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The Role of Temperament in Children's Reliance on Others as Sources of Information

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By 3 years of age, children generally have a firm understanding of others' reliability, but there is considerable variation among individual children. Little attention has been paid to factors that influence such individual differences. This study addressed this by assessing the relation between reliability understanding and temperament in children approaching their third birthday. We measured children's ability to judge a speaker's trustworthiness and to selectively learn new information from a reliable informant. Observer ratings provided assessments of children's activity, task orientation, and affect/extraversion. Significant associations between selective trust and the temperament dimension of affect/extraversion were found, along with associations between selective trust and gender and language ability. This indicates that the ability to ascertain whether a speaker is a reliable person from whom to learn is related to several individual child characteristics. Copyright © 2014 John Wiley & Sons, Ltd.

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Children actively seek others as sources of information about the world and need to select appropriate informants, by attending to their accuracy and trustworthiness, in order to become effective learners (Harris, 2007). Understanding of others' reliability develops early in life (Harris & Corriveau, 2011) and has two components. The first, *reliability tracking*, is the ability to explicitly judge whether an informant is providing accurate information. The second, *selective trust*, involves selectively learning from only a previously reliable person. Most previous research on reliability understanding has studied children's average capacities for one or

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both of these components. Although not well studied, there is much individual variation in reliability understanding among children, and we do not yet know what factors lead to such individual differences. Given the importance of reliability understanding for learning, understanding the sources of variation that lead to individual patterns of development is critical.

The goal of this study was to examine one possible source of individual variation in reliability understanding—temperament. Individual differences in temperament play an important role in cognitive development and social competence in early childhood (Eisenberg & Fabes, 1992; Matheny, 1989). Studies looking at the role of temperament in specific social cognitive abilities report temperament as an important underlying factor in joint attention (Vaughan et al., 2003) and imitation (McCall, Parke, & Kavanaugh, 1977). By exploring the temperamental traits associated with children's understanding of trustworthiness, this study will improve our understanding of why some children are better able to select appropriate informants. As such, it may suggest new avenues for improving children's abilities in this important cognitive domain.

Early Reliability Understanding

Early in development, children consider the accuracy of those around them (see Harris & Corriveau, 2011). In their second year, infants begin to distinguish between accurate and inaccurate speakers (Koenig & Echols, 2003; Pea, 1982). By 24 months, infants are sensitive to a speaker's prior accuracy, generalize it to new interactions, and do not learn well from unreliable informants (Koenig & Woodward, 2010). Once they reach their third birthday, toddlers not only keep track of reliable speakers, they actively seek out and selectively learn from reliable informants when given new information, and they remember an informant's accuracy for up to a week after exposure (Birch, Vauthier, & Bloom, 2008; Corriveau & Harris, 2009; Ganea, Koenig, & Millet, 2011; Sabbagh & Baldwin, 2001). Although many studies of reliability understanding have focused on word learning, this skill is not limited to that arena. Children will endorse object functions, and by 4 years of age, they will even selectively learn rules for games from a previously reliable speaker over an unreliable one (Birch, Vauthier, & Bloom, 2008; Koenig & Harris, 2005; Rakoczy, Warneken, & Tomasello, 2009). Thus, by preschool, a significant proportion of children demonstrate that they can determine another person's reliability and be selective in seeking out trustworthy sources of information.

Nevertheless, there is variation in reliability understanding at this age. Across studies, an average of 74% of 3-year-olds succeeded in tasks measuring their explicit reliability judgement and selective trust in a reliable source, 64% demonstrated more advanced selective trust by disregarding unreliable information in the face of their own experience, and 73% were able to recall an informant's accuracy after a delay (Birch, Vauthier, & Bloom, 2008; Clement, Koenig, & Harris, 2004; Corriveau & Harris, 2009; Koenig, Clement, & Harris, 2004; Ma & Ganea, 2010). Thus, although many 3-year-olds demonstrate a sophisticated ability to monitor reliability, this capacity seems to languish in some children. Research thus far has informed about mean levels of performance, whereas few studies have sought to explain factors associated with individual differences in this skill. The current work attempts to address this question by examining the role of temperament.

