Maternal Values and Personality Enhance Infant Cooperation with an Adult

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Abstract

This longitudinal study (N = 204) examines if the association between maternal cooperative values or personality and 14-month-olds' cooperative ability with an adult experimenter across two tasks is mediated by infant temperament (i.e., biology) or infants' early at-home cooperative experience through social gameplay at the age of 9 months (i.e., socialisation). The results revealed that infants of mothers with other-oriented cooperative values demonstrated increased coordination and success on the cooperative task requiring complementary actions. Infants of mothers high in cooperative personality traits agreeableness and honesty-humility demonstrated increased coordination and success on the cooperative task involving parallel actions. Neither infant temperament nor the frequency of social gameplay mediated these effects. These findings offer the first evidence suggesting that 14-month-old infants' cooperative ability is shaped by their parents' cooperative dispositions.

Keywords: Cooperation, Infancy, Personality, Values, Prosocial Behaviour

Maternal Values and Personality Enhance Infant Cooperation with an Adult

Cooperative competence shows marked development across the first three years of postnatal life, thereby underscoring the significance of cooperation (i.e., the ability to work with others to achieve a common goal) in society (for a review see Warneken, 2017). The present study examines if infants with mothers high in other-oriented cooperative values or personality characteristics demonstrate enhanced cooperative competence. This research is guided by Bratman's (1992) description of shared cooperative activity which suggests that cooperative partners must be: mutually responsive to each other's behaviours and intentions, motivated to attain a shared goal, and committed to aiding each other's actions. Within the first two years of their lives, infants' ability to maintain these three elements of cooperation develops in key ways (for a review see Brownell, 2013).

Before their first birthday, infants engage in cooperative social gameplay (i.e., peek-a-boo; Ross & Lollis, 1987) and can interpret the intentions and shared goals of others (Henderson et al., 2013; Krogh-Jespersen et al., 2020). By 14 months of age, infants can coordinate their actions with an adult in novel cooperative tasks involving parallel (i.e., identical actions) and simple complementary (i.e., different actions) roles (Warneken & Tomasello, 2007). However, 14-month-olds' abilities remain limited, and when compared to 18 and 24-month-olds, they display poor coordination and make more errors (see also Warneken et al., 2006). Thus, throughout their second year of life, infants continue to hone their cooperative skills with unfamiliar adults. Adults play a critical role in facilitating infants' early cooperative development by scaffolding early cooperative interactions (Warneken, 2017). Arguably, infants' adult-led cooperative experiences prepare them to cooperate with same-aged peers later in development (Brownell & Carriger, 1990; Rogoff et al., 1993).

Although infants cooperate early in life, variability exists across infants with respect to their abilities. This variability raises questions regarding the factors that support infants' early cooperative development. Prior work has focused on infant-specific factors, and thus, a lesser explored variable is how parental personality

and values influence infants' cooperative development. Developmental theorists have emphasised the role of parents as critical in driving development (Vygotsky, 1978) and transmitting culturally specific information (Csibra & Gergely, 2009). Considering that parents are a keystone in facilitating favourable developmental outcomes, understanding the ways in which they support their infants' emerging cooperative abilities is of significance.

There are several pathways through which parents may influence their infant's cooperative development. Parents may engage with infants in cooperation-enhancing experiences. Prior research suggests that 10-month-old infants' active cooperative experience (e.g., working with an experimenter to retrieve a toy from a box) supports their ability to identify shared goals in a separate task (Henderson et al., 2013; Krogh-Jespersen et al., 2020), a cognitive ability that bolsters cooperation (Knoblich et al., 2011). An infant's primary caregiver (i.e., the person who spends the most time interacting with them) is likely to be the principal provider of early cooperative experiences. Individual differences in primary caregivers' values or personality may shape the cooperative experiences that they provide to their infant; a view that is consistent with evidence suggesting that personality and values facilitate adults' cooperative behaviour (Fishbein & Ajzen, 1975; Habashi et al., 2016; Haesevoets et al., 2015; Soto, 2019). Mothers continue to be the primary caregiver for infants (Craig, 2006), thus it is plausible that these characteristics impact how mothers engage cooperatively with their infants.

Parents may also influence their infant's cooperative competence through biology. The present study takes a first step towards understanding this pathway by examining the mediating effect of infant temperament on the association between mothers' personality and infants' cooperative ability. Temperamental traits shape how individuals respond to the world (Garstein & Rothbart, 2003). Infant temperament, measured through parent-report via the Infant Behaviour Questionnaire (IBQ; Garstein & Rothbart, 2003; Rothbart & Bates, 2011), is assessed across three factors: surgency (e.g., positive affect), negative affectivity (e.g., fear), and regulatory capacity (e.g., the

ability to regulate emotional states).

Personality develops from temperament (Rothbart & Bates, 2011), which is argued to be an inherited characteristic (Rothbart & Bates, 2011; Saudino, 2005). Further, links between maternal personality and child temperament is supported by research showing positive associations between child negative affectivity and positive affect and maternal personality characteristics neuroticism (e.g., fear) and extraversion (e.g., sociability), respectively (Komsi et al., 2008). Despite evidence showing that: adult personality is associated with cooperation (Habashi et al., 2016; Hilbig & Zettler, 2009), maternal personality is associated with child temperament (Komsi et al., 2008), and child temperament is associated with cooperation (Schuhmacher & Kärtner, 2015), no studies have examined these associations simultaneously.

Expectancy-Value Theory (Fishbein & Ajzen, 1975) provides reason to hypothesise that maternal cooperative values may facilitate infants' cooperative development. Within this theory, an individual's behaviours are motivated by their values and expectations (Fishbein & Ajzen, 1975). The term "value" often represents behaviours, beliefs, and social attitudes regarding prosocial behaviour (Barry et al., 2008; Min et al., 2012; Van Lange, 1999). An individual's expectations refer to how likely they want or expect something to occur. Therefore, the values that a mother possesses regarding cooperation may shape their expectations and behaviour towards their infant, which in turn, shapes their infant's cooperative behaviour.

Previous research confirms the role that mothers' expectations play in shaping child outcomes. Schuhmacher and Kärtner (2015) demonstrated that three-year-olds whose mothers reported having high expectations regarding their child's sharing behaviours (e.g., "I expect my child to share"; rated on a scale of 1 to 4) were more likely to exhibit high levels of coordination in a cooperative task with a peer. These findings suggested that a mother's expectations regarding their child's social abilities influences their child's cooperative behaviour. However, it remains unknown what behaviours, if any, mothers with high expectations exhibit to facilitate their child's cooperative ability. Consistent with Expectancy-Value Theory (Fishbein & Ajzen, 1975), mothers who

strongly value cooperation may engage in more cooperative activities with their infant than mothers who place less value on cooperation. Increased exposure to these cooperative experiences could facilitate infants' cooperative abilities by enhancing their understanding of shared goals (Henderson et al., 2013; Krogh-Jespersen et al., 2020).

Maternal personality could shape infants' cooperative competence by affecting the frequency at which mothers provide at-home cooperative experience to their infant or by contributing to infant temperament (Krogh-Jespersen et al., 2020; Schuhmacher & Kärtner, 2015). While no studies have examined associations between maternal personality and infants' cooperative competence, research links adults' personality traits with a variety of self-reported and behavioural outcomes (Soto, 2019). For example, evidence from the Five-Factor Model (FFM) of personality suggests that the agreeableness dimension, which is characterised by compliance, kindness, and altruism (DeYoung et al., 2007), reliably predicts cooperative behaviour (Habashi et al., 2016; Kagel & Mcgee, 2014). Further, the honesty-humility dimension, which is characterised by fairness, genuineness, and modesty in the HEXACO model of personality, predicts adults' cooperation (Hilbig & Zettler, 2009; Hilbig et al., 2013). Thielmann et al. (2020) found that FFM agreeableness and HEXACO honesty-humility strongly positively correlated with cooperative behaviour across multiple cooperative contexts, while HEXACO agreeableness was a relatively weak predictor of cooperation. Together, these findings suggest that FFM agreeableness and HEXACO honesty-humility reliably predict adults' cooperation.

Thus, maternal personality may contribute to infant cooperative competence through the socialisation pathway. Mothers high in FFM agreeableness or HEXACO honesty-humility may provide increased cooperative experience to their infant via social games and other at-home experiences. However, maternal personality may also contribute to infant cooperative competence through a biological pathway. Mothers may pass on their cooperative personality characteristics to their infants through biologically acquired traits such as temperament (Rothbart & Bates, 2011; Saudino, 2005). As successful cooperation is contingent on how individuals respond to the

cooperative context and their social partner, researchers have investigated the extent to which temperament predicts children's cooperative ability. In one study, 36-month-olds who scored low on parent-reported shyness (i.e., high surgency) demonstrated more coordinated actions in a cooperative task with a peer (Schuhmacher & Kärtner, 2015). Further, Endedijk et al. (2015) demonstrated that two- to three-year-olds' increased surgency positively correlated with affiliative behaviour (i.e., positive directing or helping) during a cooperative task, which was, in turn, associated with cooperative success. Additionally, Vaughan et al. (2003) showed that increased negative affectivity predicted infants' decreased ability to coordinate their attention with others, an ability that underlies cooperation (Call, 2009; Wu et al., 2013).

