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Did I inherit my moral compass? Examining socialization and evocative mechanisms for virtuous character development.

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Abstract

Virtuous character development in children is correlated with parenting behavior, but the role of genetic influences in this association has not been examined. Using a longitudinal twin/sibling study (N = 720; Time 1 (T1) Mage = 12-14 years, Time 3 (T3) Mage = 25-27 years), the current report examines associations among parental negativity/positivity and offspring responsibility during adolescence, and subsequent young adult conscientiousness. Findings indicate that associations among parental negativity and offspring virtuous character during adolescence and young adulthood are due primarily to heritable influences. In contrast, the association between concurrent parental positivity and adolescent responsibility was due primarily to heritable and shared environmental influences. These findings underscore the contributions of heritable influences to the associations between parenting and virtuous character that have previously been assumed to be only environmentally influenced, emphasizing the complexity of mechanisms involved in the development of virtuous character.

Keywords: virtuous character, heritability, responsibility, parenting, moral development

Did I inherit my moral compass? Examining socialization and evocative mechanisms for virtuous character development.

The development of virtuous character has a direct influence on feelings of well-being (i.e. life satisfaction and fulfillment), prosocial behavior, and civic engagement in adulthood (Jolliffe & Farrington, 2004; Luengo Kanacri et al., 2014; Park & Peterson, 2006; Park, Peterson, & Seligman, 2004; Wray-Lake, Syvertsen, & Flanagan, 2016). In an effort to facilitate the virtuous character development of youth, school-based interventions have been developed and employed (Berkowitz & Bier, 2004, 2007; Durlak et al., 2007; Quinlan, Swain, & Vella-Brodrick, 2012). These interventions, however, are only effective approximately half the time, with the lowest efficacy during adolescence (Berkowitz & Bier, 2007). In part, the modest efficacy of these interventions may be due to the lack of incorporating important parental behaviors during adolescence (Kasser, Ryan, Zax, & Sameroff, 1995; Lerner, 2017; Mahatmya & Lohman, 2012) and heritable influences (Knafo & Plomin, 2006b; Spengler, Gottschling, & Spinath, 2012; Zahn-Waxler, Robinson, & Emde, 1992) that shape the development of virtuous character behaviors. By examining both genetic and environmental influences on parenting and adolescent virtuous character behaviors as well as the pathways in which genetic and environmental influences contribute to their association, we will disentangle the underlying mechanisms driving these constructs and their association. Therefore, the current study employs a behavioral genetic research design to investigate whether associations among parenting, adolescent responsibility, and young adult conscientiousness have unique and common heritable and/or environmental influences.

Virtuous Character

Virtuous character encompasses behaviors, cognitions, and motivations that make a person a "moral agent" within their social world and allows a person to achieve the highest potential (Berkowitz & Bier, 2004; Cawley III, Martin, & Johnson, 2000; Lerner, 2017; Park, 2004). Virtuous character includes a wide range of behaviors, characteristics, and personality traits, including trustworthiness, empathy, and self-control. This paper will focus on responsibility and conscientiousness, due to their increased importance during adolescence and young adulthood (Berkowitz & Bier, 2004; Cawley III et al., 2000; Park, 2004; Samuel & Widiger, 2008; Wray-Lake et al., 2016) to further explore the etiology of virtuous character development. Specifically, responsibility has been defined as a value that includes an individual's accountability for their actions towards others, and includes acting in prosocial ways like helping others (Wray-Lake & Syvertsen, 2011), which generally promotes an individual's ability to be a competent adult who engages in responsible ways with the world (Gunnoe, Hetherington, & Reiss, 1999). Conscientiousness is a component of personality that includes behaviors likes orderliness and reliability, but also responsibility (Eisenberg, Duckworth, Spinrad, & Valiente, 2014; Roberts, Chernyshenko, Stark, & Goldberg, 2005). It is also important to note that personality, like conscientiousness, is presumed to be an aspect of character (Cawley III et al., 2000; Cloninger, 1998; Linley et al., 2007), as these personality traits can be considered virtues, and as such cannot be clearly separated from other aspects of character. Both responsibility and conscientiousness are potentially rooted to the desire of an individual to be a better citizen; this is linked to less delinquent behavior and increases in prosocial behaviors (Catalano, Hawkins, & Toumbourou, 2008; Wang, Batanova, Ferris, & Lerner, 2016; Wang, Ferris, Hershberg, & Lerner, 2015).

