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Cognitive Sensitivity in Sibling Interactions: Development of the Construct and Comparison of Two Coding Methodologies

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Research Findings: The goal of this study was to develop a construct of sibling cognitive sensitivity, which describes the extent to which children take their siblings' knowledge and cognitive abilities into account when working toward a joint goal. In addition, the study compared 2 coding methodologies for measuring the construct: a thin slice approach (i.e., making intuitive, impressionistic judgments) and an interval coding approach (i.e., coding the presence of behaviors in 20-s snapshots). A sample of 385 sibling pairs (younger sibling $M = 3.15$ years, older sibling $M = 5.57$ years) was used for the present study. In Phase 1, independent raters used both methodologies to code videos of sibling interactions using a subset of sibling pairs ($n = 50$ dyads). Siblings interacted for 5 min on a challenging cooperation task, and the extent of cognitive sensitivity was coded for each child. Measures of validity and interrater agreement were acceptable for both methodologies, and thin slice coding reduced time demands. The thin slice measure was chosen as the preferred method. Phase 2 added 3 additional items to the thin slice measure and validated the measure using data from all 385 sibling pairs. Psychometric properties of the final thin slice measure were good. *Practice or Policy:* Research and practical implications are discussed.

Siblings have been shown to play an important role in the development of children's social cognition (Dunn, 2002; Jenkins & Astington, 1996), and effects may operate through siblings being sensitive to the cognitive needs of their partner. The first goal of the current study was to present the construct of sibling cognitive sensitivity, building on findings related to parental sensitivity and its effect on children's cognition as well as those related to sibling influences on children's social cognition. The second goal was to operationalize the construct. The third goal was to compare two coding methods, thin slice and interval, for the assessment of this construct.

THE ROLE OF SOCIAL INTERACTION IN CHILDREN'S DEVELOPMENT

Human development is social in origin (Carpendale & Lewis, 2004; Dunn, 2002; Fernyhough, 2008; Vygotsky, 1978). In the first 6 months of life, parent–infant interactions are characterized by parents contingently responding to the emotional expressions, vocalizations, and gestures of

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their babies. This pattern of sensitive parental responding, characterized by positive affective behavior, contributes to children's development of compliance and moral development (Kochanska, Forman, Aksan, & Dunbar, 2005), their cooperation (Kochanska, Aksan, & Carlson, 2005), and their abilities to form relationships with others (Sroufe, 2005). In the second half of the first year the dyadic interaction becomes triadic: Objects are introduced into the interaction as partners draw each other's attention to a shared aspect of the world (Moore, 2006; Tomasello, Carpenter, Call, Behne, & Moll, 2005). This begins an attunement that is more cognitive in orientation as the child thinks about what the other knows, understands, and believes (Astington, 2001; Carpendale & Lewis, 2004).

Most of the research on parental sensitivity has focused on its importance in the development of children's social and affective functioning (Atkinson et al., 2000; Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003; Sroufe, 2005). More recently its role in cognitive development has been emphasized. Children with mothers who show higher levels of sensitive responding have enhanced executive functioning (Bernier, Carlson, & Whipple, 2010) and better developed language and literacy skills (Landry, Smith, Swank, Assel, & Vellet, 2001; Tamis-LeMonda, Bornstein, & Baumwell, 2001; Tamis-LeMonda, Bornstein, Kahana-Kalman, Baumwell, & Cyphers, 1998; Wade, Prime, Browne, & Jenkins, in press). Similarly, although the traditional emphasis of sensitivity is on parents' abilities to respond appropriately to the affective state of infants, parental attunement to children's cognitions has been a recent emphasis. For instance, mind-mindedness describes parents' abilities to read and understand the thoughts, emotions, and desires of their children (Laranjo, Bernier, & Meins, 2008; Meins, Fernyhough, Fradley, & Tuckey, 2001; Meins et al., 2003), while parental mental state talk refers to how much and in what ways parents talk about the mind, including cognitions, to their children (Jenkins, Turrell, Kogushi, Lollis, & Ross, 2003).

Within the family, sensitivity is a construct mainly applied to the parent–child relationship. This construct, however, is applicable to siblings. Sibling relationships show a high level of intimacy and familiarity (Dunn, 2002). Siblings' interactions can be finely tuned and supportive, with evidence of mutual concern (Howe & Rinaldi, 2004), protective elements (Conger, Stocker, & McGuire, 2009; Gass, Jenkins, & Dunn, 2007), and teaching behaviors that are sensitive to the interactional partners' needs (Howe, Brody, & Recchia, 2006). Although the presence of siblings in the home has been found to be an important predictor of children's social cognition (Jenkins & Astington, 1996; Perner, Ruffman, & Leekam, 1994; Peterson, 2000), findings are inconsistent, and the interactional processes that confer this advantage are not well understood. Thus, exploration into the patterns of behavior through which siblings influence one another's development is an important line of research.

