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Contributions of Mother's and Father's Parenting to Children's Self-Regulation: Evidence from an Adoption Study

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Abstract

The origins of top-down self-regulation are attributed to genetic and socialization factors as evidenced by high heritability estimates from twin studies and the influential role of parenting. However, recent evidence suggests that parenting behavior itself is affected by parents' own top-down self-regulation. Because children's top-down self-regulation is influenced by genetic factors and parenting is influenced by top-down self-regulation, the effects of parenting on children's top-down self-regulation identified in prior studies may partially reflect passive gene-environment correlation. The goal of this study was to examine parenting influences on children's top-down self-regulation using a longitudinal, adoption-at-birth design, a method of identifying parenting influences that are independent of the role of shared genetic influences on children's behaviors because adoptive parents are genetically unrelated to their adopted child. Participants (N = 361) included adoptive families and biological mothers of adopted children. Adoptive mothers' and fathers' harsh/negative parenting were assessed when children were 27 months of age and biological mothers' top-down self-regulation was assessed when children were 54 months of age. Adopted children's top-down self-regulation was assessed when they were 54 and 72 months of age. Results, accounting for child gender, biological mother top-down self-regulation, and the potential evocative effects of adopted child anger, provide evidence that inherited influences and socialization processes uniquely contribute to children's top-down self-regulation. Furthermore,

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findings demonstrate the importance of both mother's and father's parenting behavior as an influence on young children's top-down self-regulation. The implications of these findings for understanding the complex mechanisms that influence children's top-down self-regulation are discussed.

Top-down self-regulatory processes encompass executive functioning, effortful control and emotion regulation (Bridgett, Burt, Edwards, & Deater-Deckard, 2015; Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013; Holzman & Bridgett, 2017; Nigg, 2017)[1]. These processes can be voluntarily employed to modulate behavior, cognition, and emotion (Karoly, 1993) and have important implications for life-long functioning. For example, those with better top-down self-regulation have fewer behavior problems (Bridgett, Valentino, & Hayden, 2012; Eisenberg, Spinrad, & Eggum, 2010), better health-related outcomes (Crocket, Raffaelli, & Shin, 2006; Gunstad, Paul, Cohen, Tate, Spitznagel, & Gordon, 2007), and more fulfilling interpersonal and romantic relationships (Bridgett, Burt, Laake, & Oddi, 2013; Busch & Hofer, 2012) than those with poorer self-regulatory capacities. Due to the broad implications of poor top-down self-regulation for health and well-being, understanding the origins of top-down self-regulation is important for promoting such skills in typically-developing children and for developing effective intervention strategies for at-risk youth.

Socialization (e.g., social learning [Bandura, 1991], attachment [Calkins & Leerkes, 2004]) and genetic processes have been implicated in the development of top-down self-regulation during childhood. Socialization views have noted the importance of family dynamics, and parenting specifically, for either promoting or hindering children's development of top-down self-regulation (e.g., Eisenberg, Cumberland, & Spinrad, 1998; Kopp, 1982; Morris, Silk, Steinberg, Myers, & Robinson, 2007). Consistent with this conceptualization, empirical reports have noted that parenting behaviors characterized by intrusiveness, frequent expressions of negative affect, and power assertive/controlling behavior are likely to undermine the development of adequate top-down self-regulation (Karreman, van Tuijl, van Aken, & Dekoic, 2006; Poehlmann, Schwichtenberg, Shlafer, Hahn, Bianchi, & Warner, 2011).

Although caregiving behavior represents a socialization pathway through which children's top-down self-regulation may be fostered or hindered, it is also clear that top-down self-regulation develops as a function of genetic influences. Much of this evidence comes from twin studies, which support the importance of genetic influences on effortful control (Goldsmith, Buss, & Lemery, 1997; Mullineaux, Deater-Deckard, Petrill, Thompson, & DeThorne, 2009) and executive functioning (Friedman et al., 2008; Miyake & Friedman, 2012), two overlapping aspects of top-down self-regulation (see Bridgett et al., 2015 or Nigg, 2017 for discussion). Estimates from twin studies suggest that heritability of top-down self-regulation is moderate to strong (for a recent overview, see Bridgett et al., 2015). Using

[1]For the purposes of the current investigation, we more broadly define top-down self-regulation to include effortful control, emotion regulation and executive functioning. This broad definition of top-down self-regulation is consistent with evidence from empirical (Bridgett, Oddi et al., 2013) and conceptual (Bridgett et al., 2015; Nigg, 2017) works pointing to a high degree of overlap between top-down regulatory processes, such as effortful control, executive functioning, and emotion regulation.

a sample of adolescent twins, Friedman et al. (2008) reported the heritability estimates of 13 different tasks representing core aspects of top-down self-regulation (inhibition/inhibitory control, working memory, and attention shifting) and identified estimates ranging from .29–.76, with eight of the tasks having heritability estimates of .50 or higher. Findings similar to those reported by Friedman and colleagues have been replicated in a sample of school-aged children (Engelhardt, Briley, Mann, Harden, & Tucker-Drob, 2015), providing evidence of genetic influences on top-down self-regulation across the lifespan. Based on such findings, Friedman and colleagues (2008) concluded that executive functions are some of the most heritable characteristics identified by the field. However, it is also important to note that some twin studies also identify modest environmental contributions (e.g., Mullineaux et al., 2009).