Individual Differences in Social Cognition and Reliability Understanding

Studies of the relation between temperamental traits and other aspects of development suggest that attention/persistence, effortful control, and affect/extraversion

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are related to social cognition more generally and thus may also be related to reliability understanding. For example, effortful control and attention enable children to take multiple sources of information into account and predict empathy and the development of conscience (Rothbart, 2004). These abilities are necessary for selective trust, as children must keep track of information from multiple sources and take into account the intentions of those sources in order to determine from whom they should learn. Furthermore, social aspects of temperament, such as shyness and interest in others, have been linked to joint attention abilities (Vaughan Van Hecke et al., 2007), and these characteristics may be related to reliability understanding as well, because gaze following in joint attention is a precursor to similar abilities, such as detection of pretence and deception (Leslie, 1987). Advanced Theory of Mind has been associated with temperamental reactivity in the absence of social withdrawal characteristics, and vice versa (Lane et al., 2013; Mink, Henning, & Aschersleben, 2014). In a recent study, such Theory of Mind capacity, as measured by false belief understanding, predicted the selective trust of children in the United States, China, and Turkey (Lucas et al., 2013). Finally, temperamental exuberance is related to children's risk-taking, at least for children low in attention shifting abilities (Lahat et al., 2012), which may also play a role in children's willingness to accept information from others' testimony.

Despite these possible links, few studies have directly investigated the relation between temperament and reliability understanding. The results of such previous studies, though, suggest that temperament is a likely mechanism underlying this skill. One of the first studies to specifically examine individual variation in selective trust found that children showed different patterns of belief in their mother's versus a stranger's testimony depending on their attachment status (Corriveau et al., 2009). Securely attached children, as compared to both avoidant and resistant children, showed more flexibility in reliance on the claims of their mother or a stranger, depending on the perceptual evidence available. The authors point out, though, that characteristics of the child, such as temperament, may mediate or moderate the effects of attachment status (Corriveau et al., 2009). More recent studies of children's trust in others' testimony when it conflicts with their own perceptual knowledge suggest that both greater inhibitory control and confidence in their own beliefs are related to increased skepticism of others' claims (Jaswal, 2010; Jaswal et al., 2014). Further, in a study that included measures of both children's verbal endorsement of others' trustworthiness and behavioural evidence of their trust, as demonstrated by their willingness to touch a strange animal (actually a toy), 3- to 5-year-old children who were high in smiling and laughter were more influenced by the valence of the testimony they received. They were more likely to endorse the positive informant, regardless of their perceived expertise. For 6- and 7-year-old children, greater inhibitory control was associated with children's endorsement of the knowledgeable informant as well as their endorsement of the negative informant (Boseovski & Thurman, 2013). Finally, in line with previous research on the link between temperament and social cognition, young children with easy temperaments have demonstrated more trust, in general, and this is especially true in trust based on reliability, as opposed to emotional trust (Alat, 2013).

The Current Study

The present research had two main purposes. First, we wanted to determine whether children's temperament and other characteristics affect their reliability tracking and selective trust skills. We predicted that individual differences in

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children's ability to understand others' reliability would be linked to differences in attentional and social aspects of temperament. In addition, we hypothesized that children's language capacity would be related to their reliability tracking and selective trust, as this ability underlies performance on several tasks, including selecting problem-solving strategies and solving false-belief problems (Milligan, Astington, & Dack, 2007; Schunn & Reder, 2001). Previous research has indicated that these skills are linked, but the ability to use previous accuracy to learn new information is more difficult than simply tracking reliability, even for four-year-olds (e.g., Koenig, Clement, & Harris, 2004). Although this may be because there are simple maturational differences in the ability to judge and use others' testimony, it may also be the case that different mechanisms underlie these two skills. In order to tease apart this question, we assessed both skills in children approaching their third birthday, an age when they are more variable.

The second goal of this study was to determine whether different types of reliability understanding are differentially associated with individual traits. In order to address this question, we assessed children's ability to track and selectively learn from a reliable informant in both word-learning and non-word-learning tasks. We also examined whether traits associated with immediate selective trust were also related to the stability of judgments of trustworthiness by assessing children's selective trust after a delay, without any additional information as to the speakers' reliability.

METHOD

Participants

Fifty-six children were recruited through public birth records. The current analyses include 49 children (67.3% female) between 28 and 38 months of age ($M = 33.89$, $SD = 2.71$). Although this age range is fairly large, it allowed us to account for age-related differences in our analyses. Most children were white (40), with some mixed race (10), and Asian (6) participants. English was the primary language spoken by all children. Parents reported no developmental delays or disorders. Seven children were excluded due to lack of cooperation (3), parental interference (1), experimenter error (2), or because preliminary analyses showed they were outliers (1).