DEVELOPING A COGNITIVE SENSITIVITY CONSTRUCT

The term *cognitive sensitivity* describes the extent to which an individual considers the knowledge and abilities of his or her partner when working toward a joint goal. It involves presenting material in a way that is meaningful for his or her partner, irrespective of competence differences between them. Prior to 3 years of age children show a range of competencies related to reading the intentions of others (see Tomasello et al., 2005). Although we expected to see differences in cognitive sensitivity because of competence and power differentials, the construct was conceptualized as an individual difference, equally applicable to younger and older siblings. We suggest three processes, not themselves mutually exclusive, that combine to foster cognitive sensitivity: building mutuality, mind reading, and communicative clarity.

Building Mutuality

As discussed previously, mutuality begins in infancy with a mutually responsive and rewarding dyadic interaction. Mutual relationships are characterized by positively valenced turn-taking interactions that have a dance-like quality (e.g., Aksan, Kochanska, & Ortmann, 2006; Feldman, 2012; Moore, 2006; Stern, 2002). As children mature, the positive valence of interactions, the engagement between interactional partners, and their ability to read and respond to one another's cues become important for children's outcomes (e.g., Forman, Aksan, & Kochanska, 2004; Kochanska, Forman, et al., 2005; Webster-Stratton, Rinaldi, & Reid, 2011). The positive and responsive parenting behaviors that foster mutuality have been shown to predict many aspects of children's later functioning (Ainsworth, Blehar, Waters, & Wall, 1978; Bakermans-Kranenburg et al., 2003; Landry et al., 2001). Similar findings have been reported for positivity and mutuality in the sibling relationship (see Howe, Ross, & Recchia, 2011). Two aspects of mutuality-building behavior were emphasized in our measure: siblings providing one another with positively valenced feedback and fostering turn taking within the interaction.

Mind Reading

To what extent are children sensitive to what their siblings know or understand? When children teach their siblings a task, their teaching behaviors are related to the difficulty of the task and the age of their siblings (Howe et al., 2006), as well as the learners' behaviors (Howe & Recchia, 2009), suggesting that siblings adjust their behavior according to the needs of their siblings. Recchia, Howe, and Alexander (2009) reported marked individual differences in the extent to which one sibling (the teacher) facilitates the understanding of the other sibling (the learner): Some siblings foster a collaborative process by actively involving their partners, whereas others deter involvement by correcting learners' errors and minimizing their own levels of instruction. Individual differences in children's teaching abilities are related to their sociocognitive development (Davis-Unger & Carlson, 2008; Strauss, Ziv, & Stein, 2002). Mind reading in children has generally been assessed using theory of mind tasks. Our focus on cognition and the rating of naturalistic interaction led us to draw on studies that examined mind reading during interaction (Realo et al., 2003; Thomas & Fletcher, 2003) to develop our items. We developed items related to sensitivity to what the partner knows or understands, rephrasing to achieve understanding, and responsiveness to subtle requests for help.

Communicative Clarity

Parent–child and sibling conversation and descriptive dialogue play a central role in the development of children's social understanding (Jenkins & Astington, 1996; Jenkins et al., 2003; Landry, Smith, & Swank, 2006; Taumoepeau & Ruffman, 2006, 2008). We see communicative clarity as part of cognitive sensitivity for two reasons. First, it shows that an individual has an implicit understanding that there is ambiguity of meaning between two minds that needs to be addressed. Meta-communication, or communication about the task, including rules and goals, is important for the success of young children's interactions (Whitebread & O'Sullivan, 2012). For instance, during the inherently ambiguous activity of sociodramatic pretend play, young children use explicit discussion of rules and goals, operating within and outside of the frame of the play, in order to communicate effectively with their partner (Göncü & Kessel, 1988; Halliday-Scher, Urberg, & Kaplan-Estrin, 1995). The second reason communicative clarity is important to the construct of cognitive sensitivity is that it is the means through which children provide meaningful input to their partners. Klein and colleagues (Klein, 1996; Klein & Alony, 1993; Klein, Feldman, & Zarur, 2002; Klein, Wieder, & Greenspan, 1987) have shown that when parents and siblings focus attention and regulate performance through verbal and nonverbal feedback, there are effects on children's task performance and cognitive development. Thus, we operationalized communicative clarity as providing verbal and nonverbal directions that are meaningful to the task as well as promoting a mutual understanding about the goals and the rules of the task.

In order to establish the convergent validity of the cognitive sensitivity construct we expected to find positive associations with the following constructs. First, we expected age to be related to cognitive sensitivity. Second, cooperation, which emerges around 18 months and involves the sharing of intentions and the coordination of behavior to achieve a joint goal (Brownell & Carriger, 1990; Warneken & Tomasello, 2007), was expected to correlate with cognitive sensitivity. Third, theory of mind, which refers to a person's ability to attribute mental states (i.e., desires, emotions, beliefs, intentions, and other inner experiences) to oneself and others, goes through substantial growth in the preschool years (Wellman, Cross, & Watson, 2001). As theory of mind understanding involves representing the internal states of the self and the other, this skill should be linked to cognitive sensitivity (Davis-Unger & Carlson, 2008; Strauss et al., 2002). Fourth, language is likely to be essential in cognitive sensitivity, as it provides the mental architecture for representing the cognitions, desires, and emotions of others (Astington & Jenkins, 1999; Milligan, Astington, & Dack, 2007). In addition, it is through linguistically based interactions that children afford their siblings with meaningful input (Fernyhough, 2008). Finally, we expected cognitive sensitivity to correlate with children's emotion knowledge. As emotions signal the status of goals both intra- and interpersonally (Keltner, Oatley, & Jenkins, 2013; Oatley & Johnson-Laird, 2011), being able to accurately identify another person's emotions allows the interactional partner to alter his or her behavior accordingly.

