



Family Cohesion and the General Factor of Personality: Examining Differences in Monozygotic Twin Pairs

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Published online: 27 March 2018

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Abstract

It was recently found that differences between monozygotic twins in the general factor of personality were positively correlated with differences in adulthood recollections of maternal and paternal affection. The current study used data from the Swedish Adoption/Twin Study on Aging to possibly replicate and extend these findings. The results were consistent with replication for monozygotic twin pairs who were reared together (base total of 166 pairs), but not for those who were reared apart (base total of 99 pairs). This finding suggests that the effect is due to the relative and not absolute aspects of the familial environment during childhood. Additionally, the general factor of personality was not shown to mediate childhood and adulthood family cohesion. These results suggest that the general factor of personality may have independent effects on recollections of childhood family cohesion and current family cohesion. Thus, both how family dynamics are related to the development of the general factor of personality and how the general factor of personality impacts adulthood family relations (e.g., parenting) are important areas of future inquiry.

Keywords General factor of personality · Monozygotic twins · Family cohesion

Introduction

The current literature on individual differences provides ample evidence that personality traits covary such that if an individual possesses a high level of one positively valenced trait (e.g., sociability), they are also likely to score relatively high on measures of other positively valenced traits (e.g., conscientiousness). Due to this trait covariance, factor analysis allows for the extraction of a so-called general factor of personality (GFP). The GFP has been confirmed in a wide variety of personality measures (e.g., Loehlin and Horn 2012; Rushton and Irwing 2011), in a meta-analysis of the Big Five personality traits (Van der Linden 2010) as well as in exceptionally

large nationally representative samples (Dunkel, Cabeza de Baca, Woodley of Menie, and Fernandes 2014; Jokela, Pekkarinen, Sarvimäki, Terviö, and Uusitalo 2017). At the proximate level of explanation, the GFP appears to reflect social-effectiveness, akin to emotional intelligence (Van der Linden, Pekaar, Bakker, Aitken Schermer, Vernon, Dunkel, and Petrides 2017), although some level of response bias also contributes to the factor. Regarding this, Dunkel, Van der Linden, Brown, and Mathes (2016) found that socially desirable response bias, positive self-evaluation, and rater-assessed social-effectiveness all accounted for unique variance in the GFP; with social-effectiveness accounting for the lion's share.

We are aware of two ultimate, and non-mutually exclusive, explanations for the evolution of and variance in the GFP. One explanation is mutation-selection balance (Penke, Denissen, and Miller 2007). There is believed to be directional selection in that individuals with a high GFP should be favored as mates (e.g., Rushton et al. 2009; Rushton, Bons, and Hur 2008), leading to increasing and uniform levels of the GFP, but deleterious random mutations may deter high GFP population convergence. Support for the role of mutation-selection balance was found by Verweij et al. (2012) who found that higher levels of inbreeding, as measured by runs of homozygosity, were predictive of a personality profile suggestive of a low

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GFP. The heritability of the GFP has been tested numerous times (Van der Linden, Dunkel, and Petrides 2016) with consistent findings. The heritability of the GFP has been found to be around 50%, with the rest of the variance accounted for by the non-shared environment, which includes measurement error. The results of behavioral genetics studies have often also indicated significance for non-additive genetic effects (e.g., Rushton et al. 2008, 2009; Van der Linden et al. 2018).

The other evolutionary explanation for a GFP is derived from life history (LH) theory (Figueredo, Vásquez, Brumbach, and Schneider 2004). From the LH perspective, a high GFP is a component of a broad developmental and reproductive strategy in which development is elongated allowing for increased somatic investment. This somatic investment is eventually transferred to increased parental investment in offspring. The combination of slower maturation and increased parental investment is referred to as a slow LH strategy. Conversely, a low GFP is seen as a part of a fast LH strategy. Individuals with a fast LH strategy exhibit accelerated development, and hence decreased somatic investment and early sexual maturation and initiation. The reproductive strategy associated with a fast LH strategy emphasizes the number or quantity of offspring over the investment in, or quality of, offspring.

Similar to results testing the heritability of the GFP, analyses show that LH strategy is significantly heritable (Figueredo et al. 2004). Yet, the non-shared environment also accounts for a significant amount of variance (Figueredo et al. 2004), and more biologically based indicators of LH strategy (e.g., Coping, Campbell, and Muncer 2014) may exhibit very little heritability (Garvus-Ion, Sjøvold, Hernández, González-José, Torné, Martínez-Abadías, and Esparza 2017). There are theoretical (Belsky, Steinberg, and Draper 1991) and empirical (e.g., Dunkel, Mathes, Kesselring, Decker, and Kelts 2015; Ellis et al., 2003) reasons to believe that the familial environment plays a significant role in developing LH strategy. For example, high investment authoritative-type parenting has consistently been found to be predictive of a child's personality profile reflective of a high GFP (e.g., Dunkel, Harbke, and Papini 2009; Robinson, Fredrick, and Ramos 2014; Van der Akker, Deković, Asscher, and Prinzie 2014).

