Influence of Social Factors on the Relation Between Lie-Telling and Children's Cognitive
Abilities

*Victoria Talwar¹, PhD

Jennifer Lavoie¹

Carlos Gomez Garibello², PhD

Angela M. Crossman³, PhD

¹Department of Educational and Counseling Psychology, McGill University

²Department of Medicine, McGill University

³John Jay College of Criminal Justice, City University of New York

*Corresponding author: Victoria Talwar, victoria.talwar@mcgill.ca

Education Building, Room 614, 3700 McTavish Street, Montreal, Quebec, H3A 1Y2

Abstract

Lie-telling may be part of a normative developmental process for children. However, little is known about the complex interaction of social and cognitive factors related to this developmental behavior. The current study examined parenting style, maternal exposure to stressors, and children's cognitive abilities in relation to children's antisocial lie-telling behavior in an experimental setting. Children (3-6 years, $N = 157$) participated in a modified temptation resistance paradigm to elicit spontaneous lies. Results indicate high authoritative parenting and high inhibitory control interact to predict a lower propensity to lie, but for those who did lie, they had better semantic leakage control. This suggests that although children's lie-telling may be normative in early development, the relation to children's cognitive abilities can be moderated by responsive parenting behaviors that discourage lying.

Keywords: lie-telling, social environments, parenting, cognitive ability

Acknowledgments

This study was funded by the National Science Foundation under Grant No. BCS-0721536. The authors would like to thank to the children and families who participated in this study. The authors would also like to thank the graduate students, and volunteers in the Talwar Child Development Lab and Child Study Lab at John Jay College.

Influence of Social Factors on the Relation Between Lie-Telling and Children's Cognitive Abilities

Lying is universally regarded as an antisocial behavior (Bok, 1978). However, at the same time, it is still a common behavior among adults that is used as a social strategy to manage interpersonal relationships (DePaulo & Kashy, 1998). Research with children has found that lie-telling emerges during the preschool years as a function of normative cognitive development (e.g., Talwar & Crossman, 2011), particularly executive functioning (EF) skills (e.g., Evans & Lee, 2011; 2013; Polak & Harris, 1999; Talwar & Lee, 2002; 2011; Xu & Lee, 2007). Although researchers have explored the role of cognitive factors, very little research has examined direct and indirect social-environmental influences on the development of deception. Yet, lying is an interpersonal exercise that is likely shaped by social-environmental factors. Moreover, social environments impact the development of cognitive abilities (e.g., Lengua, Honorado, & Bush, 2007; Morrell & Murray, 2003; Talwar, Carlson, & Lee, 2011), raising the possibility that social-environmental factors moderate the association between cognitive abilities and lie-telling. Even though their impact has been highlighted as significant (e.g., DePaulo & Jordan, 1992; Talwar & Crossman, 2011), how social-environmental and cognitive factors concurrently influence children's lie-telling is poorly understood. The current study examines how social-environmental factors, specifically parenting styles and maternal stress, interact with cognitive abilities to predict children's lie-telling to conceal a transgression.

Lying and Social Factors

Both research and theory suggest that a central social-environmental influence in children's lives is their parents, as parenting plays a critical role in children's development. Sensitive parenting is associated with more optimal cognitive, behavioral, and socio-emotional

child outcomes (e.g., Mesman, Van IJzendoorn, & Bakermans-Kranenburg, 2012; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004), and with the higher internalization of regulatory strategies (Bernier, Carlson, Deschenes, & Matte-Gagne, 2012). However, parenting that is harsh and inconsistent is correlated with less optimal development. For instance, authoritarian parental discipline (i.e., harsh, power assertive) is associated with poorer social-cognitive performance (Hughes, Deater-Deckard, & Cutting, 1999; Pears & Moses, 2003; Ruffman, Perner, & Parkin, 1999). In a meta-analysis, Karreman, van Tuijl, van Aken, and Dekovic (2006) found that positive parental control was associated with children's effective self-regulation, while negative parental control was associated with poor self-regulation. Thus, it is possible that regulatory capacities may be improved through authoritative behavioral control or undermined by authoritarian control (Grolnick & Pomerantz, 2009).

From a theoretical standpoint, Grusec and Davidov (2010) theorized that parenting influences child development in domain-specific ways. The control domain involves parental discipline that is intended to instill self-control in children, and children's moral behavior is posited to be an outcome of this domain. Hence, control strategies in particular (e.g., parenting approaches and responses) are thought to influence children's lie-telling as an aspect of moral development. The amount of parent control used must be sufficient to produce the desired behavior, but not so forceful that it undermines internalization (Bugental & Grusec, 2006; Deci & Ryan, 1985) or reduces opportunities for children to learn about others' perspectives (Pears & Moses, 2003). Thus, firm but responsive parenting (i.e., authoritative parenting) may facilitate children's development of self-control (EF) strategies as well as the socially-accepted moral behavior of truth-telling (or context appropriate, prosocial lie-telling, e.g., Popliger et al., 2011; see Talwar & Crossman, 2011).

To date, however, there is sparse research on the relation between social-environmental factors, particularly parenting, and children's lie-telling behavior. Examining children's lie-telling in school contexts, Talwar and Lee (2011) found that children studying in comparatively punitive, authoritarian school environments lied earlier and more effectively than did children in less harsh school environments. Power assertive discipline and corporal punishment have also been associated with children being rated as less trustworthy (Rotenberg, Betts, Eisner, & Ribeaud, 2012), having decreased resistance to temptation (Lepper, 1973), higher rates of antisocial behavior (Gershoff, 2002; Lansford et al., 2009), and poorer conscience development in early childhood (Kochanska & Aksan, 2006; Kochanska, Gross, Lin, & Nichols, 2002). Further, one study of the prevalence of boys' reported lies found a positive association with maternal rejection (Stouthamer-Loeber & Loeber, 1986). In contrast, three-year-old Chinese children whose parents used more controlling parenting methods were *less* likely to lie to an experimenter to cover a transgression (Ma et al., 2015). Yet, the general trend has been that authoritarian parenting tends to be associated with more problem behavior and lie-telling among children.

Researchers have found somewhat inconsistent results with regard to authoritative parenting as well, though perhaps largely related to the type of lies told (e.g., lies told to conceal a transgression or lies told to be polite). Research with adolescents found that maternal authoritativeness predicted adolescent disclosure – truth-telling (Almas, Grusec, & Tackett, 2011; Darling, Cumsille, Caldwell, & Dowdy, 2006). Findings also suggest less reliance on lie-telling among children whose parents have authoritative, supportive parenting styles. Such children may transgress less often, as they likely have better impulse control (EF) and may be less likely to use lying as a strategy as a result, despite their cognitive abilities to do so. Indeed,

sensitive and supportive parenting has been associated with lower levels of problem behaviors (e.g., Camerota, Cox, Willoughby, & Greenberg, 2015; Dishion, Patterson, Stoolmiller, & Skinner, 1991; Dishion, Spracklen, Andrews, & Patterson, 1996; Shortt, Capaldi, Dishion, Bank, & Owen, 2003), which may reduce the need for their children's reliance on lie-telling. At the same time, North American children whose parents used an authoritative parenting style were more likely to lie to be polite than to tell a harsh, rude truth (Popliger et al., 2011), which is arguably a prosocial act.