COMPARING METHODOLOGIES FOR CODING COGNITIVE SENSITIVITY

Although traditional coding schemes involve the moment-to-moment judgment of specific behaviors, more recent methodologies have explored the use of impressionistic coding. Another goal of the current study was to compare the efficiency and psychometric properties of an impressionistic coding scheme to those of a more traditional coding method.

Developmental and epidemiological studies are critical to informing public health policies and initiatives. Exploration into interaction patterns within the home helps to guide prevention and treatment services that are designed to support children and families. Observational methods provide a means of collecting ecologically valid data that capture phenomena that are not easily and validly assessed through self-report (Margolin et al., 1998). Behavior is traditionally quantified using rating scales (i.e., completing a Likert-type scale on target variables) or observational methods such as event-based coding (i.e., noting each time a codable event of interest occurs) or interval coding (i.e., dividing a period of time into a number of relatively brief intervals and noting which codable events occur). Indeed, much of the literature investigating behavioral interactions uses such methods (e.g., Bernier et al., 2010; Howe et al., 2006; Howes & Matheson, 1992; Klein et al., 2002; Meins et al., 2001; Wade et al., in press). However, the process of training and coding in these methods is resource intensive. In addition, the reliability of observers is a major concern, and considerable training is required to ensure that they will produce essentially similar records (Bakeman & Gottman, 1987). Thus, the development of an observational measure that maximizes efficiency (i.e., reducing time and money spent coding behavior) while maintaining psychometric properties (i.e., validity and reliability) of the measurement was another goal of this study.

Thin slice judgments have been defined as judgments based on brief observations of a person's expressive behaviors that provide information regarding personality, affect, and interpersonal relations (Ambady, 2010). They are characterized by intuitive, or automatic (as opposed to controlled or deliberative), evaluations (Ambady, Bernieri, & Richeson, 2000). In thin slice coding, raters are trained (albeit to a lesser extent than for other observational methods) so as to promote familiarity with the constructs and thus facilitate judgment accuracy (Ambady et al., 2000). Typically, two or more independent raters code the data. With this method, judgments of the raters are combined to obtain a group mean judgment, which increases reliability and decreases the impact of a single observer's judgment (Ambady et al., 2000; Baker, Haltigan, Brewster, Jaccard, & Messinger, 2010). Ambady and Rosenthal (1992) conducted a meta-analysis across 38 studies examining the predictive accuracy of judgments based on thin slices of behavior. The analysis revealed an overall effect size of .39, suggesting ''thin slices of behavior provide a great deal of information and permit significantly accurate predictions'' (Ambady & Rosenthal, 1992, p. 267). There has since been a wealth of research demonstrating the accuracy of thin slice judgments regarding social and interpersonal functioning, including job performance (Hecht & LaFrance, 1995), intellect (Murphy, Hall, & Colvin, 2003; Reynolds & Gifford, 2001), emotionality and the Big Five personality variables (Carney, Colvin, & Hall, 2007), and relationship quality (Bernieri, Gillis, Davis, & Grahe, 1996). Raters' intuitive judgments have been used successfully in developmental studies to rate child behavior, marital interactions, and family interaction patterns (Baker, Haltigan, et al., 2010; Baker, Messinger, Ekas, Lindahl, & Brewster, 2010; Waldinger, Hauser, Schulz, Allen, & Crowell, 2004).

Thin slicing offers an alternative to traditional coding methods that has the potential to reduce the time it takes to code and maintain reliability. In addition, the impressionistic nature of thin slicing may enhance the validity of behavioral coding schemes compared to more traditional coding. It has been demonstrated that higher level cognitive processes (e.g., deliberation) reduce the predictive validity of making judgments based on brief behavioral observations (Ambady, 2010). Indeed, Ambady (2010) suggested that thin slice judgments may be beneficial in their allowance for attention to all relevant information, as well as instinctive and affective reactions.

THE CURRENT STUDY

Based on the theoretical case made previously for the construct, our next goals were to operationalize the construct and compare two coding methodologies, thin slice and interval, for its assessment. For the thin slice methodology, raters watched the entire interaction and then provided impressionistic global codes on a Likert scale. The interval coding methodology required raters to note the presence of codable events in a series of 20-s snapshots using narrowly defined guidelines. The following predictions were made:

1. Cognitive sensitivity will form a coherent construct indicated by internal consistency. It will be reliably coded by different raters.
2. Cognitive sensitivity will demonstrate convergent validity by correlating positively with children's age, cooperation, theory of mind, language, and emotion knowledge.
3. The thin slice measure of cognitive sensitivity will show better reliability (i.e., internal consistency and interrater agreement) and convergent validity than the interval measure.
4. The thin slice measure will require fewer resources as measured by time spent on reliability and coding. Furthermore, the use of one rater's scores versus the pooled scores of two raters will result in acceptable measurement (i.e., reliability and convergent validity).

