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Elucidating the Etiology of Individual Differences in Parenting: A Meta-Analysis of Behavioral Genetic Research

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Decades of research have indicated the foundational importance of parenting to offspring outcomes during childhood and beyond. Unearthing the specific origins of parenting is therefore a critically important research objective. Extant research on this topic has suggested that parenting behaviors are multidetermined (Belsky, 1984) and are associated with a wide range of contextual and familial characteristics (e.g., ethnicity, community, family financial stress), as well as characteristics of the parents (e.g., personality) and their children (e.g., temperament). Behavioral genetic studies have further indicated that parenting behaviors are in fact heritable—that is, individual differences in parenting are at least partially a function of genetic differences between persons. Critically, however, the estimates of these genetic influences have varied dramatically across studies. It is also unclear how factors such as parent gender, child age, and methodological considerations may impact genetic influences on parenting behavior. In the current set of meta-analyses, we sought to quantitatively synthesize twin and adoption studies (n = 56) examining the etiology of parenting behavior, with the goal of more definitively cataloguing genetic and environmental effects on parenting. Results reveal significant effects of parental genetic makeup on parental behavior, but also highlight the genetic makeup of the child as a particularly prominent source of genetic transmission (via evocative gene–environment correlation). Environmental contributions to parenting also emerged as important, including both shared and nonshared environmental effects. Theoretical implications of these findings are discussed.

Keywords: parenting, genetic, environmental, twin study, adoption study

Few relationships rival the intensity, self-sacrifice, dedication, frustration, and love that characterize the parent–child relationship. Because humans are born completely helpless and remain dependent for over a decade, the task of caring for and raising children is fundamental to the successful continuation of our species and thus is at the very core of our nature as humans. Indeed, it has been argued that the structure and neurochemical organization of the human brain is, in many ways, designed for complex social behaviors such as parenthood (Bridges, 2008; Dunbar & Shultz, 2007; Numan & Insel, 2003).

Although parenting is a critical component of the human behavioral repertoire, there is nevertheless a great deal of diversity in specific parenting practices.[1] This diversity appears to have salient consequences for offspring outcome. Among other things, parenting has emerged as a robust predictor, perhaps the most robust predictor, of a wide range of psychopathological outcomes in youth. Meta-analytic results support an enduring association between early parental relationships and both internalizing (Groh, Roisman, van IJzendoorn, Bakermans-Kranenburg, & Fearon, 2012) and externalizing (Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010) forms of psychopathology. In addition, both quasi-experimental (Burt, Krueger, McGue, & Iacono, 2003; Burt, McGue, Krueger, & Iacono, 2005; Klahr, McGue, Iacono, & Burt, 2011; Lynch et al., 2006; McLeod, Wood, & Weisz, 2007) and intervention (Barkley, 1997; Kendall, Hudson, Gosch, Flannery-Schroeder, & Suveg, 2008; McMahon, Forehand, & Foster, 2005) studies have clearly suggested that the association between parenting and psychopathology is at least partially causal in nature.

Given the critical function of parenting and the potential consequences of poor parenting for individuals and society, it is somewhat surprising to note that relatively little research has sought to uncover the origins of individual differences in parenting—in other words, we do not yet know why people parent the way that they do (as described by Belsky, 2011). Belsky (1984) was the first to attempt to fill this yawning gap in the literature. He proposed that parenting is a multidetermined set of behaviors that are influenced by a broad array of factors, including the parent's developmental history and personality, characteristics of the child, and contextual sources of stress and support (Belsky, 1984). In the ensuing decades, researchers have come to describe parenting as a complex and dynamic repertoire of behaviors embedded in an ecological network that includes the family context (e.g., the marital relationship, family financial stress), characteristics of the

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[1] For a quick juxtaposition, compare Amy Chua's (2011) *Battle Hymn of the Tiger Mother* to William Sears's (1995) guide to attachment parenting.

parent (e.g., personality), characteristics of the child (e.g., temperament), and the social context (e.g., ethnicity/culture, community characteristics; Kotchick & Forehand, 2002; Luster & Okagaki, 2005). Consistent with this latter characterization, mean differences in parenting practices have been observed across nations (X. Chen et al., 1998; Porter et al., 2005). For example, mothers of preschool-aged children in China report higher levels of protectiveness, encouragement of modesty, and use of shame along with lower levels of acceptance and democratic participation compared to mothers of preschool-aged children in the United States (Wu et al., 2002).

In addition to varying between nations, parenting is known to vary within nations, across a variety of demographic and sociological factors. Parents of Native American descent, for instance, are more likely to emphasize interdependence over independence (MacPhee, Fritz, & Miller-Heyl, 1996), whereas parents of African American descent report increased use of physical discipline strategies (Bradley, Corwyn, McAdoo, & García Coll, 2001). Socioeconomic status and financial stress have also emerged as an important distal predictor of parenting, such that lower levels of parental affection and monitoring, and higher levels of physical discipline, are linked to lower socioeconomic status, regardless of ethnicity (Bradley et al., 2001; Elder, Liker, & Cross, 1984; Elder, Van Nguyen, & Caspi, 1985). Other research has indicated that middle-class parents tend to treat their children as autonomous equals, whereas working-class parents are more focused on obedience and conformity (Hoff, Laursen, & Tardif, 2002).

Although such work clearly informs our overall understanding of the etiology of parenting, these sorts of broader cultural influences come up short when attempting to explain the considerable variation in parenting practices within national, ethnic, and socioeconomic groups (Kotchick & Forehand, 2002). These within-group differences are instead likely to be a function of more proximal influences. One such influence pertains to the broader family system surrounding the parents and the children, including the quality of the marital relationship (Cox, Owen, Lewis, & Henderson, 1989) and the presence of serious medical illness in one or both parents (Armistead, Klein, & Forehand, 1995). Parental personality and psychological functioning have also emerged as potent predictors of parenting. Neuroticism, for example, has been consistently linked to low levels of positive parenting (Brook, Tseng, Whiteman, & Cohen, 1998; Clark, Kochanska, & Ready, 2000; Cummings & Davies, 1994; Kochanska, Friesenborg, Lange, & Martel, 2004; Metsäpelto & Pulkkinen, 2003), as have depressive and anxiety disorders (Chilcoat, Breslau, & Anthony, 1996; Kendler, Sham, & MacLean, 1997; Lieb et al., 2000). Likewise, mothers with past or current antisocial behavior are more likely to behave in a hostile manner toward their infants (Bosquet & Egeland, 2000), to use suboptimal parenting strategies (Jaffee, Belsky, Harrington, Caspi, & Moffitt, 2006), and to physically maltreat their children (Kim-Cohen, Caspi, Rutter, Tomás, & Moffitt, 2006).

Yet another important, if somewhat nonintuitive, proximal predictor of parenting centers on the characteristics of the child being parented. Children are not passive recipients of the parenting they receive; rather, child characteristics appear to play an active role in determining parental behavior (Davis & Carter, 2008; Kerr, Stattin, & Özdemir, 2012; McBride, Schoppe, & Rane, 2002; van Bakel & Riksen-Walraven, 2002). Anderson, Lytton, and Romney (1986), for example, observed that when interacting with nonproblem children, mothers of conduct-disordered children did not differ from the mothers of nonproblem children in terms of commands, positive behaviors, or negative behaviors. However, all mothers gave more commands to children with conduct disorder than to nonproblem children, suggesting that conduct-disordered boys exerted at least some influence on the parenting they received (Anderson et al., 1986). These results highlight the potentially powerful role of children in evoking parental responses.

A final proximal predictor of parenting that should be considered is that of the parent's family of origin. Available studies have indicated, perhaps somewhat surprisingly, that parenting behaviors appear to be "inherited" across generations (Conger, Belsky, & Capaldi, 2009), such that the way one parents his or her children is notably similar to the way he or she was parented as a child. A particularly compelling example of this general phenomenon can be found in the work of Kovan, Chung, and Sroufe (2009). The authors examined videotaped interactions of parents and their offspring at 2 years of age and subsequently compared these to interactions between these offspring and their own children many years later (when those children were also 2 years of age). Results highlighted a surprising degree of similarity in parenting behaviors across the two generations ($r = .43$), even when controlling for various confounds. Although theoretical and empirical studies have highlighted a number of different mechanisms that may account for this transmission of parenting across generations, the specific origins as yet remain unclear. One possibility, which is consistent with behavioral genetic investigations (Kendler, 1996; Neiderhiser et al., 2004), is that parenting is genetically transmitted from one generation to the next (Rutter, 1998).

The notion that there are genetic influences on something as complex and multidetermined as child-rearing may be difficult to conceptualize in light of the more frequent emphasis on cultural transmission of parenting (Belsky & Jaffee, 2006). However, a large body of research using nonhuman animals has highlighted the importance of genetic and biological processes in the development and maintenance of parental behavior. Dopamine, for example, has been implicated in the initiation and maintenance of maternal behavior in rats and mice (Giordano, Johnson, & Rosenblatt, 1990; Miller & Lonstein, 2005; Sato et al., 2010; Shahrokh, Zhang, Diorio, Gratton, & Meaney, 2010; Stern & Protomastro, 2000; Stern & Taylor, 1991; Stolzenberg et al., 2007). Oxytocin has similarly been found to predict maternal behavior in several animal species, including pup licking and grooming in rats (Champagne, Diorio, Sharma, & Meaney, 2001), parental involvement of sheep with their lambs (Kendrick, Keverne, & Baldwin, 1987), and time spent grooming and nursing in rhesus macaques (Maestripieri, Hoffman, Anderson, Carter, & Higley, 2009). Serotonin has also demonstrated clear associations with parental behavior in nonhuman primates (Maestripieri, Lindell, Ayala, Gold, & Higley, 2005). As an example, McCormack, Newman, Higley, Maestripieri, and Sanchez (2005) found that rhesus macaque mothers with the less efficient short allele of the serotonin transporter gene (rh5-HTTLPR) were prone to high levels of physical abuse and low levels of offspring protectiveness during threatening situations. This relation was strongest for mothers that had also experienced abusive parenting in childhood, suggesting the presence of a Gene $\times$ Environment interaction between rh5-HTTLPR and abuse (McCormack et al., 2009).

The above findings have considerable relevance for human parenting, particularly because the neurotransmitter systems related to parenting in nonhuman animals (i.e., dopamine, serotonin, and oxytocin) have also been linked to parenting-relevant psychological and behavioral traits in humans. Genes in the dopaminergic system, for example, have been associated with antisocial personality traits (Ponce et al., 2003), childhood aggression (Zai et al., 2012), extraversion (Smillie, Cooper, Proitsi, Powell, & Pickering, 2010), attention-deficit/hyperactivity disorder (Cornish et al., 2005), conduct problems (Burt & Mikolajewski, 2008; Lahey et al., 2011), and impulsivity (Joyce et al., 2009), all of which may influence one's parenting behaviors, as reviewed above. Similarly, serotonin genes have been related to depression (Eley et al., 2004; Walderhaug et al., 2007; Zill et al., 2004), neuroticism (Gonda et al., 2009), anxiety (You, Hu, Chen, & Zhang, 2005), aggression (Beitchman et al., 2006), novelty seeking (Heck et al., 2009), and attachment (Gillath, Shaver, Baek, & Chun, 2008). OXTR, the oxytocin receptor gene, has been linked to affect and loneliness (Lucht et al., 2009), prosocial behavior (Israel et al., 2009; Tost et al., 2010), empathy (Rodrigues, Saslow, Garcia, John, & Keltner, 2009), and attachment (Costa et al., 2009).

Other research has highlighted somewhat more direct associations. For example, plasma oxytocin levels in humans have been associated with postpartum bonding and maternal affection (Feldman, Weller, Zagoory-Sharon, & Levine, 2007; Levine, Zagoory-Sharon, Feldman, & Weller, 2007), as well as with positive fathering (Gordon, Zagoory-Sharon, Leckman, & Feldman, 2010). Similarly, a small but growing body of molecular genetic research has begun to identify specific genetic variants that may be associated with individual differences in human parenting (although all of the existing studies have relied on relatively small samples; $n <$ 350). In particular, several studies have reported a relationship between dopamine genes and human parenting (Hayden et al., 2010; Lee et al., 2010; Lucht et al., 2006; Mileva-Seitz et al., 2012; Mills-Koonce et al., 2007; Propper et al., 2008). In addition, both serotonin genes and OXTR have been linked to sensitive parenting (Bakermans-Kranenburg & van IJzendoorn, 2008; Mileva-Seitz et al., 2011).[2]

In short, extant research provides both circumstantial (e.g., biological influences on parenting in nonhuman animals) and more direct (e.g., molecular genetic studies) evidence for genetic influences on parenting behavior. The nature and magnitude of these genetic influences, however, remain largely unknown. In part, this ambiguity stems from the fact that molecular genetic studies have thus far proven to be less useful for the cataloguing of genetic effects on most human phenotypes (including parenting) than was originally hoped (Plomin & McGuffin, 2003). Perhaps more important, however, the methodology typically used in studies of parenting (i.e., traditional family studies of parents and their biological children) is not able to disambiguate the effects of shared genes from those of the environment. As such, what appears to be environmentally mediated effects on parenting may actually be attributable to genetic effects (e.g., an association between marital quality and parenting may be driven by genetic factors that influence the quality of both relationships). Rather than traditional family studies of parenting, then, the field would benefit from quasi-experimental twin or adoption studies of human parenting (this research is reviewed in detail below). This sort of genetically informed research is ideally suited for clarifying the etiology of parenting, as it allows researchers to disentangle and quantify both genetic and environmental effects, and in this way provide unique and meaningful insights into the origins of parenting behavior.

Behavioral genetic studies of parenting have yet another advantage: They are able to explicitly examine the etiology of both child-driven and parent-driven influences on parenting. In other words, twin and adoption studies of parenting should allow us to come closer to understanding the bidirectional nature of parenting, whereby parents and children both influence the quality of parenting provided. Extant behavioral genetic investigations of parenting have done just this, examining both "top-down" influences on parenting (i.e., from parents to children) and "bottom-up" influences (i.e., children influence the parenting they receive). A synthesis would allow us to more fully illuminate the origins of individual differences in parenting, clarifying not only the magnitude of genetic influences on parenting, but also whether these genetic effects reside within the child, within the parent, or both.

A Brief Overview of Behavioral Genetic Concepts

We begin with a brief description of the various methodologies used in the field of behavioral genetics. Behavioral genetics employs quasi-experimental designs that leverage the different sources of sibling similarities and differences to make inferences about the etiology of observable traits (phenotypes). Monozygotic (MZ or identical) twins result from a single fertilized zygote splitting into two and hence share 100% of their segregating genes. Dizygotic (DZ or fraternal) twins are the result of two independent conceptions and so, like all full siblings, share an average of 50% of their segregating genes. Half siblings share only one of their two biological parents, and thus share an average of 25% of their segregating genetic material. Adoptive siblings and stepsiblings do not share any segregating genetic material. All sibling types can be reared either together or apart.

Behavioral genetics utilizes these naturally occurring similarities and differences between siblings to partition the variance within phenotypes into four independent components of variance: additive genetic (A), dominant genetic (D), shared environment (C), and nonshared environment plus measurement error (E). The additive genetic component is the effect of individual genes summed over loci. If acting alone, A would create MZ correlations that are double those of DZ/full siblings. Moreover, correlations would decrease linearly with decreasing genetic relatedness. Dominant genetic influences index nonadditive or gene-to-gene interactive effects, either at a single genetic locus (referred to as dominance; i.e., the interaction between dominant and recessive genes) or across multiple loci (referred to as epistasis). Because they involve interactions between genes, D would yield MZ correlations that were more than twice as large as those of DZ/full siblings. The shared environment is that part of the environment that is common to both members of a sibling pair and acts to make siblings within a pair similar to each other. Shared effects do not

[2] Although there is a substantial body of research that has identified associations between genetic variants and behavioral phenotypes (including parenting), it is important to note that nonreplication of genetic effects is extremely common. Given these limitations, the findings from candidate gene studies should be interpreted with caution.

differ by zygosity or proportion of segregating genes shared, and if acting alone, would make all sibling correlations similar in magnitude. Correlations between genetically unrelated but reared-together siblings (e.g., adoptive and stepsiblings) function as "direct" estimates of shared environmental effects. Finally, the nonshared environment is that part of the environment that differentiates members of a sibling pair, making them less similar. Nonshared environmental influences do not differ by proportion of genes shared, and thus reduce all sibling correlations proportionally to the same degree. Measurement error, which similarly acts to reduce sibling correlations, is also contained within E. It is not possible to disambiguate measurement error from "true" nonshared environmental variance within traditional behavioral genetic designs.

The behavioral genetic concept of the gene–environment correlation (rGE; Plomin, DeFries, & Loehlin, 1977; Scarr & McCartney, 1983) is important when examining the etiology of parenting behavior. Gene-environment correlations are defined via nonrandom or genetically influenced exposures to particular "environmental" experiences, such that individuals elicit (i.e., evocative rGE) or select (i.e., active rGE) environmental experiences consistent with their genotype, that then go on to further activate this genotype. Such concepts are best illustrated with an example: Extensive research has indicated that negative or conflictual parenting is linked to the development of conduct problems in children. To the extent that such parenting is a function of the parent's own tendency toward conduct problems, a tendency passed on to the child in part via genetic mechanisms, the association between conflictive parenting and child conduct problems could be a reflection of common genes (a phenomenon referred to as passive rGE). Alternately, it may be that children with conduct problems are evoking reactions from their parents that are consistent with their genetic predisposition toward conduct problems (i.e., evocative rGE), or are actively seeking out conflict with their parents (i.e., active rGE), experiences that then further exacerbate their predilection toward conduct problems (Plomin et al., 1977; Scarr & McCartney, 1983).

Behavioral genetic studies index the overall contributions of genetic and environmental effects. When interpreting these estimates, there are several principles to bear in mind. First, the estimates that are obtained are population statistics that apply only to the population under consideration. Indeed, genetic and environmental influences are known to vary across populations (Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003). As an example, legal constraints on the use of physical discipline vary across country, but it is unclear how these differences might differentially shape heritability estimates. In addition, genetic and environmental estimates partition the variance within a population and cannot be applied to individuals (i.e., a heritability estimate of 50% does not mean that 50% of any given individual's parenting behavior is genetically influenced). Second, this design is not able to identify any of the specific genetic variants that contribute to heritability estimates, nor does it identify the environmental experiences that comprise shared and nonshared environmental effects. Finally, these models do not directly index epigenetic processes (Wolffe & Matzke, 1999) or gene–environment interactions (Cicchetti, 2007).