Finally, social-environmental factors may affect the strength of the relation between children's cognitive abilities and lie-telling (Cole & Mitchel, 1998; Talwar & Crossman, 2011). That is, different parenting styles may relate differentially to children's EF development and thus children's developing lie-telling abilities. Maternal stress, associated with children's cognitive difficulties (Piccolo, Salles, Falceto, Fernandes, & Grassi-Oliveira, 2016; Wagner et al., 2016) and poorer emotional control and inhibition (McLuckie, 2011), could impact the relation as well. Heightened stress may be associated with a harsher parenting environment and, in a harsher environment, children with lower cognitive abilities may use lie-telling to avoid severe punishment for their impulse-driven transgressions (Dukewich, Borkowski, & Whitman, 1999; Lewis, 1993; Stouthamer-Loeber, 1986; Straus & Paschall, 2009). Thus, it is important to explore the relations among social-environmental factors such as parenting style and discipline and maternal stress, children's cognitive development, and their emerging lie-telling abilities.

Lying and Cognitive Factors

Effective lie-telling requires that subsequent deceptive statements remain consistent with one's initial lie, referred to as semantic leakage control (Talwar & Lee, 2002). This ability improves throughout the elementary school years (Talwar et al., 2007; Talwar & Lee, 2002;

2008) and is related to children's increasing cognitive maturity. As children develop more cognitive sophistication, they can employ those skills to lie more effectively to avoid detection (Evans & Lee, 2011; Talwar & Lee, 2002) and to tell lies that are more other-oriented (i.e., prosocial lies to protect another's feelings; Popliger et al., 2011; Williams, Moore, Crossman, & Talwar, 2015). In contrast, the absence of or delayed development of deception occurs with neurodevelopmental disorders, such as autism (Spence, Sharifi, & Wiznitzer, 2004; Talwar et al., 2012).

Research on children's lying suggests that children's executive functioning abilities play a crucial role in the emergence of lie-telling in preschool children and its development through the elementary school years (Evans & Lee, 2013; Talwar & Lee, 2008; Williams, Leduc, Crossman, & Talwar, 2016). In particular, children's inhibitory control is positively associated with the ability to intentionally deceive and maintain a lie (e.g., Evans & Lee, 2011; Talwar & Lee, 2008; Williams et al., 2016). Inhibitory control is an executive function defined as the ability to suppress one's thoughts or feelings to state or perform another thought or feeling (Carlson, Moses, & Breton, 2002). To tell a convincing lie, a child must not only produce a false belief in another, but he or she must also inhibit the desire to report his or her own true belief (Bok, 1978). A number of studies have found that lie-telling behavior is related to children's EF abilities as measured by inhibitory control (e.g., Evans et al., 2011; Gombos, 2006; Rasmussen, Talwar, Loomes & Andrews, 2007; Talwar & Lee, 2008). For instance, Talwar and Lee (2008) found that children (3 to 8 years) who lied had better-developed inhibitory control than those who told the truth about their behavior and confessed. Similarly, both Williams et al. (2016) and Evans and Lee (2013) found that children between 2 and 3 years of age who lied to an experimenter had higher inhibitory control scores than truth-tellers.

Although numerous measures of inhibitory control exist, many studies have found that those including inhibitory control, working memory, and cognitive flexibility components of EF are the best predictors of children's lie-telling (e.g., Evans & Lee, 2011; Talwar & Lee, 2008). Working memory refers to one's capacity to hold information in short-term memory, often for manipulation or other processing. Cognitive flexibility refers to one's agility in thinking and cognitive processing. In particular, conflict tasks such as the Day/Night Stroop have been found to predict children's lie-telling (e.g., Talwar & Lee, 2008). It may be that such EF tasks that have greater inhibitory control, working memory, and cognitive flexibility demands best mirror the cognitive demands of lie-telling (e.g., Carlson, Moses, & Hix, 1998; Evans, Xu, & Lee, 2011). Therefore, children's lie-telling may be related to executive functioning skills that allow them to inhibit a truthful response, and retain that response in memory while having the cognitive flexibility to switch between the truth and false representations of their story.

Given research highlighting the importance of parenting variables for children's developing EF (Fay-Stammbach et al., 2014) and its role in lie-telling behavior (Talwar & Crossman, 2011), we examine how parenting may influence the relation between EF and lie-telling. To examine this possibility, the current study used two measures of executive functioning that required inhibitory control, working memory, and cognitive flexibility to probe their relation to lie-telling, in conjunction with parenting and social-environmental factors.

Current Study

The present study investigated how social and environmental factors contribute to the relation between children's cognitive abilities and their lie-telling. Children between 3 and 6 years of age were asked not to peek at a toy while the experimenter was absent and were later questioned about whether they peeked to assess their lie-telling. Children's executive

functioning skills were assessed, as were maternal parenting styles and exposure to stressors. We hypothesized that parenting styles (i.e., authoritative and authoritarian, based on Ma et al., 2015; Popliger et al., 2011) and maternal stress (Cole & Mitchell, 1998) would interact with cognitive factors to predict children's lie-telling. Specifically, we hypothesized that children with high executive functioning abilities in the context of authoritative parenting and/or little maternal stress would be less likely to lie. Such children may be better able to regulate whether they tell the truth or a lie in the context of responsive parenting that may include consistent, but not harsh, consequences for transgressive behavior. In contrast, we expected that children with high executive functioning abilities in the context of authoritarian parenting or high maternal stress would be most likely to lie. Such children may use their developed cognitive abilities to avoid potential harsh consequences for their actions. Thus, overall, we expected that the parenting environment a child experiences may be associated with their use of emerging cognitive abilities in positive or negative ways (Camerota et al., 2015).

Method

Participants

Participants were 157 children ($M = 4.84$ years, $SD = 0.77$ years; range 3-6 years; 73 females) from predominately middle-income families in a large North American metropolitan area. The ethnic breakdown of the sample was 62% Caucasian, 9% Latino, 7% African American, and 22% other.

Child Measures

The Day/Night Stroop task (Gerstadt, Hong, & Diamond, 1994) was used to measure inhibitory control, but also taps working memory. Children were told that they would play a game involving "opposites." Children were asked to say "day or sun" each time they saw the

picture of the moon and to say “night or moon” when the picture of the sun appeared. After successfully completing two practice trials, children viewed 16 randomly ordered pictures of the sun (8) and moon (8). The total score (maximum 16) was their number of correct “opposite” responses, reflecting better inhibitory control and working memory.