Upon examination of the psychometric properties and resource demands associated with each measure, one would be deemed a better measure and subsequently refined and validated within a larger sample.

METHODS

Sample

Subjects came from the Intensive Kids, Families, and Places (IKFP) study, which is a birth cohort longitudinal study that includes older siblings. The goal of the broader study is to investigate genetic and environmental influences on children's socioemotional and sociocognitive development by examining within- and between-family influences. Families were recruited through a program called Healthy Babies Healthy Children, run by Toronto and Hamilton Public Health, which contacts the parents of all newborn babies within several days of the newborn's birth. To participate in the study families had to have a newborn singleton (younger sibling) and an older child who had been born within 4 years of the newborn (older sibling). Additional inclusion criteria included the mother speaking English and the birthweight of the newborn being $>$1,500 g. A total of 501 families were enlisted into the IKFP study (reasons for nonenlistment included inability to contact families, families not meeting criteria, and refusals). The younger siblings were $\sim$2 months old at Time 1, and these families were followed up at Time 2 ($\sim$18 months) and Time 3 ($\sim$3 years). The IKFP sample was similar to the general population of Toronto and Hamilton in terms of the number of persons in the household and personal income but had a lower proportion of nonintact families, fewer immigrants, and more educated mothers (Meunier, Boyle, O'Connor, & Jenkins, 2013).

Participants

The study was carried out in two phases, with Phase 1 allowing for a comparison between thin slice and interval coding and Phase 2 allowing for item refinement and validation within a larger sample. Phase 1 included a subset of the full sample at Time 3: the first 50 families to be visited. Phase 2 included all IKFP families visited at Time 3.

The full sample at Time 3 (used for Phase 2) consisted of 385 sibling dyads and their families. The mean age of the younger siblings was 3.15 years ($SD = 0.27$; range = 2.5–4.5), and the mean age of the younger sibling's next-in-age older sibling was 5.57 years ($SD = 0.77$; range = 4.0–7.7). The mean age gap was 2.42 years ($SD = 0.72$; range = 0.83–4.17), and 51.8% of children were male. The sample was diverse: 57.1% of mothers were Caucasian, 13.0% were East/South East Asian, 14.0% were South Asian, and 7.0% were Black (8.8% were classified as ''other''). In all, 55% of mothers had been born in Canada. Based on maternal report, 60.1% of children were exposed to English only in the home, 34.4% were exposed to a mix of English and another heritage language, and 1.9% were exposed to their heritage language exclusively (3.5% not reported). The mean number of years of parental education was approximately 15 (range = 7–22 years). The subsample (50 sibling pairs), used in Phase 1, was similar to the full sample used in Phase 2 on most characteristics just described. However, the subsample had a higher percentage of mothers who identified themselves as Black (14.0%), a lower percentage of mothers who identified themselves as South Asian (8.0%), as well as a slightly higher percentage of male children (54.0%).

Procedure

Data from Time 2 and Time 3 were used for the current study and came from demographic questionnaire measures; direct testing of children's receptive vocabulary, cooperation, theory of mind, and emotion knowledge; and videos of sibling interactions.

Sibling pairs were filmed engaging in a cooperative building task. The camera was set up to film the faces, upper bodies, and arms of the children. Sibling dyads were instructed to sit on a ''magic carpet'' (yoga mat) and use Duplo building blocks to build a picture of a design together. They were told they only had 5 min to build it. In addition, they were each only allowed to touch two colors (e.g., the younger sibling could touch light green and light blue blocks and the older sibling could touch dark green and dark blue blocks) following the procedures suggested by Aguilar, O'Brien, August, Aoun, and Hektner (2001). To ensure understanding children were asked to point to the pieces they could each touch. If children finished the design before the end of 5 min, they were given a second model to build. All children were stopped after 5 min of the task, regardless of completion.

Measures

Cognitive Sensitivity (Time 3)

Items indexing mutuality (Aksan et al., 2006; Moore, 2006; Webster-Stratton et al., 2011), mind reading (Realo et al., 2003; Thomas & Fletcher, 2003), and communicative clarity (Klein et al., 2002; Whitebread & O'Sullivan, 2012) were generated by the investigators. Although these items were generated from three areas, the areas themselves overlap and were expected to correlate well with one another. In Phase 1, eight items were coded using both thin slice and interval coding. Items were consistent across the interval and thin slice measures but were worded to facilitate coding on the basis of an impression for the thin slice coding and absent versus present for interval coding (described below). In Phase 2, two further items assessing mind reading and one additional item assessing communicative clarity were added to the thin slice measure to enhance the scale both empirically and conceptually. The 11 items and their wording can be found in Table 1 with their corresponding derivations. Items were z-scored for ease of interpretation in multilevel models.