The Etiology of Parenting

As indicated above, extant literature examining the genetic and environmental etiology of parenting has utilized two basic design types: child-based designs and parent-based designs. The differences between these designs are often underappreciated, but they do in fact fundamentally alter the inferences one can draw (see Figure 1).

Child-Based Designs

A child-based design (see Figure 1A) is useful primarily for identifying the etiology of child-driven influences on parenting behavior, although some parent-level etiological inferences can also be drawn. Etiological influences on parenting in child-based designs are inferred on the basis of differences in the genetic relatedness between child twins or siblings (i.e., those who are being parented, rather than those who are parenting). Estimates of genetic influences within this design are thus estimates of the child's genetic makeup on the behavior of his or parents, an effect that is presumably driven via active or evocative rGE processes (as the child's genes cannot directly influence the behavior of others).

By contrast, shared environmental influences within child-based designs capture those influences on parenting behavior that are shared between siblings and that act to increase similarity in the parenting that they receive, regardless of the siblings' degree of genetic relatedness. These shared environmental influences could include such factors as family socioeconomic status, neighborhood characteristics, and perhaps most important, characteristics of the parent (i.e., personality and beliefs about parenting). Put differently, because the level of the etiologic effect in child-based designs is necessarily at the level of the child, parent-driven effects on parenting, including the effects of the parent's genes, are included in estimates of the shared environment. Consistent with this possibility, it has been suggested that estimates of C within child-based designs may serve as proxies for estimates of the effects of passive rGE on parenting (Neiderhiser et al., 2004), such that parents are providing a parental environment to their children that is consistent with both their own and their children's genotypes. Finally, nonshared environmental influences on parenting in child-based designs index the effects of the child's unique environment on the parenting he or she receives (e.g., one sibling may suffer from an environmentally caused illness while the other does not and receive differential parenting as a result; Caspi et al., 2004).

A relatively large number of studies have examined parenting within child-based behavioral genetic designs. These studies have identified evocative rGE effects on a range of parental behaviors including positivity, monitoring, and negativity (Plomin, Reiss, Hetherington, & Howe, 1994); parental involvement and regard (McGue, Elkins, Walden, & Iacono, 2005); limit-setting and physical discipline (Wade & Kendler, 2000); physical affection (Harlaar et al., 2008); and control (Klahr, Thomas, Hopwood, Klump, & Burt, 2013). Findings of evocative rGE persist across child informant reports (Herndon, McGue, Krueger, & Iacono, 2005), parent informant reports (Deater-Deckard, 2000), and observer reports (Eley, Napolitano, Lau, & Gregory, 2010). They have also been reported with both twin studies (Elkins, McGue, & Iacono, 1997) and adoption studies (Deater-Deckard & O'Connor, 2000), and for both mothers (Neiderhiser et al., 2004) and fathers (Nei-

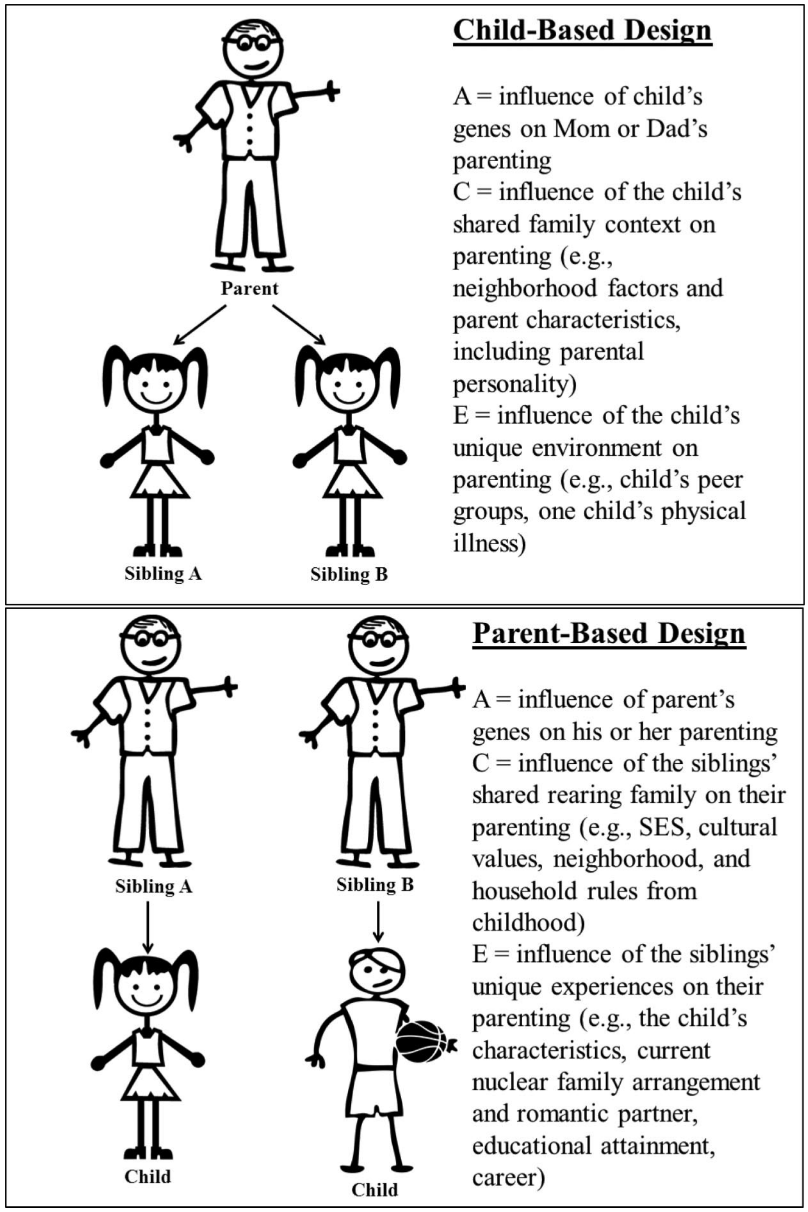

Figure 1. Etiology within child-based and parent-based designs. SES = socioeconomic status.

derhiser, Reiss, Lichtenstein, Spotts, & Ganiban, 2007). Collectively, such findings suggest strongly that evocative rGE influences on parenting are robust to sampling and methodological considerations. Even so, estimates of genetic influences have varied widely across studies. For example, heritability estimates for control range from 0% (Boivin et al., 2005; Cohen, Dibble, & Grawe, 1977) to 63% (Eley et al., 2010). In addition to evocative genetic effects, existing studies have indicated significant effects of both the shared and nonshared environment.

Parent-Based Designs

Genetically informed parent-based designs are predicated on the genetic relatedness of adult sibling/twin pairs, both members of which are currently raising their own children (see Figure 1B). Genetic influences within a parent-based design are thus interpreted primarily as estimates of the effects of the parent's genes on his or her parental behavior, although there may be some child-driven genetic effects subsumed within these estimates in twin designs (because the respective children of MZ twins are genetic half siblings, whereas the respective children of DZ twins are genetic first cousins). Estimates of the shared environment in parent-based designs similarly index the effects of the common early rearing environment of the two adult siblings, including their shared sociocultural background and family of origin. Finally, and unlike in child-based designs, the nonshared environment comprises a particularly large variety of factors in the parent-based design, because the siblings in question are adults with different spouses or partners, different children, and their own individual adult lives. Nonshared factors would therefore include each sibling's spouse (and coparent), the quality of their independent marital relationships (to the extent that this is not heritable), their independent educational and vocational experiences, separate peer groups, and current neighborhood characteristics (again to the extent that these are not heritable). Moreover, child-driven influences on parenting would be captured primarily within estimates of the nonshared environment within a parent-based design, because the siblings in this design are raising different children.

There are comparatively fewer parent-based examinations of parenting within the behavioral genetic literature. This is not surprising given the relative difficulty of recruiting adult twins or siblings and their children (i.e., one must recruit two families to complete a pair of adult twins, as opposed to one family when the twins are themselves still children). However, extant studies support the presence of environmental effects along with parent-driven genetic effects on parental behaviors across multiple informant reports and constructs, including positivity, negativity, and control (Neiderhiser et al., 2004), warmth (Kendler, 1996; Losoya, Callor, Rowe, & Goldsmith, 1997), limit-setting and physical discipline (Wade & Kendler, 2000), and emotional overinvolvement (Narusyte et al., 2008). As in the child-based literature, however, estimates vary greatly across studies and constructs, with heritability estimates ranging from 0% for maternal overprotection (Pérusse, Neale, Heath, & Eaves, 1994) to 45% for maternal positivity (Neiderhiser et al., 2004) and 48% for parental authoritarianism (Spinath & O'Connor, 2003).

The Current Study

No study to date has sought to synthesize and integrate genetically informed research to illuminate the etiology of individual differences in parenting. We attempt to do just that by focusing our attentions on both child- and parent-based study designs. In so doing, we seek to refine the field's current understanding of the origins of parenting behavior and to identify directions for future parenting research. We focus specifically on three dimensions of parenting behavior,[3] each of which has been associated with important child outcomes: parental warmth/acceptance, parental control, and parental negativity. Low warmth, for example, has been linked to the child's antisocial behavior (Feinberg, Button, Neiderhiser, Reiss, & Hetherington, 2007); control has been tied to the child's anxiety (McLeod et al., 2007); and negativity predicts the child's antisocial behavior and substance use (Lynch et al., 2006).

We also examine a series of potential moderators of the etiology of parental warmth, control, and negativity. First, because phenotypic studies of parenting have reported differences between the parenting styles of mothers and fathers (Cowan, Cowan, & Kerig, 1993), we examine the possibility of different etiologic effects by parent gender. Second, as the role of parents changes considerably across development (e.g., parents with children under the age of 6 spend more than double the amount of time doing child-care-related tasks than parents with children aged 6–17; Bureau of Labor Statistics, 2013), we also examine possible etiological differences according to the age of the child. Next, because visual inspection of study effect sizes suggests the possibility of informant effects, we test for etiological differences across informant reports. In addition, some studies analyzed retrospective reports of parenting, which may be prone to a variety of recollection biases (Hardt & Rutter, 2004). Rather than exclude these studies, we elect to examine whether the etiology of parenting differs across current versus retrospective reports. Finally, because it has been suggested that raising twins is associated with unique challenges (and thus that the processes involved in parenting twins may not generalize to other family types; Chang, 1990; Damato, 2005), we also seek to clarify whether the estimates from twin studies are consistent with those obtained from other genetically informed designs.

Method

Search Strategy

Relevant twin and adoption studies were identified via Web of Science and PsycINFO databases by searching combinations of phenotypic terms (i.e., *parenting*, *parent*, *parents*, *parent–child relationship*, *mother*, *father*) with genetically informative study terms (i.e., *twin*, *twins*, *adoptee*, *adoptees*, *adoption study*, *genetic*, *heritability*, *environment*), initially in the fall of 2011. An updated review was conducted in the summer of 2013 in order to identify studies published in 2012 and the beginning of 2013. Identified articles were then appraised for suitability. In addition, the reference sections of identified articles were examined in order to identify any additional studies of interest. To circumvent the file-drawer problem, we contacted members of the Behavior Genetics Association and asked to share any unpublished genetically informed parenting data and/or to draw attention to any published data that were not uncovered in the initial search ($N = 12$). Any study that included an examination of the genetic and environmental etiology of parenting was considered, even if this was not the primary aim of the study (e.g., Spinath & O'Connor, 2003). Forty-seven child-based and nine parent-based studies were found with these search strategies. Inclusion criteria for the studies are described below. After consideration of these criteria, 44 child-based and nine parent-based studies were retained. After accounting for nonindependence among the samples, 27 child-based and six parent-based samples were ultimately included in the analyses. See Tables 1 and 2 for a complete listing of studies.

[3] One core issue that came up in the current study was that of the parenting phenotype. Because the field of psychology has yet to broadly agree on specific definitions or measures of parental behavior, there is somewhat less consistency across studies, in either construct definition or the measures used, than one would like. For example, some researchers have characterized parenting using a typology (Baumrind, 1978), whereas others have used a dimensional approach. For those that used the latter, the number of factors in question has also been ambiguous (ranging from two to six factors; Metzler et al., 1998; Shucksmith et al., 1995). Although the two-dimensional model of warmth and control has received support (Darling & Steinberg, 1993), several empirical analyses have supported a three-factor model of parenting (Adamsons & Buehler, 2007; Hetherington & Clingempeel, 1992; Murphy, Brewin, & Silka, 1997; Robinson, Mandleco, Olsen, & Hart, 1995). In addition, some research has suggested that the predictors of negative parental behaviors, such as parent–child conflict and child maltreatment, may be distinct from parental warmth and control (Jaffee et al., 2004; Rodriguez & Green, 1997). Given this, we chose to focus our analyses on three primary parenting dimensions with known consequences for child outcomes.

Table 1
Effect Sizes for Child-Based Studies

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
Australian National Health and Medical Research Council Twin Register							
Gillespie et al. (2003)							
Coldness	Child	Parents	18–45	969	MZ	.60	Included: warmth
				608	DZ	.41	Included: warmth
Overprotection					MZ	.46	Included: control, averaged
					DZ	.35	Included: control, averaged
Autonomy					MZ	.49	Included: control, averaged
					DZ	.33	Included: control, averaged
Cardiff Study of All Wales and North West of England Twins							
Shelton et al. (2008)							
Warmth	Parent	Mother	12–17	231	MZ	.89	Included: warmth
				370	DZ	.83	Included: warmth
	Child				MZ	.61	Included: warmth
					DZ	.40	Included: warmth
Hostility	Parent				MZ	.79	Included: negativity
					DZ	.63	Included: negativity
	Child				MZ	.58	Included: negativity
					DZ	.25	Included: negativity
Colorado Sibling Study							
Rende et al. (1992)							
Affection	Observer	Mother	70 months	67	FS	.88	Included: warmth, averaged
				57	UR	.91	Included: warmth, averaged
Control	Observer	Mother			FS	.71	Included: control, averaged
					UR	.36	Included: control, averaged
Attention	Observer	Mother			FS	.86	Excluded
					UR	.65	Excluded
Dunn et al. (1986)							
Affection	Observer	Mother	24 months	26	FS	.60	Included: warmth, averaged
				19	UR	.31	Included: warmth, averaged
Control	Observer	Mother			FS	.09	Included: control, averaged
					UR	.22	Included: control, averaged
Dunn et al. (1985)							
Affection	Observer	Mother	12 months	32	FS	.70	Included: warmth, averaged
				14	UR	.37	Included: warmth, averaged
Early Childhood Longitudinal Study–Birth Cohort							
Roisman & Fraley (2008)							
Supportiveness	Observer	Parent	24 months	78	MZ	.79	Included: warmth
				234	DZ	.80	Included: warmth
Finn Twin 12							
Latendresse et al. (2010)							
Autonomy granting	Child	Parents	11–12	376	MZM	.59	Included: control, averaged
				386	MZF	.66	Included: control, averaged
				414	DZM	.46	Included: control, averaged
				364	DZF	.54	Included: control, averaged
				396	DZOS	.37	Included: control, averaged
Parental knowledge					MZM	.58	Included: control, averaged
					MZF	.60	Included: control, averaged
					DZM	.43	Included: control, averaged
					DZF	.50	Included: control, averaged
					DZOS	.42	Included: control, averaged
Parental warmth					MZM	.65	Included: warmth, averaged
					MZF	.67	Included: warmth, averaged
					DZM	.50	Included: warmth, averaged
					DZF	.54	Included: warmth, averaged
					DZOS	.44	Included: warmth, averaged
Shared activities					MZM	.66	Included: warmth, averaged
					MZF	.76	Included: warmth, averaged
					DZM	.54	Included: warmth, averaged
					DZF	.64	Included: warmth, averaged
					DZOS	.43	Included: warmth, averaged

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	N	Sibling type	ICC	Inclusion
Relational tension					MZM	.51	Included: negativity
					MZF	.65	Included: negativity
					DZM	.46	Included: negativity
					DZF	.64	Included: negativity
					DZOS	.38	Included: negativity
Parental discipline					MZM	.51	Included: control, averaged
					MZF	.70	Included: control, averaged
					DZM	.53	Included: control, averaged
					DZF	.63	Included: control, averaged
					DZOS	.49	Included: control, averaged
Finnish Genetics of Sex and Aggression							
Harlaar et al. (2008)							
Physical affection	Child	Mother	M = 37.5	763	MZ	.57	Included: warmth, averaged
				1,102	DZ	.38	Included: warmth, averaged
				489	DZOS	.12	Included: warmth, averaged
		Father			MZ	.61	Included: warmth, averaged
					DZ	.52	Included: warmth, averaged
					DZOS	.30	Included: warmth, averaged
Responsiveness	Child	Mother			MZ	.62	Included: warmth, averaged
					DZ	.38	Included: warmth, averaged
					DZOS	.09	Included: warmth, averaged
		Father			MZ	.59	Included: warmth, averaged
					DZ	.41	Included: warmth, averaged
					DZOS	.29	Included: warmth, averaged
Control	Child	Mother			MZ	.46	Included: control
					DZ	.27	Included: control
					DZOS	.00	Included: control
		Father			MZ	.66	Included: control
					DZ	.57	Included: control
					DZOS	.48	Included: control
Abuse	Child	Mother			MZ	.63	Included: negativity
					DZ	.40	Included: negativity
					DZOS	.17	Included: negativity
		Father			MZ	.58	Included: negativity
					DZ	.53	Included: negativity
					DZOS	.27	Included: negativity
G1219 and G1219 Twins							
Button et al. (2008)							
Punitive discipline	Child	Mother	12–21	153	MZM	.50	Included: negativity
			M = 15.0	192	MZF	.38	Included: negativity
				122	DZM	.15	Included: negativity
				187	DZF	.35	Included: negativity
				323	DZOS	.22	Included: negativity
				52	FSM	.32	Included: negativity
				90	FSF	.31	Included: negativity
				118	FSOS	.26	Included: negativity
		Father			MZM	.60	Included: negativity
					MZF	.49	Included: negativity
					DZM	.39	Included: negativity
					DZF	.41	Included: negativity
					DZOS	.33	Included: negativity
					FSM	.51	Included: negativity
					FSF	.49	Included: negativity
					FSOS	.46	Included: negativity
Lau et al. (2006)							
Punitive discipline	Child	Parents	12–19	153	MZM	.50	Included: negativity
				192	MZF	.55	Included: negativity
				122	DZM	.28	Included: negativity
				187	DZF	.29	Included: negativity
				323	DZOS	.31	Included: negativity
				52	FSM	.39	Included: negativity
				90	FSF	.45	Included: negativity
				118	FSOS	.31	Included: negativity

