



Relations among Temperament, Familial Socioeconomic Status, and Inhibitory Control in Typically Developing Four-Year-Old Children

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Abstract

Objective Since inhibitory control has been implicated in children's ability to successfully navigate their social and academic environments, it is important to explore factors underlying its development. We examined whether attentional focusing (a temperamental factor) and socioeconomic status (a caregiving environmental factor) influenced children's inhibitory control.

Methods Inhibitory control was coded from an observed behavioral task (Dinky Toys) and children's temperament and socioeconomic status were indexed via parent report in 70 (36 girls; M age = 4.40 years) typically developing 4-year-old children.

Results We found that children low in attentional focusing were differentially sensitive to their caregiving environment in predicting inhibitory control ($p = .001$): children with low attentional focusing displayed the highest and lowest levels of inhibitory control when their familial socioeconomic status was high and low, respectively. Children with high attentional focusing exhibited an average amount of inhibitory control regardless of their familial socioeconomic status ($p = .20$).

Conclusion Findings provide support for a differential susceptibility hypothesis and suggest that plasticity in low attentional focusing may be beneficial to children in some caregiving environments. Findings also highlight the importance of considering factors internal and external to the child when exploring influences on inhibitory control.

Keywords Temperament · Socioeconomic status · Attentional focusing · Inhibitory control · Differential susceptibility

Inhibitory control refers to an individual's ability to actively and voluntarily inhibit or regulate dominant responses and is a core component of effortful control and executive function (Diamond 2013; Kochanska et al. 2000). Emerging late in infancy, and continuing to develop throughout the preschool years, inhibitory control is critical for positive childhood adjustment in a variety of domains (Rothbart 1989). For example, it helps enable children to develop and maintain social relationships, follow parents' and teachers' instructions, and regulate their behavior in school and at

home (Rhoades et al. 2009). Because inhibitory control is a key factor in successful behavioral regulation, it is important to explore factors underlying its development. Exploring factors both internal and external to the child, as well as their interaction can better elucidate the development of inhibitory control.

One internal factor associated with children's inhibitory control is the temperamental characteristic attentional focusing. Attentional focusing refers to children's general propensity to maintain the focus of their attention while working on a task (Rothbart et al. 1994a), and represents a key component of children's attentional control. Attentional focusing is related theoretically to children's self-regulation because children with strong focus may be better able to concentrate on alternative activities if they are experiencing aversive emotions (Muris et al. 2004; Rudasill and Rimm-Kaufman 2009), or focus on alternative stimuli if something they have a strong desire for is unattainable (Rothbart and Ahadi 1994).

The development of inhibitory control has been linked to the development of the attentional network, further implicating attentional focusing in children's self-regulation. The

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development of the anterior attention network—responsible for modulating interference and attentional control—has been linked to behavioral self-regulation (Rothbart et al. 1994b). One cognitive measure that has been used to index inhibitory control is the Stroop task. During this task, participants are asked to read the name of colors. In non-conflict trials of this task, the color of the ink and the word are congruent (e.g., the ink is green and the printed word is green). During conflict trials, the printed word and color of the ink are incongruent (e.g., the ink is yellow and the printed word is green). During conflict trials in the Stroop task the anterior attentional network is more active than during non-conflict trials, suggesting this network is associated with response and interference modulation (Pardo et al. 1990; Rothbart et al. 1994a, b). Because resolution of interference and control is heavily implicated in inhibitory control, (Rothbart et al. 1994a, b) suggest that the anterior cingulate (located in the anterior attentional network) is involved in inhibitory control. Attentional coordination allows children to inhibit responses by directing focus away from some stimuli and onto others (Rothbart and Ahadi 1994). Supporting this idea, Kochanska et al. (2000) found that temperamental attentional focus in infancy predicted children's later effortful control at 22 months, although there were individual differences in outcomes. Therefore, attention-level factors are important to consider as factors that influence inhibitory control. However, focusing on attention alone (a child-level, internal characteristic) ignores the role of external factor on the development of inhibitory control.