The Dimensional Change Card Sort task (DCCS, Zelazo, 2006) assessed cognitive flexibility. During the pre-switch phase, children completed 6 trials of a game wherein they divided cards (12) into two identical trays by color (red or blue). Each tray was marked with a target card (one blue rabbit and one red boat). Cards included red rabbits with (3) and without borders (3) and blue boats with (3) and without borders (3). In the post-switch phase (6 trials), children sorted the cards into trays by shape. In the border phase (12 trials), children sorted according to the color rule when the card had a border and by the shape rule when the card had no border. Children passed the pre-switch and post-switch phases if they completed five or more correct trials, and the border phase if they completed nine or more correct trials. Children received 0 if they failed the pre-switch phase; 1 if they passed the pre-switch but failed the post-switch phase; 2 if they passed both the pre- and post-switch phases, but failed the border version; and 3 if they passed all three phases (Zelazo, 2006).

Vocabulary level. The Wechsler Preschool and Primary Scale of Intelligence Vocabulary subtest was used to assess children’s vocabulary levels. Children were asked to name the image represented in a picture or to provide the term that best fit a verbal description. They received a point for each correct response with a maximum score of 43. Children’s total raw scores were used in the analyses.

Parent Measures

Parenting styles. The Parenting Styles and Dimensions Questionnaire-Short Form (PSDQ-SF; Robinson, Mandleco, Olsen, & Hart, 1995) is a 32-item self-report inventory. Items are rated on a 5-point scale ranging from 1 (*never*) to 5 (*always*). Scores are summed into three subscales reflecting the degree to which a parent relies on each parenting style: authoritative (Cronbach $\alpha = 0.91$); authoritarian (Cronbach $\alpha = 0.86$); and permissive (Cronbach $\alpha = 0.75$).

Maternal stress. The Social Environment Inventory (SEI; Orr, James, & Charney, 1989) measures exposure to stressors. Mothers indicated whether they had experienced 35 possible stressors related to their family or other close relationships, health, finances, employment, or housing in the past six months. Scores reflect the total number of stressful events experienced (maximum 35).

Procedure

Upon arrival at the laboratory, parents provided informed consent. Following a 5-minute warm-up, children completed the experimental tasks with a researcher. Tasks were randomized, with lying behavior measured at the start or end of the session.

Lie-telling. Children played a game in which they guessed the names of different toys. Children sat on a chair with their back turned while the experimenter played a sound from a toy that they could not see. Upon hearing the sound, children guessed its identity. All toys were familiar to the children (e.g., Elmo) and made familiar accompanying sounds. Children were repeatedly told of the ‘no peeking’ rule. After the child correctly guessed the identity of two toys, the experimenter explained that she would have to leave for a minute and would resume the game when she returned. The experimenter then placed the target toy (e.g., Mickey Mouse) behind the child. The sound that accompanied it was unrelated to the toy (i.e., music from a greeting card) and could not be used to infer the toy’s identity. Children were told, “Don’t turn

around to peek and look at the toy.” The experimenter left the room for one minute, and a hidden video camera recorded the child’s behavior. Upon returning, the experimenter asked, “When I was gone, did you turn around and peek at the toy?” Among children who had peeked at the toy, if they subsequently denied it, they were categorized as lie-tellers; if they peeked at the toy and then confessed, they were categorized as confessors. The RA then asked the following two questions to evaluate children’s semantic leakage control: (1) “*What do you think the toy is?*” and (2) “*Why do you think it’s that?*” Responses consistent with the child’s lie (e.g., “I heard the music from a commercial”) were coded as having semantic leakage control. Responses that were inconsistent with their initial lie, or revealed the identity of the toy (e.g., “because that’s what the toy looked like”), were coded as not having semantic leakage control.

Results

Preliminary analyses examined age and gender differences. There were significant age differences in children’s tendency to tell a lie, but no gender differences. Thus, gender was not analyzed further. Exploratory analyses for differences in children’s lie-telling behavior according to familial SES (using parental education and household income levels as proxies; e.g., Soteriades & DiFranza, 2003) were also conducted. No differences were found, and SES was not analyzed further. Next, logistic regressions analyzed associations between cognitive factors, social-environmental factors, and their interactions with children’s peeking behavior, lying behavior, and lie-telling ability (see Table 1 for descriptive statistics, Table 2 for correlations).

Children’s Peeking Behavior

Of the 157 children, 104 (66.2%) peeked at the toy. Among children who peeked, 84 (80.8%) lied. Of the 84 children who lied, 35 (41.7%) maintained semantic leakage control when asked follow-up questions. A logistic regression analysis tested the effects of age,

cognitive ability, parenting and environmental factors, and their interactions on children's peeking behavior, with all children included in the model. Age was entered in Block 1, children's inhibitory control and cognitive flexibility scores were entered in Block 2, authoritative parenting scores and environmental stress in Block 3, and the interaction of each cognitive and social-environmental measure in Block 4 (four total interactions). None of the individual blocks, nor the overall model was significant, $\chi^2(9, N = 149) = 9.94, p = .355$. A second logistic regression was performed, substituting authoritative parenting scores for authoritarian parenting scores; none of the Blocks nor the overall model was significant, $\chi^2(9, N = 153) = 9.69, p = .376$.

Children's Lie-Telling

Logistic regression was used to identify predictors of lying behavior among children who peeked ($n = 104$). Age and vocabulary scores were entered in the first block, children's inhibitory control and cognitive flexibility scores in the second, authoritative parenting and environmental stress scores in the third, and the interactions between cognitive ability and social-environmental factors in the fourth block (see Table 3 for final model). The overall model was significant, $\chi^2(10, N = 89) = 21.92, p = .016$, as was the final block that tested the interactions, $\chi^2(4, N = 89) = 10.91, p = .028$. The final model correctly classified 81% of participants as liars or truth-tellers and explained approximately 31% of the variance in children's lie-telling.

Within the original overall model, there was a main effect of authoritative parenting, $b = 0.45, p = .033$, as increases in authoritativeness were associated with higher rates of children lying. However, this was modified by an interaction between authoritative parenting and inhibitory control, $b = -0.03, p = .047$. Overall, as authoritative parenting scores and children's Stroop scores increased, their tendency to lie decreased (Figure 1). However, to better

characterize the nature of the moderation, three linear regressions were conducted to determine whether children's inhibitory control had a differential relation with lie-telling at high (one *SD* above the mean), average, or low (one *SD* below the mean) levels of authoritative parenting. The predicted values of children's likelihood of telling a lie, calculated from the lying logistic regression model, were used as the outcome variable. This takes into account the variables that were originally included in the lying logistic regression model. A Bonferroni correction was used, and the resulting alpha cut-off was .01.

Among children whose parents ascribed to high levels of authoritative parenting ($n = 45$), there was a significant negative association between inhibitory control, $b = -0.03$, $p < .001$, 95% CI $[-0.04, -0.01]$ and children's likelihood of telling a lie, overall model $F(1, 43) = 19.43$, $p < .001$ (see Figure 1). For those children whose parents ascribed to average levels of authoritative parenting ($n = 21$), there was no significant relation between inhibitory control and children's probability of telling a lie, $b = -0.01$, $p = .458$, overall model *n.s.* For children whose parents reported low levels of authoritative parenting ($n = 35$), there was a significant positive relation between inhibitory control and children's likelihood of telling a lie, $b = 0.02$, $p = .011$, 95% CI $[0.01, 0.03]$, overall model $F(1, 33) = 7.34$, $p = .011$ (see Figure 1).