To better understand the development of virtuous character behaviors, there has been a recent shift towards understanding how and when these behaviors develop in childhood and adolescence (Berkowitz & Bier, 2014; Wang, Hilliard, et al., 2015). This recent shift might be partially due to the debate of whether virtuous character should be conceptualized as a trait, inherent in each person, or as a behavior that is learned over time (Berkowitz & Bier, 2014; Wang, Hilliard, et al., 2015). Developmental theories propose that virtuous character behaviors are not trait-like but instead develop within the context of social interactions, such as parent-child and peer interactions (Berkowitz & Grych, 1998; Clement & Bollinger, 2016; Howard, Berkowitz, & Schaeffer, 2004; Wang et al., 2016). In addition, adolescence is a particularly important time to understand responsibility and conscientiousness, in part due to the increased levels of autonomy experienced by adolescents which increases the likelihood that they will have the opportunity to interact with others within different contexts. For example, social responsibility has been found to generally decrease into adolescence and level-off during late adolescence and researchers point to positive parent and peer interactions positively impacting social responsibility (Wray-Lake & Syvertsen, 2011; Wray-Lake et al., 2016). In addition, this paper explores how adolescent responsibility is associated with conscientiousness in young adulthood, which has been shown to include responsibility (Roberts et al., 2005). Much of the research to date has assumed that only environmental experiences influence the development of virtuous character behaviors—disregarding research exploring heritable influences and further disregarding the impact of heritable influences that may account for associations between parenting and virtuous character behaviors. This paper will use findings from developmental psychology literature to examine responsibility as a specific virtuous character behavior especially relevant for adolescents and young adults using a genetically sensitive design. In

addition, the longitudinal associations among parenting, adolescent responsibility, and conscientiousness during young adulthood will be examined using this design.

Parenting and Virtuous Character

The associations between parenting and the development of virtuous character behaviors have been shown to be distinct from the impact of peer and other non-familial influences (Walker & Hennig, 2000). Numerous parenting behaviors have been indicated as important for the development of virtuous character, but for the purpose of this manuscript, the focus will be on nurturing or supportive behaviors and hostile or negative behaviors (Berkowitz & Grych, 2000). Authoritative parenting (characterized as high support and demanding) is associated with higher levels of virtuous character behaviors in adolescence including social responsibility, positive feelings towards the community, and prosocial behaviors (Baumrind, 1991; Carlo, McGinley, Hayes, Batenhorst, & Wilkinson, 2007; Kasser et al., 1995; Lenzi, Vieno, Santinello, Nation, & Voight, 2014; Mahatmya & Lohman, 2012). In contrast, critical, interfering, and coercive parenting is detrimental to the development of prosocial behaviors and increases antisocial behavior (Loeber et al., 2000; Walker & Hennig, 1999, 2000). Parents (via parenting) may be socializing children to behave (or not behave) in more prosocial ways when responding to others. Aside from socialization, positive parenting (characterized by nurturing/warm and supportive) may provide scaffolding that allows youth to develop a better understanding of virtuous behaviors that is not present when the parent is critical and interfering (Walker & Hennig, 1999). Taken together, parenting behaviors provide the building blocks for the development of virtuous character behaviors, which in turn impacts the youth's ability to embody their character in the outside world as they move into adulthood.

Although parents are typically conceptualized as an environmental socializing force, it is important to note that parenting does not operate only through environmental influences via socialization or scaffolding. In most studies, heritable influences present a potential confound with no strategy for considering whether the development of virtuous character behaviors are due to "pure" environmental influences or if heritable influences are also implicated (Horwitz & Neiderhiser, 2011; Scarr & McCartney, 1983). There are, however, many studies that have shown evocative gene-environment correlation (*r*GE) effects on parenting behaviors across development (Kendler & Baker, 2007; Klahr & Burt, 2014; Knafo & Plomin, 2006a; Reiss, Neiderhiser, Hetherington, & Plomin, 2000). For example, one study supported an evocative effect between early prosocial behaviors and parental negativity attributable to mostly heritable influences, while shared environmental influences accounted for the relationship between prosocial behaviors and parental positivity (Knafo & Plomin, 2006a). Another study found that parents' hostility was associated with adolescents' conduct problems due to evocative *r*GE, indicative of a genetically influenced adolescent characteristic that evokes the parent behavior and in turn impacts the adolescent conduct problems (Shelton et al., 2008). Therefore, not only can the parent influence their youth's behaviors through environmental mechanisms, but the heritable characteristics of the child can influence the parent's parenting that in turn could also be influencing their youth's virtuous behaviors. Specifically, the covariance between parenting and youth's virtuous behaviors might be accounted for by environmental and/or genetically-informed evocative processes.

Heritable Influences on Virtuous Character Behaviors

Virtuous character behaviors have also been the focus of a number of twin studies with the general finding that virtuous character behaviors are heritable (Knafo & Plomin, 2006b;