Materials

For this study, 11 video clips were created, based on those used in previous selective trust research (e.g., Koenig, Clement, & Harris, 2004). These included 8 familiar-object clips (4 labels and 4 functions) and 3 novel-object clips (2 labels and 1 function). In each clip, two actors in different, solid-coloured shirts sat facing the camera. They appeared on the right and left sides of the screen, with a table between them. The same two actors appeared in all of the label clips, and a different set of two actors appeared in all of the function clips. Two different sets of actors were used to control for the possibility of children's generalizing reliability from one set of clips to another, as previous research has indicated that children do generalize a speaker's past accuracy in object words to object functions (Birch, Luca, Frampton, Vauthier, & Bloom, 2005; Koenig & Harris, 2005). Further, the actors in the label clips were both males, while those in the function clips were females. Previous research has indicated that young children prefer same-sex informants, and girls with sex-typed attitudes may prefer same-sex informants even when they are unreliable (Taylor, 2013). Thus, including informants of both genders

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enabled us to control for such biases. In each clip, a different object was present on the table. In the familiar-object clips, the objects and labels used by the actors were familiar to the child. In the novel-object clips, the objects and labels were unfamiliar. The physical objects were presented to the children alongside each clip.

Each clip started with the actors greeting the camera. Then, each actor, in turn, directed their attention to the object on the table and labelled it as described below. The order of trials was maintained across participants, but the actor who was reliable and the order of the reliable versus unreliable informant were counterbalanced.

Design and Procedure

Introduction

Children were tested in a quiet room with limited decoration, so as to avoid distraction. After directing the child to sit at a small table, the experimenter introduced the task by pointing to a still image of the two actors on the screen and saying, 'Look! These are my friends, Mr. Green and Mr. White. They are going to tell us about some things!' Each actor was named according to the colour shirt he or she wore.

Familiar-object trials

This study used a within-subjects design, so all children saw both the label clips and the function clips. In each label familiar-object clip, after greeting the camera, each actor picked up the object on the table and labelled it with either an accurate or inaccurate label. For instance, when labelling a rubber duck, the reliable informant said, 'Look! This is a duck!' The unreliable speaker, on the other hand, said, 'Look! This is a horse!' Because our sample was young and we did not want to add the complexity of a third actor, the objects were present on the table in front of the actors at the beginning of each clip, rather than presented to them, as has been done in work with older children. Each clip ended with a still image of the two speakers facing the camera.

After each familiar-object clip, children were asked two types of questions. First, they were asked what the object was called, to ensure that the objects were, in fact, familiar to them. Next, the experimenter asked them to explicitly judge the reliability of the speakers, saying, 'Who was right?' If children did not respond to this question, they were again prompted with the question 'Who knew what this was called?' Children who still did not verbally answer were encouraged to point to the 'right' informant. If children claimed that the unreliable speaker was right, the experimenter corrected them, saying, 'Hmm. I don't think so. I think Mr. [reliable speaker] was right. Mr [reliable speaker] knew that this was a [object label]'. After this, the experimenter began the next clip, saying 'Let's see what they'll tell us next'. In contrast to previous studies, in which explicit judgments of reliability were gathered only after all of the familiar-object clips were presented, we were interested in possible differences in children's judgments of reliability across trials. Gathering this information after each trial also lessened the memory load for the younger sample in the current study and allowed us to judge children's responses to feedback.

Novel-object trials

Following the familiar-object trials, children watched one novel-object trial, which was identical in structure to the familiar-object trials. In these clips, the object present on the table was a novel object, and each speaker labelled it with a

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novel label (e.g., 'Look! This is a Blicket' versus 'Look! This is a Dax'). Just as in the familiar-object clips, the novel-object clip ended with a still image of the speakers facing the camera, and the experimenter asked the child both, 'What is this called?' and 'Who was right?' Rarely, children provided incongruent responses to these two questions (i.e., repeating Mr. Green's answer and indicating that Mr. White was correct). When this occurred, they were reminded of what each actor had said and were asked each question again. The response to this second set of questions was then used in the analyses. All children received positive feedback after the novel-object trials, regardless of their response.