Against the backdrop of the long standing interest in the joint influences of genetic and socialization factors on top-down self-regulation, recent work has emerged indicating that parenting behaviors and other aspects of family dynamics (Bridgett et al., 2015; Bridgett, Burt, et al., 2013) are influenced by aspects of parents' own top-down self-regulation. Deater-Deckard and colleagues (Deater-Deckard, Sewell, Petrill, & Thompson, 2010) were among the first to call attention to the influence of parent top-down self-regulation on parenting behaviors, finding that poor maternal working memory was associated with greater reactive negativity to children's behavior (also see Bridgett, Kanya, Rutherford, & Mayes, 2017; Chico, Gonzalez, Ali, Steiner, & Fleming, 2014). Although earlier studies largely relied upon cross-sectional designs, longitudinal studies have supported and extended these findings by showing that parenting behavior contributes to the intergenerational transmission of executive functioning (e.g., Cuevas, Deater-Deckard, Kim, Watson, Morasch, & Bell, 2014). Likewise, longitudinal findings also demonstrate the effects of maternal effortful control on maternal parenting (e.g., Bridgett et al., 2011; Bridgett, Laake, Gartstein, & Dorn, 2013), and have implicated maternal caregiving behavior in the intergenerational transmission of effortful control (Zeytinoglu, Calkins, Swingler, & Leerkes, 2016). Moreover, experimental animal models support the mostly correlational findings that have appeared in the human literature (e.g., Afonso, Sison, Lovic, & Fleming, 2007; Lovic & Fleming, 2004). Thus, existing evidence indicates that parents' own top-down self-regulation is important for parenting-related behaviors that are linked to the development of their children's top-down self-regulation (Bridgett et al., 2015).

In light of the findings regarding the effects of parent top-down self-regulation on parenting and family dynamics, a new issue in understanding the origins of top-down self-regulation emerges. Findings linking aspects of parent top-down self-regulation to their parenting behaviors suggest a possible mechanism for understanding how genetic influences may affect children's top-down self-regulation. Specifically, based on the known genetic contributions to top-down self-regulation, it may be that parenting behavior is linked with children's top-down self-regulation because of shared genes (passive gene-environment correlation: *r*GE) in biologically-related families. Passive *r*GE occurs when the same genetic influences affect both the rearing environment (e.g., parenting) and a trait in the child (e.g., top-down self-regulation). Thus, children's top-down self-regulation may be correlated with the parenting they receive because of genes shared with parents rather than the direct (environmental) effects of parenting. Therefore, existing findings wherein parenting has

been associated with children's top-down self-regulation in biologically-related families may reflect passive *r*GE. If this is the case, then socialization theories that posit a *causal* effect of parenting on children's emergent regulatory skills could be called into question. Though, genetically informed studies of regulation-related outcomes, such as externalizing difficulties and social competence, have highlighted the importance of parenting behavior as an environmental influence, providing some support for the presence of socialization influences on children's top-down self-regulation (e.g., Roisman & Fraley, 2012). Based on the implications for understanding mechanisms involved in the development of top-down self-regulation, it is critical to investigate whether the influence of parenting on children's top-down self-regulation can be demonstrated using a design that removes the possible confound of parents and children sharing genes, such as an adoption design.

Existing work within the top-down self-regulation literature has also rarely considered another type of genetic effect, evocative *r*GE. The presence of an evocative *r*GE may be indicated when a child's genetically influenced trait, such as anger (Clifford, Lemery-Chalfant, & Goldsmith, 2015), evokes specific parenting behaviors they experience OR when a biological parents' genetically influenced trait, such as an index of top-down self-regulation, is associated with adoptive parents' parenting behavior. That is, children's behavioral manifestations of genetically-influenced traits, such as anger or other aspects of negative emotionality, which may in part, reflect poor top-down self-regulation (i.e., children who have difficulties employing top-down self-regulation to regulate emotion may express those emotions more readily and intensely), may evoke parenting behaviors that hinder children's top-down self-regulation (Ganiban, Ulbricht, Saudino, Reiss, & Neiderhiser, 2011; Larsson, Viding, Rijsdijk, & Plomin, 2008; Marceau et al., 2013; Perry, Dollar, Calkins, & Bell, 2017). Likewise, a genetically influenced trait, like top-down self-regulation, which is assessed in a biological parent, may show an association with adoptive parents' parenting if that trait, as expressed by the adopted child, influences the parenting they receive (Knafo & Jaffee, 2013). This possibility is supported, at least in part, by some prior work within biologically related families showing that children's top-down self-regulation influences parenting behaviors (i.e., child effects; e.g., Brody & Ge, 2001; Lengua, 2006; Perry, Mackler, Calkins, & Keane, 2014).