We also analyzed the relation between authoritative parenting and children's probability of telling a lie, according to high or low levels of inhibitory control. Two linear regressions were conducted, both with children's predicted probabilities for telling a lie as the outcome variable. A Bonferroni correction was used to control for multiple analyses and the resulting alpha cut-off was .01.

For children with low inhibitory control ($n = 33$), there was a significant positive relation between authoritative parenting and their probability of telling a lie, $b = 0.03$, $p < .001$, 95% CI

[0.02, 0.04], overall model $F(1, 31) = 53.90, p < .001$. For children with high inhibitory control ($n = 68$), there was no significant relation between authoritative parenting and their probability of telling a lie, $b = 0.00, p = .920$, overall model *n.s.*

To explore the impact of authoritarianism on children's lie-telling, a logistic regression was computed, as above, with authoritarian parenting in place of authoritative. However, there was no significant main or interaction effect of authoritarian parenting on children's lie-telling, $\chi^2(10, N = 91) = 19.51, p = .034$; the only significant predictor was vocabulary scores.

Children's Semantic Leakage Control

Within the subsample of children who lied ($n = 84$), a simplified logistic regression, using the significant predictors of lie-telling (inhibitory control, authoritative parenting, and their interaction) was used to analyze children's lie-telling ability (i.e., "no semantic leakage control" versus "semantic leakage control"). This simplified model was used due to the reduction in participants from the lie-telling model to the semantic leakage control model and consequent loss of power. Children's Stroop scores were entered in the first block, parents' authoritative parenting scores in the second, and their interaction in the third. Both the overall model, $\chi^2(3, N = 84) = 9.45, p = .024$, and the interaction block, $\chi^2(1, N = 84) = 6.04, p = .014$, were significant, explaining approximately 14% of the variance in children's lie-telling ability, with 60% of children correctly classified (see Table 3 for final model).

Within the original overall model, both children's Stroop scores, $b = -2.02, p = .035$, and parents' authoritative parenting scores, $b = -0.51, p = .026$, had significant conditional linear effects. As children's Stroop scores and parents' authoritative parenting scores increased, children were more likely to have semantic leakage control. However, these effects were modified by the significant interaction between children's Stroop scores and parents'

authoritative parenting scores, $b = 0.04$, $p = .030$. Similar to the follow-up analysis for lie-telling, three linear regressions were conducted to examine the differential relation between children's inhibitory control and their semantic leakage control, as a function of authoritative parenting levels. Children's predicted probability of having semantic leakage control, using the logistic model for semantic leakage control, was used as the outcome variable. A Bonferroni correction was used to control for multiple analyses and the resulting alpha cut-off was .01.

For children whose parents reported high levels of authoritative parenting ($n = 42$), there was a significant positive relation between children's inhibitory control scores and the probability of having semantic leakage control, $b = 0.04$, $p < .001$, 95% CI [0.03, 0.05], overall model $F(1, 40) = 191.48$, $p < .001$ (see Figure 2). A similar pattern emerged for children whose parents reported average levels of authoritative parenting ($n = 18$); as children's inhibitory control scores increased, the likelihood of having semantic leakage control increased as well, $b = 0.02$, $p < .001$, 95% CI [0.02, 0.03], overall model $F(1, 16) = 97.28$, $p < .001$ (see Figure 2). However, for children whose parents reported low levels of authoritative parenting ($n = 26$), no significant relation emerged, $b = -0.01$, $p = .115$, overall model *n.s.*

We also analyzed the relation between authoritative parenting and children's probability of having semantic leakage control, according to high or low levels of inhibitory control. Two linear regressions were conducted, both with children's predicted probabilities of having semantic leakage control as the outcome variable. A Bonferroni correction was used to control for multiple analyses and the resulting alpha cut-off was .01.

For children with low inhibitory control ($n = 29$), there was a significant negative relation between authoritative parenting and the likelihood of having semantic leakage control, $b = -0.03$, $p < .001$, 95% CI [-0.04, -0.03], overall model $F(1, 27) = 109.71$, $p < .001$. No significant

relation between authoritative parenting and likelihood of having semantic leakage control emerged for children with high inhibitory control ($n = 57$), $b = 0.00$, $p = .085$, overall model *n.s.*

To explore the impact of authoritarianism on children's semantic leakage control, a logistic regression was computed, as above, with authoritarian parenting in place of authoritative. However, there was no significant main or interaction effect of authoritarian parenting on children's semantic leakage control, $\chi^2(3, N = 86) = 3.81$, $p = .283$.

Discussion

The present study explored cognitive and social-environmental variables concurrently in relation to children's lie-telling. Although the relation between cognitive variables and lying is well supported (e.g., Evans & Lee, 2011; 2013; Talwar & Lee, 2008; Talwar et al., 2007), the relations among parenting, environmental factors, and lying is less well established. Yet, as anticipated, in the current study, parenting style moderated the relation between children's inhibitory control and their tendency to lie, as well as their lie-telling ability. Thus, the relation between children's cognitive abilities and their lie-telling may not be straightforward.

Specifically, when we examined parenting styles along with cognitive ability, a distinct picture emerged. First, we examined whether children would tell an antisocial lie to conceal a transgression. As was predicted, high inhibitory control scores were associated with a higher likelihood of lying than were low inhibitory control scores, but only in the context of low levels of authoritative parenting. In contrast, with high levels of authoritative parenting, high inhibitory control scores were associated with a *lower* likelihood of lying than were low inhibitory control scores (even controlling for children's vocabulary scores). This is congruent with previous research (e.g., Talwar & Lee, 2008) finding that children's self-serving lie-telling is predicted by their executive functioning abilities. However, this research extends those findings to

demonstrate that parenting may moderate the relation between children's developing executive functioning skills and their lie-telling.

Similarly, the findings with regard to parenting are somewhat consistent with prior research. Popliger et al. (2011) found that authoritative parents had children more likely to tell a prosocial lie to be polite. Ma et al. found (2015) parents' controlling behavior was associated with children's lower cognitive abilities and reduced likelihood of lying to conceal a transgression. Both studies found main effects of parenting styles on children's lie-telling abilities. Here, however, authoritative parenting was only associated with lie-telling for children with lower inhibitory control scores.

One possible explanation for the current findings is that for children with poorer inhibitory control, lying about a misdeed is a more acceptable response when parents tend toward authoritative responding. That is, until children have sufficiently mature inhibitory control to avoid initial transgressions (i.e., peeking), lie-telling may be more adaptive. Perhaps children do not want to admit their unavoidable transgressions to avoid disappointing a trusting parent. Parents with an authoritative style may facilitate this early behavior through a bias to believe their children's lies, as violations would threaten their bond of trust (Talwar et al., 2015). This is also consistent with Grusec and Davidov's (2010) control domain of socialization. In the control domain, parents who are relying on firm but responsive authoritative parenting may eventually facilitate children's development of self-control strategies. With this development of self-control strategies, children may have a greater likelihood of truth-telling after a misdeed, despite possible consequences for their behavior. Indeed, the finding that children with highly authoritative parents showed reduced lie-telling with increasing inhibitory control further supports this possible interpretation.