This entire procedure was repeated in exactly the same way for the function clips, except that each actor verbally provided and pantomimed a function for the objects. For example, when labelling a spoon, the reliable informant said, 'Look! This is for eating!' and the unreliable informant said, 'Look! This is for singing!' In the novel-object clip, rather than providing novel labels, the speakers provided equally plausible functions (e.g., 'Look! This is for stirring!' versus 'Look! This is for digging!') for the novel objects. Further, after each clip, the experimenter asked the child, 'What is this for?' rather than 'What is this called?'

Free play

After watching the familiar-object and novel-object trials for both the label and function clips, children were taken to an adjoining room filled with toys including balloons, a play doctor's kit, several trucks, and a four-foot-tall stuffed giraffe and were allowed to play with the toys for several minutes in any way they wanted. The experimenter engaged with the children in play only if the child requested it. The free play ended with the experimenter exclaiming, 'Oh, I forgot! We have one more video to watch', and escorting the child back to the testing room.

Delay trial

After the free play session, a third novel-object clip, providing labels and involving the same actors from the previous label clips, was presented. The experimenter introduced the video with a still image of the actors on the screen and checked the children's memory for the actors, saying, 'Do you remember my friends? Who is this (pointing to one of the actors)? And who is this (pointing to the other actor)?' The experimenter then reminded the child that the actors had previously told them about a variety of objects and told the child that the actors would now tell them about one more object. After this introduction, the trial proceeded with the same structure as the previous novel-object clips, and children were asked the same questions. This clip enabled us to look at children's ability to remember and use reliability information after a delay, and to look at this ability specifically in relation to children's characteristics.

Coding and scoring

Children's responses to all questions during the familiar-object and novel-object trials were scored dichotomously (0 = incorrect; 1 = correct) from video tapes. A second, independent coder scored the responses of 30 children (61%), with no disagreements. In order to determine children's ability to keep the reliable informant in mind, a reliability tracking composite was created by summing the number of times that they were able to correctly identify the reliable speaker during all familiar-object trials (maximum score = 8). Although children were asked both what each object was called or what it was for, as well as who the correct speaker

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was, only their responses to questions about the speaker were included in the reliability tracking composite. Because the objects were familiar to the child, their responses to the object questions may not have reflected their reliability tracking ability. A selective trust composite was created by summing the number of times children endorsed the label or function provided by the reliable speaker during all novel-object trials (maximum score = 3), either by using the label or by indicating it in some other way (e.g., 'What Mr. Green said').

Additional Measures

Temperament

The Infant Behaviour Record (IBR; Bayley, 1969) provided an observational measure of temperament based on children's behaviour in the laboratory. The IBR consists of 30 items, 25 of which are 5- or 9-point rating scales evaluating broad dimensions of infant behaviour, including interpersonal, affective, motivational, and sensory domains. Factor analyses of the IBR by Matheny (1980) yielded three factors related to dimensions found in most temperament systems: Activity, Task Orientation, and Affect/Extraversion. The Activity factor includes observer ratings of the child's gross bodily movement and level of energy from low ('stays quietly in one place') to high ('hyperactive, cannot be quieted for sedentary tests'). Task Orientation includes attention span ('fleeting' to 'long-continued absorption in a toy, activity, or person'), persistence and goal directedness ('no evidence of directed effort' to 'compulsive absorption with a task'), and responsiveness to objects ('does not indicate interest in objects' to 'reluctantly relinquishes test materials'). Finally, the Affect/Extraversion factor relates to emotionality and sociability and includes social responsiveness ('avoiding' to 'inviting'), emotional tone ('child seems unhappy throughout' to 'radiates happiness'), and cooperativeness ('resists all suggestions' to 'very readily and enthusiastically enters into suggested games'). In this study, the standardized unweighted items were aggregated on three scales as suggested by Matheny (1980).

The IBR provides a standard observational measure of temperament across participants and situations, making comparisons across children possible. It is a commonly-used observational measure of temperament in the literature and has been used effectively to assess traits from sociability to negativity to attention and persistence (Canals, Hernandez-Martinez, & Fernandez-Ballart, 2011; Ciprianо-Essel, Skowron, Stifter, & Teti, 2013; Eisenberg et al., 2010; Stupica, Sherman, & Cassidy, 2011). Such behavioural observations of temperament provide more objective ratings than other methods, such as parent reports, because the testers have no connection to the children and have had experience with a wide range of child temperaments and behaviours (Schmitz, Saudino, Plomin, Fulker, & DeFries, 1996). The IBR has been used in a variety of testing situations, both in conjunction with the Bayley Scales of Infant Development and on its own. Further, its validity in both the laboratory and home environments has been confirmed (Stifter & Corey, 2001; Stifter, Willoughby, & Towe-Goodman, 2008). In this study, two raters completed the IBR for all children from video tapes of the reliability tasks and free play. Raters were blind to children's performance on the reliability tasks. Intraclass correlations between the two raters were above .70 for all three aggregated scales.