Finally, many developmental studies employing genetically sensitive designs have focused primarily on the influence of maternal parenting. Little work exists that considers the role of paternal parenting in the emergence of children's top-down self-regulation despite recognition of the unique contribution of fathers in supporting or hindering children's development (Phares, Fields, Kamboukos, & Lopez, 2005). In one of the few existing studies to consider both mothers and fathers, Kochanska, Aksan, Prisco and Adams (2008) identified negative associations of similar size between both caregivers' use of power assertiveness during interactions with their young children and children's subsequent top-down self-regulation. In contrast, although all associations were in the anticipated direction, Bernier, Carlson, Deschenes, and Matte-Gagne (2012) found that maternal caregiving was more consistently and strongly associated with children's top-down self-regulation than paternal caregiving. As these two studies illustrate, among the small number of studies that have considered both mother and father parenting in association with children's top-down self-regulation, findings are inconsistent. Such inconsistent findings may be due, in part, to

greater variability among caregivers in regards to time spent with young children, with mothers spending (on average) more time engaged in childcare activities with young children relative to fathers (Sani & Treas, 2016).

The Current Study

As described above, there are three notable gaps in existing studies of associations between parenting and children's top-down self-regulation: prior studies have not used a design that can rule-out the role of passive *r*GE as an explanation (in full or in part) for associations between parenting and children's top-down self-regulation, few studies have examined child-effects or evocative *r*GE, and few studies have considered the role of both mothers and fathers parenting in relation to children's top-down self-regulation. In light of these gaps in the literature, the purpose of the current study is to examine the association between mothers' and fathers' negative parenting behavior, characterized by expressions of negative affect, intrusiveness, and controlling behavior, on young children's top-down self-regulation using a genetically-sensitive adoption design. These aspects of negative parenting were selected because of 1) their theoretical importance for hindering children's top-down self-regulation via socialization processes (e.g., Eisenberg et al., 1998; Kopp, 1982), and 2) evidence that negative parenting behaviors, over time, perturb children's stress response system, contributing to functional and structural changes to children's prefrontal cortex, which underlies behavioral and cognitive manifestations of poor top-down self-regulation (Blair et al., 2011; Bridgett et al., 2015; Martin, Davies, Cummings, & Cicchetti, 2017).

We attempt to differentiate genetic and environmental contributions to children's top-down self-regulation through the use of an adoption design, which includes adopted children, their adoptive parents, and their biological mothers. Within this design, the adopted children and adoptive parents are not genetically related, which means that associations between adoptive parents' behavior and adopted children's characteristics cannot be attributed to shared genes, eliminating passive *r*GE effects. However, the presence of evocative *r*GE effects on adoptive parents' parenting behaviors can be assessed by including adopted child anger and an index of biological mother's top-down self-regulation. In this case, evocative *r*GE would be supported if the biological mothers' top-down self-regulation is directly or indirectly (via the adoptive child's anger) associated with adoptive parents' parenting behavior.

On the basis of theoretical work that has emphasized the joint contributions of socialization and genetic influences in the origins and intergenerational transmission of top-down self-regulation (Bridgett et al., 2015), we formed three hypotheses. We expected evidence to support genetic influences on children's top-down self-regulation, via a relation between biological mothers' top-down self-regulation and adopted children's top-down self-regulation. Likewise, we also expected support for parenting behavior in the origins of top-down self-regulation as demonstrated by negative associations between adoptive mother's and father's use of negative parenting practices and adopted children's top-down self-regulation. Because, on average, mothers spend more time engaged in childcare activities with young children (Sani & Treas, 2016), we cautiously expected adoptive mother's negative parenting behavior to be more strongly related to adopted children's top-down self-regulation than adoptive father's negative parenting behavior – a possibility supported by

some existing studies (e.g., Bernier et al., 2012). Finally, on the basis of prior work (Ganiban et al., 2011; Larsson et al., 2008; Marceau et al., 2013), we also expected adopted children's anger to be positively associated with subsequent negative parenting behavior, consistent with the notion of child effects on parenting behavior (Bell, 1968; Lengua, 2006; Perry, Dollar, Calkins, & Bell, 2017).

Method

Participants & Procedure

Participants consisted of 361 linked sets of individuals consisting of biological mothers, adoptive parents, and adopted children from Cohort I of the Early Growth and Development Study (EGDS), a nationwide study of adopted children starting 4-months postpartum. The majority of adoptive parents were Caucasian (91.4% adoptive mothers; 90.2% adoptive fathers); similarly, most biological mothers reported their race as Caucasian (71.1%). Adoption placements were all infant U.S. domestic adoptions, and the mean age of adopted children at the time of placement was 7.11 days (SD = 13.28 days). The current study builds on prior work (Leve, DeGarmo, et al., 2013) using this sample by examining the association between parenting experienced by adopted children and adopted children's top-down self-regulation, use of parallel measures of adopted child and birth mother top-down self-regulation, extension to a later developmental period, and consideration of child and evocative *r*GE effects on adoptive mother's and father's parenting. Because the details of EGDS have been comprehensively covered elsewhere (see Leve et al., 2013), further participant information is not provided here, and only the procedures/measures relevant to the current investigation are discussed.