Second, we examined children's abilities to maintain their lies during follow-up questions. As with lie-telling, findings supported the prediction that parenting style moderates the relation between cognitive ability and lie-telling skill, yet in the reverse direction. That is, as was predicted, there was a positive relation between inhibitory control scores and the likelihood of maintaining semantic leakage control, but only in the context of average or high levels of authoritative parenting. In contrast, among children whose parents reported low levels of authoritative parenting, inhibitory control scores were *not* associated with semantic leakage control. Indeed, children's rates of semantic leakage control only differed as a function of parenting style for children with poor inhibitory control scores, for whom there was an inverse association between authoritative parenting and lie maintenance.

As above, these results are somewhat consistent with previous findings that children's executive functioning is associated with lying skill (e.g., Alloway, McCallum, Alloway, & Hoicka, 2015; Evans & Lee, 2011; Talwar & Lee, 2008), while extending that understanding to include authoritative parenting as a moderator. That is, it may be that some parents socialize their children to internalize standards of behavior (i.e., don't lie) through authoritative parenting – and their children are less likely to lie. However, when these children do lie, they may deploy their cognitive skills to avoid leaking incriminating details that expose their lies. Perhaps children in authoritative parenting contexts are particularly motivated to avoid lie detection to maintain their social bonds with parents. Together these behaviors may reflect more social competence around lie-telling. Previous studies have found that children and adolescents with higher social competence may be better at maintaining their lies (e.g., Feldman, Tomasian, & Coats, 1999; Lavoie, Yachison, Crossman, & Talwar, 2016). Thus, authoritative parenting may

facilitate children's adaptive behavior by both reducing their initial reliance on lie-telling and facilitating better success when they do lie.

As previously found (e.g., Evans & Lee, 2011; Talwar & Lee, 2008), higher inhibitory control scores measured using a Stroop task predicted young children's lie-telling behavior. However, the other executive functioning measure, The Dimensional Change Card Sort task, did not predict children's lie-telling behavior or effectiveness. It is not clear why this relation was not detected, though there are a few possibilities. Although both tasks require inhibitory control and working memory, the DCCS may require greater cognitive flexibility than the Stroop task. It is possible that simple denial of wrong-doing does not sufficiently tax children's cognitive flexibility for it to be predictive of their lying, whereas the executive functioning skills recruited for the Stroop task are closer to those required to falsely deny wrong-doing. It is also possible that the young age of the children (3-6 years) limited the degree to which cognitive flexibility was developed. Scores were low on average, compared to their Stroop scores, potentially reducing its impact as a predictor. Similarly, the other parenting style, authoritarian parenting, did not predict children's lie-telling or moderate the impact of cognitive ability on their lying. Although it is possible that authoritarian parenting is not related to children's lie-telling at all, perhaps parents were not accurate in self-reporting their authoritarian parenting tendencies. Alternatively, perhaps the age of the children or the nature of the lie-telling situation were factors. Parents are unlikely to severely punish young, preschool-aged children's minor misdeeds or subsequent lie-telling (Wilson et al., 2003), perhaps reducing the risk for either behavior and possibly the predictiveness of authoritarian parenting. Future studies are needed to examine children's lie-telling behavior in other motivational contexts that may be adaptive (i.e., prosocial lies) or maladaptive (i.e., self-serving lies for personal gain) to further clarify the

development and predictors of lying. Nevertheless, the findings do suggest that social-environmental and cognitive factors interact to facilitate or attenuate the normative development of children's lie-telling ability.

Implications for Future Research on the Adaptiveness of Children's Lie-telling

With these findings, a more nuanced picture of how lying may develop as a normative behavior emerges. There is consistent support for a relation between children's cognitive abilities and the emergence and development of lie-telling (e.g., Evans & Lee, 2011; 2013; Talwar & Lee, 2008; Talwar et al., 2007; Williams et al., 2016). Yet, lying is inherently an interpersonal social behavior and examining cognition alone ignores the broader social-environmental factors that may influence children's use of this social strategy.

Furthermore, lie-telling may serve adaptive functions in some contexts, but be maladaptive in others (Talwar & Crossman, 2011). However, little is known about how lie-telling may develop along an adaptive or maladaptive trajectory. The current study starts to suggest a possible direction of inquiry for mapping this development. The current findings suggest, for instance, that when children's inhibitory skills are relatively immature, their interactions with their parents may influence their use of this strategy. Parents' use of more authoritative parenting approaches at this stage may facilitate children's emerging use of lying as a social strategy initially. Perhaps when faced with a potential misdeed, such parents focus on shaping appropriate initial behaviors around the misdeed and on explanations around lie-telling standards. In such a context, early lie-telling might be an adaptive approach and develop as a precocious skill. As children become more skilled in their inhibitory control, they become better able to self-regulate and internalize the standards taught by their parents, leading to an increased likelihood of truth-telling—in which context lie-telling becomes less necessary and adaptive.

However, for children with non-authoritative parents, higher cognitive skills may enable them to increasingly use this social strategy at a rate closer to that of other children. Future research is needed to see if, with age, these developmental trajectories continue to diverge over time or converge with different individual predictors of continued lying, and whether these developmental trajectories differ according to different types of lies (i.e., told for different motivations) and social contexts (Lavoie et al., 2016).

Unfortunately, we were unable to complete more complex analyses in the current study, given sample size limitations, which may have also restricted our ability to detect further interactional effects. It is also possible that children may experience maturational effects in their lie-telling that were not prominent in this study, but that may be captured with a wider age range. When testing this possibility, a measure of non-verbal intelligence may also be beneficial for future studies to control for potential variations in children's lying behavior as a function of differences that are not captured through verbal intelligence measures.

Furthermore, while the current study found no significant differences for maternal stress, it is possible that maternal stress may have an indirect effect on children's lie-telling behavior, such as by affecting parenting styles (e.g., Tan, Gelley, & Dedrick, 2015), which is an area for future research studies to explore. Future studies should also consider other social-environmental factors, as well as a wider range of cognitive abilities that have been implicated in lie-telling behaviors such as theory-of-mind and working memory (e.g., Talwar & Lee, 2008; Walczky, Roper, Samson & Humphrey, 2003).

The current findings also suggest the need for more research on the relation between parenting styles and children's lie-telling. While this study found support for an association between parenting styles and children's lying, it is possible that the relation is bi-directional.

However, at this time, no conclusions can be drawn regarding whether parenting style influences children's lying behavior, or vice versa. It is possible that parenting styles influence children's lying, and also possible that children's lie-telling influences the disciplinary style a parent adopts. There may be other variables that affect the relation between lying and parenting as well. Future research is needed to examine these possibilities. Furthermore, previous studies have found that expected consequences for dishonest behavior (e.g., Lee et al., 2014; Talwar, Arruda & Yachison, 2015; Talwar, Williams, Renaud, Arruda, & Saykaly, 2016) may influence children's decisions to lie. While parents, in general, report socializing their children to be honest (Lavoie et al., 2015), future studies should look at parents' responses to children's actual lies to further understand the development of children's use of lie-telling as a social strategy. Finally, although the lie-telling situation was laboratory based, it is a naturalistic proxy for real-life situations (Lewis, Stanger, & Sullivan, 1989).