The differential susceptibility theory posits that some temperamental characteristics (i.e., biologically based individual differences in temperament and personality present from birth; e.g., behavioral inhibition) are associated with individual differences in sensitivity to the positive and negative aspects of their environment, while other individuals may be less malleable (Belsky and Pluess 2009). According to differential susceptibility theory, some temperamental styles confer greater malleability, leading to relatively “better” potential outcomes when exposed to supportive environments (e.g., homes with financial stability, good parenting), but relatively “worse” outcomes when exposed to less supportive environments (e.g., financially unstable homes, punitive parenting). Still other temperamental styles confer less malleability, with relatively similar outcomes regardless of environmental influences. In short, not all children with more “difficult” temperaments end up with the worst outcomes, and not all children with more “easy” temperaments end up with the best outcomes. This difference in malleability is presumably maintained at the population level because it is adaptive to produce offspring that may end up with the best

outcomes if they end up in a positive environment above and beyond the risk of the offspring ending up in a negative environment. Indeed, a number of studies have found that children with temperaments marked by negative emotionality and poor effortful control (ostensibly more difficult temperaments) do not necessarily end up with the worst outcomes. For example, Bradley and Corwyn (2008) found that children with difficult temperaments were more susceptible to sensitive parenting than children with less difficult temperaments in that they developed fewer externalizing problems in response to this type of parental interaction. Similarly, Van Zeijl et al. (2007) found that mothers of 1-to-3-year old children with more difficult temperamental styles reported the most externalizing problems and physical aggression when parents used more negative discipline, but the least externalizing problems and physical aggression when parents used more positive discipline.

Diathesis-stress is an alternative framework to differential susceptibility. Diathesis-stress posits that temperamental characteristics (that is, biologically based differences in personality present from birth) act as vulnerability factors (diatheses). Individuals who carry the vulnerability are predicted to end up with worse outcomes in more stressful environments, but do equally well in non-stressful environments (Monroe and Simons 1991; Zuckerman 1999).

Because attentional focusing is a temperamental factor that is implicated in individual differences in children's inhibitory control, it is possible to test this relation using differential susceptibility and diathesis-stress frameworks. Although the extant literature suggests that low attentional focusing would be associated with relatively impaired inhibitory control (Kochanska et al. 2000), attentional focusing may function similarly to other temperamental characteristics such as effortful control and negative emotionality in a differential susceptibility or diathesis-stress model (Bradley and Corwyn 2008; Van Zeijl et al. 2007). Following the differential susceptibility framework, attentional focusing may be associated with impaired inhibitory control only in more negative environmental contexts. Alternatively, from a diathesis-stress framework, low attentional focusing may act as a vulnerability that predicts deleterious outcomes (e.g., poor inhibitory control), rather than a malleability factor that not always predicts negative outcomes. Using differential susceptibility and diathesis-stress frameworks as a theoretical platform, we examined whether differences in attentional focusing were associated with differences in inhibitory control depending on the caregiving environment.

Studies have found that familial socioeconomic status is another factor that is associated with children's inhibitory

control and reflects the climate of the child's caregiving environment. For example, Lipina et al. (2005) found that infants from more socioeconomically disadvantaged homes made more errors and exhibited fewer correct responses compared to infants from less disadvantaged families in a task measuring inhibitory control and working memory. Parental education and familial income are also both positively correlated with 4-year old children's self-regulation (Miech et al. 2001). This relation continues into later childhood, with familial income being positively related to 9-year-old children's ability to delay gratification (directly observed inhibitory control; Evans and Rosenbaum 2008). One hypothesis regarding this link proposes that more environmental resources allow for increased parental investment, providing a more cognitively enriching environment that allows for the development of stronger self-regulation (Hoff et al. 2002). Further, greater financial resources can decrease stress within the household, allowing for more competence promoting parenting (Brody et al. 2002; Conger and Conger 2002). Given the critical role of parenting in the development of children's self-regulation, socioeconomic status is an important factor to consider when exploring factors influencing the development of inhibitory control (Bernier et al. 2010; Karreman et al. 2006). Accordingly, it is possible that individual differences in children's attentional style may interact with socioeconomic status to confer individual differences in inhibitory control.