Language ability

The MacArthur-Bates Communicative Development Inventory III (CDI-III; Feldman et al., 2005) was used to assess language. This is a parent-report measure

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consisting of a vocabulary checklist, sentence pairs used to assess the complexity of a child's grammatical understanding, and a series of questions aimed at assessing a child's level of semantics, pragmatics, and language comprehension. Parents completed this questionnaire during their visit, while their children were engaged in the selective trust tasks. Scores are obtained by summing the positive scores on each subgroup of questionnaire items. Extensive research has established the reliability and validity of all versions of the CDI (Dale, 1991; Fenson et al., 1993).

RESULTS

Descriptive Analyses

Table 1 shows descriptive statistics for all measures, although means are not the statistic of interest in this study. There were no significant mean differences in observer-rated temperament between boys and girls. The gender difference for selective trust approached significance.

Predictors of Reliability Understanding

Correlations indicating the relation of reliability tracking and selective trust with children's temperament, language ability, and age and gender are displayed in Table 2. Language development, as assessed by the CDI, was not significantly associated with reliability tracking or selective trust, but its relation to selective trust approached significance.

Significant associations were found between selective trust and task orientation and affect/extraversion (Table 2), but no significant correlations were found between temperament characteristics and reliability tracking. Task orientation and affect/extraversion were also significantly correlated with each other, $r(47) = .62$, $p < .01$. To examine how these traits independently predicted selective trust, a hierarchical multiple linear regression analysis was conducted. Tests for multicollinearity indicated very low multicollinearity ($VIF < 2.0$ for all variables). In step one, the demographic variables of age and gender were included, and in

Table 1. Descriptive statistics for reliability understanding, demographic variables, and temperament.

	Gender				
	Females	Males	*t*	*df*	*p*
	M (*SD*)	*M* (*SD*)			
Reliability tracking	0.70 (0.24)[a]	0.68 (0.16)[a]	−.26	47	.794
Selective trust	0.56 (0.28)[a]	0.73 (0.33)[a]	1.91	47	.063
Age (months)	33.89 (2.73)	33.64 (2.60)	−.29	47	.770
CDI	79.42 (21.44)	80.94 (18.83)	.24	47	.811
Task orientation	.023 (0.82)[b]	−.054 (0.81)[b]	−.31	47	.757
Affect/extraversion	.048 (0.58)[b]	−.101 (1.26)[b]	−.57	47	.569
Activity	−.003 (0.87)[b]	006 (0.77)[b]	.04	47	.971

[a]Means presented as proportions for ease of comparison.
[b]Means based on composites of standardized variables.

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Table 2. Intercorrelations between reliability understanding, temperament, and demographic variables

	1.	2.	3.	4.	5.	6.	7.	8.
1. Reliabiliy tracking	—	.20	.34*	.04	.22	.13	.23	.12
2. Selective trust		—	.28†	−.27†	.27†	.05	.35*	.40**
3. Age (months)			—	.04	.30*	.03	.25	.13
4. Gender				—	−.04	−.01	.05	.08
5. CDI					—	.01	.15	−.22
6. Activity						—	.04	.34*
7. Task orientation							—	.62**
8. Affect/extraversion								—

Note. Females were coded as 1, males as 0.
$^{\dagger}p = .07$; *$p < .05$; **$p < .01$.

step two, the additional child variables of CDI scores, task orientation, and affect/extraversion were added. The addition of these variables significantly improved the model, R^2 change = 0.237, $F = 5.582$, $p < .01$. Gender, CDI scores, and affect/extraversion were significant predictors of selective trust in this regression model (Table 3). This indicates that children who were rated as high in affect/extraversion scored highly on selective trust tasks, above and beyond any influence of the other variables. Further, male participants and children with more advanced language skills performed well on selective trust tasks.

No significant associations were found between reliability tracking and temperament, but a significant correlation was found between this skill and age. This indicates that older children fared better on the tasks measuring reliability tracking but that they did not necessarily do so on tasks measuring selective trust.