In sum, the evidence suggests that increased surgency and decreased negative affectivity may support infants' cooperative behaviour by conveying their cooperative, or non-cooperative, intentions towards their social partner. By expressing positive affect (i.e., surgency) and low fear (i.e., negative affectivity) within a cooperative exchange, infants may convey their commitment to the shared goal and willingness to support their social partner more clearly when compared to infants who exhibit decreased surgency and increased fear.

Given the associations between honesty-humility (HEXACO) and agreeableness (FFM) and cooperation observed in adults (see Thielmann et al., 2020), the present research examines the role that maternal agreeableness (FFM) and honesty-humility (HEXACO) plays in infants' developing cooperative competence, and if the interaction between maternal personality and infant temperament or frequency of at-home social gameplay contributes to infants' cooperative abilities. Few, if any, studies have tested possible associations between cooperative personality and temperament characteristics. However, agreeableness (FFM) and honesty-humility (HEXACO) are characterised by emotional affiliation and respect for others (Ashton & Lee, 2007; DeYoung et al., 2007), which may align with infants' surgency, which is characterised by positive approach (Garstein & Rothbart, 2003). Further, characteristics of agreeableness (FFM) and honesty-humility (HEXACO) have been shown to negatively load onto infant negative

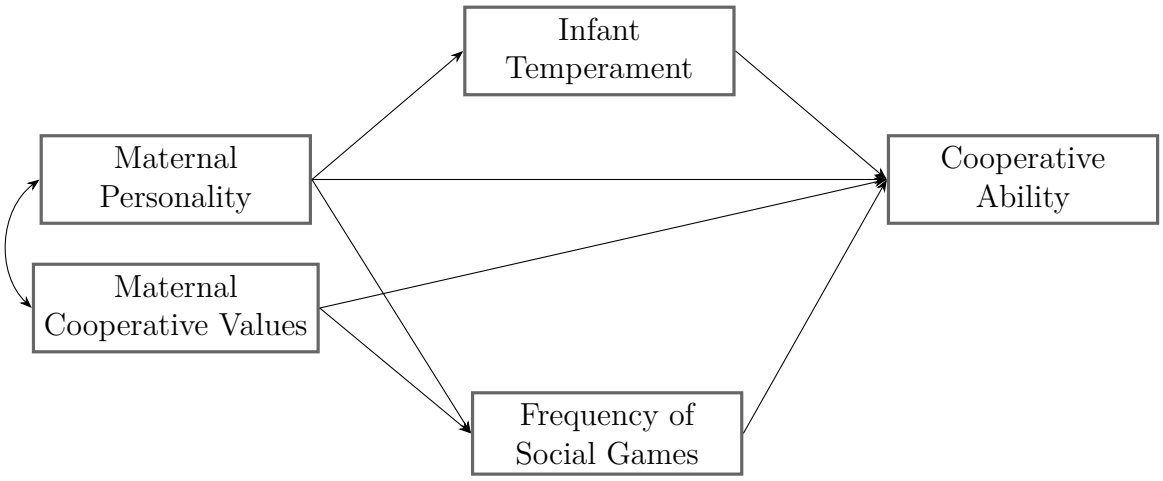
affectivity characteristics, such as fear and distress (Garstein & Rothbart, 2003).

The Present Research

The early developmental trajectory of cooperative ability is well documented yet, little is known about the role that mothers play in infants' developing cooperative competence. The present study addresses this gap by examining the extent to which mothers' personality and cooperative values predict 14-month-olds' cooperative ability. We also assess two pathways of cooperative transmission by examining if these effects are mediated by infant temperament (i.e., biology) or early cooperative experience (i.e., socialisation). See Figure 1 for hypotheses. This research takes a critical step towards understanding the intergenerational transmission of cooperative behaviour and development.

Figure 1

Conceptual Model of Mother to Infant Cooperative Transmission



Note. In Study 1, we expected that infants of mothers with altruistic cooperative values (i.e., who value cooperation for other-oriented reasons as opposed to selfish reasons) would demonstrate increased cooperative ability and that infants' early cooperative experience through increased frequency social gameplay when the infant was nine months of age would mediate this effect. Given than agreeableness is associated with cooperative behaviour (Thielmann et al., 2020), we predicted that increased maternal agreeableness would demonstrate a similar effect. However, consistent with research by Garstein and Rothbart (2003), Schuhmacher and Kärtner (2015), Vaughan et al. (2003), and Wu et al. (2013), we predicted that this effect would also be mediated by increased infant surgency and decreased negative affectivity. In Study 2 we expected that increased maternal honesty-humility (i.e., the HEXACO trait more closely associated with cooperation than agreeableness; Thielmann et al., 2020), would predict enhanced infant cooperative ability across both tasks, and that this effect would be mediated by increased infant surgency, decreased infant negative affectivity, and increased frequency of social gameplay when the infant was nine months of age.

Study 1: Method

Participants

We conducted the present study in accordance with the ethical standards proposed by the American Psychological Association and received full ethical approval from the University of Auckland Institutional Review Board. Sample size was determined by a pool of families (N = 204) living in an Australasian city and participating in an ongoing longitudinal study investigating children's social development. Table 1 contains the sample demographic information. We invited families to participate in the longitudinal study if their child was: born at or after

Table 1
Study 1 and Study 2 Demographic Information

	Mean (SD)	**Frequency**
Infant Gender		
Male		53.92%
Female		46.08%
Infant Age in Months		
DCW1	9.97 (.42)	
DCW3	14.30 (.64)	
DCW5	36.18 (1.86)	
DCW6	52.73 (6.21)	
Infant Ethnicity		
Maori-OE		.49%
OE		.98%
Asian		.98%
Asian-OE		.98%
NZE-Pacific		1.96%
NZE-Asian		7.35%
Two or more ethnicities		8.33%
NZE-Maori		10.29%
NZE		68.64%
Maternal Highest Education Attainment		
Unknown		1.96%
Bachelor degree or diploma		41.18%
Graduate degree		22.06%
Other tertiary qualification		23.53%
High school diploma		11.27%

Note. DCW = Data Collection Wave, OE = Other European, NZE = New Zealand European

37-weeks gestational age, approaching nine months of age, and exposed to English at least 70% of waking hours. We utilised data collected from three data collection waves (DCW) and excluded 51 families who did not: meet the criteria described above (n = 12), attend DCW3 (n = 36), or have the mother complete the questionnaires (n = 3). Most mothers identified as their infant's primary caregiver[1] and provided consent for their infant to participate in the study. For their participation, the experimenter (E1) gave infants a prize and entered the family into a draw to win a $50 gift voucher.

Materials, Procedure, and Coding

E1 interacted with the infant to build rapport while the mother completed the questionnaires. At each DCW, infants completed a battery of tasks. Only the tasks relevant to this study are described. Table 2 contains information regarding all

[1] With the exception of four mothers at DCW1 and two at DCW5.

constructs, operational definitions, coding, and reliability statistics. See online supplementary materials (OSM) for experimental scripts and parent questionnaires.