The goal of the present study was to explore whether individual differences in 4-year old children's attentional focusing (i.e., temperament) interacted with parental socioeconomic status (i.e., caregiving environment) to confer individual differences in performance on an inhibitory control laboratory task, when controlling for sex. Sex is an important covariate to consider when exploring inhibitory control as an outcome, as females typically have better inhibitory control than males (Ahadi et al. 1993; Davis et al. 1999; Else-Quest et al. 2006; Kochanska et al. 2000). In keeping with a differential susceptibility hypothesis, we predicted that children's attentional focusing would moderate the relation between socioeconomic status and inhibitory control, such that children with low attentional focusing would display the highest and lowest inhibitory control, depending on whether their familial socioeconomic status was high or low, respectively. On the other hand, we predicted that children high on attentional focusing would be relatively less sensitive to familial socioeconomic status level, displaying an average level of inhibitory control. An alternative prediction from a diathesis-stress framework is that children with low attentional focusing would display relatively lower inhibitory control in low socioeconomic status environments compared to children with high attentional focusing, but similar inhibitory control in relatively higher socioeconomic status environments.

Methods

Participants

Seventy typically developing 4-year-old children (36 girls, 34 boys) and their mothers were recruited from Child Database at the Department of Psychology, Neuroscience & Behaviour in McMaster University. This database contains the names and contact information for parents of healthy newborn infants recruited from university hospitals across the Hamilton, Ontario area to eventually participate in child studies conducted at McMaster University.

Of the 70 children, 6 were excluded from further analyses because their parents did not provide information about their socioeconomic status. These 6 children did not differ from the children remaining in the analyses on age ($t[68] = -.20, p = .84$), attentional focusing ($t[68] = -.20, p = .84$), inhibitory control ($t[67] = -.76, p = .45$), or sex ($\chi^2 [1, N = 70] = 3.16, p = .08$).

Following exclusion, 64 children (35 girls, 29 boys) were included in the statistical analyses reported below. The mean age of these children was 4.40 years ($SD = .28$ years). The ethnicities of the families in this study were 90.5% White, 1.6% Black, and 7.9% other (e.g., Hispanic). The highest level of achieved education by mothers was less than a high school diploma for 1.6%, a high school diploma for 1.6%, an apprenticeship or trades certificate or diploma for 4.7%, some university or college for 12.5%, a college diploma for 37.5%, a Bachelor's degree for 23.4%, some graduate education for 7.8%, and a Master's degree or higher for 10.9%. While most of the children came from homes where the parents were married (79.7%), some mothers were not married but living with the child's other parent (10.9%) or were single (9.4%). The annual household income (in Canadian dollars) before taxes for the families was: less than \$15,000 for 3.1%, between \$15,000 to \$30,000 for 3.1%, between \$30,000 to \$45,000 for 7.8%, between \$45,000 to \$60,000 for 6.3%, between \$60,000 to \$75,000 for 18.8%, between \$75,000 to \$100,000 for 10.9%, and over \$100,000 for 50.0%. The median household income in Ontario in 2015 was \$81,440 (Statistics Canada 2017).

Procedure

Children and their mothers participated in this study at the Child Emotion Laboratory at McMaster University. The child, mother, and two female experimenters began in a lab testing room together. While the child played with a puzzle with a researcher, a different researcher explained the study procedure to the mother. After consent was obtained, the mother and one researcher left the room. After the mother

left with one experimenter, the child and second researcher were left alone in the room for approximately one hour to complete a number of tasks in a standardized order. The focus of this study was inhibitory control assessed during the Dinky Toys Task. During this time, the mother was in a separate room where she could view her child on a closed-circuit computer monitor. The mother also reported on familial demographics and completed the Children's Behavior Questionnaire-Short Form (CBQ-SF; Putnam and Rothbart 2006). Families were compensated for their time with one \$10 grocery store gift card and two small toys for their child. This study was approved by the McMaster University Research Ethics Board.