Lester et al., 2016; Rushton, 2004; Steger, Hicks, Kashdan, Krueger, & Bouchard, 2007; Volbrecht, Lemery-Chalfant, Aksan, Zahn-Waxler, & Goldsmith, 2007; Yuh et al., 2009). In adult twin samples, moderate heritable influences have been found for virtuous character behaviors (Steger et al., 2007), including social responsibility (Rushton, 2004), prosocial obligations (Lewis & Bates, 2011), and conscientiousness (Jang, Livesley, & Vernon, 1996; Krueger & Johnson, 2008). Interestingly, there are distinct patterns of findings that vary as a function of the specific virtuous behaviors and the developmental timing of the assessments. These patterns of findings suggest that there may be different mechanisms involved for specific virtuous character behaviors at different developmental periods. In childhood and adolescence, for example, heritable influences, although significant, are smaller than those reported in adults (Davis, Finkel, Turkheimer, & Dickens, 2015; Knafo et al., 2009; Lester et al., 2016; Spengler et al., 2012; Zahn-Waxler et al., 1992). Most adult twin studies find no evidence of shared environmental influences, influences common to siblings within the family, on virtuous behaviors (Lewis & Bates, 2011; Steger et al., 2007; Yuh et al., 2009), while one study that included adolescents found significant shared environmental effects on social responsibility (Rushton, 2004). Additional work has found that social responsibility in a sample of adolescent twin/siblings was heritable, but also there was no shared and only non-shared environmental influences (Reiss et al., 2000). Other studies of adolescents have found shared environmental influences both cross-sectionally and longitudinally for cooperativeness and self-directiveness, with only nonshared environmental influences on conscientiousness (De Fruyt et al., 2006; Lester et al., 2016; Spengler et al., 2012). Therefore, virtuous behaviors are influenced through both heritable and environmental pathways. These findings indicate that (1) heritable, shared environmental, and nonshared environmental influences all influence virtuous character

behaviors, (2) parenting is heritable and impacted by children's heritable characteristics, and now further research should explore the mechanisms that account for the associations between parenting and virtuous character behaviors from childhood to adolescence.

The Current Study

One proposed mechanism to explain the association between parenting and virtuous character behaviors is socialization; however, this ignores findings of heritable influences on not only parenting, but also virtuous character behaviors. By using a genetically-informed design to examine how parenting behaviors are associated with virtuous character behaviors we can begin to explore potential genetic and environmental mechanisms that explain the association between parenting and youth character. The current report uses a longitudinal sample of twins and siblings and their parents who were assessed during adolescence and young adulthood to examine how parenting is associated with virtuous character behaviors (social responsibility and conscientiousness) via heritable, shared environmental, and nonshared environmental influences. This approach allows us to examine: (1) whether parenting behaviors and youth's virtuous character behaviors have common genetic and environmental underpinnings or are distinct, and (2) whether youth's heritable characteristics (e.g., virtuous character) shape the behavior of their parents.

Method

Sample

Participants were part of the Nonshared Environment and Adolescent Development (NEAD) study (Neiderhiser, Reiss, & Hetherington, 2007; Reiss et al., 2000). NEAD is a longitudinal sample of 720 families (48.4% female) that consisted of same-sex twin and sibling pairs residing in two-parent households. Participation requirements included that all parents be

married for five or more years (including nondivorced and remarried/step family households), that two adolescent children reside in the home at least half time, and non-twin siblings were no more than 4 years apart in age. Twin/sibling pairs included identical twins (MZ), fraternal twins (DZ), and full siblings (FI) in non-divorced families, and full siblings (FS), half siblings (HS), and genetically unrelated step-siblings (US) in step families. The NEAD sample was assessed longitudinally during middle adolescence (Time 1), late adolescence (Time 2), and early adulthood (Time 3). For the present study, data from twin/sibling pairs during adolescence (Time 1) and young adulthood (Time 3) were examined (adolescence: sibling 1, M_{age} = 13.5 (2.0), range = 10-18; for sibling 2 M_{age} = 12.1 (1.8), range = 9-18; young adulthood: sibling 1, M_{age} = 25.9 (2.2), range = 21-31; for sibling 2 M_{age} = 24.6 (2.1), range = 20-30) as this was when the measures for the current study were administered. At Time 1, the sample included 93 pairs of MZ twins, 99 pairs of DZ twins, 95 pairs of full siblings (FI) in non-divorced families, and 182 full sibling pairs (FS), 109 half sibling pairs (HS), and 130 genetically unrelated, or step-sibling pairs (US) in step families. At Time 3, the sample included 55 MZ twin pairs, 49 DZ twin pairs, 36 FS pairs in non-divorced families, and 53 FI pairs, 35 HS pairs, and 40 US pairs in step families.

Sample Attrition

The time between assessments during adolescence and during young adulthood spanned 7 to 13 years. Due to refusals and inability to locate some families, data was collected at Time 3 on 413 families. There were almost no differences between the families who did not participate at Time 3 compared to Time 1 on demographics and study variables after accounting for multiple testing, except that mothers participating at Time 3 were younger and family income was lower (as reported in Neiderhiser, Reiss, & Hetherington, 2007).

Families were recruited into NEAD throughout the United States in the late 1980s. Participants were primarily Caucasian (94% of mothers and 93% of fathers) and middle class with a median household income ranging from $25,000 to $35,000 and the mothers' and fathers' average years of education being 13.6 and 14.0, respectively. Only 7% of mothers and 10% of fathers did not complete their high school education, and 93% of mothers and 90% of fathers completed at least their high school education or more.