The current study is novel in the concurrent examination of multiple cognitive and social-environmental predictors of children's lie-telling to provide a more nuanced understanding of lie-telling as a normative developmental behavior in early childhood. Our findings suggest that well-developed cognitive abilities in the context of responsive parenting may be more indicative of truth-telling than lie-telling, but that the reverse may be true in contexts of low responsive parenting. This suggests that the environmental context may be influential in children's truth- and lie-telling as they mature. Future studies should include an examination of lies told for different motivations and a broader range of child ages to determine if the same relations emerge across development. For now, it is clear that children's lie-telling is influenced by a complex interaction of cognitive and social-emotional factors that bear further investigation.

References

- Alloway, T. P., McCallum, F., Alloway, R. G., & Hoicka, E. (2015). Liar, liar, working memory on fire: Investigating the role of working memory in childhood verbal deception. *Journal of Experimental Child Psychology*, 137, 30-38.
- Almas, A. N., Grusec, J. E., & Tackett, J. L. (2011). Children's disclosure and secrecy: Links to maternal parenting characteristics and children's coping skills, *Social Development*, 20, 624-643. doi:10.1111/j.1467-9507.2010.00602.x
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychological Bulletin*, 121, 1, 65-94.
- Bernier, A., Carlson, S. M., Deschenes, M., & Matte-Gagne, C. (2012). Social factors in the development of early executive functioning: A closer look at the caregiving environment. *Developmental Science*, 15, 12-24. doi:10.1111/j.1467-7687.2011.01093.x.
- Bok, S. (1978). *Lying: Moral choice in public and private life*. New York: Pantheon Books.
- Bugental, D. B., & Grusec, J. E. (2006). Socialization processes. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 366-428). New York: Wiley.
- Camerota, M., Cox, M., Willoughby, M. T., & Greenberg, M. T. (2015). Executive function in low birth weight preschoolers: The moderating effect of parenting. *Journal of Abnormal Child Psychology*, 43, 8, 1551-1562.
- Carlson, S. M., Moses, L. J., & Breton, C. (2002). How specific is the relation between executive function and theory of mind? Contributions of inhibitory control and working memory. *Infant and Child Development*, 11, 73-92.

- Carlson, S. M., Moses, L. J., & Hix, H. R. (1998). The role of inhibitory processes in young children's difficulties with deception and false belief. *Child Development, 69*, 3, 672-91.
- Clark, C., Prior, M., & Kinsella, G. (2002). The relationship between executive function abilities, adaptive behaviour, and academic achievement in children with externalising behaviour problems. *Journal of Child Psychology and Psychiatry, 43*, 6, 785-796.
- Cole, K., & Mitchell, P. (1998). Family background in relation to deceptive ability and understanding of the mind. *Social Development, 7*, 181-197.
- Darling, N., Cumsille, P., Caldwell, L., & Dowdy, B. (2006). Predictors of adolescents' disclosure to parents and perceived parental knowledge: Between- and within-person differences. *Journal of Youth and Adolescence, 35*, 667-678.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
- DePaulo, B. M., & Jordan, A. (1992). Age changes in deceiving and detecting deceit. In R. S. Feldman (Ed.), *Development of nonverbal behavior in children* (pp. 151-179). New York: Springer-Verlag.
- DePaulo, B. M., & Kashy, D. A. (1998). Everyday lies in close and casual relationships. *Journal of Personality and Social Psychology, 74*(1), 63-79.
- Dishion, T. J., Patterson, G. R., Stoolmiller, M., & Skinner, M. L. (1991). Family, school, and behavioral antecedents to early adolescent involvement with antisocial peers. *Developmental Psychology, 27*, 1, 172-180.
- Dishion, T. J., Spracklen, K. M., Andrews, D. W., & Patterson, G. R. (1996). Deviancy training in male adolescent friendships. *Behavior Therapy, 27*, 3, 373-390.

- Dukewich, T. L., Borkowski, J. G., & Whitman, T. L. (1999). A longitudinal analysis of maternal abuse potential and developmental delays in children of adolescent mothers. *Child Abuse & Neglect*, 23, 405-420.
- Eisenberg, N., Chang, L., Ma, Y., & Huang, X. (2009). Relations of parenting style to Chinese children's effortful control, ego resilience, and maladjustment. *Development and Psychopathology*, 21, 2, 455-77. doi:10.1017/S095457940900025X
- Evans, A. D., & Lee, K. (2013). Emergence of lying in very young children. *Developmental Psychology*, 49, 1958-1963. doi:10.1037/a0031409
- Evans, A. D., & Lee, K. (2011). Verbal deception from late childhood to middle adolescence and its relation to executive functioning skills. *Developmental Psychology*, 47, 1108-1116. doi:10.1037/a0023425
- Evans, A. D., Xu, F., & Lee, K. (2011). When all signs point to you: Lies told in the face of evidence. *Developmental Psychology*, 47, 39-49. doi:10.1037/a0020787
- Fay-Stammbach, T., Hawes, D. J., & Meredith, P. (2014). Parenting influences on executive function in early childhood: A review. *Child Development Perspectives*, 8, 4, 258-264.
- Feldman, R. S., Tomasian, J. C., & Coats, E. J. (1999). Nonverbal deception abilities and adolescents' social competence: Adolescents with higher social skills are better liars. *Journal of Nonverbal Behavior*, 23, 237-249.
- Gershoff, E. T. (2002). Corporal punishment by parents and associated child behaviors and experiences: A meta-analytic and theoretical review. *Psychological Bulletin*, 128, 539–579.

- Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3 1/2-7 years old on a Stroop-like day-night test. *Cognition*, 53, 129-153.
- Gervais, J., Tremblay, R., & Desmarais-Gervais, L. (2000). Children's persistent lying, gender differences, and disruptive behaviors: A longitudinal perspective. *International Journal of Behavioral Development*, 24, 213-221.
- Gombos, V. A. (2006). The cognition of deception: The role of executive processes in producing lies. *Genetic, Social, and General Psychology Monographs*, 132, 197-214.
- Grolnick, W., & Pomerantz, E. (2009). Issues and challenges in studying parental control: Toward a new conceptualization. *Child Development Perspectives*, 3, 165–170.
doi:10.1111/j.1750-8606.2009.00099.x
- Grusec, J. E., & Davidov, M. (2010). Integrating different perspectives on socialization theory and research: A domain-specific approach. *Child Development*, 81, 687-709.
- Hughes, C., & Ensor, R. (2006). Behavioural problems in 2-year-olds: Links with individual differences in theory of mind, executive function and harsh parenting. *Journal of Child Psychology and Psychiatry*, 47, 488-497.
- Hughes, C., Deater-Deckard, K., & Cutting, A. L. (1999). ‘Speak roughly to your little boy’? Sex differences in the relations between parenting and preschoolers’ understanding of mind. *Social Development*, 8, 2, 143-160.
- Karreman, A., van Tuijl, C., van Aken, M. A. G., & Deković, M. (2006). Parenting and self-regulation in preschoolers: A meta-analysis. *Infant and Child Development*, 15, 6, 561-579.