(*table continues*)

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	N	Sibling type	ICC	Inclusion
Constructive discipline					MZM	.40	Excluded
					MZF	.54	Excluded
					DZM	.32	Excluded
					DZF	.49	Excluded
					DZOS	.28	Excluded
					FSM	.30	Excluded
					FSF	.26	Excluded
					FSOS	.25	Excluded
Lau & Eley (2008)							
Punitive discipline	Child	Mother	12–21	153	MZM	.50	Included: negativity
			M = 15.0	192	MZF	.38	Included: negativity
				122	DZM	.15	Included: negativity
				187	DZF	.35	Included: negativity
				323	DZOS	.22	Included: negativity
				52	FSM	.32	Included: negativity
				90	FSF	.31	Included: negativity
				118	FSOS	.26	Included: negativity
McAdams et al. (2013); Pike & Eley (2009)							
Punitive discipline		Mother	12–21	328	MZ	.49	Included: negativity
				774	DZ	.31	Included: negativity
				424	FS	.32	Included: negativity
		Father			MZ	.53	Included: negativity
					DZ	.33	Included: negativity
					FS	.45	Included: negativity
Constructive discipline		Mother			MZ	.46	Excluded
					DZ	.33	Excluded
					FS	.26	Excluded
		Father			MZ	.49	Excluded
					DZ	.35	Excluded
					FS	.30	Excluded
			Keio Twin Project				
Shikishima et al. (2013)							
Warmth	Child	Mother	14–32	492	MZ	.52	Included: warmth
				144	DZ	.37	Included: warmth
		Father			MZ	.66	Included: warmth
					DZ	.39	Included: warmth
Authoritarianism		Mother			MZ	.52	Included: control, averaged
					DZ	.39	Included: control, averaged
		Father			MZ	.53	Included: control, averaged
					DZ	.30	Included: control, averaged
Protectiveness		Mother			MZ	.50	Included: control, averaged
					DZ	.48	Included: control, averaged
		Father			MZ	.53	Included: control, averaged
					DZ	.38	Included: control, averaged
			Michigan State University Twin Registry				
Klahr et al. (2013)							
Warmth	Observer	Mother	6–10	259	MZ	.29	Included: warmth
				287	DZ	.35	Included: warmth
Control					MZ	.55	Included: control
					DZ	.44	Included: control
			Minnesota Study of Twins Reared Apart				
Hur & Bouchard (1995)							
Acceptance	Child	Mother	M = 41	39	MZA	.32	Included: warmth
				31	DZA	−.25	Included: warmth
		Father			MZA	.30	Included: warmth
					DZA	.19	Included: warmth
Intellectual–cultural orientation	Child	Mother			MZA	.17	Excluded
					DZA	.17	Excluded
		Father			MZA	.09	Excluded
					DZA	.06	Excluded
Cohesion versus conflict	Child	Family			MZA	.42	Excluded
					DZA	.06	Excluded

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	N	Sibling type	ICC	Inclusion
Organization	Child	Family			MZA	−.07	Excluded
					DZA	.30	Excluded
Minnesota Twin Family Study							
McGue et al. (2005)							
Involvement	Child	Both (composite)	11	436	MZ	.38	Included: warmth, averaged
				281	DZ	.31	Included: warmth, averaged
			17	383	MZ	.56	Included: warmth, averaged
				203	DZ	.45	Included: warmth, averaged
Regard for child	Child		11		MZ	.30	Included: warmth, averaged
					DZ	.17	Included: warmth, averaged
			17		MZ	.38	Included: warmth, averaged
					DZ	.30	Included: warmth, averaged
Conflict	Child	Both (composite)	11		MZ	.41	Included: negativity
					DZ	.35	Included: negativity
			17		MZ	.51	Included: negativity
					DZ	.41	Included: negativity
Elkins et al. (1997)							
Involvement	Child	Mother	11	172	MZ	.47	Included: warmth, averaged
				67	DZ	.41	Included: warmth, averaged
			17	92	MZ	.47	Included: warmth, averaged
				43	DZ	.30	Included: warmth, averaged
		Father	11		MZ	.46	Included: warmth, averaged
					DZ	.28	Included: warmth, averaged
			17		MZ	.64	Included: warmth, averaged
					DZ	.39	Included: warmth, averaged
Regard for child	Child	Mother	11		MZ	.38	Included: warmth, averaged
					DZ	.17	Included: warmth, averaged
			17		MZ	.38	Included: warmth, averaged
					DZ	.35	Included: warmth, averaged
		Father	11		MZ	.34	Included: warmth, averaged
					DZ	.35	Included: warmth, averaged
			17		MZ	.53	Included: warmth, averaged
					DZ	.14	Included: warmth, averaged
Support	Child	Mother	11		MZ	.49	Included: warmth, averaged
					DZ	.33	Included: warmth, averaged
			17		MZ	.47	Included: warmth, averaged
					DZ	.24	Included: warmth, averaged
		Father	11		MZ	.45	Included: warmth, averaged
					DZ	.31	Included: warmth, averaged
			17		MZ	.64	Included: warmth, averaged
					DZ	.15	Included: warmth, averaged
Structure	Child	Mother	11		MZ	.30	Included: control
					DZ	.26	Included: control
			17		MZ	.44	Included: control
					DZ	.24	Included: control
		Father	11		MZ	.27	Included: control
					DZ	.46	Included: control
			17		MZ	.43	Included: control
					DZ	.35	Included: control
Conflict	Child	Mother	11		MZ	.50	Included: negativity
					DZ	.33	Included: negativity
			17		MZ	.47	Included: negativity
					DZ	.17	Included: negativity
		Father	11		MZ	.44	Included: negativity
					DZ	.36	Included: negativity
			17		MZ	.62	Included: negativity
					DZ	.01	Included: negativity
National Organization for Mothers of Twins Clubs							
Cohen et al. (1977)							
Child-centeredness	Mother	Mother	12–72 months	180	MZ	.92	Excluded
			M = 35 months	186	DZ	.86	Excluded
	Father	Father			MZ	.93	Excluded
					DZ	.92	Excluded
Parental temper and detachment	Mother	Mother			MZ	.92	Included: warmth

(*table continues*)

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
					DZ	.80	Included: warmth
	Father	Father			MZ	.93	Included: warmth
					DZ	.92	Included: warmth
Respect for autonomy	Mother	Mother			MZ	.91	Included: control, averaged
					DZ	.91	Included: control, averaged
	Father	Father			MZ	.95	Included: control, averaged
					DZ	.88	Included: control, averaged
Consistency	Mother	Mother			MZ	.95	Included: control, averaged
					DZ	.85	Included: control, averaged
	Father	Father			MZ	.94	Included: control, averaged
					DZ	.94	Included: control, averaged
Control through guilt and anxiety	Mother	Mother			MZ	.91	Included: negativity
					DZ	.93	Included: negativity
	Father	Father			MZ	.94	Included: negativity
					DZ	.92	Included: negativity
Nonshared Environment and Adolescent Development							
Neiderhiser et al. (2004); Ulbricht et al. (2013)							
Positivity	Child	Mother	12–21	63	MZ	.49	Included: warmth, averaged
				75	DZ	.36	Included: warmth, averaged
				58	FS	.51	Included: warmth, averaged
				95	FSDIV	.08	Included: warmth, averaged
				60	HS	.55	Included: warmth, averaged
				44	UR	−.22	Included: warmth, averaged
	Mother	Mother			MZ	.94	Included: warmth, averaged
					DZ	.90	Included: warmth, averaged
					FS	.56	Included: warmth, averaged
					FSDIV	.70	Included: warmth, averaged
					HS	.79	Included: warmth, averaged
					UR	.12	Included: warmth, averaged
	Observer				MZ	.48	Included: warmth, averaged
					DZ	.44	Included: warmth, averaged
					FS	.70	Included: warmth, averaged
					FSDIV	.42	Included: warmth, averaged
					HS	.48	Included: warmth, averaged
					UR	.56	Included: warmth, averaged
Attempted control	Child	Mother			MZ	.47	Included: control, averaged
					DZ	.36	Included: control, averaged
					FS	.30	Included: control, averaged
					FSDIV	.31	Included: control, averaged
					HS	.26	Included: control, averaged
					UR	.36	Included: control, averaged
	Mother				MZ	.92	Included: control, averaged
					DZ	.86	Included: control, averaged
					FS	.84	Included: control, averaged
					FSDIV	.72	Included: control, averaged
					HS	.84	Included: control, averaged
					UR	.70	Included: control, averaged
Actual control	Child	Mother			MZ	.53	Included: control, averaged
					DZ	.32	Included: control, averaged
					FS	.28	Included: control, averaged
					FSDIV	.27	Included: control, averaged
					HS	.21	Included: control, averaged
					UR	.34	Included: control, averaged
	Mother				MZ	.97	Included: control, averaged
					DZ	.92	Included: control, averaged
					FS	.66	Included: control, averaged
					FSDIV	.79	Included: control, averaged
					HS	.78	Included: control, averaged
					UR	.78	Included: control, averaged
Control	Observer	Mother			MZ	.10	Included: control, averaged
					DZ	.06	Included: control, averaged
					FS	.18	Included: control, averaged
					FSDIV	.23	Included: control, averaged
					HS	.29	Included: control, averaged

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
					UR	.14	Included: control, averaged
Negativity	Child	Mother			MZ	.50	Included: negativity, averaged
					DZ	.35	Included: negativity, averaged
					FS	.41	Included: negativity, averaged
					FSDIV	.35	Included: negativity, averaged
					HS	.05	Included: negativity, averaged
					UR	.10	Included: negativity, averaged
	Mother				MZ	.88	Included: negativity, averaged
					DZ	.72	Included: negativity, averaged
					FS	.70	Included: negativity, averaged
					FSDIV	.60	Included: negativity, averaged
					HS	.66	Included: negativity, averaged
					UR	.43	Included: negativity, averaged
	Observer				MZ	.29	Included: negativity, averaged
					DZ	.30	Included: negativity, averaged
					FS	.36	Included: negativity, averaged
					FSDIV	.29	Included: negativity, averaged
					HS	.23	Included: negativity, averaged
					UR	.18	Included: negativity, averaged
O'Connor et al. (1995)							
Warmth	Observer	Mother	10–18	92	MZ	.46	Included: warmth, averaged
				94	DZ	.40	Included: warmth, averaged
				90	FS	.46	Included: warmth, averaged
				171	FSDIV	.39	Included: warmth, averaged
				104	HS	.39	Included: warmth, averaged
				124	UR	.38	Included: warmth, averaged
		Father			MZ	.58	Included: warmth, averaged
					DZ	.42	Included: warmth, averaged
					FS	.29	Included: warmth, averaged
					FSDIV	.70	Included: warmth, averaged
					HS	.30	Included: warmth, averaged
					UR	.45	Included: warmth, averaged
Communication	Observer	Mother			MZ	.39	Included: warmth, averaged
					DZ	.32	Included: warmth, averaged
					FS	.43	Included: warmth, averaged
					FSDIV	.38	Included: warmth, averaged
					HS	.43	Included: warmth, averaged
					UR	.46	Included: warmth, averaged
		Father			MZ	.42	Included: warmth, averaged
					DZ	.31	Included: warmth, averaged
					FS	.49	Included: warmth, averaged
					FSDIV	.46	Included: warmth, averaged
					HS	.55	Included: warmth, averaged
					UR	.37	Included: warmth, averaged
Involvement	Observer	Mother			MZ	.45	Included: warmth, averaged
					DZ	.07	Included: warmth, averaged
					FS	.50	Included: warmth, averaged
					FSDIV	.29	Included: warmth, averaged
					HS	.27	Included: warmth, averaged
					UR	.49	Included: warmth, averaged
		Father			MZ	.48	Included: warmth, averaged
					DZ	.32	Included: warmth, averaged
					FS	.44	Included: warmth, averaged
					FSDIV	.43	Included: warmth, averaged
					HS	.28	Included: warmth, averaged
					UR	.46	Included: warmth, averaged
Assertive	Observer	Mother			MZ	.38	Included: warmth, averaged
					DZ	.35	Included: warmth, averaged
					FS	.47	Included: warmth, averaged
					FSDIV	.39	Included: warmth, averaged
					HS	.36	Included: warmth, averaged
					UR	.43	Included: warmth, averaged
		Father			MZ	.40	Included: warmth, averaged
					DZ	.33	Included: warmth, averaged
					FS	.40	Included: warmth, averaged
					FSDIV	.38	Included: warmth, averaged

(*table continues*)

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
					HS	.43	Included: warmth, averaged
					UR	.52	Included: warmth, averaged
Control	Observer	Mother			MZ	.22	Included: control, averaged
					DZ	.12	Included: control, averaged
					FS	.14	Included: control, averaged
					FSDIV	.19	Included: control, averaged
					HS	.06	Included: control, averaged
					UR	.11	Included: control, averaged
		Father			MZ	.43	Included: control, averaged
					DZ	.15	Included: control, averaged
					FS	.42	Included: control, averaged
					FSDIV	.38	Included: control, averaged
					HS	.24	Included: control, averaged
					UR	.31	Included: control, averaged
Influence	Observer	Mother			MZ	.14	Included: control, averaged
					DZ	.13	Included: control, averaged
					FS	.21	Included: control, averaged
					FSDIV	.31	Included: control, averaged
					HS	.14	Included: control, averaged
					UR	.17	Included: control, averaged
		Father			MZ	.44	Included: control, averaged
					DZ	.37	Included: control, averaged
					FS	.36	Included: control, averaged
					FSDIV	.48	Included: control, averaged
					HS	.25	Included: control, averaged
					UR	.28	Included: control, averaged
Monitoring	Observer	Mother			MZ	.21	Included: control, averaged
					DZ	.20	Included: control, averaged
					FS	.21	Included: control, averaged
					FSDIV	.25	Included: control, averaged
					HS	.35	Included: control, averaged
					UR	.07	Included: control, averaged
		Father			MZ	.38	Included: control, averaged
					DZ	.19	Included: control, averaged
					FS	.19	Included: control, averaged
					FSDIV	.37	Included: control, averaged
					HS	.29	Included: control, averaged
					UR	.18	Included: control, averaged
Anger	Observer	Mother			MZ	.32	Included: negativity, averaged
					DZ	.21	Included: negativity, averaged
					FS	.36	Included: negativity, averaged
					FSDIV	.34	Included: negativity, averaged
					HS	.40	Included: negativity, averaged
					UR	.29	Included: negativity, averaged
		Father			MZ	.25	Included: negativity, averaged
					DZ	.45	Included: negativity, averaged
					FS	.46	Included: negativity, averaged
					FSDIV	.36	Included: negativity, averaged
					HS	.29	Included: negativity, averaged
					UR	.39	Included: negativity, averaged
Coercion	Observer	Mother			MZ	.27	Included: negativity, averaged
					DZ	.29	Included: negativity, averaged
					FS	.19	Included: negativity, averaged
					FSDIV	.35	Included: negativity, averaged
					HS	.38	Included: negativity, averaged
					UR	.18	Included: negativity, averaged
		Father			MZ	.35	Included: negativity, averaged
					DZ	.46	Included: negativity, averaged
					FS	.45	Included: negativity, averaged
					FSDIV	.36	Included: negativity, averaged
					HS	.31	Included: negativity, averaged
					UR	.37	Included: negativity, averaged
Transactional control	Observer	Mother			MZ	.26	Included: negativity, averaged
					DZ	.26	Included: negativity, averaged
					FS	.23	Included: negativity, averaged
					FSDIV	.03	Included: negativity, averaged

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
					HS	.44	Included: negativity, averaged
					UR	.02	Included: negativity, averaged
		Father			MZ	.42	Included: negativity, averaged
					DZ	.35	Included: negativity, averaged
					FS	.27	Included: negativity, averaged
					FSDIV	.30	Included: negativity, averaged
					HS	.22	Included: negativity, averaged
					UR	.15	Included: negativity, averaged
Self-disclosure	Observer	Mother			MZ	.42	Excluded
					DZ	.11	Excluded
					FS	.41	Excluded
					FSDIV	.32	Excluded
					HS	.17	Excluded
					UR	.27	Excluded
		Father			MZ	.39	Excluded
					DZ	.22	Excluded
					FS	.32	Excluded
					FSDIV	.37	Excluded
					HS	.36	Excluded
					UR	.34	Excluded
Positive mood	Observer	Mother			MZ	.41	Excluded
					DZ	.17	Excluded
					FS	.54	Excluded
					FSDIV	.36	Excluded
					HS	.30	Excluded
					UR	.10	Excluded
		Father			MZ	.47	Excluded
					DZ	.45	Excluded
					FS	.42	Excluded
					FSDIV	.33	Excluded
					HS	.43	Excluded
					UR	.43	Excluded
Depressed mood	Observer	Mother			MZ	.21	Excluded
					DZ	.12	Excluded
					FS	.25	Excluded
					FSDIV	.24	Excluded
					HS	−.01	Excluded
					UR	−.03	Excluded
		Father			MZ	.09	Excluded
					DZ	.14	Excluded
					FS	.28	Excluded
					FSDIV	.10	Excluded
					HS	.27	Excluded
					UR	.11	Excluded
Problem solve	Observer	Mother			MZ	−.10	Excluded
					DZ	.16	Excluded
					FS	.24	Excluded
					FSDIV	.20	Excluded
					HS	.21	Excluded
					UR	.15	Excluded
		Father			MZ	.17	Excluded
					DZ	.17	Excluded
					FS	.28	Excluded
					FSDIV	.38	Excluded
					HS	.22	Excluded
					UR	.18	Excluded
Plomin et al. (1994)							
Positivity	Child	Mother	10–18	93	MZ	.46	Included: warmth, averaged
				98	DZ	.46	Included: warmth, averaged
				95	FS	.26	Included: warmth, averaged
				182	FSDIV	.17	Included: warmth, averaged
				109	HS	.24	Included: warmth, averaged
				130	UR	.03	Included: warmth, averaged
		Father			MZ	.57	Included: warmth, averaged
					DZ	.51	Included: warmth, averaged
					FS	.30	Included: warmth, averaged

(*table continues*)