During young adulthood (late 1990s to early 2000s), approximately 59% of child 1 and 50% child 2 of the sibling pairs were married. The median income of participants ranged from $40,000 to $49,000 for child 1 and $30,000 to $39,000 for child 2. The average years of education were 14.9 and 14.6 for child 1 and child 2, respectively.

Measures

Zygosity. Twins were rated for physical similarity by the interviewer, the parents, and self-report using a questionnaire designed for adolescents (Nichols & Bilbro, 1966). If there were differences in characteristics reported by the respondents or if participants responded that there was never confusion about the identity of the twins, the pair was classified as DZ. Zygosity was unclear for 12 twin pairs (of the original 720) which were excluded from the analyses.

Parental negativity and positivity. Parent reports of parenting behaviors were assessed at Time 1 with the Parent-Child Relationship closeness and conflict subscales (Hetherington & Clingempeel, 1992), Child Rearing Issues total conflict and punitive discipline subscales (Hetherington & Clingempeel, 1992), Conflict Tactics Scale conflict subscale (Straus, 1979), and Expression of Affection expressive and instrumental affection subscales. The parental negativity composite consisted of the conflict subscale of the Parent-Child Relationships scale, the total conflict and punitive discipline subscale of the Child Rearing Issues, and the conflict subscale of

the Conflict Tactics Scale (alphas ranged from .72-.89). Parental negativity was meant to assess anger and conflict that the parent displays in the parent-child relationship. Example items include: “How much do you yell at this person after you’ve had a bad day?”, “How often have you had disagreements with the child about the way the child acts toward mother or stepmother in this household?”, “How often have you punished this child more severely than usual for misbehavior?”, How often did you throw something at the other?” The parental positivity factor consisted of the closeness/rapport subscale of the Parent-Child Relationships scale, and the expressive and instrumental affection subscales of the Expression of Affection scale (alphas ranged from .72-90). Parental positivity was created to assess affection and closeness that the parent displays within the parent-child relationship. Example items include: “How responsive are you to this person?”, “How often have you give praise or a compliment?”, and “How often have you made a gift for another family member?”

These composites were created and used in prior reports focused on associations between the parenting constructs and youth outcomes like depressive symptoms and antisocial behaviors (Marceau et al., 2013; Pike, Mcguire, Hetherington, Reiss, & Plomin, 1996; Reiss et al., 2000). Composites were created for each dyad: mother-child 1, mother-child 2, father-child 1, and father-child 2 by combining and averaging the scores across scales. For the current study, mother-child and father-child dyads scores were averaged together for both negativity (mother and father report for Sibling 1: .61, and mother and father report for Sibling 2: .65) and positivity (mother and father report for Sibling 1: r = .44, and mother and father report for Sibling 2: .45) in order to create an overall construct of parental negativity and positivity within the home environment (Cronbach’s alpha for scale composites: negativity = .77, positivity = .62). The

aggregation of these assessments have been shown to provide a better picture of parenting behavior (Maccoby, 2000).

Responsibility. Adolescent responsibility was assessed using a composite of parent and self-report on multiple assessments at Time 1. Responsibility assesses a youths' conscientiousness, dependability, and responsibility towards others. Adolescents reported about themselves on the responsibility subscale of the California Psychological Inventory (Domino, 1984). Adolescents rated items whether they agreed or disagreed with statements (alphas ranged .72 and .70), for example "There's no use in doing things for people; you only find that you get it in the neck in the long run." Parents reported on their adolescent's behavior using the Responsibility (alphas ranged from .79-.81) and Cognitive Agency (alphas ranged from .64-.72) subscales of the Child Competence Inventory (Hetherington & Clingempeel, 1992). An example item for responsibility is "Some kids care about others' feelings, and are considerate BUT other kids hurt others' feelings without realizing it, and don't care or do not know how others feel". An example item for cognitive agency is "Some kids are methodological and well organized about learning things and think problems through BUT other kids don't think problems through before trying to solve them." First, we averaged parent reports of the responsibility and cognitive agency subscales (Sibling 1: r = .62 and Sibling 2: r = .65), then based on the correlations between youth reported responsibility, parent combined responsibility and cognitive agency (above .39) we standardized the subscales and then took an average of the three standardized subscales (Cronbach's alpha for scaled composite = .69).

Conscientiousness. Young adults self-reported on the Conscientious subscale of the NEO Personality Inventory (Costa & McCrae, 1992) at Time 3. This measure assesses the degree of persistence and motivation in goal-oriented behavior. Example items include "I don't take

civic duties like voting very seriously (R).", and "I always consider the consequences before I take action." The young adults respond to 48 items with a 5-point likert scale from strongly disagree to strongly agree (alphas were .90 and .92 for Sibling 1 and Sibling 2, respectively). Higher scores indicate higher levels of conscientiousness.