Table 2

Study 1 and Study 2 Variable Definitions, Scoring, and Inter-rater Reliability

Construct	Definition	Scoring & Reliability
Parent Prosocial Interview (DCW1)		
Cooperative Values	Mother's reasoning as to why infants should cooperate with others.	Coded as either an: Egoistic response or Altruistic response (κ = .86)
Social Games	Number of times per week that mothers indicated they played social games with their infant	Number provided
Parent Personality (DCW5 & DCW6)		
FFM	Index of five personality traits: openness (e.g., curious), conscientiousness (e.g., organised), extraversion (e.g., outgoing), agreeableness (e.g., friendly) and neuroticism (e.g., nervous)	7-point Likert scale 1 = *strongly disagree* 7 = *strongly agree*
HEXACO	Index of six personality traits: openness (e.g., creative), conscientiousness (e.g., careful), extraversion (e.g., sociable), agreeableness (e.g., tolerant), emotionality (e.g., anxious), and honesty-humility (e.g., fair)	7-point Likert scale 1 = *strongly disagree* 7 = *strongly agree*
Infant Temperament (DCW1)		
IBQ-R	Index of infant temperament traits: surgency (e.g., increased activity), negative affectivity (e.g., fear), and regulatory capacity (e.g., cuddliness)	7-point Likert scale 1 = *never* 7 = *always*

Table 2

Study 1 and Study 2 Variable Definitions, Scoring, and Inter-rater Reliability

Construct	Definition	Scoring & Reliability
Cooperative Ability (DCW3)		
Spatial Coordination	How well the infant used their spatial and motor coordination skills to complete the task	1 = failed to locate the appropriate components 2 = located appropriate components after at least one failed attempt 3 = located one of two appropriate components 4 = chose two of two appropriate components after at least one failed attempt 5 = chose two of two appropriate components (κ's = .70 - .94)
Success	Measure of how successful the infant was at achieving the task goal	0 = failed to move the object 1 = moved the object only one level 2 = achieved task specific end-goal (κ's = .94 - 1)
Latency to Success	How long it took the infant to complete the two required actions to attain the goal (i.e., the duration of time between the initiation of the infant's turn and successful action completion)	Total time in seconds (% agreement = 78.45 - 100)

Note. PRT = Parallel Roles Task, CRT = Complementary Roles Task. FFM = Five-Factor Model Personality Inventory (DeYoung et al., 2007). HEXACO = Six-Factor Model Personality Inventory as measured by the Mini-IPIP6 (Sibley et al., 2011). Mothers completed the FFM at DCW5 and the HEXACO at DCW6. Items and scoring for FFM and HEXACO are available in the online supplementary materials (OSM). Infants received a score of "missing" for spatial coordination if they did not attempt the task in either test trial. Coders recorded latency frame by frame at 25 frames per second using INTERACT (Mangold, 2020). Kappa's were calculated for all reliability statistics with the exception of the reliability statistics for latency, which were calculated by percent agreement using an agreement window of 160 milliseconds.

Prosocial Interview, Maternal Personality, and Infant Temperament

Mothers provided responses to the questions: "In your opinion, why should children cooperate with others?" and "How many times per week to you play social games with your infant (e.g., peek-a-boo)?" during a written interview in DCW1. Coders rated mothers' responses to why children should cooperate as either egoistic or altruistic (see OSM for procedure). A research assistant coded the entire sample and the lead author coded a random subset (30%) of the responses for reliability. Mothers received a Cooperative Value Score (CVS) calculated by subtracting the number of egoistic responses from the number of altruistic responses, then dividing this value by number of responses provided. If mothers provided a range response (e.g., "10-12") to the question "How many times per week do you play social games with your baby?", we calculated the average value (e.g., 11).

Mothers completed a FFM personality inventory (DeYoung et al., 2007) during DCW5 due to task and time constraints at earlier DCWs. We did not expect this timing to affect the findings given evidence that personality is stable through adulthood (Cobb-Clark & Schurer, 2012). Mothers completed Infant Behaviour Questionnaire-Revised (IBQ-R), short form (Putnam et al., 2014), at DCW1.

Infant-Experimenter Cooperation Tasks (DCW3)

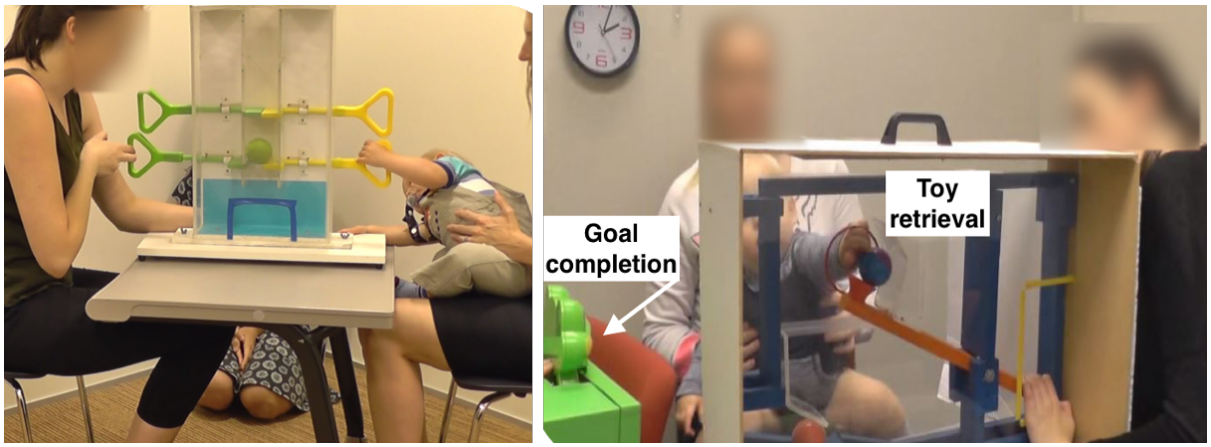
Infants completed two tasks that required them to coordinate their actions with E1 to attain a shared goal (See Figure 2). E1 and a secondary experimenter (E2) showed the infant how to obtain the shared goal for each task twice. Following the demonstration, E2 disengaged from the task and E1 initiated the test trials. One coder coded the entire sample and the second coded a randomly selected subset (25%) of the sample for reliability. Infant's final scores for each cooperative ability measure (see Table 2) consisted of the average score across both test trials per task.

Results and Discussion

We used R (R Core Team, 2020) to test the model described in Figure 1. All statistical information and analyses can be viewed at https://bit.ly/3jhqZWC. Data is available upon request. We assessed statistical significance at $p < .05$.

Figure 2

Infant-Experimenter Cooperative Tasks



Note. The Parallel Roles (PRT: left) and Complementary Roles (CRT; right) Cooperative Tasks used in the present research. The tasks and procedures were modelled from studies conducted by Warneken et al. (2006). For each task, E1 conducted the demonstration followed by test. PRT: the infant and E1 pulled two sets of opposing handles (one high, one low) in order to release a toy ball from a tube in the apparatus. CRT: E1 and the infant performed differing actions to free coloured balls from an apparatus in order to feed them to a toy frog. Here, E1 pushed a lever, which raised the coloured ball in the apparatus to an opening where the infant retrieved it with their hand (Action 1) and then placed it into the toy frog (Action 2). The PRT always preceded the CRT as we determined task order based on expected difficulty. From auckland.figshare.com. Copyright Breeland and Henderson (2020).

Descriptive Statistics and Correlations

Table 3 contains all descriptive statistics. Mothers' CVS and infant cooperative ability measures for both tasks violated normality assumptions, thus we conducted non-parametric or robust analyses when necessary. Social games frequency and FFM personality variables satisfied normality assumptions. We did not exclude or replace outliers; however, we conducted analyses with outliers windsorized and indistinguishable patterns of results emerged between both data sets.

Table 3

Descriptives for Maternal Predictors and Infant Cooperative Outcomes in Study 1 and 2.

Measures	***M***	***SD***	***n***	**range**
Maternal Values & Behaviours				
CVS (-1= Egoistic to 1 = Altruistic)	-.29	.80	193	[-1, 1]
Social Games	12.10	8.41	188	[3, 70]
Maternal FFM Personality (1 = Low, 7 = High)				
Openness (α = .85)	5.02	.73	146	[3.20, 6.90]
Conscientiousness (α = .84)	5.01	.76	146	[3.00, 6.90]
Extraversion (α = .91)	4.82	.89	146	[2.70, 7]
Agreeableness (α = .84)	5.80	.60	147	[3.45, 6.90]
Neuroticism (α = .90)	3.35	.90	149	[1, 5.75]
Maternal HEXACO Personality (1 = Low, 7 = High)				
Openness (α = .70)	5.13	1.15	113	[2.50, 7]
Conscientiousness (α = .74)	5.12	1.14	113	[2.75, 7]
Extraversion (α = .79)	3.91	1.33	113	[1.25, 6.50]
Agreeableness (α = .58)	5.85	.85	113	[2.75, 7]
Neuroticism (α = .75)	3.62	1.13	113	[1.25, 6.25]
Honesty-Humility (α = .70)	5.67	.97	113	[3.50, 7]
Infant Temperament (1 = Low, 7 = High)				
Surgency	4.96	.57	157	[3, 6]
Negative Affectivity	3.34	.80	158	[2, 5]
Regulatory Capacity	4.72	.68	158	[3, 6]
Infant Spatial Coordination (1 = Low, 5 = High)				
PRT	3.65	.76	174	[1, 5]
CRT	3.39	.82	142	[2, 4.50]
Infant Cooperative Success (0 = None, 2 = High)				
PRT	1.18	.81	174	[0, 2]
CRT	1.67	.42	144	[1, 2]
Infant Latency to Success (in Seconds)				
PRT	18.89	12.83	134	[.04, 65.60]
CRT				
Toy Retrieval (Action 1)	5.90	4.84	145	[1.4, 19.40]
Goal Completion (Action 2)	12.07	10.83	111	[.04, 45.34]

Note. FFM = Five-Factor Model Personality Inventory (DeYoung et al., 2007). HEXACO = Six-Factor Model Personality Inventory as measured by the Mini-IPIP6 (Sibley et al., 2011). PRT = Parallel Roles Task. CRT = Complementary Roles Task.