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
					FSDIV	.29	Included: warmth, averaged
					HS	.18	Included: warmth, averaged
					UR	.06	Included: warmth, averaged
	Mother	Mother			MZ	.84	Included: warmth, averaged
					DZ	.81	Included: warmth, averaged
					FS	.75	Included: warmth, averaged
					FSDIV	.73	Included: warmth, averaged
					HS	.76	Included: warmth, averaged
					UR	.29	Included: warmth, averaged
	Father	Father			MZ	.93	Included: warmth, averaged
					DZ	.87	Included: warmth, averaged
					FS	.76	Included: warmth, averaged
					FSDIV	.70	Included: warmth, averaged
					HS	.71	Included: warmth, averaged
					UR	.48	Included: warmth, averaged
Monitoring	Child	Mother			MZ	.36	Included: control, averaged
					DZ	.24	Included: control, averaged
					FS	.25	Included: control, averaged
					FSDIV	.07	Included: control, averaged
					HS	.18	Included: control, averaged
					UR	.10	Included: control, averaged
		Father			MZ	.35	Included: control, averaged
					DZ	.34	Included: control, averaged
					FS	.29	Included: control, averaged
					FSDIV	.24	Included: control, averaged
					HS	.12	Included: control, averaged
					UR	−.04	Included: control, averaged
	Mother	Mother			MZ	.99	Included: control, averaged
					DZ	.99	Included: control, averaged
					FS	.97	Included: control, averaged
					FSDIV	.93	Included: control, averaged
					HS	.88	Included: control, averaged
					UR	.73	Included: control, averaged
	Father	Father			MZ	.99	Included: control, averaged
					DZ	.99	Included: control, averaged
					FS	.97	Included: control, averaged
					FSDIV	.96	Included: control, averaged
					HS	.98	Included: control, averaged
					UR	.87	Included: control, averaged
Negativity	Child	Mother			MZ	.50	Included: negativity, averaged
					DZ	.43	Included: negativity, averaged
					FS	.27	Included: negativity, averaged
					FSDIV	.36	Included: negativity, averaged
					HS	.26	Included: negativity, averaged
					UR	.11	Included: negativity, averaged
		Father			MZ	.39	Included: negativity, averaged
					DZ	.43	Included: negativity, averaged
					FS	.29	Included: negativity, averaged
					FSDIV	.28	Included: negativity, averaged
					HS	.15	Included: negativity, averaged
					UR	.28	Included: negativity, averaged
	Mother	Mother			MZ	.89	Included: negativity, averaged
					DZ	.69	Included: negativity, averaged
					FS	.70	Included: negativity, averaged
					FSDIV	.63	Included: negativity, averaged
					HS	.48	Included: negativity, averaged
					UR	.38	Included: negativity, averaged
	Father	Father			MZ	.87	Included: negativity, averaged
					DZ	.80	Included: negativity, averaged
					FS	.67	Included: negativity, averaged
					FSDIV	.69	Included: negativity, averaged
					HS	.65	Included: negativity, averaged
					UR	.58	Included: negativity, averaged
Neiderhiser et al. (2007)							
Positivity	Child	Father	12–21	63	MZ	.49	Included: warmth, averaged
				75	DZ	.36	Included: warmth, averaged

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
				58	FS	.51	Included: warmth, averaged
					FSDIV	.08	Included: warmth, averaged
				60	HS	.55	Included: warmth, averaged
				44	UR	−.22	Included: warmth, averaged
	Father				MZ	.94	Included: warmth, averaged
					DZ	.91	Included: warmth, averaged
					FS	.71	Included: warmth, averaged
					FSDIV	.75	Included: warmth, averaged
					HS	.71	Included: warmth, averaged
					UR	.57	Included: warmth, averaged
Attempted control	Child	Father			MZ	.58	Included: control, averaged
					DZ	.48	Included: control, averaged
					FS	.21	Included: control, averaged
					FSDIV	.33	Included: control, averaged
					HS	.41	Included: control, averaged
					UR	.32	Included: control, averaged
	Father				MZ	.91	Included: control, averaged
					DZ	.87	Included: control, averaged
					FS	.69	Included: control, averaged
					FSDIV	.79	Included: control, averaged
					HS	.75	Included: control, averaged
					UR	.54	Included: control, averaged
Actual control	Child	Father			MZ	.62	Included: control, averaged
					DZ	.41	Included: control, averaged
					FS	.47	Included: control, averaged
					FSDIV	.29	Included: control, averaged
					HS	.19	Included: control, averaged
					UR	.30	Included: control, averaged
	Father				MZ	.95	Included: control, averaged
					DZ	.86	Included: control, averaged
					FS	.72	Included: control, averaged
					FSDIV	.82	Included: control, averaged
					HS	.83	Included: control, averaged
					UR	.65	Included: control, averaged
Negativity	Child	Father			MZ	.32	Included: negativity, averaged
					DZ	.42	Included: negativity, averaged
					FS	.32	Included: negativity, averaged
					FSDIV	.25	Included: negativity, averaged
					HS	.16	Included: negativity, averaged
					UR	.06	Included: negativity, averaged
	Father				MZ	.93	Included: negativity, averaged
					DZ	.78	Included: negativity, averaged
					FS	.53	Included: negativity, averaged
					FSDIV	.62	Included: negativity, averaged
					HS	.60	Included: negativity, averaged
					UR	.53	Included: negativity, averaged
Reiss et al. (2003)							
Positivity	All	Mother	12–21	98	MZ	.59	Included: warmth
				99	DZ	.56	Included: warmth
				95	FS	.45	Included: warmth
				182	FSDIV	.41	Included: warmth
				60	HS	.60	Included: warmth
				44	UR	.23	Included: warmth
	All	Father			MZ	.64	Included: warmth
					DZ	.52	Included: warmth
					FS	.51	Included: warmth
					FSDIV	.42	Included: warmth
					HS	.57	Included: warmth
					UR	.47	Included: warmth
Negativity	All	Mother			MZ	.60	Included: negativity
					DZ	.51	Included: negativity
					FS	.33	Included: negativity
					FSDIV	.32	Included: negativity
					HS	.37	Included: negativity
					UR	.10	Included: negativity
	All	Father			MZ	.62	Included: negativity

(*table continues*)

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
					DZ	.57	Included: negativity
					FS	.22	Included: negativity
					FSDIV	.32	Included: negativity
					HS	.24	Included: negativity
					UR	.30	Included: negativity
Monitoring	All	Mother			MZ	.11	Included: control, averaged
					DZ	.20	Included: control, averaged
					FS	.13	Included: control, averaged
					FSDIV	.20	Included: control, averaged
					HS	.21	Included: control, averaged
					UR	.33	Included: control, averaged
	All	Father			MZ	.34	Included: control, averaged
					DZ	.45	Included: control, averaged
					FS	.21	Included: control, averaged
					FSDIV	.13	Included: control, averaged
					HS	.42	Included: control, averaged
					UR	.22	Included: control, averaged
Attempted control	All	Mother			MZ	.30	Included: control, averaged
					DZ	.46	Included: control, averaged
					FS	.25	Included: control, averaged
					FSDIV	.32	Included: control, averaged
					HS	.29	Included: control, averaged
					UR	.13	Included: control, averaged
	All	Father			MZ	.41	Included: control, averaged
					DZ	.46	Included: control, averaged
					FS	.39	Included: control, averaged
					FSDIV	.25	Included: control, averaged
					HS	.27	Included: control, averaged
					UR	.41	Included: control, averaged
Actual control	All	Mother			MZ	.46	Included: control, averaged
					DZ	.43	Included: control, averaged
					FS	.35	Included: control, averaged
					FSDIV	.34	Included: control, averaged
					HS	.33	Included: control, averaged
					UR	.25	Included: control, averaged
	All	Father			MZ	.46	Included: control, averaged
					DZ	.44	Included: control, averaged
					FS	.57	Included: control, averaged
					FSDIV	.37	Included: control, averaged
					HS	.34	Included: control, averaged
					UR	.37	Included: control, averaged
Northwest Collaborative Adoption Projects							
Deater-Deckard et al. (2006)							
Positivity	Parent	Mother	3–13	452	UR	.20	Included: warmth
		Father		261	UR	.43	Included: warmth
Negativity	Parent	Mother		452	UR	.23	Included: negativity
		Father		261	UR	.41	Included: negativity
Oregon Twin Project							
Leve et al. (1998)							
Directive	Observer	Parent	6–11	77	MZ	.60	Included: control
				77	DZ	.51	Included: control
Negativity					MZ	.77	Included: negativity
					DZ	.80	Included: negativity
Overlin College Twin Study							
Rowe (1981)							
Acceptance versus rejection	Child	Mother	$M = 17.3$	46	MZ	.54	Included: warmth
				43	DZ	.17	Included: warmth
		Father			MZ	.74	Included: warmth
					DZ	.21	Included: warmth
Psychological control versus psychological autonomy	Child	Mother			MZ	.44	Included: control, averaged
					DZ	.47	Included: control, averaged
		Father			MZ	.43	Included: control, averaged
					DZ	.46	Included: control, averaged

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
Firm versus lax control	Child	Mother			MZ	.55	Included: control, averaged
					DZ	.46	Included: control, averaged
		Father			MZ	.43	Included: control, averaged
					DZ	.45	Included: control, averaged
Quebec Twin Newborn Study							
Boivin et al. (2005)							
Overprotection	Mother	Mother	5 months	185	MZ	.86	Excluded
				290	DZ	.86	Excluded
Hostile-reactive behavior	Mother	Mother			MZ	.83	Included: negativity
					DZ	.66	Included: negativity
Parental self-efficacy	Mother	Mother			MZ	.71	Excluded
					DZ	.81	Excluded
Perceived parental impact	Mother	Mother			MZ	.68	Excluded
					DZ	.70	Excluded
Twins, Adoptees, Peers, and Siblings Study							
McGuire et al. (2012)							
Warmth	Parent	Parent	7–13	54	MZ	.73	Included: warmth
				86	DZ	.78	Included: warmth
				69	FS	.72	Included: warmth
				43	UR	.39	Included: warmth
	Child	Parent			MZ	.44	Included: warmth
					DZ	.28	Included: warmth
					FS	.12	Included: warmth
					UR	.13	Included: warmth
Twins Early Development Study							
Knafo & Plomin (2006)							
Positivity	Parent	Parent	3	943	MZM	.77	Included: warmth
				913	DZM	.67	Included: warmth
				898	MZF	.79	Included: warmth
				900	DZF	.68	Included: warmth
				1,026	DZOS	.65	Included: warmth
			4	1,215	MZM	.77	Included: warmth
				1,193	DZM	.61	Included: warmth
				1,243	MZF	.78	Included: warmth
				1,187	DZF	.68	Included: warmth
				1,332	DZOS	.65	Included: warmth
			7	984	MZM	.68	Included: warmth
				957	DZM	.58	Included: warmth
				1,068	MZF	.69	Included: warmth
				993	DZF	.61	Included: warmth
				1,212	DZOS	.58	Included: warmth
Negativity			3	943	MZM	.76	Included: negativity
				913	DZM	.48	Included: negativity
				898	MZF	.76	Included: negativity
				900	DZF	.51	Included: negativity
				1,026	DZOS	.50	Included: negativity
			4	1,215	MZM	.75	Included: negativity
				1,193	DZM	.51	Included: negativity
				1,243	MZF	.76	Included: negativity
				1,187	DZF	.54	Included: negativity
				1,332	DZOS	.49	Included: negativity
			7	984	MZM	.73	Included: negativity
				957	DZM	.46	Included: negativity
				1,068	MZF	.72	Included: negativity
				993	DZF	.48	Included: negativity
				1,212	DZOS	.46	Included: negativity
Eley et al. (2010)							
Extreme control	Observer	Mother	8	89	MZ	.72	Excluded
				176	DZ	.20	Excluded
TRACKS Twin Study							
Deater-Deckard (2000)							
Negative affect	Parent	Parent		62	MZ	.77	Excluded

(*table continues*)

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
				58	DZ	.51	Excluded
	Observer	Parent			MZ	.21	Excluded
					DZ	.20	Excluded
Positive affect	Parent	Parent			MZ	.73	Excluded
					DZ	.66	Excluded
	Observer	Parent			MZ	.55	Excluded
					DZ	.48	Excluded
Harsh discipline	Parent	Parent			MZ	.76	Included: negativity, averaged
					DZ	.66	Included: negativity, averaged
Negative control	Observer	Parent			MZ	.29	Included: negativity, averaged
					DZ	.63	Included: negativity, averaged
Positive control	Observer	Parent			MZ	.38	Excluded
					DZ	.57	Excluded
Responsiveness	Observer	Parent			MZ	.50	Excluded
					DZ	.21	Excluded
TRACKS Twin Study and Colorado Adoption Project							
Deater-Deckard & O'Connor (2000)							
Parent–child mutuality	Observer	Parent		62	MZ	.61	Excluded
				58	DZ	.26	Excluded
				56	FS	.25	Excluded
				46	UR	−.04	Excluded
Twin Infant Project and the Longitudinal Twin Study							
Boeldt et al. (2012)							
Positive parenting	Observer	Mother	7–36 months	78	MZ	.57	Included: warmth
				234	MZF	.59	Included: warmth
					MZM	.52	Included: warmth
					DZ	.58	Included: warmth
					DZF	.74	Included: warmth
					DZM	.49	Included: warmth
Twin Mothers Study							
Lichtenstein et al. (2003)							
Warmth	Child	Mother	$M = 37.5$	287	MZ	.72	Included: warmth
				335	DZ	.46	Included: warmth
		Father		288	MZ	.68	Included: warmth
				335	DZ	.56	Included: warmth
Protectiveness	Child	Mother			MZ	.57	Included: control, averaged
					DZ	.48	Included: control, averaged
		Father			MZ	.48	Included: control, averaged
					DZ	.49	Included: control, averaged
Authoritarianism	Child	Mother			MZ	.54	Included: control, averaged
					DZ	.50	Included: control, averaged
		Father			MZ	.42	Included: control, averaged
					DZ	.44	Included: control, averaged
Twin Study of Child and Adolescent Development							
Narusyte et al. (2007)							
Parental criticism	Parent	Parents	16–17	196	MZM	.66	Included: negativity
				196	MZF	.79	Included: negativity
				139	DZM	.47	Included: negativity
				140	DZF	.46	Included: negativity
Narusyte et al. (2008)							
Emotional over involvement	Parent	Mother	$M = 16.7$	508	MZ	.82	Excluded
				366	DZ	.61	Excluded
Narusyte et al. (2011)							
Parental criticism	Parent	Mother	16–17	311	MZ	.73	Included: negativity
				228	DZ	.45	Included: negativity
		Father		59	MZ	.66	Included: negativity
				41	DZ	.32	Included: negativity
Moberg et al. (2011)							
Emotional overinvolvement	Parent	Parent	16–17	235	MZM	.75	Excluded
				261	MZF	.80	Excluded
				163	DZM	.59	Excluded
				193	DZF	.56	Excluded

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	N	Sibling type	ICC	Inclusion
				361	DZOS	.58	Excluded
	Parent	Parent	19–20		MZM	.75	Excluded
					MZF	.69	Excluded
					DZM	.58	Excluded
					DZF	.58	Excluded
					DZOS	.46	Excluded
Parental criticism	Parent	Parent	16–17		MZM	.71	Included: negativity
					MZF	.76	Included: negativity
					DZM	.44	Included: negativity
					DZF	.47	Included: negativity
					DZOS	.44	Included: negativity
	Parent	Parent	19–20		MZM	.71	Included: negativity
					MZF	.68	Included: negativity
					DZM	.44	Included: negativity
					DZF	.47	Included: negativity
					DZOS	.48	Included: negativity
Virginia Twin Registry							
Kendler (1996); Kendler et al. (2000); Otowa et al. (2013)							
Warmth	Child	Mother	$M = 30.1$	546	MZ	.61	Included: warmth
				390	DZ	.38	Included: warmth
		Father			MZ	.71	Included: warmth
					DZ	.48	Included: warmth
	Cotwin	Mother			MZ	.66	Excluded
					DZ	.48	Excluded
		Father			MZ	.66	Excluded
					DZ	.54	Excluded
	Mother	Mother			MZ	.83	Included: warmth
					DZ	.76	Included: warmth
	Father	Father			MZ	.86	Included: warmth
					DZ	.84	Included: warmth
Protectiveness	Child	Mother			MZ	.51	Included: control, averaged
					DZ	.39	Included: control, averaged
		Father			MZ	.46	Included: control, averaged
					DZ	.32	Included: control, averaged
	Cotwin	Mother			MZ	.44	Excluded
					DZ	.32	Excluded
		Father			MZ	.39	Excluded
					DZ	.31	Excluded
	Mother	Mother			MZ	.88	Included: control, averaged
					DZ	.85	Included: control, averaged
	Father	Father			MZ	.88	Included: control, averaged
					DZ	.84	Included: control, averaged
Authoritarianism	Child	Mother			MZ	.46	Included: control, averaged
					DZ	.39	Included: control, averaged
		Father			MZ	.42	Included: control, averaged
					DZ	.32	Included: control, averaged
	Cotwin	Mother			MZ	.43	Excluded
					DZ	.33	Excluded
		Father			MZ	.44	Excluded
					DZ	.28	Excluded
	Mother	Mother			MZ	.86	Included: control, averaged
					DZ	.84	Included: control, averaged
	Father	Father			MZ	.86	Included: control, averaged
					DZ	.82	Included: control, averaged
Wade & Kendler (2000)							
Limit setting	Child	Mother	$M = 31.6$	555	MZ	.54	Included: control, averaged
				383	DZ	.47	Included: control, averaged
		Father		543	MZ	.63	Included: control, averaged
				341	DZ	.53	Included: control, averaged
	Mother	Mother		506	MZ	.89	Included: control, averaged
				346	DZ	.82	Included: control, averaged
		Father		336	MZ	.92	Included: control, averaged
				215	DZ	.86	Included: control, averaged
	Father	Mother		500	MZ	.87	Included: control, averaged

(*table continues*)

Table 1 (*continued*)

Phenotype	Informant	Parent	Child age (years)	*N*	Sibling type	ICC	Inclusion
				341	DZ	.84	Included: control, averaged
		Father		337	MZ	.94	Included: control, averaged
				217	DZ	.81	Included: control, averaged
Physical discipline	Child	Mother			MZ	.72	Included: negativity
					DZ	.62	Included: negativity
		Father			MZ	.74	Included: negativity
					DZ	.60	Included: negativity
	Mother	Mother			MZ	.88	Included: negativity
					DZ	.84	Included: negativity
		Father			MZ	.83	Included: negativity
					DZ	.76	Included: negativity
	Father	Mother			MZ	.88	Included: negativity
					DZ	.85	Included: negativity
		Father			MZ	.88	Included: negativity
					DZ	.80	Included: negativity
Western Reserve Reading Project							
Deater-Deckard et al. (2006)							
Positivity	Parent	Mother	4–8	115	MZ	.76	Included: warmth
				162	DZ	.59	Included: warmth
			5–9	106	MZ	.87	Included: warmth
				145	DZ	.63	Included: warmth
			6–10	90	MZ	.85	Included: warmth
				127	DZ	.66	Included: warmth
		Father		68	MZ	.90	Included: warmth
				83	DZ	.79	Included: warmth
				67	MZ	.81	Included: warmth
				70	DZ	.69	Included: warmth
				40	MZ	.95	Included: warmth
				55	DZ	.79	Included: warmth
Negativity	Parent	Mother		115	MZ	.75	Included: negativity
				162	DZ	.61	Included: negativity
				106	MZ	.83	Included: negativity
				145	DZ	.65	Included: negativity
				90	MZ	.80	Included: negativity
				127	DZ	.61	Included: negativity
		Father		68	MZ	.85	Included: negativity
				83	DZ	.63	Included: negativity
				67	MZ	.90	Included: negativity
				70	DZ	.68	Included: negativity
				40	MZ	.92	Included: negativity
				55	DZ	.74	Included: negativity

Note. ICC = intraclass correlation coefficient; AARP = American Association of Retired Persons; MZ = monozygotic twin pairs; DZ = dizygotic twin pairs; MZM = monozygotic male twin pairs; MZF = monozygotic female twin pairs; DZM = dizygotic male twin pairs; DZF = dizygotic female twin pairs; DZOS = opposite-sex dizygotic twin pairs; FS = full siblings; FSDIV = full siblings in a divorced family; HS = half siblings; UR = unrelated sibling pairs; MZA = MZ twins reared apart; DZA = DZ twins reared apart.