Measures

Dinky toys task

Procedure This task is a measure of inhibitory control and is adapted from Kochanska et al. (1996). During this task, the experimenter and child were seated cross-legged across from each other on the floor. The child was presented with a box of attractive toys and told to indicate using their words which toy they would like while keeping their hands on their lap. Once the experimenter slid the box over to the child, the child was given up to two reminders to keep their hands on their lap. The child then either told the researcher what toy they wanted or grabbed the toy. Following the first choice, the child was told, "Because you did such a good job today, I'm going to let you pick another prize to take home." The procedure was then repeated. After the task was completed, the child was able to switch their toys if they become upset.

Behavioral observation and coding Children's performance on the Dinky Toys Task was unobtrusively digitally recorded. Their strategy during the task was subsequently coded from the digital recordings. Children's strategy was coded on a 0- to 5-point scale, following the coding scheme of Kochanska et al. (1996). A 0-point score was assigned if the child grabbed the toy out of the container, a 1 represented the child touching the toys in the container, but not taking them out, a score of 2 was given if the child pointed to the toys, a 3 represented the child removing their hands from their lap, a score of 4 was given if child's hands were twitching or moving but not leaving the lap, and a 5 represented the child not moving their hands from their lap. Because this task was completed twice, scores for children's strategies and inter-rater reliability were averaged between the two trials. The videos were coded by 3 independent coders for inhibitory control during the Dinky Toys Task using Kochanska et al.'s coding scheme, and high inter-

rater reliability was established ($\alpha = .80$). The coders overlapped on 48% of the original videos.

Parental questionnaires

Children's temperament The Children's Behavior Questionnaire-Short Form (CBQ-SF; Putnam and Rothbart 2006) was used to index temperament. The CBQ-SF is a parent-rated questionnaire evaluating 3- to 8-year-old children's temperament on a 7-point scale (1 = never; 7 = always). Of particular interest to the present study was parental ratings of attentional focusing. Attentional focusing is a reliable 14-item subscale on the CBQ-SF, with the authors reporting high internal consistency ($\alpha = .73$; Putnam and Rothbart 2006). Higher scores on this scale are indicative of greater attentional focusing. Our sample demonstrated comparable high internal consistency for this subscale ($\alpha = .78$). Examples of questions in this subscale include: *when drawing or coloring in a book, shows strong concentration, and when building or putting something together, becomes very involved in what s/he is doing, and works for long periods.*

Parental sociodemographic characteristics A demographics questionnaire was also completed by mothers, which included questions about marital status, highest level of achieved education, and household income. Of particular interest to the present study were household income and mothers' highest level of achieved education. Combined household income (in Canadian dollars) was measured on a 7-point scale, where 1 = less than CAN\$15,000, 2 = between \$15,000 to \$30,000, 3 = \$30,000 to \$45,000, 4 = \$45,000 to \$60,000, 5 = \$60,000 to \$75,000, 6 = \$75,000 to \$100,000, and 7 = over \$100,000. Highest level of maternal education achieved was measured on a 10-point scale, where 1 = grade school, 2 = some high school, 3 = high school diploma, 4 = apprenticeship or trades diploma or certificate, 5 = some college or university, 6 = college degree, 7 = Bachelor's degree, 8 = some graduate education, 9 = Master's degree, and 10 = PhD, MD, or other doctoral level degree. The income and maternal education variables were summed to create a new variable to represent socioeconomic status ($M = 12.06$, $SD = 2.55$), where the minimum value was 2, and the maximum value was 16.

Data analyses

We examined associations by performing partial correlations among socioeconomic status, attentional focusing, and inhibitory control, controlling for children's sex. To explore whether children's attentional focusing moderated the association between socioeconomic status and inhibitory

Table 1 Partial correlations, mean and standard deviation (SD) for socioeconomic status, attentional focusing, and observed inhibitory control, controlling for children’s sex

Variables	1	2	3	Mean (SD)
1. Socioeconomic status	–	–.08	.18	12.06 (2.56)
2. Attentional focusing	–	–	–.03	4.49 (0.65)
3. Inhibitory control	–	–	–	2.12 (1.66)

control, we utilized a linear regression (Aiken and West 1991). The predictors were attentional focusing and socioeconomic status, both of which were centered at their means. The dependent measure was the behavioral measure of inhibitory control coded from children’s strategy during the Dinky Toys Task. In the first model, sex was entered as a covariate. In the second model, socioeconomic status (i.e., combined household income and maternal education) were entered. In the third model, children’s continuous attentional focusing scores from the CBQ-SF were entered. In the final model, an interaction term (socioeconomic status by attentional focusing) was entered.