Analytic Plan

This study uses a twin/sibling design to disentangle heritable and environmental influences on virtuous character development by examining the unique and common genetic and environmental influences on the covariation of parent-child relationships and responsibility during adolescence and conscientiousness during young adulthood.

Analyses were conducted using OpenMX 2.7.11, a structural equation modeling package in "R" (Neale et al., 2016). This program addresses incomplete data (missing at random) using maximum likelihood estimation. Standard regression-based corrections for age, sex, ageXsex, and age differences were applied to raw scores (McGue & Bouchard, 1984) and residual scores were analyzed. Means and variances within traits, as well as phenotypic correlations across traits were equated across twins in a pair and twin/sibling group to generate phenotypic correlation coefficients representative of the entire sample while taking the non-independence of the data into account (i.e., data from related individuals). Model-fitting analyses provided estimates of fit between the assumed model and the observed data, and allowed for hypothesis testing with alternative models (Neale & Maes, 2006).

A multivariate Cholesky decomposition was modeled, in which the variances and covariances of the observed variables were decomposed into genetic, shared environmental, and nonshared environmental components. This model included only additive genetic influences, since MZ twin correlations were not more than twice as large as DZ twin and full sibling

correlations. The factor and residual variances were decomposed into their genetic, shared environmental, and nonshared environmental components. Thus, there are two potential sources of genetic, shared environmental, and nonshared environmental variance in a Cholesky model: 1) Those associated with latent factors (referred to hereafter as common A, C, and E), and 2) Those unique to each observed variable (residual A, C, and E). The order that the variables were placed within the model were derived based on non-genetic literature previously discussed. Specifically, that parents have the most proximal influence on the development of responsibility and conscientiousness; therefore, it was placed first within the Cholesky model.

The fit was assessed using Akaike's Information Criterion (AIC; large and negative AIC indicating a good fit) and −2 log likelihood (-2lnL; large -2lnL indicating a good fit). To establish the best fit for the data, alternative models were tested by systematically dropping paths from the full model. The saturated and nested constrained models were compared using the Chi-square difference test and comparing the AIC value (Neale & Maes, 2006). If the constrained model removing paths did not result in a significant decrement of fit, we concluded the paths were not different from zero, and the model dropping that path was the better fitting and more parsimonious model.

Results

First the phenotypic correlations are presented, followed by the Multivariate Cholesky decomposition of parental negativity, parental positivity, adolescent responsibility, and young adult conscientiousness.

Phenotypic Correlations

Phenotypic correlations are presented in Table 1. Overall, parental negativity was found to be negatively associated with both adolescent responsibility (r = -.50, p <.05) and young adult

conscientiousness (r = -.16, p <.05). Parental positivity was positively associated with adolescent responsibility (r = .37, p <.05), but only modestly associated with young adult conscientiousness (r = .10, p <.05). Adolescent responsibility was also moderately positively associated with young adult conscientiousness (r = .23, p <.05). It should be noted that parental negativity, parental positivity, and adolescent responsibility were assessed during adolescence (T1) so the ordering of the constructs in the Multivariate Cholesky decomposition model was based on the previous literature.

Cholesky Decomposition

Unstandardized parameter estimates and 95% confidence intervals for the fully saturated and best fitting models are presented in Tables 2 and 3, and the best fitting model is illustrated in Figure 1. The constrained model (dropping nonsignificant paths) fit the data better than the fully saturated model: fully saturated model: -2 log likelihood (-2LL) (4636) = 11967.91, AIC = 2695.91, RMSEA = 0.00, constrained model: -2LL (4650) = 11977.07, AIC = 2677.07, RMSEA = χ^2 diff (14) = 9.16, p = .82, AIC diff = 18.84.

The best fitting model found that the latent factors A1, A2, A3, A4, C1, C2, E1, E2, E3, and E4 were significant. Specifically, heritable influences on parental negativity during adolescence accounted for variance in parental positivity, adolescent responsibility, and young adult conscientiousness (A1). There was shared genetic variance among parental positivity and adolescent responsibility (A2), after accounting for genetic variance shared with parental negativity. Shared environmental influences also contributed significantly to the association between parental negativity and positivity (C1), as well as parental positivity and adolescent responsibility (C2). Finally, there were unique genetic influences on responsibility during adolescence (A3), and young adult conscientiousness (A4), and unique nonshared environmental

influences on parental negativity (E1), parental positivity (E2), adolescent responsibility (E3), and young adult conscientiousness (E4).