We conducted preliminary analyses on the original data set with missing values present. Table 4 contains correlation coefficients for all variables of interest. Moderate to strong correlations emerged between the maternal and infant measures, with associations varying between cooperative task type. Considering this and to maintain adequate statistical power, we investigated the hypothesised model in relation to each

cooperative task by constructing separate, task-based structural equation models (SEMs).

Table 4

Pearson Correlation Coefficients for all Variables in Study 1

Variable	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**	**16.**
Maternal Values and Behaviours																
1. CVS																
2. Social Games	.03															
Maternal FFM Personality																
3. Openness	**.19***	.01														
4. Cons	.05	-.08	-.08													
5. Extraversion	-.00	.10	**.24****	**.19***												
6. Agreeableness	.10	.18	**.19***	-.03	-.00											
7. Neuroticism	-.07	.15	-.18	**-.42****	**-.20***	-.03										
Infant Temperament																
8. Surgency	-.01	.10	.15	.03	.07	.04	-.11									
9. Neg Aff	-.02	-.04	-.05	-.18	-.06	.05	.10	.05								
10. Reg Cap	.07	.09	.15	.16	**.20***	-.00	**-.20***	**.27****	-.04							
Infant Spatial Coordination																
11. PRT	.06	.11	.05	.07	.01	**.27****	**-.30****	.02	.02	.10						
12. CRT	**.23****	.06	.14	.07	-.03	.02	-.03	.03	.07	.03	.06					
Infant Success																
13. PRT	.13	-.06	-.07	.10	.07	.03	**-.21***	-.04	.06	.03	**.57****	.14				
14. CRT	**.26****	.05	.17	.09	.02	.05	-.04	.04	.10	.05	.07	**.97****	.14			
Infant Latency																
15. PRT	.03	.07	-.03	.03	-.03	-.11	-.07	-.08	-.16	-.15	-.16	.04	-.12	.05		
16. CRT-1	**.19***	-.10	**.29****	.04	-.10	.01	-.10	.06	-.07	-.09	.04	**-.22****	-.02	-.17	-.01	
17. CRT-2	**.20***	-.09	.03	-.18	-.10	.00	.16	.04	-.11	.05	-.07	**-.22***	.07	-.18	.04	**.19***

Note. Calculations based on raw data with missing values. All p-values were adjusted for multiple comparisons using the Benjamini (1995) method for controlling for false discovery rates. Significant correlations are bolded. *indicates $p < .05$. **indicates $p < .01$. FFM = Five-Factor Model, Cons = Conscientiousness, Neg Aff = Negative Affectivity, Reg Cap = Regulatory Capacity, PRT = Parallel Roles Task, CRT = Complementary Roles Task, CRT-1 = Action 1 (i.e., removing object from apparatus), CRT-2 = Action 2 (i.e., placing the object which was removed from the apparatus into the frog toy)

Gender and Age Differences

Preliminary analyses revealed that females exhibited slightly more spatial coordination than males on the PRT (Mann–Whitney U = 2899, $p = .003$) and older infants demonstrated shorter latencies to end-goal completion on the CRT ($r = -.22$, $p = .02$). Thus, we included age and gender within the relevant focal analyses.

Focal Analyses

We tested all SEMs by using the R package "lavaan" (Rosseel, 2012) with all exogenous covariates considered random so that the means, variances, and covariances were estimated as free parameters. Further, we implemented the full information maximum likelihood technique to overcome issues associated with missing data and utilised the maximum likelihood robust estimator to overcome normality issues.

PRT

A SEM revealed that the hypothesised model was empirically under-identified (see OSM Figure 1), thus we adopted a model-generating approach based upon the correlation matrix of the original data. We compared the retained model (Figure 3; AIC = 3104.28) to an alternative model (AIC = 3104.28) with the non-significant paths from Figure 3 removed; however, the models did not differ significantly, $X^2(3) = 2.24$, $p = .52$.

CRT

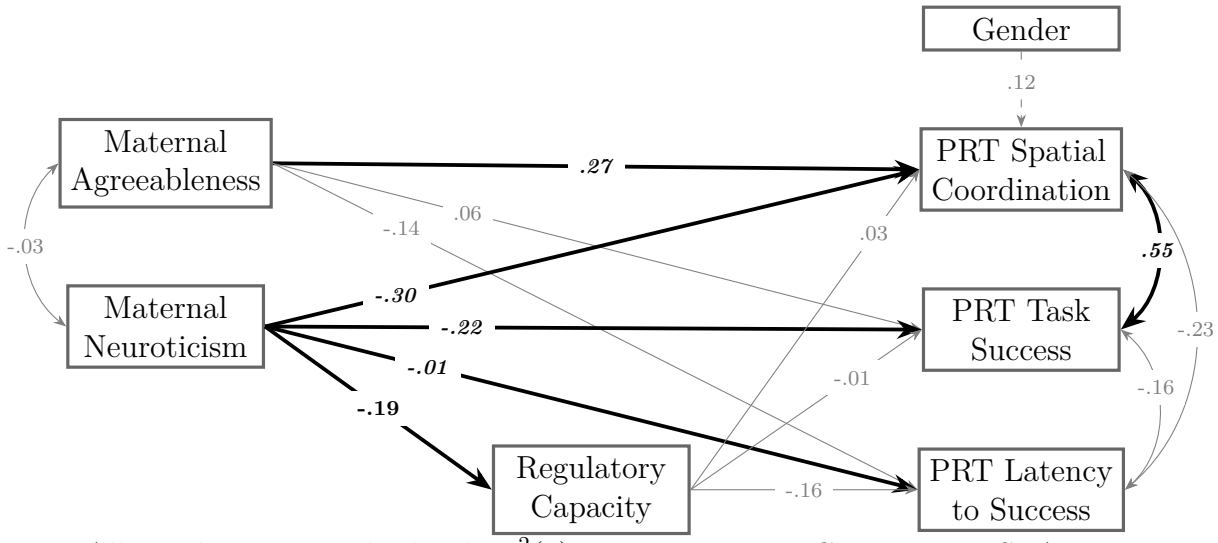
The hypothesised model (see OSM Figure 2) was an adequate but empirically under-identified fit, so we generated two alternative models. The retained model (Figure 4; AIC = 4304.60) did not differ significantly from the alternative model with the non-significant paths from Figure 4 removed (AIC = 1724.54), $X^2(6) = .50$, $p = 1$.

Maternal Cooperative Values and Infant Cooperative Ability

We predicted that mothers with other-oriented cooperative values would have infants who showed enhanced cooperative abilities across both tasks. Contrary to our hypotheses, maternal CVS predicted infant cooperative outcomes only on the CRT. Results from the retained CRT model revealed that increased maternal CVS predicted a

Figure 3

Structural Model of Maternal FFM Agreeableness and Neuroticism (Mediated by Infant Regulatory Capacity) Predicting Infants' Cooperative Ability in the PRT



Note. All weights are standardized. $X^2(5) = 2.83$, $p = .73$; CFI = 1, RMSEA = 0, SRMR = .02. Values in bold are statistically significant at $p < .05$. Values in bold and *italics* are statistically significant at $p < .01$.

moderate increase in infants' spatial coordination and success, but not latency to toy retrieval or goal completion (see Figure 4).