Results

Table 1 displays partial correlations (controlling for children’s sex) and descriptive statistics for the main study variables. Socioeconomic status, attentional focusing, and inhibitory control were all not statistically significantly correlated.

Preliminary analyses revealed that, as predicted, girls ($M = 2.70, SD = 1.71$) had significantly higher inhibitory control compared to boys ($M = 1.46, SD = 1.36$), $t(61) = 3.11, p = .003, d = .71$. There was no significant difference in girls’ and boys’ attentional focusing $t(62) = 1.76, p = .08$, or socioeconomic status, $t(62) = -.41, p = .68$.

We used a multiple linear regression to predict inhibitory control based on socioeconomic status and attentional focusing, adjusting for children’s sex. Our full model accounted for 27% of the total variance, $F(4, 62) = 5.41, p = .001, f^2 = .37$. Results revealed a significant interaction between socioeconomic status and children’s attentional focusing ($B = -.34, p = .005, CI [-.58, -.11]$). Table 2 depicts this regression.

In order to probe this interaction, we calculated the simple slope of socioeconomic status predicting inhibitory control at high (one standard deviation above the mean) and low (one standard deviation below the mean; Aiken and West 1991) values of attentional focusing, controlling for children’s sex. In children with high attentional focusing, socioeconomic status was unrelated to inhibitory control ($B = -.15, p = .20$). However, in children with low attentional focusing, socioeconomic status was positively associated with inhibitory control ($B = .29, p = .001$).

Table 2 Regression analysis predicting observed inhibitory control from socioeconomic status and attentional focusing

Predictors	Inhibitory control			
	Unstandardized beta	SE	R ²	ΔR ²
Model 1			.14**	.14**
Child’s Sex ^a	–1.23**	.39		
Model 2			.17**	.03
Child’s Sex	–1.26**	.39		
Socioeconomic status	0.11	.08		
Model 3			.17*	.001
Child’s Sex	–1.28**	.40		
Socioeconomic status	0.11	.08		
Attentional focusing	–0.10	.32		
Model 4			.27**	.11**
Child’s Sex	–1.27**	.38		
Socioeconomic status	0.07	.07		
Attentional focusing	–0.26	.30		
Socioeconomic status x attentional focusing	–0.34**	.12		

Note: Familial socioeconomic status and attentional focusing were centered at their means

SE standard error

$n = 64, **p \leq .01$

^aGirls were coded as 1, boys were coded as 2

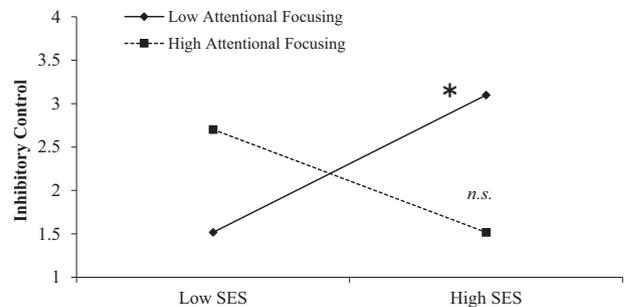


Fig. 1 Moderating influences of parent-reported attentional focusing on the association between familial socioeconomic status (SES) and observed inhibitory control in typically developing 4-year-olds

As predicted, children with a temperament characterized by low attentional focusing displayed the highest inhibitory control when their familial socioeconomic status was relatively high, and the lowest inhibitory control when their familial socioeconomic status was relatively low (Fig. 1). Children with a temperament characterized by relatively high attentional focusing displayed a relatively average

amount of inhibitory control regardless of whether their familial socioeconomic status was relatively high or low.