Inclusion Criteria

Construct definition and related issues. Studies were included if they examined parental warmth/positivity, control, or negativity. Warmth/positivity was defined as physical affection, verbal expression of affection, acceptance, care, supportiveness, empathy, and responsiveness. Control subsumed assertiveness, dominance, protection, and authoritativeness. Negativity included hostility, conflict, anger, and abuse. Specific measures of these constructs included the Parental Environment Questionnaire (Elkins et al., 1997), the Parental Bonding Instrument (Parker, 1990; Parker, Tupling, & Brown, 1979), the Parent–Child Relationship Scale (Wamboldt, Wamboldt, Gavin, & McTaggart, 2001), the Parent Discipline Behavior Scale (Reiss et al., 1994), several observer-rated coding schemes (Deater-Deckard, Pylas, & Petrill, 1997), and others. Because of the wide variety of measures, item content in each scale was examined closely to determine whether items primarily tapped warmth, control, or negativity. To confirm the assignment of particular scales to warmth, control, or negativity, two graduate-level volunteers were asked to independently sort scales into particular phenotypic categories based on item content. The independent graduate student ratings were then compared to the independent ratings of the two study authors. All available scales were included in this sorting task. The four raters achieved full agreement for 65% of the scales (i.e., all four raters agreed on placement). For those scales on which there was some disagreement, most (60%) included elements of multiple constructs (e.g., extreme control included elements of both control and negativity; Eley et al., 2010). This

Table 2
Effect Sizes for Parent-Based Studies

Phenotype	Informant	Parent	Child age	*N*	Sibling type	ICC	Inclusion
			AARP Study				
Pérusse et al. (1994)							
Care	Mother	Mother	Not reported	506	MZ	.40	Included: warmth
				206	DZ	.08	Included: warmth
	Father	Father		169	MZ	.27	Included: warmth
				72	DZ	.04	Included: warmth
	Parent	Parent		164	DZOS	.07	Included: warmth
Overprotection	Mother	Mother			MZ	−.03	Included: control
					DZ	.02	Included: control
	Father	Father			MZ	.19	Included: control
					DZ	−.10	Included: control
	Parent	Parent			DZOS	.20	Included: control
			German Observational Study on Adult Twins				
Spinath & O'Connor (2003)							
Indulgent	Parent	Parent	Child through adult	47	MZ	.33	Included: control, averaged
				40	DZ	.12	Included: control, averaged
Overprotection	Parent	Parent			MZ	.48	Included: control, averaged
					DZ	.27	Included: control, averaged
Authoritarian	Parent	Parent			MZ	.43	Included: negativity, averaged
					DZ	.16	Included: negativity, averaged
Rejecting	Parent	Parent			MZ	.26	Included: negativity, averaged
					DZ	.22	Included: negativity, averaged
			Oregon Twin Study + Callor/Rowe Adoption Sample				
Losoya et al. (1997)							
Warmth	Parent	Parent	<8 years	45	MZ	.37	Included: warmth
				28	DZ	.13	Included: warmth
				20	UR	−.40	Included: warmth
Encouragement of independence	Parent	Parent			MZ	.29	Included: control
					DZ	−.21	Included: control
					UR	−.09	Included: control
Strictness	Parent	Parent			MZ	.48	Excluded
					DZ	.08	Excluded
					UR	.00	Excluded
Aggravation	Parent	Parent			MZ	.39	Included: negativity
					DZ	.26	Included: negativity
					UR	.21	Included: negativity
Positive dominant	Parent	Parent			MZ	.54	Excluded
					DZ	.29	Excluded
					UR	.00	Excluded
Positive submissive	Parent	Parent			MZ	.60	Excluded
					DZ	.36	Excluded
					UR	−.27	Excluded
Negative dominant	Parent	Parent			MZ	.21	Excluded
					DZ	.16	Excluded
					UR	−.01	Excluded
Negative submissive	Parent	Parent			MZ	.36	Excluded
					DZ	.16	Excluded
					UR	−.17	Excluded
			Twin and Offspring Study in Sweden				
Neiderhiser et al. (2007)							
Positivity	Father	Father	Adolescent	128	MZ	.33	Included: warmth
				183	DZ	.33	Included: warmth
	Child				MZ	.28	Included: warmth
					DZ	.15	Included: warmth
Attempted control	Father	Father			MZ	.22	Included: control, averaged
					DZ	.26	Included: control, averaged
	Child				MZ	.04	Included: control, averaged
					DZ	−.02	Included: control, averaged
Actual control	Father	Father			MZ	.23	Included: control, averaged
					DZ	.21	Included: control, averaged
	Child				MZ	.09	Included: control, averaged

(*table continues*)

Table 2 (*continued*)

Phenotype	Informant	Parent	Child age	N	Sibling type	ICC	Inclusion
					DZ	.08	Included: control, averaged
Negativity	Father	Father			MZ	.40	Included: negativity
					DZ	.13	Included: negativity
	Child				MZ	.16	Included: negativity
					DZ	.06	Included: negativity
Narusyte et al. (2008)							
Emotional overinvolvement	Mother	Mother	Adolescent	254	MZ	.31	Excluded
				285	DZ	.14	Excluded
Narusyte et al. (2011)							
Parental criticism	Parent	Mother	Adolescent	256	MZ	.29	Included: negativity
			M = 15.9 years	283	DZ	.22	Included: negativity
		Father		125	MZ	.22	Included: negativity
				186	DZ	.11	Included: negativity
Twin Moms Project							
Neiderhiser et al. (2004)							
Positivity	Mother	Mother	11–21 years	150	MZ	.47	Included: warmth
				176	DZ	.19	Included: warmth
	Child				MZ	.32	Included: warmth
					DZ	.17	Included: warmth
	Observer				MZ	.24	Included: warmth
					DZ	.07	Included: warmth
Attempted control	Mother	Mother			MZ	.24	Included: control, averaged
					DZ	.25	Included: control, averaged
	Child				MZ	−.09	Included: control, averaged
					DZ	−.03	Included: control, averaged
Actual control	Mother	Mother			MZ	.12	Included: control, averaged
					DZ	.13	Included: control, averaged
	Child				MZ	−.10	Included: control, averaged
					DZ	.10	Included: control, averaged
Control	Observer	Mother			MZ	.15	Included: control, averaged
					DZ	.06	Included: control, averaged
Negativity	Mother	Mother			MZ	.41	Included: negativity
					DZ	.14	Included: negativity
	Child				MZ	.05	Included: negativity
					DZ	.06	Included: negativity
	Observer				MZ	.21	Included: negativity
					DZ	.22	Included: negativity
Virginia Twin Registry							
Kendler (1996)							
Warmth	Mother	Mother	4 years and older	145	MZ	.44	Included: warmth
				117	DZ	−.01	Included: warmth
Protectiveness	Mother	Mother			MZ	.48	Included: control, averaged
					DZ	.27	Included: control, averaged
Wade & Kendler (2000)							
Limit setting	Mother	Mother	4 years and older	146	MZ	.33	Included: control, averaged
				117	DZ	.08	Included: control, averaged
Physical discipline	Mother	Mother			MZ	.28	Included: negativity
					DZ	.11	Included: negativity

Note. ICC = intraclass correlation coefficient; AARP = American Association of Retired Persons; MZ = monozygotic twin pairs; DZ = dizygotic twin pairs; DZOS = opposite-sex dizygotic twin pairs; FS = full siblings; UR = unrelated sibling pairs.

left 10 scales for which there was rater disagreement (12% of all scales examined). In three of these cases, we relied upon factor-analytic results from the authors of the original work in order to determine scale placement. Of the remaining seven scales, majority consensus (three of the four raters agreed) was obtained in five cases. The final two cases were resolved via discussion. Scales assessing aspects of parental behavior other than warmth, control, or negativity (e.g., parental self-efficacy; Boivin et al., 2005) or assessing parental mood (e.g., positive mood; O'Connor, Hetherington, Reiss, & Plomin, 1995) were not included. Studies measuring the overall family environment rather than parental behavior per se were also not included (Herndon et al., 2005).

Inability to compute effect sizes. Consistent with prior meta-analyses of twin studies (Burt, 2009a, 2009b; Rhee & Waldman, 2002), the effect sizes used in this study were intraclass Pearson product–moment correlations. When intraclass Pearson product–moment correlations were not reported, the authors were contacted and asked to share these data. One study was excluded from our analyses because intraclass correlations were not reported and could not be calculated (Lytton, 1977). In this study, Lytton (1977) examined differences in the variance in parenting within MZ and DZ twins pairs ($N = 46$) in a child-based twin design. The results suggested that MZ twins are parented more similarly than are DZ twins, which is consistent with child-driven genetic influences on parenting (i.e., evocative rGE).

Nonindependent samples. Studies were also excluded from our analyses as a result of nonindependent sampling. Sample effect sizes were judged to be nonindependent for several reasons. Many authors examined more than one measure of a given phenotype within the same sample, either within publications (e.g., mother and child reports of positivity; Neiderhiser et al., 2004) or across multiple publications (e.g., other publications using the Nonshared Environment in Adolescent Development data set). This could take the form of multiple measures that could be grouped into the same parenting construct (e.g., multiple scales tapping parental warmth such as physical affection and responsiveness; Harlaar et al., 2008) or data from multiple informants examined separately (e.g., parent report, child report, and observer report).

There are several approaches for dealing with nonindependent data. Experts recommend averaging effect sizes of the different measures, selecting one measure (presumably the best measure using the largest sample) and omitting the others, or conducting separate meta-analyses (Lipsey & Wilson, 2001). We elected to average the effect sizes of different measures, as has been done in other recent behavioral genetic meta-analyses (Burt, 2009a, 2009b). We made this decision for several reasons. First, multiple informants and measures are quite common in these data. Within longitudinal data sets, because of attrition, the intake (or youngest) sample is typically the largest. Second, because questionnaires are less labor intensive to collect than are observer ratings, they are better represented in the data. Finally, because mothers are more likely than fathers to attend the testing session, maternal reports are more available than father reports. Given potential etiological differences across age, informant, and parent sex, we decided that simply choosing the largest sample size would be inappropriate. As such, we instead evaluated each sample according to the following rules. When nonindependent samples varied across age, informant report, and/or measure, we made use of weighted averages to compute the study effect size (i.e., the sample size was used to weight the contribution of a given effect size to the average effect size). This procedure allowed us to accommodate different sample sizes without biasing our results with the consistent selection of maternal reports, younger age, and questionnaire measures. If nonindependent samples contained multiple measures but did not vary by sample size, we then computed simple averages.

Analyses: Theoretical and Methodological Overview

The analyses employed within make use of the difference in the proportion of segregating genes shared between siblings (either reared apart or reared together). Using these differences, we partitioned the variance into three of four components: additive genetic (A), dominant genetic (D), shared environment (C), and nonshared environment plus measurement error (E). These variance components are discussed in some detail in the introduction. It is not possible to simultaneously estimate C and D in traditional decompositions of variance between siblings because these parameters are estimated with the same information. As such, only three of the four components can be estimated within a single model.

The equal-environments assumption is a critical component of twin methodology. It assumes that MZ twin pairs are no more likely to share the environmental factors that are etiologically relevant to the phenotype under study than DZ twin pairs. Under this assumption, any differences in MZ and DZ correlations are due to differences in their genetic similarity. The equal-environments assumption has been examined and found to be valid for numerous phenotypes (Cronk et al., 2002), although it has not been specifically evaluated in relation to the etiology of parenting. Adoption studies, by contrast, are susceptible to environmental range restriction, because adoptive parents are typically better educated, more affluent, and perhaps less prone to psychopathology than the entire population of parents. However, a recent study of the impact of this issue demonstrated that the range restriction present in adoptive families had no effect on adoptive-sibling similarity for several adolescent outcomes, including delinquency, drug use, and IQ (McGue et al., 2007). Still, it is unclear the extent to which environmental restriction of range may influence research examining the etiology of parenting.

In the present meta-analyses, the ACE and ADE models were fit to the data and were compared. We also fit reduced AE, DE, and CE models to determine the best fitting model for each parenting phenotype. Note that like the two-stage structural equation modeling method (Cheung & Chan, 2005), structural equation modeling is used both to effectively synthesize the observed correlation matrices and fit the proposed models, as outlined in detail by Rhee and Waldman (2002). This procedure includes the appropriate weighting of effect sizes by sample size.

Mx, a structural equation modeling program, was used to perform the model-fitting analyses (Neale, Boker, Xie, & Maes, 2003). Mx uses maximum likelihood model-fitting techniques to fit models to the observed correlation matrices (as done in Rhee & Waldman, 2002). The chi-square test statistic provides a goodness-of-fit index of the model to the observed correlation matrices. These chi-square values are then converted to the Akaike information criterion (AIC): AIC $= \chi^2 - (2^* df)$ (Akaike, 1987). AIC measures model fit relative to parsimony and is the most commonly employed fit index within the field of behavioral genetics. AIC is used to determine the best fitting model among a set of fitted models, with the lowest (or most negative) AIC considered the best. Using Mx, we computed 95% confidence intervals for all proportions of variance estimated in the model. These estimates enabled us to determine whether a specific variance estimate was significantly greater than zero (i.e., if the confidence interval does not overlap with zero, then the variance estimate is statistically significant).

Order of Analyses

We first estimated and compared the overall ACE and ADE models, separately for each phenotype and for both child-based and parent-based designs. The better fitting model, as indicated by a lower AIC value, is then presented and discussed. We next tested a series of reduced (constrained) models to determine whether particular variance components could be fixed to zero. A lower AIC and nonsignificant change in chi-square between the constrained and the unconstrained model indicates that the constrained model is the better fitting model. Results from the best fitting models are then presented.

Following our primary analyses, we examined a series of moderators of these effects. Moderators included parent sex (mothers vs. fathers), informant (child report, parent report, and observer report), age of children in child-based designs (child vs. adolescent), reporting time frame (current vs. retrospective reports of parenting), and study type (twin study vs. sibling/adoption study). When parent sex was examined as a potential moderator, analyses were restricted to those studies in which correlations were presented separately for mothers and fathers. For the parent-based designs, opposite-sex pairs were omitted for the sex moderation analyses, thereby allowing us to compute and compare estimates separately across mothers and fathers. When examining informant effects, we restricted analyses to three specific informant types: parent report on self, child report on parent, and observer ratings. When examining age as a potential moderator of the child-based results, we omitted those studies that spanned multiple age categories and those studies that made use of retrospective reports of recalled parenting from across development. For analyses examining the reporting time frame, we compared estimates from current reports of parenting to lifetime reports of adult twins recalling the parenting they received as children. Finally, for analyses comparing twin and nontwin designs, we compared twin correlations to all other sibling types (i.e., full siblings, half siblings, and unrelated siblings).

Results

Model-fitting results from child-based and parent-based designs are presented in Tables 3 and 4. For the child-based analyses (Table 3), the ACE model provided a better fit to the data than the ADE model across all three domains of parenting behavior. Reduced ACE models (i.e., AE and CE models) provided a uniformly worse fit to the child-based data, indicating that genetic and shared environmental influences contribute significantly to all three parenting phenotypes. Moreover, parameter estimates were largely similar across parental control, warmth, and negativity, collectively suggesting that A, C, and E all make moderate contributions to individual differences in parenting behavior (at least at the level of the children being parented). Genetic influences ranged from 23% to 40% of the variance, shared environmental influences ranged from 27% to 39% of the variance, and nonshared environmental influences ranged from 32% to 44% of the variance. The presence of moderate genetic influences across phenotypes is particularly noteworthy, as it offers confirmation of the importance of evocative rGE effects on parenting. Put differently, children's genetically influenced characteristics appear to shape, at least to some extent, the parenting they receive. Evocative genetic influences on parenting were significantly larger for negativity than for warmth and control, $\Delta\chi^2(1) \geq 32.32$, *p*s $< .01$, whereas shared environmental influences were largest for warmth, $\Delta\chi^2(1) \geq 6.43$, *p*s $\leq .01$, and nonshared environmental influences were largest for control, $\Delta\chi^2(1) \geq 88.68$, *p*s $< .01$.

Results from parent-based designs (see Table 4) were far less consistent across the various aspects of parenting behavior. The ADE model was the better fitting model for parental warmth, whereas the ACE model was the better fitting model for parental control and negativity. However, reduced models provided the best fit to the data in all three cases. The DE model was the best fitting model for warmth, the CE model was the best fitting model for control, and negativity was best represented by the AE model. Genetic estimates were moderate (28%–37%) for parental warmth and negativity, although as noted the type of genetic influences varied (i.e., warmth was influenced by dominant genetic influences, whereas negativity was influenced by additive genetic influences). Genetic estimates did not make significant contributions to parental control. For all three phenotypes, however, nonshared environmental influences accounted for the largest proportion of variance (63%–90%). The latter findings are consistent with the notion that at the level of the parent, parenting behaviors are largely a function of parents' unique experiences and circumstances (including their different spouses, adult socioeconomic conditions, and the characteristics of their children, as shown above). Of course, measurement error is also included in any estimate of nonshared environmental influences.