Interval coding. Two independent raters were trained in interval coding. Raters used narrowly defined, detailed descriptions of each item to guide their coding. They were instructed to make notes and watch the clip as many times as necessary to ensure accurate coding. Each sibling interaction was coded in a series of 20-s intervals, and each sensitivity item was noted as present (1) or absent (0) within each interval. The proportions of episodes in which the behaviors occurred, for each child, were the final interval item scores.

Thin slice coding. Two raters (different than the interval raters) were provided with brief descriptions of the individual cognitive sensitivity items. They were directed to use all available

TABLE 1
List of Thin Slice and Interval Items, Including the Component of Cognitive Sensitivity That the Items Index

Item	*Thin slice*	*Interval*	*Component of cognitive sensitivity*
Phase 1			
1	This person gives clear and specific verbal directions.	Specific verbal direction	Communicative clarity
2	This person gives positive nonverbal directions.	Positive nonverbal direction	Communicative clarity
3	This person reminds his/her partner about goals/rules of the task.	Metalevel direction	Communicative clarity
4	This person is responsive to his/her partner's requests for help, even those that are subtle and/or nonverbal.	Response to a request for help	Mind reading
5	This person gives positive feedback to reinforce his/her partner.	Positive feedback	Mutuality
6	This person reminds his/her partner when it's his/her turn.	Turn-taking directions	Mutuality
7	If given a task, this person will try to complete it.	On task	Communicative clarity
8	If given a task, this person will try his/her best to follow the rules.	Noncompliance with rules (reversed for analyses)	Communicative clarity
Phase 2			
9	This person is sensitive to what his/her partner knows and/or understands.		Mind reading
10	This person is good at rephrasing what his/her partner does not understand.		Mind reading
11	This person is clear in his/her requests for help.		Communicative clarity

information from the video and to rate quickly based on general impressions. The prompt for each of the 11 items was ''Give your impression of how this person would interact with his/her her partner on a day-to-day basis, based on what you have seen.'' Raters watched the 5-min film clip once per sibling pair and then each provided independent thin slice codes for each child on a 5-point Likert scale ranging from *not at all true* (1) to *very true* (5). For Phase 1, raters' judgments on each item were pooled to create mean judgments and used as the thin slice item scores. We then tested the viability of thin slicing using a single rater rather than pooling the scores of two raters. The psychometric properties of these two methods are discussed in the Results section. Based on the results from Phase 1, single raters' ratings made up the thin slice scores for Phase 2.

Language (Time 3)

The Peabody Picture Vocabulary Test, a standardized test of receptive language skills (Dunn & Dunn, 1997), consists of 204 questions grouped into 17 sets of 12 items that are arranged in order of increasing difficulty. For each item, children are presented with four black-and-white pictures and asked to select the picture that best represents an orally presented word. The starting point of the test is determined by the child's age. Item sets that are too easy or too difficult for a child (as dictated by a standardized administration protocol) are not administered. The test yields one overall standardized summary score representing the child's level of receptive vocabulary skills. The test has been shown to have good psychometric properties (Dunn & Dunn, 1997).

Theory of Mind (Time 3)

An adaptation of the scale described by Wellman and Liu (2004) was used. This scale presents various tasks in a sequential format that map closely onto the development of children's theory of mind understanding. As children move through the scale, tasks become conceptually more difficult. Thus, progression further along the scale reflects more sophisticated theory of mind understanding. The first three tasks of the theory of mind scale assessed children's understanding of diverse desires and beliefs, and knowledge and ignorance. This was followed by tasks that assessed more sophisticated theory of mind understanding, such as false belief, belief-based emotion, and real-apparent emotion. At the end of the scale, we added a second-order belief question (Astington, Pelletier, & Homer, 2002). If children failed two consecutive tasks on the theory of mind scale, testing was stopped. For all theory of mind tasks, stories were enacted for children with the use of puppets and props/pictures (i.e., second-order false belief). For each of the tasks, the child is given a score of 0 (fail) or 1 (pass). A mean was taken across tasks, and the internal consistency of the scale was $\alpha = .85$.

Cooperation (Time 2)