Discussion

This longitudinal twin/sibling study examined the heritable, shared, and nonshared environmental influences on the associations among parental negativity, parental positivity, adolescent responsibility, and young adult conscientiousness. To our knowledge, this is the first study to investigate these associations using a genetically-informed design. The findings from this study indicate that parenting is associated with character behaviors in adolescence via heritable and environmental pathways, while parenting is associated with character behaviors in young adulthood via only heritable pathways. Specifically, we found that parental negativity was associated with virtuous character through only heritable pathways, but not via environmental pathways. In contrast, we found that parental positivity was associated with virtuous character through heritable and shared environmental pathways. In addition, aside from the heritable pathway that accounted for associations between parenting and virtuous character, there were no additional unique pathways between adolescent responsibility and young adult conscientiousness. After all variance shared with parental negativity/positivity, and adolescent responsibility was accounted for, there was still unique heritable and nonshared environmental influences on both adolescent responsibility and young adult conscientiousness.

The first heritable pathway evident from parental negativity to parental positivity, adolescent responsibility, and young adult conscientiousness indicates an evocative gene-environment correlation. It is less likely to be active *r*GE because it is more difficult to conceive that an adolescent actively selects their parents or their parents' parenting behaviors, although it is possible that adolescents may choose to spend more or less time with their parents. Our

findings suggest that parental negativity (and positivity) are influenced by heritable characteristics of the adolescent, and this evoked parenting is associated with adolescents' responsibility and young adult conscientiousness. This evocative effect is consistent with previous findings of adolescent's heritable characteristics evoking parental negativity and positivity (Knafo & Plomin, 2006a; Neiderhiser, Marceau, & Reiss, 2013; Neiderhiser et al., 2004; O'Connor, Deater-Deckard, Fulker, Rutter, & Plomin, 1998). One possibility is that these evocative effects could be due to earlier antisocial behaviors, which have been shown to evoke higher levels of parental negativity (Narusyte, Andershed, Neiderhiser, & Lichtenstein, 2007) and less parental warmth (Waller et al., 2014), or earlier prosocial behaviors, found to decrease parental negativity and increase parental positivity (Knafo & Plomin, 2006a), that in turn can impact youth's sense of responsibility/need to help others. This heritable pathway between parental negativity, positivity, adolescent responsibility, and young adult conscientiousness also suggests that adolescent heritable characteristics might evoke a specific combination of parenting behaviors (i.e. high negativity, low positivity), which negatively impacts the development of important prosocial behaviors. These findings have implications for virtuous character literature, such that associations between parenting and virtuous behaviors might actually be partially due to adolescent's heritable characteristics and not just the effect of the rearing environment (e.g., parenting). Given this finding, it is evident that parents are susceptible to their youth's heritable characteristics, at least in part, and in response the parent provides the youth with an environment that allows for the further enhancement/undermining of these positive behaviors. Therefore, not only is the relationship between parenting and youth virtuous behaviors parent-driven as previous literature suggests, but is also child-driven, which theories and interventions must take into consideration.

The second heritable pathway between parental positivity and adolescent responsibility suggests a potential additional evocative pathway that is distinct from parental negativity. This paper extends previous work finding heritable influences on parental positivity in this sample (Neiderhiser et al., 2004; Plomin, Reiss, Hetherington, & Howe, 1994; Reiss et al., 2000), by examining the impact that this has on positive adolescent behaviors. Specifically, this finding suggests that adolescent heritable characteristics might be specifically evoking parental positivity, which in turn positively impacts adolescent responsibility. This might be particularly important for strengths-based approaches that attempt to focus on family strengths and not weaknesses in an effort to positively impact development.

In addition to the heritable pathways, there was an association between parental negativity and positivity that was due to shared environmental influences. This was expected due to previous work in this sample (Reiss et al., 2000) and also considering this association captures aspects of the entire family environment. As such, as parental negativity towards the twins/siblings increases, parental positivity may decrease, and vice versa, although there is some literature that suggests that the two are not mutually exclusive (e.g., Borden et al., 2014). Overall, the association between parental negativity and positivity is accounted for by both heritable and shared environmental influences, with non-shared environmental influences uniquely influencing parental negativity and positivity.

In addition, the association between parental positivity and adolescent responsibility is due to shared environmental influences. This finding is especially important to furthering our understanding of the disparate findings regarding these constructs in the literature. Specifically, the positive parenting literature suggests that parents who provide their children with high levels of support and praise are positively impacting their youth's development of virtuous behaviors

potentially because of socialization (Kasser et al., 1995; Lenzi et al., 2014; Walker & Hennig, 1999). This in part is better explicated by behavioral genetics clarification of the environment, as the shared environment within twin designs is explaining the environment that the siblings share or that make them similar. Therefore, this shared environment could represent a parent-driven effect, such that parental positivity and adolescent responsibility covary because of environmental influences that account for sibling similarity.

Within the behavioral genetics literature this finding between parental positivity and responsibility is somewhat inconsistent, with studies in early childhood finding shared environmental influences (Knafo & Plomin, 2006b), while a study using the current adolescent sample found shared environment influences to be non-significant (Reiss et al., 2000). This inconsistency with previous work could be due to the way the responsibility construct was assessed. For instance, Knafo and Plomin (2006b) used prosocial behaviors, Reiss and colleagues (2000) used behavioral measures of social responsibility, and this study uses a combination of behavioral and cognitive measures of responsibility, which have been shown to be particularly important during adolescence (Wray-Lake et al., 2011). However, these differential findings could also speak to the importance of developmental timing in accounting for the varying degrees of heritable and environmental influences. More specifically, the smaller shared environmental effect found here compared to Knafo and Plomin (2006b) could be due to the developmental importance of the home environment for young children compared to adolescence who spend a large amount of time out of the home.