Measures

Adoptive parent negative parenting behaviors—Adopted children participated in a free-play (3-minutes) and subsequent clean-up task (5-minutes) separately with each adoptive parent when they were 27 months old. Interactions were subsequently rated by trained coders for parenting behaviors (Pears & Ayers, 2000), including behaviors that fall under the broader umbrella of negative parenting (e.g., expression of negative affectivity, intrusiveness, and controlling/power assertive behavior). For the purposes of the current investigation, three codes (e.g., "Overall, how much hostility did the parent express during the task?") were used to develop a composite indicator of adoptive parent Expression of Negative Affect. Zero-order associations for the three codes ranged from r = .46 to r = .60 for adoptive mothers and from r = .51 to r = .78 for adoptive fathers (all ps < .001). Two codes (e.g., "Overall, how intrusive was the parent during the task?") were used to develop a composite indicator of adoptive parent Intrusiveness. Zero-order associations between the two codes used to form the composite of Intrusiveness were r = .58, p < .001 for adoptive mothers, and r = .36, p < .001 for adoptive fathers. Likewise, two codes (e.g., "The parent used physical force to get the child to comply") were also selected to develop a composite indicator of adoptive parent Controlling/Power-Assertive parenting behavior. Zero-order associations between the two codes used to form the composite of Intrusiveness were r = .39, p < .001 for adoptive mothers, and r = .34, p < .001 for adoptive fathers. All codes were rated on a 1 to 5 or a 1 to 4 scale, depending on the specific code; codes were standardized

prior to being used to form composites. These composite indicators, α = .77 for adoptive mothers and α = .71 for adoptive fathers, formed latent variables of Harsh/Negative Parenting for use in analyses. A second rater coded approximately 12% of all cases, with the mean intra-class correlation across indicators for adoptive mothers being .55 and .60 for adoptive fathers.

Child top-down self-regulation—Children's top-down self-regulation was measured in two ways for the purposes of the current investigation: adoptive parent-rated effortful control when children were 54 months of age, and a Go/No Go computerized task when children were 72 months of age. The Go/No Go task employed different shapes as stimuli across 84 trials (Nosek & Banaji, 2001), and were coded for correct inhibition responses to No Go trials. Both adoptive mothers and fathers completed the Children's Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001), a measure of temperament that includes an effortful control factor (mother's α = .83; father's α = .86). Because adoptive mother and father ratings of child effortful control were significantly related, $r = .53$, $p < .01$, the mean of these two standardized effortful control scores was used as one indicator of children's top-down self-regulation. Children's Go/No Go performance represented the second indicator of the child top-down self-regulation construct. Adoptive parent-reported effortful control and children's Go/No Go task performance were significantly related to one another, $r = .26$, $p < .01$, supporting the use of these measures as indicators of adoptive children's top-down self-regulation.

Biological mother top-down self-regulation—At 54 months postpartum, adopted children's biological mothers completed a similar computerized task Go/No Go task (Nosek & Banaji, 2001), employing letters as stimuli across 84 trials, that the adopted children completed 2 years later. For the purposes of the current investigation, inhibition No Go trials, with fewer correct trials indicating poorer inhibition, were used as an index of biological mother top-down self-regulation.[2]

Child anger—To examine the possible evocative effects of toddler anger on adoptive parent parenting behavior and to control for potential child effects, adoptive mothers and fathers completed the Toddler Behavior Assessment Questionnaire (TBAQ, Goldsmith, 1996). The TBAQ is a measure of toddler temperament that includes a 28-item anger subscale (adoptive mother's α = .87; adoptive father's α = .87) and was administered when children were 18 months of age. Because adoptive parent reports of anger were related, $r = .40$, $p < .001$, a single indicator of anger was generated from the mean of the standardized scores from adoptive mother and father reports.

Covariates—Based on prior findings indicating that girls demonstrate better top-down self-regulation than boys (e.g., Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006), child gender (girls coded as 1, and boys coded as 0) was used as a covariate. Because prior research has suggested that openness in the adoption (i.e., contact between birth and

[2]Attempts were made to obtain information from adopted children's biological fathers. However, relatively few biological fathers participated, about 35%, resulting in sample sizes generally considered to be too modest for analyses similar to those performed using data obtained from biological mothers.

adoptive families), obstetric complications, and/or neonatal complications may be related to adoptive parent caregiving practices and children's socio-emotional outcomes (Caspi et al., 1996; McNeil & Sjostron, 1995; Marceau et al., 2013), these factors also were included as covariates in analyses.

Results

Data Analytic Approach, Missing Data & Preliminary Analyses

As with most longitudinal studies, some data were missing across time points, with the most missing data (23.5%) occurring for adoptive father report of child effortful control when children were 4.5 years of age. Little's MCAR test (Little, 1998) was used to examine the possibility that data were not missing completely at random across time points, χ^2 (394) = 425.32, $p > .10$. The non-significant finding from Little's MCAR suggests that missing data in the current study are missing completely at random. As such, Full Information Maximum Likelihood Estimation, a preferred method of handling missing data (Graham, 2009), was used to model missing data in SEM analyses.

Prior to SEM analyses, zero-order associations between the potential covariates of adoption openness, and prenatal and obstetric complications and primary study variables were examined. Although at times these variables have been found to be related to child outcomes in adoptive families (Ge et al., 2008) or to children's top-down self-regulation (e.g., Bridgett & Mayes, 2011; Poehlmann et al., 2011), none were significantly associated with indicators of children's top-down self-regulation or parenting, or with the constructs of substantive interest in the current investigation.[3] As such, these variables were not included in the SEM analyses. Descriptive statistics for variables are presented in Table 1 and zero-order associations among variables are in Table 2.