- Kochanska, G. & Aksan, N. (2006). Children's conscience and self-regulation. *Journal of Personality, 74*, 1587–1618.
- Kochanska, G., Gross, J. N., Lin, M. H., & Nichols, K. E. (2002). Guilt in young children: Development, determinants, and relations with a broader system of standards. *Child Development, 73*, 461–483.
- Lansford, J. E., Criss, M. M., Dodge, K. A., Shaw, D. S., Pettit, G. S., & Bates, J. E. (2009). Trajectories of physical discipline: Early childhood antecedents and developmental outcomes. *Child Development, 80*, 1385–1402.
- Lavoie, J., Leduc, K., Crossman, A. M., & Talwar, V. (2015). Do as I say and not as I think: Parent socialisation of lie-telling behaviour. *Children & Society, 1-12*.
doi:10.1111/chso.12139
- Lavoie, J., Yachison, S., Crossman, A., & Talwar, V. (2016). Polite, instrumental, and dual liars: Relation to children's developing social skills and cognitive ability. *International Journal of Behavioral Development, 1-8*. doi:10.1177/0165025415626518
- Lee, K. (2013). Little liars: Development of verbal deception in children. *Child Development Perspectives, 7*, 91-96.
- Lee, K., Talwar, V., McCarthy, A., Ross, I., Evans, A., & Arruda, C. (2014). Can classic moral stories promote honesty in children? *Psychological Science*.
doi:10.1177/0956797614536401
- Lengua, L. J., Honorado, E., & Bush, N. R. (2007). Contextual risk and parenting as predictors of effortful control and social competence in preschool children. *Journal of Applied Developmental Psychology, 28*, 40-55.
- Lepper, M. R. (1973). Dissonance, self-perception, and honesty in children. *Journal of*

- Personality and Social Psychology*, 25, 65–74.
- Lewis, M. (1993). Development of deception. In M. Lewis & C. Saarni (Eds.), *Lying and deception in everyday life* (pp. 90-105). New York: Guilford Press.
- Lewis, M., Stanger, C., & Sullivan, M. W. (1989). Deception in 3-year-olds. *Developmental Psychology*, 25, 439-443.
- Ma, F., Xu, F., Evans, A. D., Liu, Y., & Luo, X. (2015). To lie or not to lie? The influence of parenting and theory-of-mind understanding on three-year-old children's honesty. *Journal of Moral Education*, 44, 1-15.
- McLuckie, A. (2011). *Are executive difficulties reported by parents and teachers associated with elevated levels of parenting stress for children diagnosed with attention-deficit/hyperactivity disorder, with and without oppositional defiant disorder?* (Unpublished doctoral dissertation). University of Toronto, Toronto, CA.
- Mesman, J., van IJzendoorn, J. M. H., & Bakermans-Kranenburg, M. J. (2012). Unequal in opportunity, equal in process: Parental sensitivity promotes positive child development in ethnic minority families. *Child Development Perspectives*, 6, 3, 239-250.
- Morrell, J., & Murray, L. (2003). Parenting and the development of conduct disorder and hyperactive symptoms in childhood: A prospective longitudinal study from 2 months to 8 years. *Journal of Child Psychology and Psychiatry*, 44, 489-508.
- NICHD Early Childcare Research Network. (2004). Are child developmental outcomes related to before- and after-school care arrangements? Results from the NICHD study of early child care. *Child Development*, 75, 280-295. doi:10.1111/j.1467-8624.2004.00669.x
- Newton, P., Reddy, V., & Bull, R. (2000). Children's everyday deception and performance on false-belief tasks. *British Journal of Developmental Psychology*, 18, 297-317.

- Orr, S. T., James, S. A., & Charney, E. (1989). A social environment inventory for the pediatric office. *Journal of Developmental and Behavioral Pediatrics, 10*, 287-291.
- Pears, K. C., & Moses, L. J. (2003). Demographics, parenting, and theory of mind in preschool children. *Social Development, 12*, 1-20.
- Piccolo, L. R., Salles, J. F., Falceto, O. G., Fernandes, C. L., & Grassi-Oliveira, R. (2016). Can reactivity to stress and family environment explain memory and executive function performance in early and middle childhood? *Trends in Psychiatry and Psychotherapy, 38*, 80-89.
- Polak, A., & Harris, P. L. (1999). Deception by young children following noncompliance. *Developmental Psychology, 35*, 561-568. doi:10.1037/0012-1649.35.2.561
- Popliger, M., Talwar, V., & Crossman, A. M. (2011). Predictors of children's prosocial lie-telling: Motivation, socialization variables, and moral understanding. *Journal of Experimental Child Psychology, 110*, 373-392. doi:10.1016/j.jecp.2011.05.003
- Rasmussen, C., Talwar, V., Loomes, C., & Andrew, G. (2007). Brief report: Lie-telling in children with fetal alcohol spectrum disorder. *Journal of Pediatric Psychology, 33*, 220-225.
- Robinson, C. C., Mandleco, B., Olsen, S. F., & Hart, C. H. (1995). Authoritative, authoritarian, and permissive parenting practices: Development of a new measure. *Psychological Reports, 77*, 819-830.
- Rotenberg, K. J., Betts, L. R., Eisner, M., & Ribeaud, D. (2012). Social antecedents of children's trustworthiness. *Infant and Child Development, 21*, 310-322.

- Rubia, K., Taylor, E., Smith, A. B., Oksanen, H., Overmeyer, S., & Newman, S. (2001). Neuropsychological analyses of impulsiveness in childhood hyperactivity. *The British Journal of Psychiatry: The Journal of Mental Science*, 179, 138-43.
- Ruffman, T., Perner, J., & Parkin, L. (1999). How parenting style affects false belief understanding. *Social Development*, 8, 3, 395-411.
- Shortt, J. W., Capaldi, D. M., Dishion, T. J., Bank, L., & Owen, L. D. (2003). The role of adolescent friends, romantic partners, and siblings in the emergence of the adult antisocial lifestyle. *Journal of Family Psychology*, 17, 521-33.
- Soteriades, E. S., & DiFranza, J. R. (2003). Parent's socioeconomic status, adolescents' disposable income, and adolescents' smoking status in Massachusetts. *American Journal of Public Health*, 93, 1155-60.
- Spence, S. J., Sharifi, P., & Wiznitzer, M. (2004). Autism spectrum disorder: Screening, diagnosis, and medical evaluation. *Seminars in Pediatric Neurology*, 11, 186-195.
- Stouthamer-Loeber, M. (1986). Lying as a problem behavior in children: A review. *Clinical Psychology Review*, 6, 267-289.
- Stouthamer-Loeber, M., & Loeber, R. (1986). Boys who lie. *Journal of Abnormal Child Psychology*, 14, 551-564.
- Straus, M. A., & Paschall, M. J. (2009). Corporal punishment by mothers and development of children's cognitive ability: A longitudinal study of two nationally representative age cohorts. *Journal of Aggression, Maltreatment & Trauma*, 18, 5, 459-483.
- Talwar, V., Arruda, C., & Yachison, S. (2015). The effects of punishment and appeals for honesty on children's truth-telling behavior. *Journal of Experimental Child Psychology*, 130, 209-217. doi:10.1016/j.jecp.2014.09.011