Children's cooperation skills were measured with two previously developed cooperation tasks drawn from Warneken, Chen, and Tomasello (2006). The cooperation tasks included the trampoline and double tubes tasks. The tasks measure the extent to which children cooperate with the tester to achieve a mutual goal. In the trampoline task, the child was invited by the tester to help make a bear dance on a handheld trampoline. In the double tubes tasks, the child was invited to help the experimenter complete a sequence of actions in which she rolled a ball down one of two tubes and asked the child to catch it at the bottom. Discrete 10-s intervals were coded on a 5-point scale, up to a maximum of 80 s for each task. For the trampoline task, the scale ranged from 1 (*no success*) to 5 (*high engagement*). A mean of each child's scores on the trampoline trials was derived. For the double tubes task, the scale ranged from 1 (*no attempt*) to 5 (*complete success*). A mean of each child's scores on the double tubes catch trials was derived. Coders then rated a global cooperation score along a 4-point scale based on the percentage of the task on which the child was cooperative (0%–25%, 26%–50%, 51%–75%, 76%–100%). Finally, after the tasks were completed, coders also rated a global impression of the extent to which children were cooperative with the tester for each task along a 4-point scale of 0 (uncooperative 3 or more times), 1 (uncooperative twice), 2 (uncooperative once), and 3 (cooperative at all times); the items were then reversed. A total of 10% of films were double-coded by independent coders, and the mean interrater reliability across all cooperation tasks was $\alpha = .86$ (range = .68–.96). A composite cooperation variable was constructed by taking the mean of the standardized scores, and the internal consistency of the five items making up the composite was $\alpha = .71$.

Emotion Knowledge (Time 3)

The Assessment of Children's Emotion Skills (Schultz & Izard, 1998) was used to measure children's emotion knowledge. In this task, children are shown a series of pictures in which children display different emotions. They are asked to identify the emotion. In previous research, children's scores on the Assessment of Children's Emotion Skills emotion knowledge accuracy scale related to their attention regulation and social functioning (Mostow, Izard, Fine, & Trentacosta, 2002; Trentacosta, Izard, Mostow, & Fine, 2006). The mean number of correctly identified emotions made up the final score.

RESULTS

Phase 1

First, to test our hypothesis that cognitive sensitivity represents a coherent construct, we examined the internal consistency of the cognitive sensitivity scales. Internal consistency for the thin slice and the interval scales was calculated using Cronbach's alpha. Thin slice item scores were on a Likert scale, and interval item scores were the proportion of snapshot episodes in which the behavior occurred. Both measures included eight items (Phase 1 in Table 1). Internal consistency was excellent for the thin slice composite, $\alpha = .90$, with item–total correlations ranging between .49 and .81. Internal consistency for the interval composite was acceptable, $\alpha = .60$, with item–total correlations ranging from .15 to .61. The interval items that showed low item–total correlations were those that occurred infrequently, demonstrating that these items made less of a contribution to the overall construct. We can conclude that there is evidence for a coherent construct for cognitive sensitivity involving mutuality, mind reading, and communicative clarity. Thin slice and interval composites were constructed by taking the mean of the items ($N = 8$) for each measure, respectively.

Second, we hypothesized that cognitive sensitivity would be reliably coded by different raters. The interrater reliability of the total scale as assessed by Cronbach's alpha (based on generalizability theory; Cronbach, Rajaratnman, & Gleser, 1963) was acceptable for the thin slice rating (younger, $\alpha = .75$; older, $\alpha = .75$) and high for the interval coding (younger, $\alpha = .97$; older, $\alpha = .99$). The interrater reliability for single thin slice items ranged from $\alpha = .48$ to $\alpha = .76$, and for single interval codes it ranged from $\alpha = .84$ to $\alpha = .99$. Thus, for the thin slice ratings there was consensus between raters on the cognitive sensitivity scale but not for single items. For the interval ratings both single items and the total scale were reliably rated.

Third, we examined the convergent validity of the two composites by testing their association with constructs hypothesized earlier to be related to cognitive sensitivity. As the data structure was nested (children within families), multilevel models were carried out with cognitive sensitivity as the outcome (Level 1 = child, Level 2 = family). Models were run separately for each convergent validity construct (as the goal was to examine bivariate relationships between the measure and constructs). Further details about separate models are available from the first author. Coefficients are shown in Table 2. Both the thin slice and the interval composites were positively related to children's age, theory of mind, linguistic skills, cooperation, and emotion knowledge. Effect sizes were in the medium to large range for the thin slice and interval measures. The relation of the cognitive sensitivity scales to expected social cognitive variables suggests that the scale was measuring the hypothesized construct.

Fourth, we hypothesized that thin slice coding would show better reliability (i.e., internal consistency and interrater agreement) and convergent validity than interval coding. As indicated previously, both the interval and thin slice methodologies demonstrated acceptable internal consistency, interrater agreement, and convergent validity. Although the interval measure showed better item- and scale-level interrater agreement, the thin slice measure showed better internal consistency and convergent validity. However, all differences were negligible, and thus the measures are considered to have similar validity and reliability.