Table 3
Model Fit Statistics and Parameter Estimates From the Better Fitting Child-Based Models

Phenotype[a]	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC	Parameters from best fitting model		
Warmth	ACE	1118.52	54				1010.52[b]	A	0.26	0.23–0.29
	ADE	1815.32	54				1707.32	C	0.39	0.37–0.42
	AE	1815.32	55	696.80	1	<.01	1705.32	E	0.34	0.33–0.35
	CE	1416.66	55	298.14	1	<.01	1306.66			
Control	ACE	538.16	38				462.16[b]	A	0.23	0.19–0.28
	ADE	768.32	38				692.32	C	0.33	0.29–0.37
	AE	768.32	39	230.16	1	<.01	690.32	E	0.44	0.42–0.45
	CE	630.36	39	92.20	1	<.01	552.36			
Negativity	ACE	990.77	51				888.77[b]	A	0.40	0.37–0.44
	ADE	1289.55	51				1187.55	C	0.27	0.24–0.30
	AE	1289.55	52	298.78	1	<.01	1185.55	E	0.32	0.31–0.33
	CE	1533.83	52	543.06	1	<.01	1429.83			

Note. AIC = Akaike information criterion; A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment.
[a] Warmth, *n* = 19,637 sibling pairs in 19 samples; control, *n* = 8,992 sibling pairs in 15 samples; negativity, *n* = 20,064 sibling pairs in 15 samples. [b] Best fitting model.

Table 4
Model Fit Statistics and Parameter Estimates From the Better Fitting Parent-Based Models

Phenotype[a]	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC	Parameters from best fitting model		
Warmth	ACE	19.54	14				−8.46	D	0.37	0.31–0.42
	ADE	14.49	14				−13.51	E	0.63	0.59–0.68
	AE	19.54	15	5.05	1	.02	−10.46			
	CE	62.45	15	47.96	1	<.01	32.45			
	DE	14.77	15	0.28	1	*ns*	−15.23[b]			
Control	ACE	33.99	14				5.99	C	0.10	0.06–0.14
	ADE	35.57	14				7.57	E	0.90	0.85–0.96
	AE	35.57	15	1.98	1	*ns*	5.57			
	CE	34.05	15	0.04	1	*ns*	4.05[b]			
	E	55.68	16	24.76	2	<.01	23.68			
Negativity	ACE	5.76	13				−20.24	A	0.28	0.22–0.34
	ADE	6.21	13				−19.79	E	0.72	0.67–0.78
	AE	6.21	14	0.00	1	*ns*	−21.79[b]			
	CE	13.25	14	7.49	1	<.01	−14.75			
	DE	12.79	14	6.58	1	*ns*	−15.21			
	E	98.55	15	92.34	2	<.01	68.55			

Note. AIC = Akaike information criterion; A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment.
[a] Warmth, n = 2,196 sibling pairs in six samples; control, n = 2,514 sibling pairs in six samples; negativity, n = 2,230 sibling pairs in six samples. [b] Best fitting model.

Parent Sex

Parameter estimates were computed separately for mothers and fathers and then constrained to be equal across parent sex. The fit indices and parameter estimates are presented in Tables 5 and 6, respectively. Child-based results are also depicted in Figure 2. Results from the child-based analyses suggested that the parental sex differences model was the better fitting model across all three parenting phenotypes (i.e., estimates could not be constrained to be equal across mothers and fathers). Parameter estimates from the better fitting parental sex differences models indicated that genetic influences on maternal control and negativity were larger than genetic influences on paternal control and negativity. These differences were statistically significant: control (maternal A = 36%; paternal A = 15%), $\Delta\chi^2(1) = 20.68$, $p < .01$; negativity (maternal A = 51%; paternal A = 28%), $\Delta\chi^2(1) = 38.55$, $p < .01$. Conversely, fathering was influenced to a significantly greater extent by shared environmental factors than mothering: warmth (maternal C = 26%; paternal C = 34%), $\Delta\chi^2(1) = 6.44$; control (maternal C = 20%; paternal C = 47%), $\Delta\chi^2(1) = 49.91$; negativity (ma-

Table 5
Model Fit Statistics for Maternal and Paternal Warmth, Control, and Negativity

Phenotype	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC
			Child based				
Warmth	Sex differences ACE	1141.57	62				1017.57[a]
	Constrained ACE	1192.46	65	50.89	3	<.01	1062.46
Control	Sex differences ACE	1113.50	41				1031.50[a]
	Constrained ACE	1231.98	44	118.48	3	<.01	1143.98
Negativity	Sex differences ACE	1343.55	43				1257.55[a]
	Constrained ACE	1394.02	46	50.47	3	<.01	1302.02
			Parent based				
Warmth	Sex differences ADE	5.72	5				−4.28
	Constrained ADE	10.79	8	5.07	3	*ns*	−5.21
	Sex differences DE	8.52	7	2.80	2	*ns*	−5.48
	Constrained DE	11.21	9	0.41	2	*ns*	−6.80[a]
Control	Sex differences ACE	18.18	5				8.18
	Constrained ACE	21.15	8	2.97	3	*ns*	5.15
	Sex differences CE	18.40	7	0.23	2	*ns*	4.40
	Constrained CE	21.15	9	0.00	2	*ns*	3.15[a]
Negativity	Sex differences ACE	3.11	5				−6.89
	Constrained ACE	3.45	8	0.34	3	*ns*	−12.55
	Sex differences AE	3.62	7	0.51	2	*ns*	−10.38
	Constrained AE	3.64	9	0.53	2	*ns*	−14.36[a]

Note. AIC = Akaike information criterion; A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment.
[a] Best fitting model.

Table 6
Parameter Estimates for Maternal and Paternal Warmth, Control, and Negativity

Phenotype	Parent	A	95% CI	D	95% CI	C	95% CI	E	95% CI
				Child based					
Warmth	Mother	0.35	[0.30, 0.40]			0.26	[0.22, 0.31]	0.38	[0.37, 0.40]
	Father	0.34	[0.29, 0.39]			0.34	[0.30, 0.39]	0.32	[0.30, 0.33]
Control	Mother	0.36	[0.29, 0.42]			0.20	[0.14, 0.25]	0.45	[0.42, 0.47]
	Father	0.15	[0.10, 0.21]			0.47	[0.42, 0.52]	0.38	[0.36, 0.40]
Negativity	Mother	0.51	[0.47, 0.56]			0.17	[0.13, 0.20]	0.32	[0.31, 0.34]
	Father	0.28	[0.22, 0.34]			0.38	[0.32, 0.43]	0.34	[0.33, 0.37]
				Parent based					
Warmth[a]	Mother			0.39	[0.33, 0.46]			0.61	[0.55, 0.67]
	Father			0.30	[0.20, 0.41]			0.69	[0.60, 0.81]
Control[a]	Mother					0.07	[0.01, 0.12]	0.93	[0.87, 1.01]
	Father					0.06	[0.00, 0.15]	0.84	[0.75, 0.96]
Negativity[a]	Mother	0.27	[0.20, 0.34]					0.73	[0.67, 0.80]
	Father	0.26	[0.11, 0.42]					0.74	[0.60, 0.91]

Note. A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment; CI = confidence interval.
[a] Estimates can be constrained to be equal across mothers and fathers.

ternal C = 17%; paternal C = 38%), $\Delta\chi^2(1) = 43.99$, *ps* < .01. Nonshared environmental estimates could be constrained for negativity; however, the estimates for mothers were larger than for fathers for warmth and control: warmth (maternal E = 38%; paternal E = 32%), $\Delta\chi^2(1) = 30.37$; control (maternal E = 45%; paternal E = 38%), $\Delta\chi^2(1) = 19.39$, *ps* < .01. Such results collectively indicate that mothers are more responsive to their children's genetically influenced characteristics and/or other individual characteristics. Fathers, by contrast, are more influenced by shared family characteristics.

Results from the parent-based analyses (see Tables 5 and 6), by contrast, indicated that estimates can be constrained to be equal across mothers and fathers for all phenotypes. Such results indicate that although mothers and fathers do appear to be differentially responsive to their children's genetically influenced characteristics, the parent-level etiologic influences on parenting do not differ across mothers and fathers.

Informant

We computed parameter estimates separately for parent, child, and observer reports of parenting and then constrained these estimates to be equal across informants (fit statistics and parameter estimates are presented in Tables 7 and 8, respectively). The informant differences model was the best fitting model across all three phenotypes in the child-based designs. For parental warmth, genetic influences were significantly larger for child reports than for parent and observer reports (41% of the variance compared to 26% and 0% of the variance), $\Delta\chi^2(1) \geq 21.60$, *ps* < .01. In addition, estimates of shared environment influences on warmth were significantly smaller for child reports (19% of the variance compared to 53% and 51%), $\Delta\chi^2(1) \geq 57.13$, *ps* < .01. The pattern of results differed somewhat for control. Most strikingly, estimates of A for parent reports were significantly smaller (7% of the variance compared to 28% and 23%), $\Delta\chi^2(1) \geq 4.90$, *p* < .03, whereas estimates of C were significantly larger (83% of the variance compared to 25% and 26%), $\Delta\chi^2(1) \geq 94.81$, *ps* < .01. For parental negativity, estimates of genetic influences (36%, 45%, and 13% for child reports, parent reports, and observer ratings, respectively) were significantly smaller for observer ratings, $\Delta\chi^2(1) \geq 7.84$, *ps* < .01. In addition, estimates of the shared environment were significantly smaller for child reports (22%) than for parent and observer reports (33% and 37%), $\Delta\chi^2 \geq 5.03$, $p \leq .03$. Across all phenotypes, parent reports yielded the lowest estimates for the nonshared environment: warmth (20% of the variance compared to 40% and 49%), $\Delta\chi^2(1) \geq 328.26$, *ps* < .01; control (10% compared to 47% and 51%), $\Delta\chi^2(1) \geq 438.28$, *ps* < .01; negativity (22% compared to 42% and 51%), $\Delta\chi^2(1) \geq 103.14$, *p* < .01. Despite important differences across informants, nearly all parameter estimates were significant across all informants (with the exception of observer-rated genetic influences on warmth and negativity).

For the parent-based analyses, parameter estimates could be constrained to be equal across child informant reports, parental self-reports, and observer ratings for both parental warmth and parental control. However, estimates could not be constrained to be equal across child and parent reports of parental negativity. Parent reports of negativity suggested stronger additive genetic influences (24%) than child reports (11%), $\Delta\chi^2(1) = 4.82$, *p* = .03, although genetic influences were significant in both cases. Larger nonshared environmental influences were observed for child informant reports than for parental self-reports.

Child Age

Parameter estimates were computed separately for preadolescent and adolescent children within child-based designs (results are presented in Table 9; we were unable to conduct such analyses within parent-based designs given the very broad range in child ages in most of those studies). Model-fitting results indicated that the age differences model was the best fitting model across all three parenting phenotypes. Parameter estimates (presented in Table 10 and Figure 3) revealed that nonshared environmental influences increased from childhood to adolescence for all three phenotypes: warmth (29%–41%), $\Delta\chi^2(1) = 63.17$; control (30%–

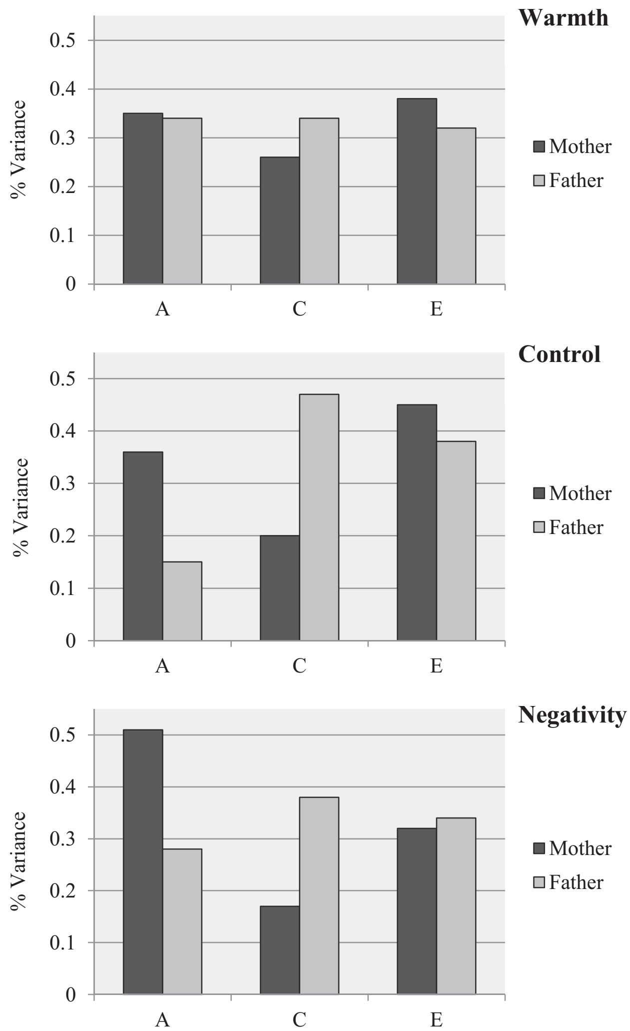

Figure 2. Child-based etiology of parenting for mothers and fathers. A = additive genetic; C = shared environment; E = nonshared environment.

46%), $\Delta\chi^2(1) = 28.11$; negativity (24%–43%), $\Delta\chi^2(1) = 219.89$, *ps* $< .01$; whereas shared environmental influences decreased for warmth (52%–38%), $\Delta\chi^2(1) = 14.78$, and control (52%–33%), $\Delta\chi^2(1) = 7.94$, *ps* $< .01$. Genetic influences remained largely stable for both warmth and control but were found to decrease for negativity (44%–29%), $\Delta\chi^2(1) = 14.06$, $p < .01$.

Retrospective Versus Current Reports

Several child-based studies made use of retrospective lifetime reports of parenting ($N = 3{,}982$ pairs from four unique samples), rather than current reports. To assess potential differences associated with reporting windows, we computed parameter estimates separately for current versus retrospective reports of parenting and then constrained these parameters to be equal. The model-fitting results (presented in Table 11) indicated that parameter estimates differed between current and retrospective reports of parenting across all three phenotypes. As seen in Table 12, genetic estimates were uniformly larger for retrospective lifetime reports (30%–47%) than for current reports (21%–39%), although the difference was only significant for warmth, $\Delta\chi^2(1) = 35.96$, $p < .01$. Conversely, shared environmental estimates were larger for current reports (29%–46%) than for lifetime retrospective reports (21%–25%), although this difference was only significant for warmth and control, $\Delta\chi^2(1) \geq 7.19$, *ps* $< .01$.

Study Type

To examine potential differences between twin studies and studies utilizing full, half, and/or unrelated siblings, we compared parameter estimates across twin studies and nontwin studies. The model-fitting results (see Table 13) indicated that we could constrain estimates to be equal across study type for control and negativity without a significant decrement in model fit. The parameter estimates are presented in Table 14. Results could not be constrained for warmth, however. Genetic influences were smaller in twin studies than other design types, although this difference was not statistically significant. Shared environmental influences were significantly larger in twin families (41% vs. 32%), $\Delta\chi^2(1) = 5.04$, $p = .02$. These results largely indicate that our overall findings are not unduly influenced by the unique experience of raising twin children (although there may be some differences in the etiology of warmth in twin families) and thus lend further support to the overall etiological patterns noted above.

Sensitivity Analyses

To examine whether our results were unduly influenced by a few very large samples, we dropped the largest sample from each of the child-based and parent-based analyses, respectively, and compared these results to the results from the full samples. The model-fitting results (presented in Table 15) did not change for the child-based models (i.e., the ACE models continued to provide the best fit to the data). Inspection of the parameter estimates from these models (presented in Table 16) confirmed these impressions. The heritability estimates were quite similar (i.e., within 5% or less) regardless of whether the largest sample was included in the analyses. As one might expect, given the smaller number of samples in the parent-based analyses, dropping the largest sample ($N = 1{,}117$ twin pairs; Pérusse et al., 1994) did result in a change of best fitting model for both warmth and control (see Table 17). For warmth, the best fitting model from the reduced sample was the AE rather than the DE model. Of note, however, the magnitude of those genetic effects was essentially identical (see Table 18). For control, the best fitting model from the reduced sample was the AE rather than the CE model. As noted, these changes are not all that surprising given the relatively small number of parent-based samples and highlight the need for additional parent-based research to clarify etiological estimates.

Discussion

The primary goal of this meta-analysis was to quantitatively synthesize genetically informed studies of human parenting, in order to more definitely catalogue the magnitude of the genetic and environmental effects underlying individual differences in parenting. We collected 47 child-based and nine parent-based twin and family studies of the etiology of parenting, with a focus on parental warmth,

Table 7
Model Fit Statistics for Informant Reports of Warmth, Control, and Negativity

Phenotype	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC
			Child based				
Warmth	Informant differences ACE	891.22	70				751.22[a]
	Constrained ACE	1902.21	76	1010.99	6	<.01	1750.21
Control	Informant differences ACE	259.39	40				179.39[a]
	Constrained ACE	1564.87	46	1305.48	6	<.01	1472.87
Negativity	Informant differences ACE	890.86	61				768.86[a]
	Constrained ACE	1417.56	67	526.70	6	<.01	1283.56
			Parent based				
Warmth	Informant differences ADE	22.45	17				−11.55
	Constrained ADE	28.80	23	6.35	6	*ns*	−17.21
	Informant differences DE	27.05	20	4.60	3	*ns*	−12.95
	Constrained DE	32.31	24	3.52	1	*ns*	−15.69
	Informant differences AE	23.24	20	0.79	3	*ns*	−16.76
	Constrained AE	29.10	24	0.30	1	*ns*	−18.91[a]
Control	Informant differences ACE	46.13	14				18.13
	Constrained ACE	54.48	20	8.35	6	*ns*	14.48
	Informant differences CE	46.78	17	0.64	3	*ns*	12.78
	Constrained CE	54.49	21	0.01	1	*ns*	12.49[a]
Negativity	Informant differences ACE	8.95	13				−17.05
	Constrained ACE	23.57	16	14.62	3	<.01	−8.43
	Informant differences AE	9.13	15	0.18	2	*ns*	−20.87[a]
	Constrained AE	23.57	17	0.00	1	*ns*	−10.43

Note. AIC = Akaike information criterion; A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment.
[a] Best fitting model.

parental control, and parental negativity. We then conducted a series of meta-analyses using 27 child-based and six parent-based independent samples. Results supported the role of both genetic and environmental influences on parenting behavior. Moreover, these effects appear to occur at both the level of the child who is being parented and the level of the parent who is providing the parenting.