- Talwar, V., Carlson, S. M., & Lee, K. (2011). Effects of a punitive environment on children's executive functioning: A natural experiment. *Social Development, 20*, 805-824.
- Talwar, V., & Crossman, A. (2011). From little white lies to filthy liars. The evolution of honesty and deception in young children. *Advances in Child Development and Behavior, 40*, 139-141.
- Talwar, V., Gordon, H. M., & Lee, K. (2007). Lying in the elementary school years: Verbal deception and its relation to second-order belief understanding. *Developmental Psychology, 43*, 804-810.
- Talwar, V., & Lee, K. (2011). A punitive environment fosters children's dishonesty: A natural experiment. *Child Development, 82*, 1751-1758.
- Talwar, V., & Lee, K. (2008). Social and cognitive correlates of children's lying behavior. *Child Development, 79*, 866-881.
- Talwar, V., & Lee, K. (2002). Development of lying to conceal a transgression: Children's control of expressive behavior during verbal deception. *International Journal of Behavioral Development, 26*, 436-444.
- Talwar, V., Manji, S., Zwaigenbaum, L., Loomes, C., Goulden, K. J., & Rasmussen, C. (2012). Lie-telling behavior in children with autism and its relation to false-belief understanding. *Focus on Autism and Other Developmental Disabilities, 27*, 122-129.
- Talwar, V., Renaud, S.-J., & Conway, L. (2015). Detecting children's lies: Are parents accurate judges of their own children's lies? *Journal of Moral Education, 44*, 81-96.
- Talwar, V., Williams, S. M., Renaud, S. J., Arruda, C., & Saykaly, C. (2016). Children's evaluations of tattles, confessions, prosocial and antisocial lies. *International Review of Pragmatics, 8*, 334-352. doi:10.1163/18773109-00802007

- Tamis-LeMonda, C. S., Shannon, J. D., Cabrera, N. J., & Lamb, M. E. (2004). Fathers and mothers at play with their 2- and 3-year-olds: Contributions to language and cognitive development. *Child Development*, 75, 1806-1820. doi:10.1111/j.1467-8624.2004.00818.x
- Tan, T. X., Gelley, C. D., & Dedrick, R. F. (2015). Non-child-related family stress, parenting styles, and behavior problems in school-age girls adopted from China. *Journal of Child and Family Studies*, 24, 2881-2891.
- Wagner, S. L., Cepeda, I., Krieger, D., Grunau, R. E., Maggi, S., D'Angiulli, A., D'Angiulli, A., ... Grunau, R. E. (2016). Higher cortisol is associated with poorer executive functioning in preschool children: The role of parenting stress, parent coping and quality of daycare. *Child Neuropsychology*, 22, 7, 853-869.
- Walczyk, J. J., Roper, K. S., Seemann, E. & Humphrey, A. M. (2003). Cognitive mechanisms underlying lying to questions: response time as a cue to deception. *Applied Cognitive Psychology*, 17, 755–774. doi:10.1002/acp.914
- Williams, S., Leduc, K., Crossman, A. M., & Talwar, V. (2016). Young deceivers: The identification of lying, executive functions and antisocial lies in preschool aged children. *Infant and Child Development*. doi:10.1002/icd.1956
- Williams, S., Moore, K., Crossman, A. M., & Talwar, V. (2015). The role of executive functions and theory of mind in children's prosocial lie-telling. *Journal of Experimental Child Psychology*, 141, 256-266. doi:10.1016/j.jecp.2015.08.001
- Wilson, A. E., Smith, M. D., & Ross, H. S. (2003). The nature and effects of young children's lies. *Social Development*, 12, 21-45.
- Xu, F., & Lee, K. (2007). *Promoting honesty*. In: Presented at the Society for Research in Child Development Biennial Meeting, Boston, MA.

Zelazo, P. D. (2006). The dimensional change card sort (DCCS): A method of assessing executive function in children. *Nature Protocols*, 1, 297-301.

Table 1

Descriptive Information on Children's Cognitive Ability and Social-Environmental Factors

	Range	<i>M</i>	<i>SD</i>
Inhibitory Control (Stroop)	0-16	12.36	4.80
Cognitive Flexibility Card Borders	0-12	5.94	2.77
Authoritative Parenting	41-74	61.89	6.63
Authoritarian Parenting	12-37	21.41	4.91
Maternal Stress	0-25	6.28	4.77

Table 2

Pearson Correlation Coefficients Among Parent and Cognitive Measures

	2	3	4	5	Maternal Stress
1. Age (months)	.17*	.23**	.08	.03	.19**
2. Stroop		.17*	.05	.02	.08
3. Card Borders			-.06	-.05	.04
4. Authoritative				-.22**	-.03
5. Authoritarian					.13

* $p < .05$ ** $p < .01$

Table 3

Unstandardized Regression Coefficients for Logistic Regression Models

Model 1 (Outcome: lie-telling)						
$\chi^2(10, N = 89) = 21.92, p = .016$; Nagelkerke $R^2 = .31$						
	Coefficient	S.E.	<i>p</i>	OR	LLCI	ULCI
Age	0.05	0.04	.196	1.05	0.98	1.13
Vocabulary	0.07	0.04	.114	1.07	0.98	1.17
Stroop	1.42	0.80	.075	4.13	0.87	19.61
Card Border	0.70	1.06	.506	2.02	0.26	15.93
Authoritative Parenting	0.45	0.21	.033	1.56	1.04	2.35
Maternal Stress	-0.07	0.39	.859	0.93	0.43	2.02
Stroop * Authoritative	-0.03	0.01	.047	0.97	0.95	1.00
Stroop * Maternal Stress	0.03	0.02	.140	1.03	0.99	1.08
Card Border * Authoritative	-0.01	0.02	.595	0.99	0.96	1.02
Card Border * Maternal Stress	-0.05	0.04	.246	0.95	0.87	1.04
Model 2 (Outcome: lie-telling ability)						
$\chi^2(3, N = 84) = 9.45, p = .024$; Nagelkerke $R^2 = .14$						
Stroop	-2.02	0.96	.035	0.13	0.02	0.87
Authoritative Parenting	-0.51	0.23	.026	0.60	0.38	0.94
Stroop * Authoritative	0.04	0.02	.030	1.04	1.00	1.07

Figure 1. Moderating effect of authoritative parenting in the relation between inhibitory control and lying.

Figure 2. Moderating effect of authoritative parenting on the relation between inhibitory control and semantic leakage control.