Next, we expected that the thin slice measure would require fewer resources as measured by time spent on reliability and coding. It took approximately 7 min per rater to code one dyad (providing codes for each sibling's behavior) using the thin slice methodology. As this methodology requires two raters, the total time spent was 14 min. Training (i.e., discussion of concepts) took approximately 1 hr. The total time expenditure for coding using the thin slice methodology was 12.7 hr. For interval coding, each sibling dyad took approximately 20 min to code. However, the

TABLE 2
Regression Coefficients and Standard Errors for Correlates of Cognitive Sensitivity (Phase 1) Derived From Multilevel Models

Variable	*Thin slice pooled raters*	*Interval*	*Thin slice rater 1*	*Thin slice rater 2*
Age ($N = 100$)	.49 (.06)***	.45 (.06)***	.57 (.06)***	.36 (.06)***
Language ($N = 93$)	.39 (.10)***	.38 (.10)***	.35 (.10)***	.33 (.10)***
Theory of mind ($N = 99$)	.60 (.07)***	.53 (.07)***	.62 (.08)***	.48 (.08)***
Cooperation ($N = 82$)	.47 (.08)***	.37 (.08)***	.58 (.08)***	.33 (.08)***
Emotion knowledge ($N = 100$)	.38 (.10)***	.33 (.10)***	.41 (.11)***	.30 (.10)**

Note. The number of children in the multilevel models varied as a function of missing data.
$^{**}p < .01$. $^{***}p < .001$.

training of interval raters (including reliability) required approximately 30 additional hours, which resulted in a total expenditure of 46.6 hr of coding. The interval approach took 3.7 times longer to complete than the thin slice approach. Given the strong psychometric properties of both measures, the reduced demand on laboratory resources associated with thin slice coding led us to prefer it as the methodology for coding cognitive sensitivity in siblings.

Finally, we expected that using single raters' codes independently, rather than pooling thin slice codes across two raters, would provide acceptable measurement. Internal consistency of the thin slice items was good for both raters independently (rater 1, $\alpha = .82$; rater 2, $\alpha = .91$). Independent composite scores were calculated for Rater 1 and Rater 2, respectively. As noted previously, rater agreement on these composite scores was good. An examination of each rater's data independently, as opposed to averaged, showed that each rater's scores were significantly correlated with constructs hypothesized to be related to cognitive sensitivity, although there were small differences in the magnitude of correlations (see Table 2). Thus, the use of one rater rather than an aggregation of two raters is considered to be psychometrically sound.

Phase 2

In Phase 2 we added items to give us better coverage of children's mind reading (''This person is sensitive to what his/her partner knows and/or understands'' and ''This person is good at rephrasing what his/her partner does not understand'') and communicative clarity (''This person is clear in his/her requests for help''). Cronbach's alpha was found to be good for the new cognitive sensitivity composite ($N = 11$; $\alpha = .89$). Item–total correlations ranged from .43 to .79. Interrater reliability was tested using Cronbach's alpha by double-coding a minimum of 10% of the videos and revealed good agreement for younger siblings ($\alpha = .88$) and acceptable agreement for older siblings ($\alpha = .72$). Finally, associations with social cognitive variables showed the same pattern as that seen for Phase 1, with effect sizes in the medium to large range (data not shown; analyses are available from the first author on request).

DISCUSSION

The Construct of Cognitive Sensitivity

The first two goals of the study included presenting the construct of sibling cognitive sensitivity and operationalizing it using observational measures. Attunement between interactional partners has been demonstrated to be an important contributor to children's social and cognitive functioning (Carpendale & Lewis, 2004). Past research has focused on the responsiveness of interactional partners (mostly mothers) to children's emotional and affective states. More recent research has examined parents' awareness of children's cognitive and mental states (Jenkins et al., 2003; Meins et al., 2001, 2003). Our goal was to develop a measure of sibling cognitive sensitivity that was applicable to siblings of varying ages. Our construction of a measure of cognitive sensitivity allowed us to measure individual differences in children's awareness of their siblings' knowledge and abilities. We hypothesized three components of cognitive sensitivity: children's contributions to building mutuality, their mind-reading abilities, and their communicative clarity. These three abilities were shown to form one internally consistent construct that could be reliably coded by different raters. It was found to be related to hypothesized components of the child's social cognitive skills.

These findings provide evidence for the plausibility of rating cognitive sensitivity in siblings as young as 3 years old and offer insight into potential mechanisms through which siblings influence one another's social cognitive development. Fernyhough (2008) described how multiple alternative perspectives that children are afforded in their social interactions facilitate the restructuring of their cognition, contributing to the development of social understanding. The alternative viewpoint needs to be at a level that is in line with the child's cognitive functioning in order to be assimilated (Piaget, 1926; Vygotsky, 1978). In line with other studies investigating sibling interactions (Davis-Unger & Carlson, 2008; Howe & Recchia, 2009; Klein et al., 2002), we demonstrated that it is possible to code sibling interactions for the extent to which children engage with their siblings' minds in a way that is cognitively meaningful for their partners. We operationalized these concepts within an individual difference framework that could be used to rate the interactions of siblings.