SEM analyses were performed with EQS 6.3 (Bentler, 2017), with the chi-square goodness of fit index, the comparative fit index (CFI), standardized root mean-square residual (SRMR), and the root mean-square error of approximation (RMSEA) used to evaluate model fit. To account for non-normal data, robust fit indices, where available (all measures of fit noted above, with the exception of the SRMR), and robust parameter estimates are reported and interpreted (Ullman, 2006). For the chi-square goodness of fit index, non-significant values are ideal. However, significant values should be evaluated in the context of model complexity and sample size, as more complex models with larger samples (such as in the current investigation) are more likely to have significant chi-square values even for adequately or well-fitting models. For the CFI, values equal to or greater than 0.95 indicate good model fit, though values as low as 0.90 may be consistent with adequate model fit. Ideal values, indicating good model fit, for the SRMR are less than 0.08, and for the RMSEA less than 0.06, though values as high as 0.08 may be acceptable for the RMSEA (for additional information on evaluating model fit, see West, Taylor, & Wu, 2012).

[3]Even though zero-order associations were not suggestive of potential relationships between these covariates and parenting or children's top-down self-regulation, an attempt was made to include these variables in the SEM analysis. The resulting SEM model was a poor fit to the data, providing additional evidence that these potential covariates are not related to parenting or children's top-down self-regulation in the current study.

As an initial check on the suitability of the measurement models of the latent variables, a confirmatory factor analysis (CFA) was performed, with the latent variables of parenting and adopted children's top-down self-regulation correlated. The associations between latent variables were needed, as opposed to testing three separate measurement models, due to inadequate degrees of freedom for testing each latent variable alone. For the CFA, model fit was good, χ^2 (22) = 35.23, p = .036, CFI = .95, SRMR = .04, and RMSEA = .042.

SEM Analysis

The SEM examining the influences of adoptive mother's and father's parenting, birth mother's top-down self-regulation and adopted child's anger and gender on children's top-down self-regulation was a good fit to the data, χ^2 (38) = 50.98, p = .078, CFI = .98, SRMR = .034, and RMSEA = .031. After accounting for child gender, biological mother's top-down self-regulation, and child anger, both adoptive mother's (b = −0.143, SE = .046, z = −3.10, p = .002) and father's (b = −0.211, SE = .066, z = −3.21, p = .001) negative parenting behaviors were related to subsequent child top-down self-regulation (see Figure 1, which includes standardized coefficients). Child anger, measured prior to parenting interactions, was associated with adoptive mothers' (b = 0.119, SE = .050, z = 2.38, p = .018), but not adoptive fathers' (b = −0.038, SE = .023, z = −1.62, p = .106), negative parenting and with children's subsequent top-down self-regulation (b = −0.078, SE = .038, z = −2.06, p = .038).

Although biological mother's top-down self-regulation was associated with children's top-down self-regulation (b = 0.117, SE = .038, z = 3.06, p = .002), biological mother's top-down self-regulation was not associated with adoptive mothers (b = 0.013, SE = .045, z = 0.299, p = .79) or fathers (b = 0.034, SE = .046, z = 1.06, p = .29) negative parenting behavior or with child anger (b = −0.015, SE = .062, z = −0.25, p = .80). Adopted child gender was related to the negative caregiving they received from their adoptive fathers (b = −0.12, SE = .048, z = −2.53, p = .011) and, at a trend level, from their adoptive mothers (b = −0.172, SE = .094, z = −1.83, p = .067). Children's gender also was significantly associated with their top-down self-regulation (b = −0.466, SE = .075, z = 6.22, p < .001). Finally, there was a significant association between adoptive mothers and fathers negative parenting (b = 0.096, SE = .026, z = 3.65, p < .001). Overall, variables included in the model accounted for 47.1% of the variance in children's top-down self-regulation.

Discussion

In the current investigation, we used an adoption research design, which is particularly well suited for differentiating between environmental and genetic contributions children's attributes, to examine associations between adoptive mother's and father's negative parenting and birth mother's top-down self-regulation, and adopted children's top-down self-regulation. Consistent with recent theoretical work (Bridgett et al., 2015), we found support for the premise that top-down self-regulation in early childhood is influenced by both genetic and environmental factors. Importantly, the current investigation is the first, to our knowledge, to show that parenting behavior continues to contribute to children's top-down self-regulation after accounting for effects attributable to genes (e.g., passive *r*GE) shared among family members.

There are several other notable findings in the current investigation. For instance, the sizes of the effects of negative parenting on children's top-down self-regulation were between medium and large, and substantially larger than the mean effect of −0.14 obtained in a meta-analysis (Karreman et al., 2006). In the current study, one might have anticipated smaller effects based on the lower risk nature of the adoptive parents, which might have minimized variability in negative parenting behaviors, and because the adoption design removes confounds due to *r*GE. More modest effects also might have been anticipated on the basis of parenting assessments from coded observations and multi-method assessment of children's top-down self-regulation, which are strengths insomuch as these approaches minimized within-rater inflation of correlations. However, our use of SEM likely minimized random measurement error to a greater degree than past studies that have examined the link between parenting and children's top-down self-regulation. In this regard, it may be that using an SEM/latent variable approach to examining parenting influences (and perhaps other aspects of children's proximal rearing contexts) in the context of genetically-sensitive designs may yield more precise estimates of effects, similar to what has been noted when using latent variable approaches to estimate the heritability of top-down self-regulation (see Miyake & Friedman, 2012, for further discussion). Based on this potential, future studies should consider using a similar data analytic approach to that used in the current investigation.

