when comparing the occurrence of the markers corrected for the total number of words (χ^2 (3) = 10.25; p = .017). A post-hoc Mann-Whitney test with Bonferroni correction showed a significant difference between fourth grade children (group 2) and junior secondary school children (group 4) (Z= -3.43, p < .05 for non-corrected occurrences; Z = -3.40, p < .05 for corrected occurrences). The difference between group 1 and group 4 in the production of markers of uncertainty did not reach significance when applying the Bonferroni correction.

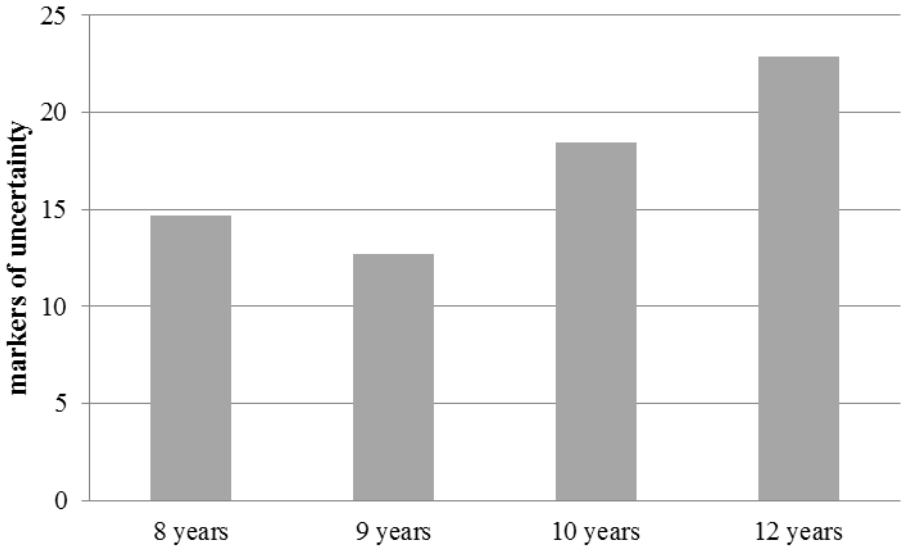

Figure 2. Mean number of occurrences of markers of uncertainty across the four age groups.

The relationship between verbal ability, gender and mental state talk

Neither markers of uncertainty nor cognitive verbs were correlated with verbal IQ at any age level. Markers of uncertainty were correlated with both types of cognitive verbs (*know*: Spearman rho = .44; $p < .001$; *think*: Spearman rho = .19; $p = .031$).

With regard to gender, even though females as a group produced more markers of uncertainty than did males (M = 20.4, SD = 18.6 for females; M = 15.1, SD = 11 for males), this difference was not statistically significant. The difference between the genders showed a trend towards significance only at 12 years of age (M = 29.5, SD = 24.4 for females; M = 17.2, SD = 11.1 for males; Z = -1.73, $p = .082$).

The only gender difference was found in fifth grade children (group 3), in which girls showed a higher occurrence of the cognitive verb *know* (M = 13.2, SD = 11.2 for females; M = 4.7, SD = 3.28 for males; Z = -2.51, $p = .01$).

Discussion

According to Schwanenflugel et al. (1998), one of the major developmental changes that occurs in the organization of cognitive verbs from childhood to adulthood is the increasing relevance that children place on the certainty/uncertainty aspects of mental activity.

This change reflects the growing recognition of the role of cognitive activities in the construction of knowledge and belief and constitutes an important advancement in children's appreciation of subjectivity (Pillow, 2008).

The increasing importance that children attribute to the certainty aspects of mental activity reflects a change in their mentalization. A relevant step in this capacity is the understanding that beliefs depend on having access to information. However, a more complex understanding is achieved only at approximately middle school age, when children realize that even with access to the same information, people may interpret such information differently and thus have different beliefs (Sharp, 2006).

In general, our data confirm a developmental progression of the understanding of the relative certainty of mental processes from middle childhood to preadolescence

The results indicate an increase in the use of *think* from 8 to 12 years, whereas the use of *know* is quite stable across the different age levels. As Booth and Hall (1994) underlined, cognitive words whose prototypical meanings are of a lower

level (e.g., *know*) are mastered semantically earlier than cognitive words whose prototypical meanings are of a higher level (e.g., *think*): the prototypical usage of *know* does not increase after 8 years of age (Pepi & Alesi, 2002). At the pragmatic level, *know* is used to indicate a high level of certainty and generally indicates successful access to information. On the contrary, *think* expresses a minor level of certainty and is characterized by the reference to hypothetical thinking. From a semantic perspective, *know* is considered a factive verb, which presumes for the speaker a judgment of truth on the complement, whereas *think* is a non-factive verb and does not imply a judgment of truth on the complement. Thus, the significant increase in occurrences of *think* with age suggests improvements in the ability to process uncertainty, particularly in preadolescence. There was an unexpected result concerning the metacognitive uses of *know* and *think*, which proved to be rare across all age levels and did not increase from childhood onward. However, this result is congruent with the observation that the metacognitive use of cognitive verbs in autobiographical narratives is also limited in adults (Scopesi, Rosso, & Panchieri, 2011).