Cognitive sensitivity was found to relate to several aspects of children's social cognition. As cognitive sensitivity demonstrates the extent to which an individual engages with the mind of his or her partner and provides him or her with meaningful input, it was expected to relate to children's capacities to share intentions and coordinate behavior to reach a joint goal (Brownell & Carriger, 1990; Warneken & Tomasello, 2007), understand that others have beliefs that are different from their own (Wellman et al., 2001), and read emotional signals that represent the status of goals (Keltner et al., 2013). It is of interest to note that language competence also relates to this skill. The relationship between children's theory of mind and language is well established (Milligan et al., 2007), with one hypothesis being that language provides the mental architecture, in the form of syntactic structures, that allows for the representation of others' beliefs and goals (Astington, 2001). As with the development of other social cognitive skills in the preschool period, we found that cognitive sensitivity increases with age. As well as increasing competence, such differences also reflect the natural power balance between older and younger siblings (Perlman, Siddiqui, Ram, & Ross, 2000). Although theory of mind measurement reaches a ceiling with age, because all normally developing children eventually pass these tasks, the cognitive sensitivity measure was designed to be applicable to children of different ages, without a ceiling. We are currently achieving good variability on the same thin slice measure in a sample of adult mothers interacting with their children (Browne, Leckie, & Jenkins, 2012).

Although our goal was to develop an individual difference measure, the behavior of one person is rarely independent of his or her interactional partner, with evidence for reciprocal effects or bidirectionality in a variety of relationships (Perlman & Ross, 1997). Several methodologies allow for an investigation of this issue, including sequential analyses (Perlman & Ross, 2005), hazard models (Stoolmiller & Snyder, 2006), and the social relations model (Kenny, Kashy, & Cook, 2006; Rasbash, Jenkins, O'Connor, Tackett, & Reiss, 2011). For instance, by requiring all family members to interact with all other family members, the social relations model allows researchers to partition variance into that which is attributable to the individual, that which is attributable to the dyad, and that which is attributable to the family as a whole. We are currently utilizing the cognitive sensitivity measure within a social relations model context, which allows us to determine the extent to which cognitive sensitivity is attributable to an individual (i.e., trait-like), emergent between members of a dyad (i.e., reciprocal), or attributable to the family as a whole (indicating genetic or shared environmental influence; Browne & Leckie, 2013).

The construct of cognitive sensitivity may have important implications for research investigating the relationship between sibship size and children's theory of mind. Results have been mixed, with some studies showing a positive relation between sibship size and theory of mind (e.g., Jenkins & Astington, 1996; Peterson, 2000), some showing that having older siblings is the most beneficial (e.g., Ruffman, Perner, Naito, Parkin, & Clements, 1998), and some showing no relationship (e.g., Cole & Mitchell, 2000; Pears & Moses, 2003). Others have suggested that it is not the presence or absence of siblings that explains this relationship but the quality of siblings' interaction. We suggest that cognitive sensitivity is a key aspect of relationship quality that builds this understanding of mind. This hypothesis will be tested in future work.

Thin Slice Versus Interval Coding

In addition to outlining and operationalizing the construct of cognitive sensitivity, we sought to compare the reliability, validity, and efficiency of thin slice and interval coding measures to inform our decision of the preferred methodology for coding the construct. We found the thin slice measure to be of greater viability in terms of internal consistency and convergent validity. Note that the attenuated convergent validity of the interval measure is likely related to its weak internal consistency. In terms of interrater reliability, the thin slice measure demonstrated lower, albeit adequate, properties in comparison to the interval measure. These differences were negligible, and thus both measures were considered to be of equal viability in terms of psychometric properties.

The similarity in the psychometric properties of an impressionistic measure and a more traditional observational methodology speaks to the accuracy of intuitive judgments. Waldinger and colleagues (2004) suggested that nonexperts may make important contributions to observational coding, bringing a sophisticated level of intuition that comes with social experiences. Thin slice coding allows for instinctive reactions and the automatic integration of all relevant information, which has been argued to be a natural process occurring within human social behavior (Ambady, 2010). In addition, the thin slice measure reduced demands in terms of time spent on training, maintaining reliability, and coding videos. This supports the suggestion that the use of automatic judgments rather than the cognitive demands associated with manual-based coding reduces the process of training raters and coding data (Waldinger et al., 2004). Insofar as intuitive judgments provide for the psychometrically sound measurement of behavior and a relief from resource demands, they appear to be a viable option for an increasing number of domains in psychological research. Using independent raters rather than aggregating rater judgments provides a further means by which investigators can minimize resource demands and has the potential to provide an impetus for an increased use of observational methodology.

There are potential implications of this work for both researchers and practitioners working in children's early development. The construct of cognitive sensitivity needs to be more widely investigated. Perhaps it is not just the affective sensitivity of interactional partners that is critical for early development but also their *cognitive* sensitivity. This article has established that a child's cognitive sensitivity relates to his or her own social cognitive capacities. The next step is to determine whether children's cognitive sensitivity predicts change in their siblings' development. We have found expected associations between children's cognitive sensitivity and their siblings' language development (Prime, Pauker, Plamondon, Perlman, & Jenkins, 2014), supporting the value of the construct. Such findings provide support for further consideration of intervention studies that target sibling interaction (Brotman et al., 2005; Kennedy & Kramer, 2008; Siddiqui & Ross, 2004). Of course, cognitive sensitivity may also be important for teachers and parents, and we are currently investigating this possibility. Finally, the thin slice methodology, because it is not resource intensive, may be useful in education and public health contexts as researchers and practitioners try to evaluate programs and services that aim to optimize children's environments.

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