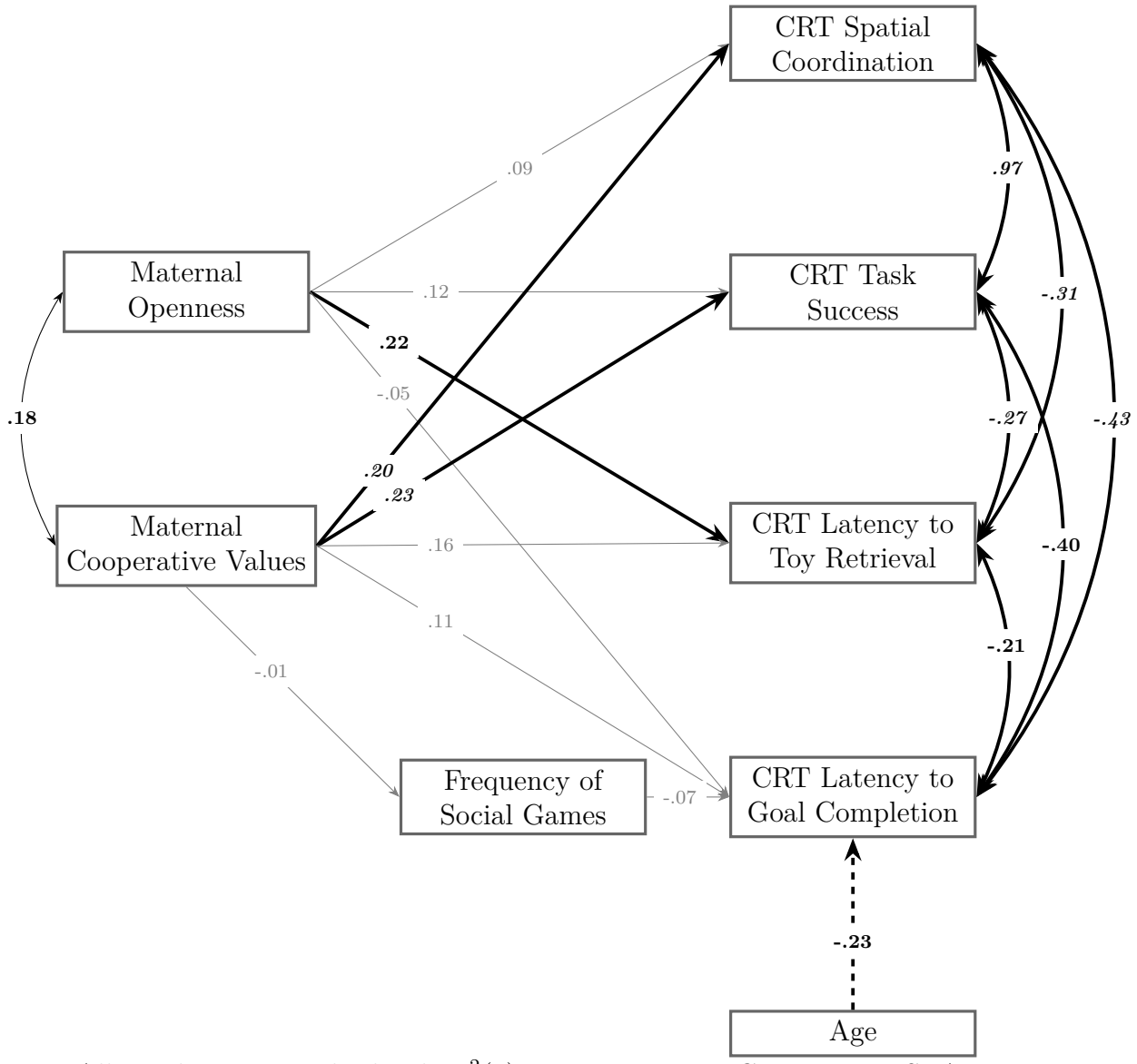
Our results are consistent with related research suggesting that maternal expectations (Schuhmacher & Kärtner, 2015) and socialisation goals (Fonseca et al., 2018) regarding their child's prosociality predict increased prosocial behaviour. Unexpectedly, associations between maternal CVS and infants' cooperative ability emerged in relation to only the CRT and maternal reports of frequency of social gameplay did not mediate these effects. We discuss these findings in the General Discussion

Maternal FFM Personality and Infant Cooperative Ability

We predicted that infants with mothers high in agreeableness would demonstrate enhanced cooperative abilities across both tasks. Analyses revealed that increased maternal agreeableness predicted an increase in infants' spatial coordination, but not success or latency (see Figure 3) on the PRT. Maternal agreeableness did not predict infant outcomes on the CRT (see Figure 4).

Figure 4

Structural Model of Maternal FFM Openness and Cooperative Values (Mediated by Frequency of Social Games) Predicting Infants' Cooperative Ability in the CRT



Note. All weights are standardized. $X^2(8) = 3.72$, $p = .88$; CFI = 1, RMSEA = 0, SRMR = .03. Values in bold are statistically significant at $p < .05$. Values in bold and *italics* are statistically significant at $p < .01$.

The association between maternal agreeableness and infants' spatial coordination on the PRT suggests that mothers with traits such as compassion, compliance, and politeness (DeYoung et al., 2007) are more likely to have infants who are better able to coordinate their actions with an adult in tasks that are based on imitation. Surprisingly, maternal agreeableness did not relate to infants' success or latency. To demonstrate increased success or latency, infants must also have enhanced motor

abilities; however, enhanced spatial coordination requires only that they understand which action is correct. Perhaps infants of highly agreeable mothers embodied characteristics of compliance, engaged in enhanced imitation, and thus gained a better understanding their cooperative role. This could also be a reason as to why we did not find associations between maternal agreeableness and infants' cooperative ability on the CRT. Specifically, the PRT is an imitative-based task, whereas the CRT requires that infants predict the actions of the experimenter in order to achieve the shared goal. Overall, our finding that maternal agreeableness predicted infant spatial coordination in the PRT expands on the existing research showing that adult agreeableness (FFM) is linked with cooperative behaviour (Habashi et al., 2016; Kagel & Mcgee, 2014) by suggesting that personality-life outcomes may extend from parent to child.

Unexpectedly, increased maternal neuroticism was associated with decreased PRT latency, which would suggest enhanced cooperative ability; however, the effect size was not practically significant. Additionally, increased maternal neuroticism predicted a moderate decrease in infant spatial coordination and success on the PRT (see Figure 3). Previous work regarding adult neuroticism and cooperation suggests that trait characteristics of neuroticism (i.e., fear and insecurity) motivate an individual to engage in cooperation due fear of repercussions, or punishment aversion (Fehr & Gächter, 2000; Hirsh & Peterson, 2009). It is possible that infants of mothers high in neuroticism perceived that there may be repercussions for not cooperating with E1; however, rather than supporting cooperation, punishment aversion may have increased infants' cognitive load and taxed cognitive mediator systems which resulted in poorer spatial coordination and success (Berger, 2004; Boudreau & Bushnell, 2000; Keen et al., 2003). At the age of 14 months, infants' spatial abilities are not fully developed (Warneken & Tomasello, 2007), thus additional stressors may have negatively impacted their abilities to replicate their partners' actions in the PRT.

Maternal openness predicted increased CRT latency (see Figure 4). To our knowledge, no studies have linked openness to reduced cooperative competence. If infants of mothers high in openness shared their characteristics of day dreaming

(DeYoung et al., 2007), it is possible that they demonstrated longer latencies due to being preoccupied with introspection; however, this explanation requires further research.

We utilised the FFM of personality to address our research questions in Study 1. The HEXACO model (Ashton & Lee, 2007) of personality includes of a sixth factor of personality, honesty-humility, which has been argued to be a better predictor of cooperative behaviour across diverse contexts (Thielmann et al., 2020). In Study 2, we extend our investigation of the associations between maternal personality and infants' cooperative competence by testing the extent to which maternal HEXACO personality accounts for variation in infants' cooperative ability.

Study 2: Method

In Study 2 we utilised the Mini-IPIP6 (HEXACO; Sibley et al., 2011), a culturally specific Six Factor personality inventory developed from the Six-Factor HEXACO Model (Ashton & Lee, 2007). Critically, Study 2 tests the stability of the associations between maternal personality and infants' cooperative competence between assessment tools. See Figure 1 for hypotheses. Study 2 was identical to Study 1 with one exception: we used mothers' HEXACO personality data collected from DCW6 (see Table 1 for demographics and Table 2 for variables, definitions, and scoring).

Results and Discussion

Statistical approaches, significance parameters, and supplemental information in this study were identical Study 1.

Descriptive Statistics and Preliminary Analyses

See Table 3 for descriptive statistics. Mothers' HEXACO scores satisfied normality criteria. Table 5 contains correlation coefficients for all variables of interest.