The significant increase of markers of uncertainty confirms a critical step in the rising consciousness of evaluation dimensions and margins of doubt in the mental processes that are typical of adolescence. Markers of uncertainty are words with low semantic density that do not convey direct reference to explicit content but rather imply critical thinking, awareness of the subjectivity of knowledge and the acquisition of concepts such as likelihood. The growing weight that is given to uncertainty in preadolescence reflects increasing understanding that different interpretations are common because they ensue from mental processes and not only from scarce information. Certainty and uncertainty represent basic cognitive feelings that can be used to generate information seeking and direct attention in learning settings (Berlyne, 1960) as well as to monitor comprehension and guide actions and decisions (Clore & Parrot, 1994). When feelings of uncertainty orient mental processing, individuals tend to process such feelings more deeply and to perceive those processes as emotionally laden.

The absence of correlation between mental state talk and verbal intelligence supports previous findings that indicate a developmental trend in the link between mental state talk and verbal ability: individual differences in inner state talk and language appear to be strongly related with 2- and 3-year-olds (Hughes, Fujisawa, Ensor, Lecce, & Marfleet, 2006), but the relationship becomes insignificant in 4-year-olds (Hughes & Dunn, 1997) and clearly independent in early adolescence (O'Connor & Hirsch, 1999). In short, according to this developmental trend, after the early years of life, mental state talk becomes a relatively independent compe-

tence. However, we cannot exclude a relationship between mental state talk and more specific linguistic abilities, such as vocabulary and pragmatics.

Finally, regarding the role of gender, we did not find remarkable differences between males and females; however, girls seem to have a slightly better ability to reflect on the possible ambiguities of reality and are more aware of the subjectivity of judgment and knowledge. Our results are consistent with the literature in this field. Although findings on gender differences in this domain are mixed, with some studies reporting no difference between males' and females' use of mental terms (Fivush, Hazzard, Sarfati, & Brown, 2003; Gobbo & Racanello, 2007; O'Connor & Hirsch, 1999), studies that have found a gender difference tend to report that girls, both in childhood and adolescence, are more competent than boys (Fox, 1991; Bosacki & Astington, 1999). For example, two studies with primary school children indicate that girls are more inclined to describe imaginary characters in terms of mental states and tend to use more emotional terms than boys (Camaioni, Longobardi, & Bellagamba, 1998; Longobardi, Piras, & Presaghi, 2008). In preadolescence, Bosacki and Astington (1999) found that girls between eleven and thirteen years of age were more proficient than boys in explaining stories in terms of mental states and performed significantly better on a task assessing the understanding of the psychological worlds of the characters of short stories. These results can be considered within the literature about gender differences in identity formation across preadolescence and adolescence (Fermani, Crocetti, Pojaghi, & Meeus, 2010; Mancini, 1997).

The current results should be considered in the context of the study limitations. Specifically, the cross-sectional design and the descriptive slant do not allow for an understanding of the development of the mental processes underlying uncertainty references. Furthermore, a qualitative analysis of the specific contextual usages of uncertainty markers could be useful.

Further research in different contexts could be conducted to gain an appreciation of the increasing relevance of cognitive certainty and uncertainty in different cognitive activities (e.g., autobiographical narratives vs. other forms of spontaneous talk) and according to intra-individual variation in the quality of interpersonal relationships (e.g., different types of attachment and individual empathetic capacities).

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Alda Maria Scopesi obtained a Master degree in Literature at the University of Genoa (Italy) and a Master degree in Psychology at the University of Padua (Italy). She is currently Full Professor of Developmental Psychology at the University of Genoa. She carried out researches in the fields of communicative and linguistic abilities in typical and atypical development and of transition phases in life span development. Contact author: alda.scopesi@unige.it.

Anna Maria Rosso is a clinical psychologist and psychotherapist. She has private practice in Genoa (Italy), where she provides psychoanalytic psychotherapy for adolescents and adults. She is lecturer in Clinical Psychology and Projective Techniques at the Department of Education Sciences of the University of Genoa. Her research interests include adolescent psychology and psychopathology, psychological assessment, mentalization in typical and atypical development from a psychoanalytic standpoint.

Paola Viterbori obtained her Master degree in General and Experimental Psychology at the University of Padua (Italy), and then her PhD in Psychology Research Methods and her specialization in Clinical Psychology at the University of Genoa (Italy). She is currently Assistant Professor in Developmental and Educational Psychology at the University of Genoa. Her research interests include typical and atypical language acquisition and the development of executive function and self-regulatory skills in childhood.

Erika Panchieri is a clinical psychologist specialized in developmental disorders. She has private practice in Chiavari and La Spezia (Italy), where she also collaborates with associations and schools. She is attending a postgraduate course in Psychopathology of Learning Disabilities at the University of Padua (Italy).
Her research interests include learning disabilities, mentalization and the development of psychological lexicon in childhood.