Despite some evidence that maternal and paternal parenting may be differentially associated with children's top-down self-regulation (e.g., Bernier et al., 2012), most studies have focused primarily on the influence of maternal parenting. Comparatively little work exists that considers the role of paternal parenting in the emergence of children's top-down self-regulation. In the current study, both adoptive mothers and fathers parenting emerged as influential in relation to adopted children's top-down self-regulation. Moreover, associations between adoptive mothers and fathers parenting and children's top-down self-regulation were similar in strength, after accounting for the shared association between adoptive mothers and fathers parenting. This finding suggests that parenting received from both parents is similar in regards to the importance of influencing the development of young children's self-regulatory capacities. Furthermore, our assessment of fathers parenting represents only one of a handful of studies to consider the unique contributions of paternal parenting on children's top-down self-regulation (e.g., Bernier et al., 2012; Feldman & Klein, 2003; Kochanska et al., 2008). Thus, albeit correlational in nature, the current findings suggest that both maternal *and* paternal parenting have important effects on children's top-down self-regulation.

Adoptive parents' perceptions of their adopted child's anger, measured before parenting observations, support the importance of considering reciprocal effects in studies of parenting (Bell, 1968; Brody & Ge, 2001; Lengua, 2006; Perry et al., 2014, 2017; Shaw & Bell, 1993). That is, children who display more anger may be at greater risk of eliciting negative parenting behaviors, particularly from their mothers, a finding that is consistent with similar work in this area (e.g., Larsson et al., 2008; Marceau et al., 2013). These effects may be specific to mothers due to mothers spending more time, on average, with their young children relative to fathers, a possibility that future work will need to specifically consider. Although some evidence of a child effect was observed in regards to adopted child anger, findings did not support a role of evocative *r*GE. Biological mothers' top-down self-

regulation was not associated with adoptive mothers' or fathers' parenting, or adopted children's anger. However, it will be important for future work to continue to consider such effects, and to do so by assessing adopted children's top-down self-regulation prior to assessments of the parenting they receive from their adoptive parents.

The findings regarding adopted child gender, with girls demonstrating better top-down self-regulation and receiving less negative parenting than boys, are also notable. Whereas the relationship between gender and top-down self-regulation is consistent with prior work (Else-Quest et al., 2006), the effect of child gender on negative parenting behaviors is more difficult to interpret. It may be that parents engage in more negative parenting behavior with boys, a possibility that is consistent with prior work (e.g., McKee et al., 2007). On the other hand, given that boys in our study had lower top-down self-regulation than girls, it is also a possibility that boys engage in more dysregulated behavior that evokes more negative parenting behavior. To directly test this possibility, future studies would need to measure children's top-down self-regulation prior to assessing parenting behavior, or over time concurrently with parenting behavior (e.g., using a cross-panel design) while accounting for the contribution of child gender, and perhaps consider an interaction between child gender and top-down self-regulation.

Finally, it is also noteworthy that children's anger at 18 months was associated with their subsequently lower top-down self-regulation. These findings are consistent with prior work (e.g., Bridgett et al., 2009; Leve et al., 2013) suggesting that children's heightened early negative affect may compromise their subsequent top-down self-regulation. Although yet to be examined in young children, experimental evidence from work employing adults indicates that negative affect can disrupt neural processes underlying aspects of top-down self-regulation, such as inhibitory control (Patterson, Lenartowicz, Berkman, Ji, Poldrack, & Knowlton, 2016). These findings provide insight into one potential mechanism by which children's negative affect may comprise their top-down self-regulation as development of areas (e.g., prefrontal cortex) critical for top-down self-regulation unfolds relatively early in life. The pattern of findings in the current study also suggests another potential mechanism by which children's top-down self-regulation may be disrupted. That is, young children that have higher negative affect may elicit parenting responses that contribute to their subsequently lower top-down self-regulation – a possibility that has received some support from work examining parental reactions to children's negative affect (e.g., Eisenberg et al., 1999)[4]. Future work that directly considers the possible mechanisms, outlined above, by which children's negative affect may disrupt their own top-down self-regulation is warranted.

[4]Although not an a priori question, post-hoc, we examined the possibility that child anger may indirectly affect their own top-down self-regulation through parenting behavior that is elicited by child anger using the available data. Because the association between child anger and adoptive father parenting was not significant, to isolate the indirect path between child anger and child top-down self-regulation through only adoptive mother parenting, the path between child anger and adoptive father parenting was fixed to 0. The fit of this model was good, χ^2 (39) = 52.90, p = .068, CFI = .98, SRMR = .035, RMSEA = .031, and nearly identical to the fit of the model reported in the results section. Moreover, the indirect effect of child anger, through maternal negative parenting, on child top-down self-regulation was significant, b = −.02/b* = −.04 (unstandardized/standardized values), z = −2.03, p = .02. This supplementary analysis provides additional, tentative evidence of the possibility that child anger may indirectly affect their own top-down self-regulation through the maternal parenting behavior that their anger may elicit, and more broadly, provides evidence that child attributes shape the environment in which children are being raised, which may further shape child attributes.