The child-based analyses indicated that genetic, shared environmental, and nonshared environmental influences at the level of the child all make significant and moderate contributions to parenting. Importantly, they do so regardless of the aspect of parenting under study. Moreover, these results largely persisted across twin and sibling/adoption study types, indicating that the above results are not a

Table 8
Parameter Estimates for Warmth, Control, and Negativity by Informant

Phenotype	Informant	A	95% CI	C	95% CI	E	95% CI
				Child based			
Warmth	Child	0.41	[0.36, 0.46]	0.19	[0.15, 0.24]	0.40	[0.38, 0.41]
	Parent	0.26	[0.16, 0.25]	0.53	[0.49, 0.56]	0.20	[0.20, 0.21]
	Observer	0.00	[0.00, 0.05]	0.51	[0.46, 0.56]	0.49	[0.46, 0.53]
Control	Child	0.28	[0.22, 0.34]	0.25	[0.20, 0.30]	0.47	[0.45, 0.49]
	Parent	0.07	[0.04, 0.09]	0.83	[0.77, 0.90]	0.10	[0.09, 0.11]
	Observer	0.23	[0.09, 0.37]	0.26	[0.16, 0.37]	0.51	[0.45, 0.58]
Negativity	Child	0.36	[0.31, 0.42]	0.22	[0.17, 0.26]	0.42	[0.40, 0.44]
	Parent	0.44	[0.41, 0.48]	0.33	[0.30, 0.37]	0.22	[0.21, 0.23]
	Observer	0.13	[0.00, 0.28]	0.37	[0.25, 0.48]	0.51	[0.43, 0.60]
				Parent based			
Warmth[a]	Child	0.22	[0.13, 0.33]			0.69	[0.60, 0.79]
	Parent	0.29	[0.24, 0.34]			0.62	[0.58, 0.67]
	Observer	0.14	[0.00, 0.28]			0.77	[0.64, 0.94]
Control[a]	Child			0.01	[0.00, 0.09]	0.99	[0.89, 1.08]
	Parent			0.13	[0.09, 0.18]	0.87	[0.82, 0.92]
	Observer			0.10	[0.00, 0.21]	0.90	[0.77, 1.05]
Negativity	Child	0.11	[0.003, 0.21]			0.89	[0.78, 1.00]
	Parent	0.24	[0.18, 0.30]			0.67	[0.62, 0.73]

Note. A = additive genetic; C = shared environment; E = nonshared environment; CI = confidence interval.
[a] Estimates could be constrained to be equal across informants.

Table 9
Model Fit Statistics for Warmth, Control, and Negativity During Childhood and Adolescence

Phenotype	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC
Warmth	Age differences ACE	716.13	30				656.13[a]
	Constrained ACE	850.50	33	134.37	3	<.01	784.50
Control	Age differences ACE	380.30	25				344.30[a]
	Constrained ACE	708.45	28	328.15	3	<.01	658.45
Negativity	Age differences ACE	531.22	41				449.22[a]
	Constrained ACE	801.79	44	270.57	3	<.01	713.79[a]

Note. Child-based analysis only. AIC = Akaike information criterion; A = additive genetic; C = shared environment; E = nonshared environment.
[a] Best fitting model.

function of the unique experience of raising twins. Such findings strongly suggest that children's genetically influenced characteristics influence the parenting they receive, further highlighting both the bidirectional nature of the parent–child relationship and the role of rGE.

The results of the child-based analyses also highlighted a role for characteristics of the parent in the etiology of parenting, via the significance of the shared environment. Although the importance of the shared environment has often been overlooked within the field of behavioral genetics, there has been a resurgence of interest in, and a recognition of the importance of, shared environmental effects (Burt, 2009b). Shared environmental influences on parenting at the level of the child include such potentially important factors as the family's socioeconomic status, neighborhood characteristics, and culture. However, they also include the effects of parental characteristics (e.g., parent personality and other genetically influenced characteristics), at least to the extent that these characteristics create similarities in parenting across children regardless of the siblings' genetic relatedness.

The results of the parent-based analyses augment both of these conclusions. Parenting at the level of the parent was influenced primarily by the nonshared environment, which includes such factors as siblings' spouses (and coparents), the quality of the marital relationships, the characteristics of their children (including most genetically influenced characteristics), their independent educational and vocational experiences, peer groups, and the characteristics of the neighborhood in which they are raising their children. Moreover, there was also evidence of genetic influences on parenting at the level of the parent, in that parental genetic influences were found to influence both warmth and negativity. Such findings not only suggest that parental genes exert an influence on parenting behavior, but also provide a possible candidate for the shared environmental influences on parenting uncovered in the child-based design (because genetic influences at the level of the parent should be constant across full siblings). Future work, perhaps via molecular genetic studies, could illuminate whether these genetic effects are direct (via genetic influences on parental behavior) or indirect (via genetic influences on parental personality and psychopathology).

Limitations

Construct definition. One key limitation of the current meta-analysis relates to the relative lack of measurement consistency in the parenting literature. Although the three-factor structure favored here is fully consistent with prior empirical examinations of parenting (Neiderhiser et al., 2007, 2004), other factor structures of parenting have also been proposed (Metzler, Biglan, Ary, & Li, 1998; Shucksmith, Hendry, & Glendinning, 1995). Even so, we would argue that our focus on warmth, control, and negativity enabled us to maximize predictive validity (as warmth, control, and negativity have all been independently associated with important child outcomes), while also allowing us to maximize the number of studies included in our analyses, particularly in light of the broad range of constructs examined within the parenting literature.

Additional quandaries arise when comparing parenting across developmental stages. At the phenotypic level, parenting is highly likely to differ in meaningful ways with the age of the child. For example, parental warmth may include physically affectionate behaviors such as tickling and cuddling when the child in question is young, but not when that same child is in late adolescence. It is unclear whether these changes are best conceptualized as an example of heterotypic continuity (Kagan,

Table 10
Parameter Estimates for Warmth, Control, and Negativity by Child Age

Phenotype	Age	A	95% CI	C	95% CI	E	95% CI
Warmth	Childhood	0.19	[0.15, 0.22]	0.52	[0.48, 0.56]	0.29	[0.28, 0.30]
	Adolescence	0.21	[0.14, 0.28]	0.38	[0.32, 0.44]	0.41	[0.38, 0.44]
Control	Childhood	0.18	[0.07, 0.29]	0.52	[0.41, 0.63]	0.30	[0.27, 0.34]
	Adolescence	0.21	[0.12, 0.30]	0.33	[0.26, 0.40]	0.46	[0.42, 0.50]
Negativity	Childhood	0.44	[0.40, 0.49]	0.31	[0.27, 0.36]	0.24	[0.23, 0.26]
	Adolescence	0.29	[0.23, 0.36]	0.28	[0.22, 0.33]	0.43	[0.41, 0.46]

Note. Child-based analysis only. A = additive genetic; C = shared environment; E = nonshared environment; CI = confidence interval.

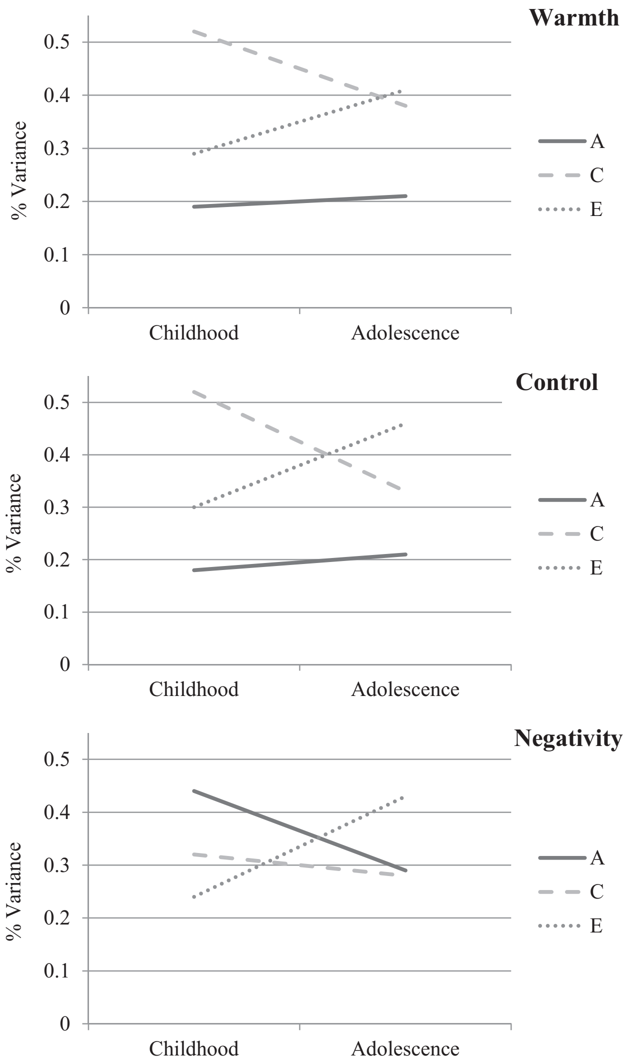

Figure 3. Child-based etiology of parenting for children and adolescents. A = additive genetic; C = shared environment; E = nonshared environment.

1969, 1971), whereby the underlying processes of parenting remain the same while the outward manifestations of these processes change over time, or whether the underlying processes also shift across development. We assume heterotypic continuity in our analyses comparing parenting in childhood and adolescence, but additional research is needed to elucidate the best ways to conceptualize and measure changes in parenting over time.

The parenting behaviors of interest in this study are particularly relevant for social, behavioral, and emotional development. More basic caretaking behaviors necessary for survival (e.g., providing food and shelter) were not examined here. Moreover, the current study focused on the normal range of parenting behavior and did not generally examine abuse or neglect (only one included study used a measure of abuse, Harlaar et al., 2008; items measuring abuse included "verbally abusive of me," "unpredictable toward me," "physically violent or abusive of me," "made me feel in danger," and "made me feel unsafe," used in a retrospective design). Additional research is needed to uncover the etiology of more basic human caretaking behaviors as well as the extremes of abuse and neglect.

Use of maximum likelihood estimation. These model-fitting analyses assume that the variables under study are normally distributed, an assumption that holds in most, but not all, of the data under examination. Many studies included in these analyses indicated that their data were normally distributed (e.g., McGue et al., 2005; Wade & Kendler, 2000). Of note, however, there was evidence of skew in some of the negativity data (e.g., hostile-reactive behaviors; Boivin et al., 2005). This difference is important because when the normal distribution assumption is violated, weighted least squares estimation is preferable to maximum likelihood estimation for obtaining asymptotically correct standard errors and chi-square fit statistics (see Rhee & Waldman, 2002, for a more detailed discussion). Unfortunately, weighted least squares estimation requires weight matrices (i.e., variance–covariance matrices), and we were limited to examining published data (i.e., intraclass correlations) that do not include weight matrices. Because parameter estimates based on correlations rather than on weight matrices may slightly overestimate genetic influences at the expense of estimates of the shared environment (Rhee & Waldman, 2002), we have somewhat less confidence in the estimates of genetic influence on negativity. Future work should seek to clarify these findings with weight matrices.

The small number of parent-based studies. Because there were fewer examinations of the etiology of parenting at the parent-based level than at the child-based level, our parent-based meta-analytic results are less certain than those at the child-based level (as highlighted in the parent-based sensitivity analyses). Perhaps even more important, parent-based studies generally examined

Table 11
Model Fit Statistics for Warmth, Control, and Negativity in Retrospective Versus Current Reports of Parenting

Phenotype	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC
Warmth	Retrospective differences ACE	990.89	51				888.89[a]
	Constrained ACE	1118.52	54	127.63	3	<.01	1010.52
Control	Retrospective differences ACE	527.54	29				469.54[a]
	Constrained ACE	549.22	32	21.68	3	<.01	485.22
Negativity	Retrospective differences ACE	987.21	60				867.21
	Constrained ACE	990.77	63	3.56	3	*ns*	864.77[a]

Note. Child-based analysis only. AIC = Akaike information criterion; A = additive genetic; C = shared environment; E = nonshared environment.
[a] Best fitting model.

Table 12
Parameter Estimates for Warmth, Control, and Negativity for Current and Retrospective Reports of Parenting

Phenotype	Age	A	95% CI	C	95% CI	E	95% CI
Warmth	Current	0.21	[0.18, 0.25]	0.46	[0.43, 0.49]	0.33	[0.31, 0.34]
	Retrospective	0.43	[0.37, 0.49]	0.21	[0.15, 0.26]	0.37	[0.35, 0.39]
Control	Current	0.22	[0.15, 0.29]	0.37	[0.31, 0.43]	0.41	[0.38, 0.44]
	Retrospective	0.30	[0.23, 0.37]	0.25	[0.19, 0.32]	0.45	[0.43, 0.48]
Negativity	Current	0.39	[0.35, 0.43]	0.29	[0.25, 0.32]	0.32	[0.31, 0.34]
	Retrospective	0.47	[0.39, 0.56]	0.21	[0.14, 0.29]	0.32	[0.29, 0.34]

Note. Child-based analysis only. A = additive genetic; C = shared environment; E = nonshared environment; CI = confidence interval.

siblings without regard to the age of their children. As such, it is fully possible that one sibling was parenting a 3-year-old while the other was parenting a teenager. This discrepancy is likely to increase estimates of E and might camouflage more prominent genetic or shared environmental effects that may be evident when comparing siblings who are parenting children of the same age. Future research should seek to develop more finely tuned analyses of parenting at the parent-based level.

The limits of quantitative genetic designs. Although twin and adoption studies are well established in behavioral genetic and psychological research, quantitative genetic approaches have come under criticism (Charney, 2008, 2012). Most recently, it has been noted that a decade of molecular genetic research has not recovered the high heritability estimates typically obtained with quantitative genetic approaches (commonly referred to as the "missing heritability" problem; Maher, 2008; Turkheimer, 2011), a finding that has led some to conclude that quantitative heritability estimates may be inflated (Joseph, 2012). Fortunately, the recently developed genome-wide complex-trait analysis approach has shed some light on this issue, recovering heritability estimates from additive single-nucleotide polymorphism similarity profiles that approach estimates obtained from traditional twin and adoption designs and thus providing additional support for the validity of the twin and adoption study approach (Plomin, 2012; Yang, Lee, Goddard, & Visscher, 2011). Even so, there are limitations of the quantitative genetic approach. For example, although our results highlight the role of both shared and nonshared environmental factors, we are only able to speculate about the specific environmental variables comprising these effects. In addition, our analyses do not directly index epigenetic processes (Wolffe & Matzke, 1999) or gene–environment interactions (Cicchetti, 2007). Because of the exclusion of epigenetics and gene–environment interactions, estimates from traditional biometric models are considered approximations of genetic and environmental effects (McGue, 2010). Despite the inherently descriptive nature of quantitative genetics, however, the current result nevertheless provides a solid framework from which to understand the determinants of parenting, a framework that can be pursued with an array of methodological approaches across various levels of analysis. Establishing the relative contributions of genetic and environmental factors to parenting is in no way the final step in understanding the etiology of parenting. Rather, now that genetic and environmental contributions to parenting are more established, it would be crucial to specifically identify the genetic and environmental processes that underlie these estimates and ultimately to understand how genetic and environmental factors interact. Our expectation is that our findings will inspire renewed interest in this critical area of inquiry.

Implications and Future Directions

Genetic influences on parenting. The results of this meta-analysis confirm previous findings of genetic influences on parenting while also shedding light on the nature of these genetic effects. Significant genetic influences at the level of the child are consistent with evocative rGE effects, such that children's genetically influenced characteristics shape the parenting they receive (O'Connor, Deater-Deckard, Fulker, Rutter, & Plomin, 1998). In short, the current findings bolster prior work indicating that children are not passive recipients of parenting, but rather appear to be active participants in this experience. In addition, these findings highlight what Plomin and others have dubbed "the nature of nurture" (Plomin & Bergeman, 1991), namely, that many environmental or nurture experiences are at least partially heritable be-

Table 13
Model Fit Statistics for Warmth, Control, and Negativity for Twin Studies Versus Other Study Types

Phenotype	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC
Warmth	Design differences ACE	1108.44	51				1006.44[a]
	Constrained ACE	1118.52	54	10.08	3	.02	1010.52
Control	Design differences ACE	536.81	35				466.81
	Constrained ACE	538.16	38	1.35	3	*ns*	462.16[a]
Negativity	Design differences ACE	990.13	60				870.13
	Constrained ACE	996.44	63	6.31	3	*ns*	870.44[a]

Note. Child-based analysis only. Other study design types include full siblings, half siblings, siblings in divorced families, and unrelated siblings. AIC = Akaike information criterion; A = additive genetic; C = shared environment; E = nonshared environment.
[a] Best fitting model.

Table 14
Parameter Estimates for Warmth, Control, and Negativity for Twin Study and Other Study Types

Phenotype	Age	A	95% CI	C	95% CI	E	95% CI
Warmth	Twin study	0.24	[0.21, 0.27]	0.41	[0.38, 0.44]	0.35	[0.34, 0.36]
	Other	0.32	[0.12, 0.52]	0.32	[0.24, 0.40]	0.36	[0.21, 0.53]
Control	Twin study	0.25	[0.20, 0.30]	0.32	[0.27, 0.36]	0.44	[0.42, 0.45]
	Other	0.23	[0.00, 0.48]	0.36	[0.25, 0.46]	0.41	[0.25, 0.58]
Negativity	Twin study	0.39	[0.35, 0.43]	0.29	[0.25, 0.32]	0.33	[0.31, 0.34]
	Other	0.21	[0.03, 0.40]	0.31	[0.23, 0.38]	0.48	[0.35, 0.62]

Note. Child-based analysis only. Other study design types include full siblings, half siblings, siblings in divorced families, and unrelated siblings. A = additive genetic; C = shared environment; E = nonshared environment; CI = confidence interval.

cause these experiences are associated with and/or elicited by genetically influenced characteristics of individuals (Kendler & Baker, 2007).