Finally, there are additional unique pathways on each construct. Specifically, there are additional unique heritable pathways on adolescent responsibility and young adult conscientiousness. This supports previous personality literature as well as additional character

literature that finds genetic influences on these constructs (Jang et al., 1996; Rushton, 2004). Similarly to Rushton (2004), there was evidence of shared environmental influences, although found in the association between parental positivity and adolescent responsibility alone, and also unique non-shared environmental influences on adolescent responsibility. It is possible that this manuscript, by adding a parenting variable, has helped to specify the shared environment (i.e. parental positivity). This helps the field to move beyond exploring whether variables are heritable or not, and instead further understand what accounts for the associations between parenting and character behaviors.

Finally, the nonshared environmental influences found for adolescent responsibility and young adult conscientiousness, separately, might be interpreted as indications of free will or agency (Turkheimer, 2011). Nonshared environmental influences are an index of nongenetic influences that account for twin/sibling differences. Therefore, these influences are most likely things that an adolescent might select; therefore, the adolescent could be construed as actively engaging with their environment which in turn has an impact on their development. For example, feelings of responsibility to community during adolescence and young adulthood is influenced by peers, such that associating with delinquent peers is likely to reduce virtuous behaviors (Barnes, Hoffman, Welte, Farrell, & Dintcheff, 2006), while associating with prosocial peers may increase adolescent feelings of responsibility to community (e.g., Walker & Hennig, 2000). This is due to the developmental saliency of peer influence compared to parental influence during adolescence (Lam, McHale, & Crouter, 2012, 2014).

Limitations

The results of this longitudinal twin/sibling design should be interpreted in the context of several limitations. First, attrition in our sample from Time 1 to Time 3 could directly impact our

power to find shared environmental influences that previous studies have found for adolescent samples; however, there are some shared environmental pathways. Second, because parental negativity, positivity, and adolescent responsibility were assessed at the same time, it makes it difficult to determine which variable comes first in the Cholesky decomposition. To address this, we use prior literature to guide the order (see Loehlin, 1996 for a discussion of Cholesky modeling). Lastly, because this was a child twin study, we were only able to examine child evocative *r*GE paths and not incorporate the potential for passive *r*GE paths, such that the parent's heritable characteristics influence their parenting (Neiderhiser et al., 2004). Despite these limitations, this study has implications for our understanding of virtuous character development and theories used to describe this development.

Conclusions

The findings of this study build upon previous literature by further exploring the relationship between parenting and the development of virtuous character. First, the developmental nature of our study provides contextualization for the development of virtuous character behaviors that are specific for adolescents and young adults. Secondly, the findings from this study underscore the contributions of heritable influences on responsibility and conscientiousness that have previously been proposed to be "purely" environmentally influenced, while also showing the flexibility of these virtuous character behaviors. Finally, the evidence suggests that theories stressing the importance of the transactional nature of the development of virtuous character behaviors through parenting need to also consider the heritable characteristics shared within the family that can directly impact the relationships within the family, thereby impacting development. Therefore, theories and research that assume the

etiology of virtuous character to be solely environmental, should no longer disregard the complexity of the mechanisms involved.

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Compliance with ethical standards

Conflict of interest. Authors Amanda M. Ramos, Amanda M. Griffin, Jenae M. Neiderhiser, and David Reiss declare that they have no conflict of interest.

Ethical approval and informed consent. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all participants included in the study.