Comparisons between Labels, Functions, and Delay

Children's responses during the reliability tracking and selective trust portions of all of the videos were collapsed for the main analyses to ensure that the data would include sufficient variability. However, we were also interested to see if there were differences in children's performance in the label versus the function clips. First, we compared children's average performance to chance to determine

Table 3. Hierarchical multiple linear regression predicting selective trust from demographic and child variables

Variable	*B*	*SE B*	*β*
Step 1			
Age	.099	.047	.287*
Gender	−.545	.267	−.280*
Step 2			
Age	.045	.044	.130
Gender	−.587	.232	−.302*
CDI	.015	.006	.328*
Task orientation	−.025	.187	−.022
Affect/extraversion	.530	.181	.489**

Note. Females were coded as 1, males as 0.
*$p < .05$; **$p < .01$.

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how children performed as a group. Children performed at above chance levels on both reliability tracking, $t(48) = 6.27$, $p < .001$, and selective trust, $t(48) = 2.56$, $p < .05$, when the function and label clips were combined, but this held true only for the label clips when the two were split for analysis (reliability tracking $t(48) = 9.55$, $p < .001$; selective trust $t(48) = 2.62$, $p < .05$). Further, a Wilcoxon Signed-ranks test indicated that children were, on average, better able to track the reliability of speakers during the label clips, M (SD) = 3.39 (1.02), than during the function clips, M (SD) = 2.14 (1.24), $z = -4.44$, $p < .01$. In contrast, there were no significant differences between children's average proportion of correct responses to the selective trust questions in the label, M (SD) = 0.64 (0.38), and function clips, M (SD) = 0.55 (0.50), $z = -1.08$, $p = .28$. Based on the differences in children's reliability tracking performance across the function and label clips, the analysis of the relations between reliability tracking and children's characteristics was performed separately for the two types of video clips. Reliability tracking during the function clips, but not during the label clips, was correlated with age ($r = .32$, $p < .05$) and with children's CDI scores ($r = .32$, $p < .05$).

We were also interested in whether the same underlying characteristics were associated with selective trust at the time when reliability information was presented as well as when trust was assessed after a delay. Again, these results reflected the main findings. Affect/extraversion was significantly associated with both immediate selective trust ($r = .26$, $p < .05$) and selective trust in the delay trial ($r_{pb} = .39$, $p < .05$), indicating that children rated as high in affect/extraversion were more likely to endorse the information provided by a reliable informant both immediately after learning about the informant's reliability, as well as after a delay. Immediate selective trust, as with overall selective trust scores, was also associated with language ability ($r = .29$, $p < .05$), whereas the stability of selective trust was significantly correlated with task orientation ($r_{pb} = .29$, $p < .05$).

DISCUSSION

The goal of this research was to examine which aspects of temperament are related to variability in young children's reliability understanding. The results indicate that children become better at tracking reliable speakers with age but that selective trust in reliable speakers is related to child specific factors—specifically, to affect/extraversion and language ability. That is, children who were rated as high in these areas performed well on selective trust tasks.

Because this is one of the first studies to examine the relation between temperament and reliability understanding, the consistent association between selective trust and affect/extraversion is particularly compelling. Two possible explanations may account for this link. First, individual differences in affect/extraversion may influence the capacity for selective trust, possibly by affecting infants' and young children's social interactions, which in turn affect their competence in this ability. Sociable infants may encounter more rewarding social interactions from early in life, as previous research has indicated that sociable, positive temperament in infancy is related to warm, responsive parenting (Kyrios & Prior, 1990). Shyness in toddlerhood, on the other hand, is related to social withdrawal and social difficulty in childhood (Rubin, Coplan, Bowker, & Menzer, 2010). Thus, children's characteristics may affect their interactions with the social world and shape their cognitive and social cognitive development.

Alternatively, temperament may affect *performance* on measures of selective trust, but not competence. Children who are high in affect/extraversion may do

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better on tasks measuring selective trust because of their increased attention and willingness to interact with the experimenter. Shy, less extroverted children may not perform as well because they are less interactive and more prone to social anxiety. Research in school-aged children indicates that shy children's performance suffers in face-to-face testing situations, lending some support to the hypothesized role of temperament in test performance (Crozier & Hostettler, 2003). Based on the current findings, we think this account is unlikely. In correlational analyses, both task orientation and affect/extraversion were associated with selective trust, but not reliability tracking. Moreover, only affect/extraversion made an independent contribution to selective trust. Thus, it is not simply the case that children who did poorly on selective trust tasks were inattentive or socially unresponsive in the test situation. Children identified the reliable versus the unreliable speaker equally well regardless of temperament, but children rated as low in affect/extraversion did not use that information in deciding from whom to learn.