Table 5

Pearson Correlation Coefficients for all Variables in Study 2

Variable	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**
Maternal Values and Behaviours																	
1. CVS																	
2. Social Games	.03																
Maternal HEXACO Personality																	
3. Openness	.14	**.23***															
4. Cons	.11	-.02	-.07														
5. Extraversion	.17	.13	**.26****	-.05													
6. Agreeableness	.15	**.22***	**.23***	.16	**.26****												
7. Neuroticism	.03	.07	-.01	-.17	-.14	.03											
8. Honesty-Humility	.04	**.23***	.04	.00	**-.26****	.12	-.11										
Infant Temperament																	
9. Surgency	-.01	.10	.14	.10	.06	-.00	-.08	**.26***									
10. Neg Aff	-.02	-.04	-.01	.03	.03	.00	.02	.12	.05								
11. Reg Cap	.07	.09	.09	.04	.05	-.05	-.05	**.23***	**.27****	-.04							
Infant Spatial Coordination																	
12. PRT	.06	.11	.07	-.10	-.14	.01	-.12	**.28****	.02	.02	.10						
13. CRT	**.23****	.06	.08	.01	.01	.08	.10	.06	.03	.07	.03	.06					
Infant Success																	
14. PRT	.13	-.06	.05	-.03	-.06	-.00	-.06	.19	-.04	.06	.03	**.57****	.14				
15. CRT	**.26****	.05	.11	-.01	.04	.09	.10	.06	.04	.10	.05	.07	**.97****	.14			
Infant Latency																	
16. PRT	.03	.07	-.12	.05	-.14	-.12	-.11	-.18	-.08	-.16	-.15	-.16	.04	-.12	.05		
17. CRT-1	**.19***	-.10	.10	.01	-.07	.04	-.11	-.12	.06	-.07	-.09	.04	**-.22****	-.02	-.17	-.01	
18. CRT-2	**.20***	-.09	-.07	-.02	-.08	.06	.10	-.01	.04	-.11	.05	-.07	**-.22***	.07	-.18	.04	**.19***

Note. Calculations based on raw data with missing values. All p-values were adjusted for multiple comparisons using the Benjamini (1995) method for controlling for false discovery rates. Significant correlations are bolded. *indicates $p < .05$. **indicates $p < .01$. HEXACO = Six-Factor Model, Cons = Conscientiousness, Neg Aff = Negative Affectivity, Reg Cap = Regulatory Capacity, PRT = Parallel Roles Task, CRT = Complementary Roles Task, CRT-1 = Action 1 (i.e., removing object from apparatus), CRT-2 = Action 2 (i.e., placing the object which was removed from the apparatus into the frog toy)

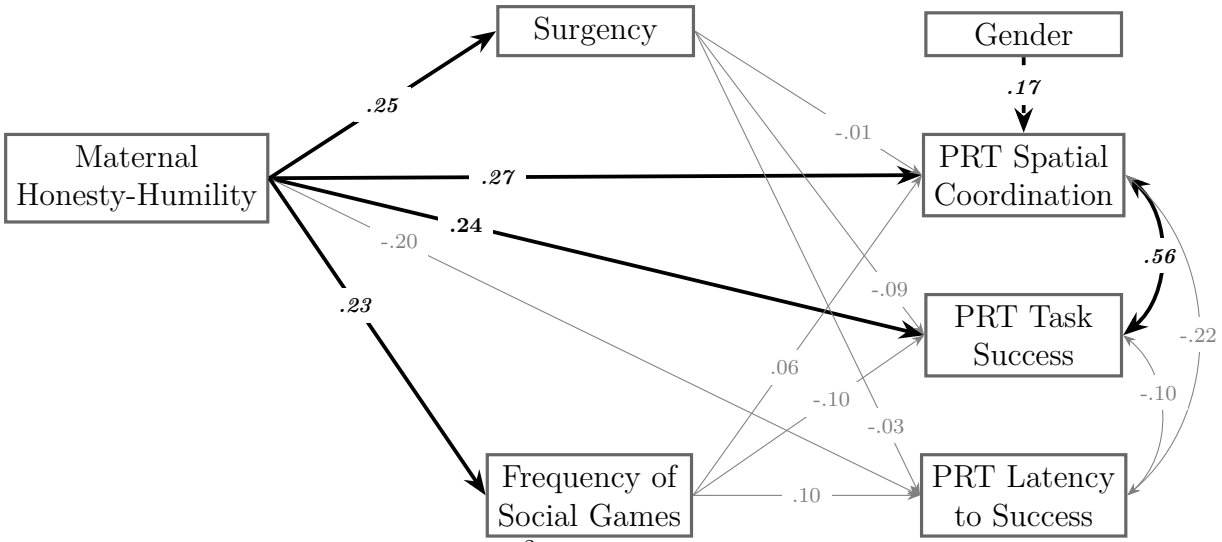
Focal Analyses

PRT

A SEM revealed that the hypothesised model (see OSM Figure 3) remained empirically under-identified. Thus, we generated two alternative models based upon the correlation matrix of the original data. The retained model of best fit (Figure 5; AIC = 4039.87) did not differ significantly from an alternative model with the non-significant paths from Figure 5 removed (AIC = 1368.43), $X^2(4) = 6.29$, $p = .18$.

Figure 5

Structural Model of Maternal HEXACO Honesty-Humility (Mediated by Infant Surgency and Frequency of Social Games) Predicting Infants' Cooperative Ability in the Parallel Roles Task (PRT)



Note. All weights are standardized. $X^2(5) = 6.22$, $p = .29$; CFI = .99, RMSEA = .03, SRMR = .03. Values in bold are statistically significant at $p < .05$. Values in bold and *italics* are statistically significant at $p < .01$.

CRT

The hypothesised model was empirically under-identified (see OSM Figure 4). Given that the personality traits assessed by the HEXACO were not correlated with infants' CRT cooperative ability (see Table 5), we did not retain a model.

Maternal HEXACO Personality and Infant Cooperative Ability

We predicted that infants of mothers high in honesty-humility would demonstrate enhanced cooperative ability on both tasks. A SEM revealed that

increased maternal honesty-humility predicted infants' enhanced PRT spatial coordination and success, but not latency (see Figure 5). Previous research suggests that honesty-humility is related to unconditional cooperation (e.g., acting fairly towards others) whereas agreeableness is related to reactive cooperation (e.g., forgiveness towards others; Hilbig et al., 2013). Our findings support the possibility that the qualities of maternal unconditional cooperation translates into infants' tendency to effectively coordinate and attain shared goals during cooperation. Contrary to our hypotheses, neither surgency nor frequency of social games mediated the association between maternal honesty-humility and infants' PRT cooperative ability. Possible explanations will be addressed in the General Discussion.

General Discussion

Utilising data from an ongoing longitudinal study, the present research examines if maternal cooperative values and personality are associated 14-month-olds' cooperative ability. While support for our hypotheses (see Figure 1) was mixed, the findings contribute to the literature in several ways.

Maternal Values and Infant Cooperative Ability

Consistent with our hypotheses, infants of mothers with altruistic cooperative values were more likely to demonstrate enhanced cooperative competence; however, this finding emerged only in relation to the CRT. Previous research indicates that infants demonstrate the cooperative ability in complementary roles tasks later than they do in parallel roles tasks (Warneken et al., 2006; Warneken & Tomasello, 2007). Complementary roles tasks require that infants' forecast the actions of their social partner and produce a differential action, which is arguably different to imitative-based actions. Our findings suggest that mothers who value the other-oriented nature of cooperation may encourage their infants to be particularly attentive to others' actions, which may enable infants to better anticipate and respond to the actions of their social partner, a key component of cooperation (Bratman, 1992).

Although frequency of social gameplay did not mediate the relationship between maternal CVS and infant cooperative ability, mothers with other-oriented CVS may be

more likely to engage in certain parenting behaviours such as inductive reasoning. Inductive reasoning stresses taking the perspective of others, which has been shown to promote empathy and children's perspective-taking (Hoffman, 2000; Krevans & Gibbs, 1996), and has been linked to child prosocial outcomes (Laible et al., 2017). However, more research is needed to establish these links.

Maternal Personality and Infant Cooperative Ability

Findings from both studies are consistent with evidence linking agreeableness (FFM) and honesty-humility (HEXACO) with cooperation (Thielmann et al., 2020). Our results extend previous work from adults to mother-infant dyads by suggesting that infants of mothers high in agreeableness (FFM) or honesty-humility (HEXACO) may have an advantage in cooperative exchanges, if those exchanges involve imitation-based roles. Mothers high in FFM agreeableness rate higher on compassion, politeness, and conformity (DeYoung et al., 2007; Saroglou, 2010), thus it is possible that they are more likely to stress the importance of watching and imitating the actions of social partners. Additionally, infants of mothers high in FFM agreeableness might be particularly sensitive to conformity pressures, and thus may be more sensitive to correctly fulfilling their cooperative role.

Traits of increased honesty-humility (HEXACO) include fairness and willingness to cooperate unconditionally (Thielmann et al., 2020). It is possible that increased imitation abilities, a cognitive skill that buttresses learning (Bandura, 1977) and arguably facilitates cooperation (Heyes, 2013; Van Baaren et al., 2009), enables individuals high in honesty-humility to cooperate unconditionally. Perhaps mothers high in honesty-humility are more inclined to social imitation, and thus have infants who are better able to imitate others. Although no prior research has explored links between honesty-humility and automatic imitation (i.e., imitation that occurs unconsciously and is linked with coordinated abilities and cooperation; Heyes, 2013; Knoblich et al., 2011), evidence indicates that individuals high in agreeableness (FFM) are not particularly sensitive to automatic imitation (Butler et al., 2016). Thus, imitation could be an important cognitive mediator for individuals with

honesty-humility traits and could serve as an important differentiating variable between cooperation associated with agreeableness (FFM) versus honesty-humility (HEXACO).