Although such findings make a compelling case for the role of evocative rGE in parental behavior, it is worth noting that neither the particular genes of interest nor the particular child behaviors evoking parental behavior are as yet fully identified. Recent efforts have begun this sort of work. Klahr et al. (2013), for example, found that evocative influences on parental control appear to operate in part through children's dominant and submissive behaviors. Other work has begun to identify specific genes that may underlie these evocative rGE, including the dopamine receptor gene DRD2 (Hayden et al., 2010; Lucht et al., 2006; Mills-Koonce et al., 2007; Propper et al., 2008). Future research should seek to further identify both the child genes and the child behaviors that act to shape parental warmth, control, and negativity.

In addition to the genetic effects of the child, parent-level genetic effects were observed for parental warmth and negativity. Given the many etiological factors that could influence parenting at the level of the parent, including spouse or coparent characteristics, child characteristics, and sociocultural factors, the confirmation of parent-driven genetic influences on parenting is particularly noteworthy. These results are also consistent with the handful of molecular genetic studies identifying genetic effects on parenting (Bakermans-Kranenburg & van IJzendoorn, 2008; Burkhouse, Gibb, Coles, Knopik, & McGeary, 2011; Lee et al., 2010; Mileva-Seitz et al., 2011; Prichard, Mackinnon, Jorm, & Easteal, 2007; van IJzendoorn, Bakermans-Kranenburg, & Mesman, 2008). Nevertheless, the mechanisms through which these genetic effects influence parental behavior in humans remain largely unknown. Parent genes may directly influence parenting via biological pathways specific to parental behavior (e.g., via hormonal pathways

Table 15
Model Fit Statistics for Child-Based Warmth, Control, and Negativity, Dropping the Largest Sample

Phenotype	Design	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC
Warmth	Full sample (*n* = 19,637 pairs)	ACE	1118.52	54				1010.52[a]
		ADE	1815.32	54				1707.32
		AE	1815.32	55	696.80	1	<.01	1705.32
		CE	1416.66	55	298.14	1	<.01	1306.66
	Without Knafo (*n* = 14,287 pairs)	ACE	845.28	49				747.28[a]
		ADE	1187.69	49				1089.69
		AE	1187.69	50	342.41	1	<.01	1087.69
		CE	1065.29	50	220.01	1	<.01	965.29
Control	Full sample (*n* = 11,260 pairs)	ACE	538.16	38				462.16[a]
		ADE	768.32	38				692.32
		AE	768.32	39	230.16	1	<.01	690.32
		CE	630.36	39	92.20	1	<.01	552.36
	Without Harlaar (*n* = 8,110 pairs)	ACE	842.80	36				770.80[a]
		ADE	1045.52	36				973.52
		AE	1045.52	37	202.72	1	<.01	971.52
		CE	959.05	37	116.25	1	<.01	885.05
Negativity	Full Sample (*n* = 20,064 pairs)	ACE	990.77	51				888.77[a]
		ADE	1289.55	51				1187.55
		AE	1289.55	52	298.78	1	<.01	1185.55
		CE	1533.83	52	543.06	1	<.01	1429.83
	Without Knafo (*n* = 14,709 pairs)	ACE	895.36	48				803.36[a]
		ADE	1229.31	48				1133.31
		AE	1229.31	49	333.95	1	<.01	1131.31
		CE	1456.90	49	561.54	1	<.01	1358.90

Note. AIC = Akaike information criterion; A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment; Knafo = Knafo & Plomin (2006); Harlaar = Harlaar et al. (2008).
[a] Best fitting model.

Table 16
Parameter Estimates for Warmth, Control, and Negativity for Child-Based Sensitivity Analyses

Phenotype	Design	A	95% CI	C	95% CI	E	95% CI
Warmth	Full sample	0.26	[0.23, 0.29]	0.39	[0.37, 0.42]	0.34	[0.33, 0.35]
	Without Knafo	0.28	[0.25, 0.33]	0.34	[0.30, 0.37]	0.38	[0.37, 0.39]
Control	Full sample	0.23	[0.19, 0.28]	0.33	[0.29, 0.37]	0.44	[0.42, 0.45]
	Without Harlaar	0.26	[0.21, 0.31]	0.31	[0.27, 0.35]	0.42	[0.41, 0.44]
Negativity	Full sample	0.40	[0.37, 0.44]	0.27	[0.24, 0.30]	0.32	[0.31, 0.33]
	Without Knafo	0.35	[0.31, 0.40]	0.29	[0.25, 0.32]	0.36	[0.34, 0.37]

Note. A = additive genetic; C = shared environment; E = nonshared environment; CI = confidence interval; Knafo = Knafo & Plomin (2006); Harlaar = Harlaar et al. (2008).

that are activated in pregnancy; Corter & Fleming, 1995). Alternatively, parent genes may indirectly influence parenting behavior via genetically mediated effects on parental personality, psychopathology, and/or cognitive factors, all of which have been associated with parental behavior (Azar, Reitz, & Goslin; Clark, et al., 2000; Jaffee et al., 2006; Leung & Slep, 2006). Critically, however, the one study examining the etiology of the overlap between parenting and personality (Spinath & O'Connor, 2003) found that the overlap was largely attributable to nonshared environmental effects. Although it would be premature to dismiss the mediating role of personality based on the results of one study, such findings tentatively suggest that parent personality does not mediate genetic effects on parenting. Future research should continue to investigate whether genetic influences on personality and other parent characteristics account for the genetic influences on parenting.

Environmental influences on parenting. Shared and nonshared environmental influences were uniformly significant across all phenotypes at the child-based level. Although such findings may highlight a role for the nuclear family environment in the

Table 17
Model Fit Statistics for Parent-Based Warmth, Control, and Negativity, Dropping the Largest Sample

Phenotype	Design	Model	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*	AIC
Warmth	Full sample (n = 2,196 pairs)	ACE	19.54	14				−8.46
		ADE	14.49	14				−13.51
		AE	19.54	15	5.05	1	.02	−10.46
		CE	62.45	15	47.96	1	<.01	32.45
		DE	14.77	15	0.28	1	*ns*	−15.23[a]
	Without Pérusse (n = 1,079 pairs)	ACE	10.94	9				−7.06
		ADE	10.09	9				−7.91
		AE	10.94	10	0.00	1		−9.06[a]
		CE	31.10	10	20.16	1		11.10
		DE	11.37	10	1.28	1		−8.63
Control	Full sample (n = 2,514 pairs)	ACE	38.06	14				10.06
		ADE	40.04	14				12.04
		AE	40.04	15	1.98	1	*ns*	10.04
		CE	38.10	15	0.04	1	*ns*	8.10[a]
		E	62.82	16	24.76	2	<.01	30.82
	Without Pérusse (n = 1,397 pairs)	ACE	13.66	9				−4.34
		ADE	13.95	9				−4.06
		AE	13.95	10				−6.06[a]
		CE	16.17	10				−3.83
		E	48.74	11				26.74
Negativity	Full sample (n = 2,230)	ACE	5.76	13				−20.24
		ADE	6.21	13				−19.79
		AE	6.21	14	0.00	1	*ns*	−21.79[a]
		CE	13.25	14	7.49	1	.01	−14.75
		DE	12.79	14	6.58	1	*ns*	−15.21
		E	98.55	15	92.34	2	<.01	68.55
	Without Narusyte (n = 1,380 pairs)	ACE	3.45	7				−10.55
		ADE	3.43	7				−10.57
		AE	3.47	8	0.02	1	*ns*	−12.53[a]
		CE	9.16	8	5.71	1	.01	−6.84
		DE	5.33	8	1.88	1	*ns*	−10.67
		E	53.76	9	50.31	2	<.01	35.76

Note. AIC = Akaike information criterion; A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment; Pérusse = Pérusse et al. (1994); Narusyte = Narusyte et al. (2011).
[a] Best fitting model.

Table 18
Parameter Estimates From Best Fitting Models for Warmth, Control, and Negativity for Parent-Based Sensitivity Analyses

Phenotype	Model	A	95% CI	D	95% CI	C	95% CI	E	95% CI
Warmth	Full Sample			0.37	[0.31, 0.42]			0.63	[0.59, 0.69]
	Without Pérusse	0.35	[0.27, 0.43]					0.65	[0.59, 0.73]
Control	Full Sample					0.12	[0.06, 0.15]	0.89	[0.84, 0.95]
	Without Pérusse	0.23	[0.15, 0.31]					0.77	[0.70, 0.86]
Negativity	Full Sample	0.28	[0.22, 0.34]					0.72	[0.67, 0.78]
	Without Narusyte	0.27	[0.20, 0.35]					0.73	[0.65, 0.81]

Note. A = additive genetic; D = dominant genetic; C = shared environment; E = nonshared environment; CI = confidence interval; Pérusse = Pérusse et al. (1994); Narusyte = Narusyte et al. (2011).

origins of parenting behavior, estimates of shared environmental influences in child-based designs also include the effects of parental characteristics, including parent genes. Moreover, because parental genes were observed to contribute to warmth and negativity, child-based estimates of C for these phenotypes seem likely to include parental genetic influences. By contrast, the absence of parent-level genetic influences on control in the full analyses (although not in the sensitivity analyses) could indicate that passive rGE is unlikely to account for the estimates of C for parental control observed in child-based designs.

At the parent-based level, environmental influences were largely or entirely nonshared in origin. Given all of the factors that comprise E at the parent-based level, it is perhaps unsurprising that the nonshared environment plays such a critical role in parenting behaviors. Nevertheless, this finding has important ramifications, in part because it implies that neither parental genes nor observational learning in childhood is primarily responsible for shaping parenting behavior. Such findings are also consistent with the evocative rGE effects discussed above, in that the characteristics of the child being parented should load primarily onto estimates of E at the parent-based level. Measurement error is also contained within these estimates of E, and we cannot disambiguate this error from true nonshared environmental variance.

The small but significant effect of C on parental control at the level of the parent is also worthy of additional comment, as it could suggest that observational learning or other aspects of the rearing environment influence subsequent parental control behavior. Alternately, these estimates may capture broader sociocultural influences on parental control. The latter hypothesis is consistent with research indicating that parenting practices differ across socioeconomic status and cultural groups (García Coll, Meyer, & Brillon, 1995; Hoff et al., 2002; Pinderhughes, Dodge, Bates, Pettit, & Zelli, 2000). These conclusions should be interpreted with caution, however, as estimates of C for control were not significant in the sensitivity analyses.

Etiological differences across mothers and fathers. We examined whether there were etiological differences across mothering and fathering. Analyses revealed that the etiology of parenting behavior across mothers and fathers differs at the level of the child, but not at the level of the parent. In particular, genetic influences on mothering in child-based designs were greater than those on fathering for both control and negativity (with child genes accounting for as much as 51% of the variance in maternal negativity). Fathering, by contrast, was influenced more by the shared environment than mothering. These results are suggestive of two broad possibilities: (a) mothers are generally more influenced by, or responsive to, the specific characteristics of their children than are fathers, and/or (b) fathering is heavily influenced by family-wide factors such as the quality of the marital relationship and the parenting alliance (Aldous, Mulligan, & Bjarnason, 1998; Lamb & Elster, 1985; McBride & Rane, 1998) or by the father's personality. Consistent with these possibilities, research has highlighted clear differences in parenting behaviors across mothers and fathers (Collins & Russell, 1991; Cowan et al., 1993). For example, mothers typically spend more time with children and are more responsible for managing the care of children, whereas fathers' interactions with their children are defined somewhat more by leisure activities (Craig, 2006). Future research should further explore these possibilities.

Etiological differences across informants. Our child-based analyses revealed substantial etiological differences across informants. Although these informant differences are in some respects troubling, this finding is not surprising, as it is fully consistent with previously reported patterns of differential heritability across informants (Burt, 2009a, 2009b). Moreover, the fact that these informant differences emerged more or less consistently across the parenting phenotypes suggests that these differences may be capturing meaningful informant effects. In particular, shared environmental influences were most prominent for parental self-reports of child-based warmth and control, whereas estimates of the nonshared environment were smallest for parent reports across all phenotypes. This may reflect a measurement challenge associated with parent reports, namely, that the same person (the parent) is filling out the same questionnaire twice (once for each child). This is not a problem associated with parent informant reports within parent-based designs because each parent fills out the parenting questionnaire only one time, describing his or her overall parenting behavior toward his or her children (i.e., parents are not required to differentiate between children).

Another possible explanation is that parents may be particularly motivated to see their parenting behavior as egalitarian across their children (whereas children and observers are not). Indeed, available research suggests that parents may be inclined to represent their own parenting in a positive light (Morsbach & Prinz, 2006). The higher estimates of C obtained for parent reports in the child-based design may thus reflect parents' beliefs that they do not differentially parent their children and/or a desire to present their parenting in a positive light. It is worth noting, however, that the above issues with parental self-reports are not thought to undermine the general presence of C on parenting behavior, as significant and generally moderate levels of shared environmental contributions were also observed for child informant reports and observer ratings. Thus, although they may be inflated for parental self-reports, shared environmental influences do appear to make substantive contributions to the etiology of parenting behavior at the child-based level. Similar logic applies to the informant effects observed for genetic and nonshared environmental influences—their consistent presence across multiple informant reports provides strong support for their etiological contributions to parenting at the child-based level.

Finally, our analyses of informant differences at the level of the parent revealed minimal differences across informants for parental warmth or control, but significant differences across child informant reports and parent self-reports of negativity. In the latter case, child informant reports were influenced more by nonshared environmental effects than parent self-reports. Parental self-reports, by contrast, yielded higher estimates of genetic influences than child reports. Higher estimates of the nonshared environment for child informant reports may reflect the fact that each twin parent in this design is parenting different children than is the sibling. As such, genetically influenced response tendencies on child reports would likely load primarily on E. These interpretations are considered speculative, however, as this pattern of differences was observed only for parental negativity and not for parental warmth or control.

Measurement issues. Etiologic effects in the child-based designs also varied somewhat with the time frame under study, such that genetic influences were observed to be larger when examined retrospectively (for warmth only), whereas shared environmental influences were larger when parenting was assessed via current reports (for warmth and control). Such findings may reflect the notion that genetic influences are most readily measured across time and context (McGuire, 2003), presumably because retrospective reports require respondents to reflect on broader behavioral trends. By contrast, current reports of parenting may be overly influenced by recent, salient events (Paulhus & Vazire, 2007). Nevertheless, the limitations associated with retrospective reports have been well established (Brewin, Andrews, & Gotlib, 1993; Hardt & Rutter, 2004). Future parenting research should not neglect to consider the potential effects of measurement strategy on etiological estimates.

Etiological differences across age groups. We also examined whether the etiology of parenting in child-based designs varied with the age of the children in question. Although these findings should be interpreted with some caution, given that there were few longitudinal studies examining parenting over time and the potential for measurement of invariance of parenting over time (as discussed above), a pattern of possible age-related etiological changes did emerge. Estimates of C on parenting behaviors (at the level of the child) appeared to decrease across development, whereas estimates of E appeared to increase across development. The decrease in C and corresponding increase in E is consistent with the notion that as siblings age, they become increasingly differentiated from one another, and thus parenting is accordingly less influenced by family-wide processes. The pattern of changes in genetic influences was less consistent across phenotype, with genetic influences remaining relatively stable for warmth and control but decreasing for negativity. These findings contrast somewhat with the more common pattern of increasing genetic influences with age (Plomin, DeFries, Knopik, & Neiderhiser, 2012). Regardless, our results suggest that the etiology of parenting is likely to shift across development and that these developmental changes may differ for different aspects of parenting. Given the relatively small number of studies examining these processes longitudinally, however, future research should seek to capture and characterize developmental changes in the etiology of parenting behavior.

Conclusions

The results of the current meta-analysis have several interrelated implications. The first point has been made before but is not considered as often as it should be: Parenting is a dyadic enterprise between parents and children. Much of the early research examining the origins of parenting focused exclusively on the role of parent characteristics and broader contextual factors at the parent level, such as socioeconomic status (Abidin, 1992; Izzo, Weiss, Shanahan, & Rodriguez-Brown, 2000; Kotchick, Dorsey, & Heller, 2005). The exclusion of child characteristics as predictors of parenting in such studies is particularly troubling, given that most parenting studies are conducted using biological families in which parents and children share genes. As such, what appears to be a direct effect of parent characteristics on parenting may instead be the result of genetically influenced child characteristics. Indeed, one of the most consistent and striking findings to emerge from this study was the important role that children's characteristics play in shaping all aspects of the parenting (Belsky, 1984; F.-M. Chen & Luster, 2002; McBride et al., 2002). Given the pervasive role of child effects, we would argue that it is necessary for future studies to measure and account for child-driven effects across parenting research. In addition, parenting interventions should carefully assess child characteristics and assist parents in becoming adaptively responsive to the individual needs of their child.

The role of child-driven genetic influences on parenting also has implications for the intergenerational transmission of parenting. The presence of evocative rGE suggests that the intergenerational transmission may partially function via bottom-up processes (i.e., from children to parents). How might this look in practice? Work by Scaramella and Conger (2003) provides some insights. They found evidence for the intergenerational transmission of harsh parenting only when children were high in reactivity and negative emotionality (Scaramella & Conger, 2003). In other words, because genetically related individuals often exhibit similar behaviors, they may evoke similar parental responses (e.g., children with genetically influenced tendencies toward aggressive behavior may evoke patterns of negative parenting from parents also prone to aggressive behavior, who evoked similar patterns of negative parenting when they were children). The consistency in parenting across generations may thus be in part a function of the intergenerational consistency of child characteristics.

This is not to say that characteristics of the parents are unimportant, however. Indeed, our results also provide confirmation that parental genes influence some (but not all) aspects of their parenting. Parent-driven genetic influences on negativity are particularly noteworthy, given that child-driven genetic influences were also important and moderate in magnitude. The etiology of negativity may thus be largely a function of genetic effects (at the level of the child and the parent), a possibility that is contrary to theories suggesting that the intergenerational continuity in negative parenting is the result of observational learning or mediated via poor adjustment in the children of highly negative parents

(Conger et al., 2009; Simons, Whitbeck, Conger, & Wu, 1991). Even so, nonshared environmental influences at the level of the parent were influential regardless of phenotype, a finding that is consistent with the vast body of work identifying proximal and contextual factors that predict parenting behavior. Future work is needed to further elucidate the complex interplay between specific environmental effects and genetic influences on parenting.

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