Nevertheless, it is possible that children's performance on the reliability understanding tasks affected the expression of, and therefore the observable behaviours related to, their temperament characteristics. For instance, children who received negative feedback during the familiar-object trials may have become less confident and more socially withdrawn than children who performed better and were given mostly positive feedback. Only 18 (36.7%) children received any negative feedback on label trials, and more than half of those ($N = 11$; 61.1%) received negative feedback on only one of the four familiar-object trials. There was much greater variation in the function trials, though. Nearly all of the children ($N = 43$; 87.8%) received negative feedback on at least one trial. However, when the sample was split between those children who performed poorly and thus received negative feedback on two or more function trials, and those who were correct on three or more trials, there were no differences in levels of affect/extraversion between the groups ($t(40.7) = -.73$, $p = .47$). Further, correlations between temperament and selective trust did not differ between the subgroups and the overall findings. Thus, feedback does not appear to have influenced children's expressions of their temperaments. This makes sense given that temperament theory suggests that temperament refers to behavioural tendencies rather than behavioural acts in specific situations (Goldsmith et al., 1987). Instead, we suggest that children's level of affect/extraversion influences the development of selective trust itself so that children high in this trait have more advanced skills in determining from whom they should learn.

This may be the case because, as indicated above, children high in affect/extraversion experience more and more varied social environments. This social experience may help them recognize contextual cues that create more successful interactions with others, prompting even more social experiences. Sociability has been linked to a number of social competence skills, including peer acceptance, positive coping strategies, and prosocial responses to others' distress (Eisenberg, Fabes, & Spinrad, 2007; Rubin, Bukowski, & Parker, 2006). It is thus likely that extraverted children are better able to learn the skills necessary for social success, one of which is surely selective trust.

The relation between selective trust and affect/extraversion seems particularly strong when immediate trust is compared to children's selective trust after a delay. At both time points, children's successful endorsement of the information provided by the reliable informant was related to their affect/extraversion. Thus, it is not only children's ability to use reliability information effectively that is linked to their level of extraversion, but their ability to remember this information and use it to their benefit in the future. In fact, although all children were reminded

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of the actors before the delay trial, it is not clear that this memory check served its intended purpose, as it involved only the speakers' names, which had been based on the colour of the actors' shirts throughout the activities. Consequently, it may be the case that children high in affect/extraversion were better able than their more introverted peers to remember the actors and their previous reliability, perhaps because social information is more salient for these children. This ability to remember a person's reliability and regard it as stable when no additional evidence has been provided is a skill that could help guide children's conduct and ultimate success in both learning and social situations.

Although affect/extraversion accounts for some of the individual differences in selective trust, reliability tracking is a necessary precursor to this capacity. Reliability tracking was related only to age, indicating that it may be associated with maturational factors, such as working memory or processing speed. Children need this skill in order to make selective trust judgments, but it is also plausible that selective trust requires different and more complex cognitive skills. Selective trust requires the additional judgement of a speaker's intentions, that is, the ability to determine both informant accuracy and benevolence (Sperber et al., 2010). An important consideration is that tracking reliability may be easier overall for children, making variability within our sample uninformative in terms of underlying temperament factors. This may be especially true for reliability tracking in the label clips, as that ability was not correlated with any of the other factors measured. Although this may be the case, older children were still able to track the reliability of a speaker more successfully, indicating that some maturational factors are at play. Further research with younger children may help to elucidate other reasons for the divergent findings between reliability tracking and selective trust.

It is interesting to note that the relation between reliability tracking and selective trust in our sample was not significant. Koenig, Clement, and Harris (2004), on the other hand, found that reliability tracking predicted children's selective trust ability. In that study, children who were able to successfully keep track of the reliable informant were also able to choose the accurate informant when asked to decide who would provide correct information in a learning situation. One possible reason for our contradictory finding may be that our test of reliability tracking was easier for children overall. Koenig and colleagues asked children which speaker had said something right and which had said something wrong only once. In the current study, children were asked after each familiar-object trial, which may have helped them keep track of the accurate and inaccurate informants. Moreover, the selective trust tasks in the current study may have been more difficult for our slightly younger sample, so it may be that even those children who were able to keep track of the reliable speaker were unable to actively choose that speaker in a learning situation, thus weakening the relation between the two aspects of reliability understanding.