The factors that mediate the effects found in this research remain unclear. The lack of mediation effects observed in this study are inconsistent with research suggesting that 1) increased surgency (Endedijk et al., 2015) or decreased negative affectivity (Vaughan et al., 2003) enhances cooperative outcomes and 2) temperament is biologically based and should be associated with parent personality characteristics (Bouchard & McGue, 2003; Saudino, 2005). However, temperament may be particularly important in facilitating cooperative exchanges with peers, rather than with adults. Evidence suggests that increased surgency is associated with increased positive interaction quality, which supports cooperative exchanges between peers (Endedijk et al., 2015). Since adults scaffold infants' early cooperative exchanges, perhaps the functional aspects of interaction quality (i.e., to convey intentions) and associated temperament characteristics are less paramount.

Active cooperative experience bolsters infants' cooperative understanding (Henderson et al., 2013; Krogh-Jespersen et al., 2020) and social games are regarded as the building blocks of cooperative development (Ross & Lollis, 1987); however, frequency of social gameplay did not mediate the effects found in the present study. Social gameplay was assessed when infants were nine months of age and cooperative ability when they were 14 months of age, thus it is possible that the timing of our assessments impacted our results. Specifically, it is unclear if social gameplay assessed during the same DCW would exert a mediating effect on infants' cooperative abilities.

Social games are one behaviour that could facilitate infants' cooperative skills (Ross & Kay, 1980). Mothers may provide cooperative experience to their infant in a variety of other ways, such as through volunteerism (e.g., volunteering to assist others in prosocial contexts) and social reinforcement (e.g., telling their child: "you are so cooperative" upon seeing their child cooperate with an adult or peer; Bower & Casas, 2016). Perhaps associations between maternal personality and alternative cooperative experiences exist; an exciting direction for future research.

Caveats, Considerations and Future Directions

Our findings showed that mothers' personality and values differentially predicted infants' cooperative behaviour; however, our findings do not address the extent to which infants' cooperative behaviour shapes mothers' personality or values. Although one study found bidirectional effects between maternal personality and infant temperament, such bidirectional effects are unlikely to confound the interpretations presented in this paper given the stability of personality in adulthood and the short time frame during which the present study was conducted (Cobb-Clark & Schurer, 2012; Komsi et al., 2008). Further, focusing on mothers as primary caregivers remains a common research practice (see Laible et al., 2017; Schuhmacher et al., 2017); however, we acknowledge that a comprehensive examination of the role that parents' personality and values play in infants' development requires information from both parents. In our future research, we will also examine the developmental stability of our findings by examining the cooperative development of children in this study across early childhood. This work will provide insights regarding the extent to which mothers' personality and values shape children's cooperative development as they encounter new opportunities for social learning.

Conclusion

Parents influence the development of their infant's cooperative skills in diverse ways. Our findings suggest that mothers who stress cooperation for altruistic reasons may engage in behaviours that encourage their infants to excel at attaining shared goals in tasks where forecasting their social partner's actions is paramount. Our findings also show that mothers high in agreeableness (FFM) and honesty-humility (HEXACO) may engage in behaviours that support their children's cooperative development by encouraging them to learn rules and social routines that translate well into supporting their behaviour in cooperative tasks that rely on imitation, rules, and structure for successful outcomes. These findings add to the existing literature on the early development of cooperation by being the first to demonstrate that mothers' personality and values affect infants' cooperative outcomes early in life.

References

Ashton, M. C., & Lee, K. (2007). Empirical, theoretical, and practical advantages of the HEXACO model of personality structure. *Personality and Social Psychology Review*, *11*(2), 150–166. https://doi.org/10.1177/1088868306294907

Bandura, A. J. (1977). *Social learning theory*. Prentice Hall.

Barry, C., Padilla-Walker, L., Madsen, S., & Nelson, L. (2008). The impact of maternal relationship quality on emerging adults' prosocial tendencies: Indirect effects via regulation of prosocial values. *Journal of Youth and Adolescence*, *37*(5), 581–591. https://doi.org/10.1007/s10964-007-9238-7

Berger, S. E. (2004). Demands on finite cognitive capacity cause infants' perseverative errors. *Infancy*, *5*(2), 217–238. https://doi.org/10.1207/s15327078in0502{_}7

Bouchard, T. J., & McGue, M. (2003). Genetic and environmental influences on human psychological differences. *Journal of Neurobiology*, *54*(1), 4–45. https://doi.org/10.1002/neu.10160

Boudreau, J. P., & Bushnell, E. W. (2000). Spilling thoughts: Configuring attentional resources in infants' goal-directed actions. *Infant Behavior and Development*, *23*(3-4), 543–566. https://doi.org/10.1016/S0163-6383(01)00059-5

Bower, A. A., & Casas, J. F. (2016). What parents do when children are good: Parent reports of strategies for reinforcing early childhood prosocial behaviors. *Journal of Child and Family Studies*, *25*(4), 1310–1324. https://doi.org/10.1007/s10826-015-0293-5

Bratman, M. E. (1992). Shared cooperative activity. *The Philosophical Review*, *101*(2), 327–341.

Breeland, N., & Henderson, A. (2020). Adult-infant experimental cooperative tasks. https://doi.org/10.17608/k6.auckland.13394063.v1

Brownell, C. A. (2013). Early development of prosocial behavior: Current perspectives. *Infancy*, *18*(1), 1–9. https://doi.org/10.1111/infa.12004

Brownell, C. A., & Carriger, M. S. (1990). Changes in cooperation and self-other differentiation during the second year. *Child Development*, *61*(4), 1164–1174. https://doi.org/10.1111/j.1467-8624.1990.tb02850.x

Butler, E. E., Ward, R., & Ramsey, R. (2016). The influence of facial signals on the automatic imitation of hand actions. *Frontiers in Psychology*, *7*, 1–21. https://doi.org/10.3389/fpsyg.2016.01653

Call, J. (2009). Contrasting the social cognition of humans and nonhuman apes: The shared intentionality hypothesis. *Topics in Cognitive Science*, *1*(2), 368–379. https://doi.org/10.1111/j.1756-8765.2009.01025.x

Cobb-Clark, D. A., & Schurer, S. (2012). The stability of big-five personality traits. *Economics Letters*, *115*(1), 11–15. https://doi.org/10.1016/j.econlet.2011.11.015

Craig, L. (2006). Does father care mean fathers share?: A comparison of how mothers and fathers in intact families spend time with children. *Gender and Society*, *20*(2), 259–281. https://doi.org/10.1177/0891243205285212

Csibra, G., & Gergely, G. (2009). Natural pedagogy. *Trends in Cognitive Sciences*, *13*(4), 148–153. https://doi.org/10.1016/j.tics.2009.01.005

DeYoung, C. G., Quilty, L. C., & Peterson, J. B. (2007). Between facets and domains: 10 aspects of the Big Five. *Journal of Personality and Social Psychology*, *93*(5), 880–896. https://doi.org/10.1037/0022-3514.93.5.880

Endedijk, H. M., Cillessen, A. H. N., Cox, R. F. A., Bekkering, H., & Hunnius, S. (2015). The role of child characteristics and peer experiences in the development of peer cooperation. *Social Development*, *24*(3), 521–540. https://doi.org/10.1111/sode.12106

Fehr, E., & Gächter, S. (2000). Cooperation and punishment in public goods experiments. *American Economic Review*, *90*(4), 980–994. https://doi.org/10.1257/aer.90.4.980

Fishbein, I., & Ajzen, M. (1975). *Belief, attitude, intention, and behavior: an introduction to theory and research*. Reading, MA: Addison-Wesley.