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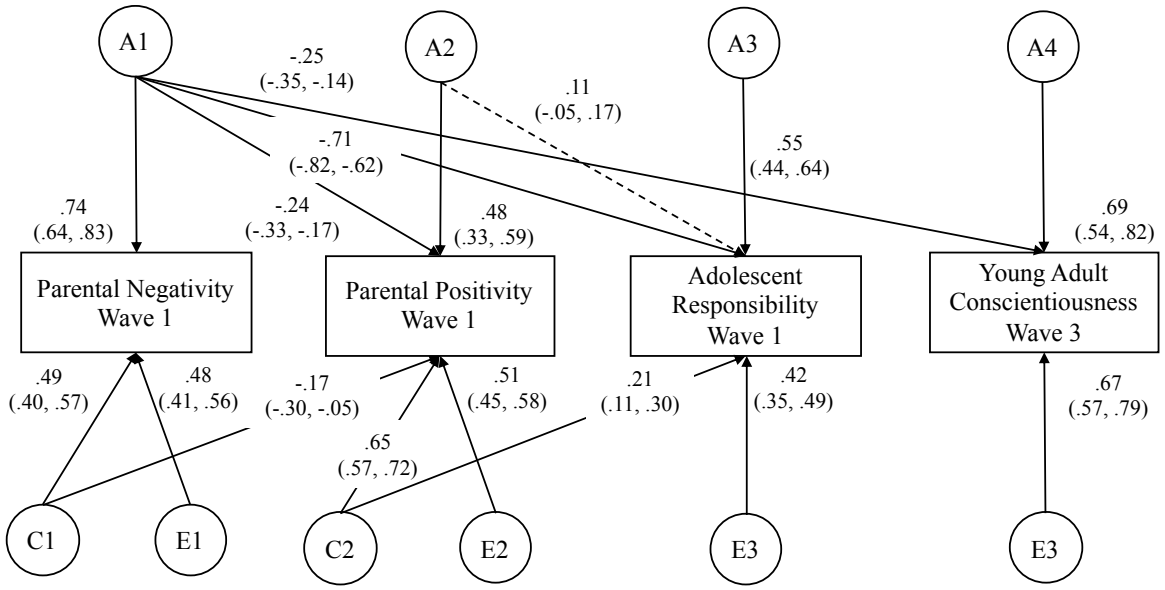

Figure 1.
An illustration of the multivariate Cholesky model. Unstandardized parameter estimates (95% confidence intervals) for the best fitting model. The latent factors A1, C1, and E1 refer to the respective genetic, shared, and nonshared environmental influences on parental negativity. A2, C2, and E2 refer to the respective unique genetic, shared, and nonshared environmental influences on parental positivity, or the genetic, shared, and nonshared environmental influences on parental positivity that are not shared with negative parenting A3 and E3 refer to the respective unique genetic and nonshared environmental influences on adolescent responsibility not in common with parental negativity or positivity. A4 and E4 refer to the respective unique genetic and nonshared environmental influences on conscientiousness in young adulthood, not in common with either parental negativity, positivity, or adolescent responsibility.

Table 1. Phenotypic correlations among study variables.

	Parental positivity	Parental negativity	Responsibility
Parental positivity			
Parental negativity	-.24*		
Responsibility	.37*	-.50*	
Conscientiousness	.10*	-.16*	.23*

Table 2. Model estimates for the fully saturated model.

	A1	C1	E1	A2	C2	E2	A3	C3	E3	A4	C4	E4
Parental Negativity	.77 (.66, .85)	.48 (.36, .58)	.45 (.39, .53)									
Parental Positivity	-.17 (-.28, -.04)	-.24 (-.38, -.08)	-.08 (-.17, .02)	.50 (.37, .61)	.64 (.55, .71)	.50 (.44, .57)						
Adolescent Responsibility	-.75 (-.79, -.53)	-.04 (-.17, .10)	-.03 (-.12, .07)	.23 (.02, .46)	.21 (.11, .31)	-.01 (-.10, .08)	.58 (.35, .70)	.06 (.00, .28)	.41 (.34 - .49)			
Young Adult Conscientiousness	-.19 (-.42, .03)	.05 (-.18, .26)	-.04 (-.23, .16)	.13 (-.22, .49)	.08 (-.11, .26)	-.004 (-.18, .17)	.09 (-.36, .46)	-.09 (-.43, .43)	.02 (-.16, .20)	.68 (.54-.81)	.0001 (.00, .43)	.67 (.57 - .80)

Note. Unstandardized beta weights are presented (95% confidence intervals). The latent factors A1, C1, and E1 refer to the genetic, shared, and non-shared environmental influences respectively on parental negativity. A2, C2, and E2 refer to the genetic, shared, and nonshared environmental influences respectively on parental positivity not shared with parental negativity. A3, C3, and E3 refer to the genetic, shared, and nonshared environmental influences respectively on adolescent responsibility not shared with parental negativity or positivity. A4, C4, and E4 refer to the unique genetic, shared, and nonshared environmental influences respectively on young adult conscientiousness.

Table 3. Model fitting results for the best fitting model.

	A1	C1	E1	A2	C2	E2	A3	C3	E3	A4	C4	E4
Parental Negativity	.74 (.64, .83)	.49 (.40, .57)	.48 (.41, .56)									
Parental Positivity	-.24 (-.33, -.17)	-.17 (-.30, -.05)	--	.48 (.33, .59)	.65 (.57, .72)	.51 (.45, .58)						
Adolescent Responsibility	-.71 (-.82, --.62)	--	--	.11[a] (-.05, .17)	.21 (.11, .30)	--	.55 (.44, .64)	--	.42 (.35 - .49)			
Young Adult Conscientiousness	-.25 (-.35, -.14)	--	--	--	--	--	--	--	--	.69 (.54-.82)	--	.67 (.57 - .79)

Note. Unstandardized beta weights are presented (95% confidence intervals). Paths designated with – indicate parameters not estimated in the model. [a]A parameter estimate is not significantly different from zero, but is required to be in the model or there is decriment of fit.