Gender was also found to be a significant predictor of selective trust, with boys outperforming girls on such tasks. This finding is interesting because several previous studies have indicated that girls tend to perform better on tasks of social cognition. We would suggest that this gender difference may be a product of our methodology. Boys are more likely to take risks than girls, even in toddlerhood. This applies to injury-risk behaviours (Morrongiello, & Dawber, 1998), but also to socially risky behaviours, such as raising one's hand in the classroom (Sadker & Zittleman, 2009). Because our task asked children first to vocalize their choice of informants, boys may have been more willing to take the risk of answering at all, and girls' more delayed responses may have been more likely to reflect doubt or indecision. In fact, proportionally, more girls (58.1%) than boys (41.2%) required repeated questioning during the novel-object trials.

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Although this gender difference is intriguing, it reflects a difference at the group level. More important for our investigation of individual differences is the relation between selective trust and language. We expected language capacity to be an important factor in children's performance on the reliability understanding tasks, not least because the tasks themselves were language based. Moreover, as mentioned previously, language has been shown to be significantly related to several social cognitive abilities, such as theory of mind understanding (see Milligan, Astington, & Dack, 2007). Few studies, though, have looked at the influence of language ability on reliability judgement. One previous finding, in a study of 24-month-olds by Koenig and Woodward (2010), seems at odds with our results. In that study, toddlers with higher vocabulary knowledge performed better than those with low vocabulary knowledge in ambiguous situations—such as when the inaccurate speaker also used accurate labels during an attention monitoring task. However, when such ambiguities were not a factor, vocabulary had no effect on children's learning from accurate versus inaccurate speakers. That study looked simply at learning a novel word, as indicated by choosing a target object in a comprehension test, rather than choosing a person from whom to learn. The added difficulty of choosing a reliable informant based on his or her past accuracy may have been more taxing for children who lagged behind their peers in language, as the demands of processing the labels that they heard would be greater for these children. Participants with higher vocabulary scores, on the other hand, would be able to process familiar words faster, making them better able to concentrate on the accuracy of the label and to choose an accurate informant when learning a novel word.

One possible limitation of this study is that only one novel-object trial was included for each type of information. In the general analyses, when label and function novel-object trials were collapsed, measures of children's selective trust were based on their endorsement of the reliable speaker's information on three different novel-object trials. When comparing label to function trials, or immediate selective trust to selective trust after a delay, the power of the analyses may have been limited by the single novel-object trial. However, using just one novel-object trial to index children's selective trust ability is not out of keeping with the previous literature, either in children's social cognition or in reliability understanding specifically (Birch, Vauthier, & Bloom, 2008, Experiment 1; Fusaro, Corriveau, & Harris, 2011).

In addition to children's temperament, parental responsiveness and interaction patterns may play a role in children's reliability understanding. This question falls beyond the scope of the current study, as the present work was focused on children's internal characteristics. However, previous work in behaviour genetics indicates that the quality of parent-child relationships may be due in part to evocative gene-environment correlations. That is, parents' behaviours towards children are to some extent attributable to genetically influenced child behavioural characteristics, such as temperament traits (Deater-Deckard & O'Connor, 2000). Therefore, it is likely that the influence of parent–child interactions on young children's understanding of trustworthiness would be in part associated with the influence of children's temperament on that understanding. Further research focusing on the potential influence of parent behaviours on children's reliability understanding would thus add to the mechanisms elucidated in the current study.

Future research including clinical populations may also help explain the relation between extraversion and reliability understanding further. For instance, several studies have found that children with ASD are rated as lower in sociability or affect/extraversion than their typically developing peers (Garon et al., 2009; Landry, 2000; Watson et al., 2007). This difference in temperament may help

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explain differences in social cognition in children with ASD and could lead to another avenue of intervention.

The current research represents one of the first studies of individual differences in young children's understanding of reliability. By assessing children's temperament traits in relation to the ability to use others as sources of information, this study provides an indication of the potential characteristics contributing to reliability understanding. Along with gender and language, there was a clear link between observer ratings of affect/extraversion and selective trust. Thus, while tracking reliability may be a capacity that develops with maturation, selective trust may depend in part on the child's characteristics. Identifying the traits that enable young children to rely on other people as sources of information can help us construct a better model of the development of this critical skill.

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