539 Fonseca, B. R., Cavalcante, L. I. C., Kärtner, J., Köster, M., Iêda, L., Cavalcante, C.,
540 Kärtner, J., & Köster, M. (2018). Maternal socialization goals and the
541 spontaneous prosocial behavior of children in rural contexts. *Psicologia: Reflexao*
542 *e Critica*, *31*(1). https://doi.org/10.1186/s41155-018-0108-x
543 Garstein, M., & Rothbart, M. K. (2003). Studying infant temperament via a revision of
544 the Infant Behavior Questionnaire. *Infant Behavior & Development*, *26*, 64–86.
545 https://doi.org/10.1016/S0163-6383(02)00169-8
546 Habashi, M. M., Graziano, W. G., & Hoover, A. E. (2016). Searching for the prosocial
547 personality. *Personality and Social Psychology Bulletin*, *42*(9), 1177–1192.
548 https://doi.org/10.1177/0146167216652859
549 Haesevoets, T., Folmer, C. R., & Van Hiel, A. (2015). Cooperation in mixed-motive
550 games: the role of individual differences in selfish and social orientation. *European*
551 *Journal of Personality*, *29*(4), 445–458. https://doi.org/10.1002/per.1992
552 Henderson, A. M., Wang, Y., Matz, L., & Woodward, A. (2013). Active experience
553 shapes 10-month-old infants' understanding of collaborative goals. *Infancy*,
554 *18*(1), 10–39. https://doi.org/10.1111/j.1532-7078.2012.00126.x
555 Heyes, C. (2013). What can imitation do for cooperation? In K. Sterelny, R. Joyce, B.
556 Calcott, & B. Fraser (Eds.), *Cooperation and its evolution* (pp. 313–331). The
557 MIT Press.
558 Hilbig, B. E., & Zettler, I. (2009). Pillars of cooperation: Honesty-Humility, social value
559 orientations, and economic behavior. *Journal of Research in Personality*, *43*(3),
560 516–519. https://doi.org/10.1016/j.jrp.2009.01.003
561 Hilbig, B. E., Zettler, I., Leist, F., & Heydasch, T. (2013). It takes two:
562 Honesty-Humility and Agreeableness differentially predict active versus reactive
563 cooperation. *Personality and Individual Differences*, *54*(5), 598–603.
564 https://doi.org/10.1016/j.paid.2012.11.008
565 Hirsh, J. B., & Peterson, J. B. (2009). Extraversion, neuroticism, and the prisoner's
566 dilemma. *Personality and Individual Differences*, *46*(2), 254–256.
567 https://doi.org/10.1016/j.paid.2008.10.006

Hoffman, M. (2000). *Empathy and moral development: Implications for caring and justice*. Cambridge University Press.

Kagel, J., & Mcgee, P. (2014). Personality and cooperation in finitely repeated prisoner's dilemma games. https://doi.org/10.1016/j.jns.2003.09.014

Keen, R., Carrico, R. L., Sylvia, M. R., & Berthier, N. E. (2003). How infants use perceptual information to guide action. *Developmental Science*, *6*(2), 221–231. https://doi.org/10.1111/1467-7687.00274

Knoblich, G., Butterfill, S., & Sebanz, N. (2011). Psychological research on joint action: Theory and data. *Psychology of learning and motivation - advances in research and theory* (pp. 59–101). Elsevier. https://doi.org/10.1016/B978-0-12-385527-5.00003-6

Komsi, N., Räikkönen, K., Heinonen, K., Pesonen, A.-K., Keskivaara, P., Järvenpää, A.-L., & Strandberg, T. E. (2008). Transactional development of parent personality and child temperament. *European Journal of Personality*, *22*(6), 553–573. https://doi.org/10.1002/per.690

Krevans, J., & Gibbs, J. C. (1996). Parents' use of inductive discipline: Relations to children's empathy and prosocial behavior. *Child Development*, *67*(6), 3263–3277.

Krogh-Jespersen, S., Henderson, A. M., & Woodward, A. L. (2020). Let's get it together: Infants generate visual predictions based on collaborative goals. *Infant Behavior and Development*, *59*(March), 101446. https://doi.org/10.1016/j.infbeh.2020.101446

Laible, D., Kumru, A., Carlo, G., Streit, C., Selcuk, B., & Sayil, M. (2017). The longitudinal associations among temperament, parenting, and turkish children's prosocial behaviors. *Child Development*, *88*(4), 1057–1062. https://doi.org/10.1111/cdev.12877

Mangold. (2020). INTERACT User Guide.

Min, J., Silverstein, M., & Lendon, J. P. (2012). Intergenerational transmission of values over the family life course. *Advances in Life Course Research*, *17*(3), 112–120. https://doi.org/10.1016/j.alcr.2012.05.001

Putnam, S. P., Helbig, A. L., Gartstein, M. A., Rothbart, M. K., & Leerkes, E. (2014). Development and assessment of short and very short forms of the infant behavior questionnaire-revised. *Journal of Personality Assessment*, *96*(4), 445–458. https://doi.org/10.1080/00223891.2013.841171

R Core Team. (2020). R: A language and environment for statistical computing.

Rogoff, B., Mistry, J., Göncü, A., Mosier, C., Chavajay, P., Heath, S. B., & Goncu, A. (1993). Guided participation in cultural activity by toddlers and caregivers. *Monographs of the Society for Research in Child Development*, *58*(8), i. https://doi.org/10.2307/1166109

Ross, H., & Lollis, S. (1987). Communication within infant social games. *Developmental Psychology*, *23*(2), 241–248. https://doi.org/10.1037/0012-1649.23.2.241

Ross, H. S., & Kay, D. A. (1980). The origins of social games. *New Directions for Child and Adolescent Development*, *1980*(9), 17–31. https://doi.org/10.1002/cd.23219800904

Rosseel, Y. (2012). lavaan: An R package for Structural Equation Modeling. *Journal of Statistical Software*, *48*(2), 1–36.

Rothbart, M., & Bates, J. (2011). Temperament. In N. Eisenberg, W. Damon, & R. Lerner (Eds.), *Handbook of child psychology: Social, emotional, and personality development* (pp. 33–61). John Wiley & Sons, Inc.

Saroglou, V. (2010). Religiousness as a cultural adaptation of basic traits: A five-factor model perspective. *Personality and Social Psychology Review*, *14*(1), 108–125. https://doi.org/10.1177/1088868309352322

Saudino, K. (2005). Behavioral genetics and child temperament. *Journal of Developmental and Behavioral Pediatrics*, *26*(3), 214–223. https://doi.org/10.1038/jid.2014.371

Schuhmacher, N., Collard, J., & Kärtner, J. (2017). The differential role of parenting, peers, and temperament for explaining interindividual differences in 18-months-olds' comforting and helping. *Infant Behavior and Development*, *46*, 124–134. https://doi.org/10.1016/j.infbeh.2017.01.002

Schuhmacher, N., & Kärtner, J. (2015). Explaining interindividual differences in toddlers' collaboration with unfamiliar peers: Individual, dyadic, and social factors. *Frontiers in Psychology*, *6*, 1–14. https://doi.org/10.3389/fpsyg.2015.00493

Sibley, C. G., Luyten, N., Purnomo, M., Mobberley, A., Wootton, L. W., Hammond, M. D., Sengupta, N., Perry, R., West-Newman, T., Wilson, M. S., McLellan, L., Hoverd, W. J., & Robertson, A. (2011). The Mini-IPIP6: Validation and extension of a short measure of the Big-Six factors of personality in New Zealand. *New Zealand Journal of Psychology*, *40*(3), 142–159. https://doi.org/10.1002/per.417;M4-Citavi

Soto, C. J. (2019). How replicable are links between personality traits and consequential life outcomes? The Life Outcomes Of Personality Replication Project. *Psychological Science*, *30*(5), 711–727. https://doi.org/10.1177/0956797619831612

Thielmann, I., Spadaro, G., & Balliet, D. (2020). Personality and prosocial behavior: A theoretical framework and meta-analysis. *Psychological Bulletin*, *146*(1), 30–90. https://doi.org/10.1037/bul0000217

Van Baaren, R., Janssen, L., Chartrand, T. L., & Dijksterhuis, A. (2009). Where is the love? The social aspects of mimicry. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1528), 2381–2389. https://doi.org/10.1098/rstb.2009.0057

Van Lange, P. A. M. (1999). The pursuit of joint outcomes and equality in outcomes: An integrative model of social value orientation. *Journal of Personality and Social Psychology*, *77*(2), 337–349. https://doi.org/10.1037/0022-3514.77.2.337

Vaughan, A., Mundy, P., Block, J., Burnette, C., Delgado, C., Gomez, Y., Meyer, J., Neal, A. R., & Pomares, Y. (2003). Child, caregiver, and temperament contributions to infant joint attention. *Infancy*, *4*(4), 603–616. https://doi.org/10.1207/S15327078IN0404{_}11

654 Vygotsky, L. S. (1978). *Mind in Society: Development of Higher Psychological Processes*.
655 Cambridge: Harvard University Press.
656 Warneken, F. (2017). How children solve the two challenges of cooperation. *Annual*
657 *Review of Psychology*, *69*(9), 1–25.
658 https://doi.org/10.1146/annurev-psych-122216-011813
659 Warneken, F., Chen, F., & Tomasello, M. (2006). Cooperative activies in young children
660 and chimpanzees. *Child Development*, *77*(3), 640–663.
661 https://doi.org/10.1111/j.1467-8624.2006.00895.x
662 Warneken, F., & Tomasello, M. (2007). Helping and cooperation at 14 months of age.
663 *Infancy*, *11*(3), 271–294. https://doi.org/10.1111/j.1532-7078.2007.tb00227.x
664 Wu, Z., Pan, J., Su, Y., & Gros-Louis, J. (2013). How joint attention relates to
665 cooperation in 1- and 2-year-olds. *International Journal of Behavioral*
666 *Development*, *37*(6), 542–548. https://doi.org/10.1177/0165025413505264