Limitations and Conclusions

Although the current study has a number of important strengths, there are several limitations that should be considered in informing future research. Most notably, a comparable assessment of adopted children's top-down self-regulation prior to when parenting behaviors were observed was not available, leaving open the possibility that children's top-down self-regulation has evocative effects on parenting behaviors. However, we took steps to minimize this possibility. Specifically, we accounted for child anger prior to when parenting was assessed because, based on previous research, similar child attributes can have evocative effects on parenting behaviors (e.g., Eisenberg et al., 1999; Larsson et al., 2008; Marceau et al., 2013). Similarly, prior studies have noted that anger and aspects of negative affectivity more broadly, and top-down self-regulation are inversely related (e.g., Bridgett, Oddi et al., 2013; Cole, Dennis, Smith-Simon, & Cohen, 2009; Rothbart et al., 2001). Insomuch as high anger might be indicative of poor self- or emotion-regulation, inclusion of anger in our model helps to partially mitigate some of the limitations stemming from the absence of earlier measures of children's top-down self-regulation. We also included an index of biological mothers' top-down self-regulation. While links between biological mothers' top-down self-regulation and adopted children's top-down self-regulation were noted, indicating inherited influences on top-down self-regulation, biological mothers' top-down self-regulation was not related to adoptive mother's or father's parenting, or to adopted children's anger. Although these findings suggest that children's top-down self-regulation may not be acting as an evocative influence on negative parenting in the current sample, future work should include a prior evaluation of children's top-down self-regulation in the context of a genetically-sensitive design to more directly examine the possibility that children's poor top-down self-regulation is related to increases in negative parenting behavior.

An additional limitation is our relatively narrow index of inherited top-down self-regulation, which was only based on biological mother's performance during a Go/No Go task and was not conducive to a latent variable approach. Furthermore, whereas efforts were made to recruit biological fathers into the project, only 35% participated. Thus, the genetic effects implied by the association between biological mother's top-down self-regulation and adopted child's top-down self-regulation may have been more robust if a greater percentage of biological fathers had provided data, resulting in a sufficiently high number to use in the current analyses. Similarly, more robust findings might have emerged had we included a broader assessment of biological mother's top-down self-regulation. Next, as is the case in most adoption studies, families into which children are adopted could generally be characterized as low risk (i.e., generally middle and upper class families) and relatively more homogeneous in terms of parent characteristics (e.g., mostly Caucasian). As such, the findings reported here may not entirely be representative of what might be expected with more heterogeneous samples. For example, in samples wherein there is a wider range of individual differences in negative parenting behaviors, it would be reasonable to expect that the effects of such behaviors on children's top-down self-regulation may be more pronounced than the effects observed in the current investigation. Finally, while part of the impetus for the current investigation was existing work showing associations between parent top-down self-regulation and parenting behaviors within biologically related families, a

thorough assessment of adoptive parents top-down self-regulation was not available, and should be included in future studies that employ similar designs.

Despite the limitations of the current investigation, findings make a notable contribution to research seeking to identify the influence of parenting on children's top-down self-regulation. Importantly, recent theoretical and empirical studies linking parent top-down self-regulation to parenting behaviors, coupled with the evidence of the hereditability of top-down self-regulation, suggest that it is difficult to distinguish environmental influences, specifically in the form of parenting, from genetic effects on children's top-down self-regulation in studies of biologically related families (Bridgett et al., 2015). The findings reported in the current investigation provide important evidence of the effects of parenting on children's top-down self-regulation, and increase the confidence with which effects specific to parenting on children's top-down self-regulation can be claimed in theoretical and empirical work in this area.

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Research Highlights

- Adoptive mother and father negative parenting behaviors were related their adopted children's lower self-regulation
- An index of birth mother self-regulation also was related to adopted children's self-regulation
- Adopted children's anger was related to adoptive mother's, but not father's, parenting
- Findings support the independent contributions of genetic and socialization factors to children's self-regulation