Discussion

In the present study, we explored whether children's temperament moderated the relation between familial socioeconomic status and inhibitory control at age four and found that attentional focusing moderated the association between these two variables. Consistent with a differential susceptibility hypothesis, as predicted, children with relatively low attentional focusing displayed the highest levels of inhibitory control when their familial socioeconomic status was relatively high, and the lowest levels of inhibitory control when their familial socioeconomic status was relatively low. On the other hand, children with relatively high attentional focusing displayed similar inhibitory control regardless of their familial socioeconomic status.

Child-level and Caregiving Environmental Influences on Inhibitory Control

Children's temperamental attentional focusing has been implicated in inhibitory control (Kochanska et al. 2000). Children's ability to maintain focus on a presumably aversive task can allow for the modulation or inhibition of dominant responses (Rothbart and Ahadi 1994). Socioeconomic status also has been implicated in the development of inhibitory control. Greater financial resources can allow families to provide more enriching environments for their children to develop good self-regulation (Hoff et al. 2002). Having greater resources can also remove financial stress, making it easier to more effectively parent children (Brody et al. 2002).

Children's self-regulation is hypothesized to emerge at least partially from external regulation, largely from parents (Bernier et al. 2010; Karreman et al. 2006). Parents who are experiencing less stress may be more likely to utilize more positive strategies to regulate their children's behavior including using distraction, induction, and understanding, rather than coercion, making demands, or giving in (Van Zeijl et al. 2007). Children with parents who positively regulate their children's behavior may develop better inhibitory control.

For children with "good" attentional focusing, there was no association between familial socioeconomic status and inhibitory control. It is possible that high attentional focusing may be a resilience factor for inhibitory control in that their temperamental disposition may protect them from the potential negative influences of their environment. However, children with poor attentional focusing appeared to be more malleable. When in a lower familial socioeconomic status environment, these children had relatively

lower inhibitory control. Given that their temperamental style is associated with poorer self-regulation (Kochanska et al. 2002), and they are less likely to have the resources that allow for the optimal development of inhibitory control (Hoff et al. 2002), these results are in line with the literature. However, children with low attentional focusing in relatively high familial socioeconomic status households displayed the relatively highest inhibitory control. Because these children are presumably temperamentally predisposed to poorer self-regulation, they may be able to benefit the most from high caregiving environmental quality or enrichment. Further, it is possible that early in development, parents with greater resources notice their child's relatively poor attention and invest more resources into providing a developmentally enriched environment because they have the means to do so, leading to enhanced inhibitory control. Essentially, children with low attentional focus have the most to lose in a relatively "poorer" environment, and the most to gain in a relatively "enriched" environment.

Theoretical Implications: Differential Susceptibility Hypothesis

Our findings were consistent with a differential susceptibility framework. Plasticity in low attentional focusing may provide multiple potential benefits to children. While in a less than ideal caregiving environmental circumstance, children with low attention focusing are not well regulated, they are able to reap the rewards of better environmental conditions. Plasticity in attentional focusing may have been advantageous in stressful environments (low socioeconomic status) where quick reactions and disengaging from threatening stimuli were beneficial. While children with low attentional focusing may have the most to lose in less enriched environments, these children may also have the most to gain in an enriched environment (high socioeconomic status), given they display the highest inhibitory control. Alternatively, plasticity in attentional focusing may represent a high-risk strategy where payoffs are only present on one end of the spectrum. This circumstance is the foundation of differential susceptibility.

From an evolutionary perspective, Belsky and Pluess (2009) provided a rationale for why natural selection would favor variability in susceptibility to the environment. If the ultimate goal is to pass on one's genes to the next generation, and there is great variability in the environment, it is reasonable to assume that variation in environmental susceptibility can be beneficial as it may produce the most phenotypic plasticity. Although individuals with specific traits such as low attentional focusing may end up with the "worst" outcomes in a less supportive environment, there is the potential benefit of these individuals conferring the "best" outcomes in a supportive environment. Given that the

offspring's future environment is uncertain, it is likely advantageous to produce offspring which have plasticity in temperamental phenotypes (e.g., children with low attentional focusing).