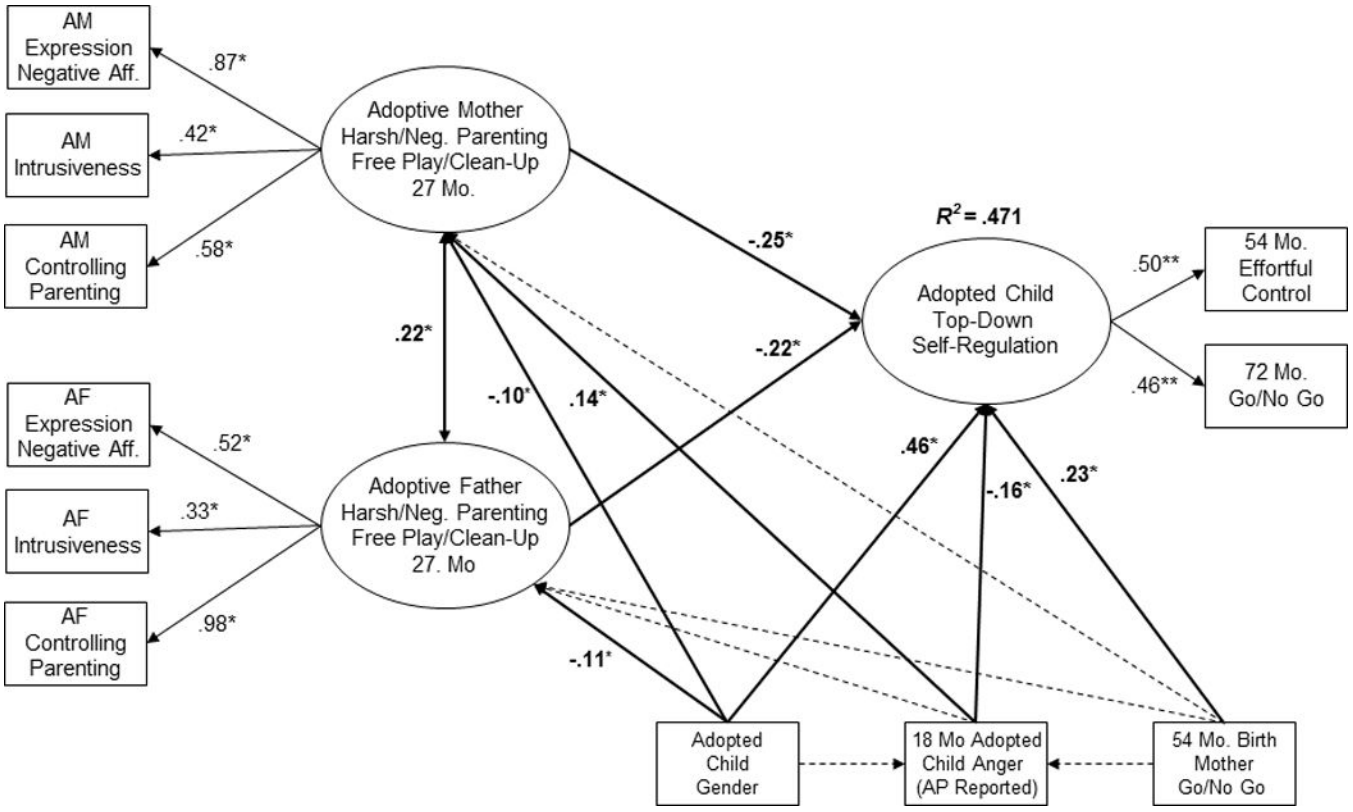

Figure 1.

Table 1

Descriptive Statistics for Study Variables

Variable	Mean	SD	*N*[1]
Adoption Openness[2]	0.04	0.93	358
Neonatal Complications	0.22	0.52	361
Obstetric Complications	2.30	1.33	361
Biological Mother Percent Correct Go/No-Go Inhibition Trials (i.e. Top-down self-regulation)	86.20	11.46	324
Adoptive Parent Composite of Child Anger	0.00	0.84	319
Adoptive Mother Expression of Negative Affect	1.32	0.40	319
Adoptive Mother Intrusiveness	1.51	0.55	319
Adoptive Mother Controlling Behavior	1.93	1.05	319
Adoptive Father Expression of Negative Affect	1.41	0.52	303
Adoptive Father Intrusiveness	1.47	0.45	303
Adoptive Father Controlling Behavior	1.70	0.89	303
Adoptive Parent Composite Report of Adopted Child Effortful Control	5.08	0.49	267
Adopted Child Percent Correct Go/No-Go Inhibition Trials (i.e. Top-down self-regulation)	62.67	20.60	291

[1]Available sample size for each variable

[2]Adoption openness was assessed using a composite of adoptive parents and birth mother ratings of openness on a scale from 1 (no contact/information about adoptive or birth parents) to 7 (monthly visits, and regular communication). Neonatal and obstetric complications consisted of the total number of such complications that birth mothers reported.

Table 2

Zero-Order Associations between Study Variables

Variable[1]	1	2	3	4	5	6	7	8	9	10	11	12
1. Adoption Openness												
2. Neonatal Comp.	−.04											
3. Obstetric Comp.	.03	.35*										
4. BM Top-down self-regulation	−.05	−.03	−.10+									
5. AP Report of AC Anger	.05	−.04	−.02	−.02								
6. AM Expression of N. Affect	−.08	−.06	.03	−.01	.13*							
7. AM Intrusiveness	−.08	.02	.05	.02	.04	.38**						
8. AM Controlling Behavior	.03	.05	.01	.08	.11+	.51**	.17**					
9. AF Expression of N. Affect	−.04	−.07	.01	.00	.04	.23**	.05	.11+				
10. AF Intrusiveness	.07	.10+	.08	.00	.04	−.04	−.02	.00	.09			
11. AF Controlling Behavior	−.07	−.07	.03	−.07	−.01	.18**	.19**	.18**	.52**	.13*		
12. AP Report of AC EFC	.08	−.02	−.04	.04	−.14*	−.16*	−.18**	−.19**	−.03	−.06	−.14*	
13. AC Go/No Go	.03	−.02	−.04	.16**	−.06	−.11+	−.07	−.12*	−.08	−.21**	−.13*	.23**

Note. Comp. = Complications; BM = Biological Mother; AM = Adoptive Mother; AC = Adopted Child; AF = Adoptive Father; N. Affect = Negative Affect; AP = Adoptive Parents; EFC = Effortful Control

+ $p < .10$;

* $p < .05$;

** $p < .01$