These results also provide support for other studies that conceptualize temperament as a differential susceptibility factor. A number of studies have found, for example, that temperament and parenting do not work in isolation to affect children's outcomes. Gagnon et al. (2014) found that only in highly reactive children was authoritarian parenting associated with maladaptive play behavior. Similarly, Van Zeijl et al. (2007) found that positive discipline was negatively associated with externalizing problems and negative discipline was positively associated with externalizing problems, but only in children with difficult temperaments. These results add to the growing body of literature suggesting that children's temperament serves as a differential susceptibility factor which interacts with the environment to produce different outcomes.

Sex Differences in Inhibitory Control

We also found that boys displayed lower inhibitory control compared to girls. This result is in line with the extant literature (Ahadi et al. 1993; Davis et al. 1999; Else-Quest et al. 2006; Kochanska et al. 2000). From an evolutionary perspective, we can see why it would be adaptive for females to display strong inhibition abilities. Bjorklund and Kipp (1996) argue that because of females' high initial and sustained investment in offspring, it is beneficial to conceal interest in potential mates until they have been identified as good candidates with whom to produce offspring. Further, because traditionally females have taken on the majority of childrearing responsibilities, the ability to delay gratification and serve the needs of one's offspring before satisfying one's own needs would also be important for rearing quality offspring. Because of the different selection pressures on males and females, Bjorklund and Kipp (1996) argue that natural selection would favor strong inhibitory control in females. The importance of inhibitory control in adult women may have roots during the preschool years when inhibitory control begins to take form. Socialization may also play a role, as self-control may be valued and encouraged more in girls than boys, facilitating stronger inhibitory control in girls (Silverman 2003).

Limitations

The present study had several limitations worth discussing. First, our sample size was relatively small, limiting statistical power and some of our analyses may have been underpowered. Being underpowered may have reduced our ability to detect statistically significant findings when we probed our significant interaction one standard deviation above and

below the mean. Lack of power may have also led the high attentional focusing slope to be non-significant, which would make our differential susceptibility interpretation to be incorrect. Although our hypotheses were theoretically driven, it is important to replicate this effect with a larger sample size. Children's attentional focusing was also maternally reported as opposed to being measured via direct observation. However, the CBQ-SF is a widely-used, validated and reliable index of children's temperament (Putnam and Rothbart 2006). Further, while we hypothesized about the role of parenting in discussing the association between familial socioeconomic status and inhibitory control in children with low attentional focusing, a limitation of the present study was that we did not include a direct measure of parenting. It is also possible that there was self-report bias in our measure of familial socioeconomic status, as household income and maternal education were self-reported. However, income is something that is very difficult to measure in ways other than self-report, and families were ensured their questionnaires were completely confidential and that only their participant IDs would be attached to data. Further, while our mean household income appears relatively high, it was representative of the greater Hamilton, Ontario metropolitan area (Statistics Canada 2017). It is also important to note that our sample was primarily Caucasian, which may limit the generalizability of our results. Finally, it is important to note that the present study used a cross-sectional design, and thus we are unable to infer causality.

Conclusions

Future studies should utilize longitudinal designs to systematically investigate the influence of familial socioeconomic status and attentional focusing on the development of inhibitory control. Future studies also should aim to replicate these results with a larger sample, utilizing a performance-based measure of attentional control such as National Institute of Health Toolbox cognitive battery, a standardized measure of familial socioeconomic status such as the Hollingshead (1975) four-factor classification of social position, and include parenting measures. Finally, it would be interesting to explore in future work whether the effects noted in the present study hold for non-behavioral, psychophysiological measures of self-regulation such as respiratory sinus arrhythmia.

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Author contribution R.H. aided with data collection, conceptualized and executed the data analyses, wrote the manuscript, and handled revisions. A.S.M. aided with conducting the analyses and edited the final manuscript. K.L.D. designed and executed the study, aided with data collection, and edited the final manuscript. R.V.L. edited multiple drafts of the manuscript. L.A.S. aided in conceptualizing the manuscript, edited the final manuscript, aided with handling revisions, and provided funding, research support and resources.

Compliance with ethical standards All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. IRB approval was granted by McMaster University Research Ethics Board.

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent Informed consent and assent were obtained from all individual participants included in the study.

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