Recently, Dunkel, Nedelec, and Van der Linden (2018) used a genetically controlled research design to examine possible childhood familial effects on the GFP. Because monozygotic (MZ) twins essentially share the same DNA, differences between pairs of MZ twins are due to the environment. The correlation of phenotypic differences between twins with differences in environmental exposure may indicate a role for the environmental exposure in causing the phenotypic difference. Dunkel et al. (2018) correlated MZ differences in personality with MZ differences in reported maternal and paternal affection. They found that differences in both, reported maternal and paternal affection, were positively correlated with differences in the GFP.

Purpose of the Study

The purpose of the current study is three-fold. First, we aimed to examine the replicability of previous findings in which differences between MZ twins in childhood family environment were associated with differences in the GFP, more positive childhood experiences being associated with a higher GFP.

The second purpose is to examine whether the association between differences in childhood environment and the GFP is a function of absolute or relative positive family relations. If the association is due to absolute differences in parental treatment, then differences in childhood family relations in MZ twins raised apart should be predictive of differences in the GFP. However, if the effect of childhood family environment is relative (e.g., parental favoritism), then the effect should be limited to MZ twins raised together. As the present study includes twins that have been raised together as well as twins raised separately, this provides an excellent opportunity to test possible environmental effects by comparing the results between these two groups.

The third purpose is to examine differences in the GFP in relation to not just the childhood family environment, but the adult or current family environment as well. It is predicted that differences in the GFP will be associated with differences in the current family environment such that the twin with the higher GFP should also report having a more cohesive family as an adult. Of theoretical importance is the test for mediation (differences in childhood family environment → differences in the GFP → differences in adult family environment). Support for this model suggests that the childhood environment leads to differences in the GFP which then carried forth to family relations as an adult. This model is consistent with a LH strategy account in which childhood attachment quality (Belsky et al. 1991) directs the developmental trajectory and ties early familial experiences with parental proclivities (Benoit and Parker 1994; Cassibba, Coppola, Sette, Curci, and Costantini 2017; Verhage et al. 2016). If, however, the mediation model is not significant, other possible explanations for the association between the GFP and familial environments are needed (Barbaro, Boutwell, Barnes, and Shackelford 2017).

Method

Participants were part of the Swedish Adoption/Twin Study on Aging (SATSA; Pedersen 1984; Pedersen et al. 1991). SATSA was designed to examine genetic and environmental effects on aging. All twins from the Swedish Twin Registry who were identified as being separated at an early age were sent the initial questionnaire packet. For control purposes, a sample of twins raised together was also contacted and enrolled in the study. The data used in the current investigation

was taken from the 1984 wave of data collection, which was the first wave of data collection. Prospective participants were sent an initial questionnaire packet (identified as “Red” by the project administrators) and, subsequently those who responded were sent a second questionnaire packet (identified as “Blue” by the project administrators) about a week after the first questionnaire packet was returned. At the time of testing, the twins’ age ranged from 26 to 87 years of age ($M = 58.6$ years, $SD = 13.16$); 60% female (e.g., Pedersen et al. 1988). Of the total MZ sample, there were a total of 99 MZ twin pairs reared apart and 166 MZ twin pairs reared together (Pedersen et al. 1991). More specific information describing the details of sample and methods (e.g., determination of zygosity) is included in Pedersen et al. (1991).

Data Preparation

All participants in the comprehensive data file who were identified as an MZ twin were selected. Because the scale totals were taken from two separate questionnaire packets administered at two different times (yet both in 1984), the files from these two data collection points (identified by the project administrators as Red and Blue) were merged. The measures for childhood family cohesion, neuroticism, and extraversion were administered first (i.e., Red). The measures for current family cohesion, openness, agreeableness, and conscientiousness were administered subsequently (i.e., Blue). The project administrators describe the handling of values for missing item level data (Pedersen 1984). We did not impute values for missing scale totals.

In order to test the hypotheses, the data file was restructured following the directions set down by Beaver (2013). Difference scores for each of the variables were calculated by subtracting the value for each variable of the second member of the twin pair from the value of the corresponding variable of the first member of the twin pair (twin 1 and twin 2 designations were randomly assigned; Rovine 1994). Correlations between the family cohesion variables and the personality variables were run separately for MZ twin pairs raised together and MZ twin pairs raised apart with additional regression analyses being performed.

Measures

Family Cohesion

Both childhood and current family cohesion were measured using variations of the Moos Family Environment Scales (Moos and Moos 1981). The original measure consisted of nine items rated by participants as either “true” or “false.” The modified family cohesion scale (Plomin, McClearn, Pedersen, Nesselrode, and Bergeman 1988) was composed of five statements (e.g., Family supported each other) which

were rated using a 5-point Likert-type scale; anchored at 1 = exactly right and 5 = not right at all. For twins reared apart, when responding to the items about their childhood family, they were instructed to consider the family in which they were raised subsequent to their separation from their sibling. It is important to note that the scale measuring childhood family environment was based upon the participant’s recollections. The internal consistency of the scales for childhood family cohesion was $\alpha = .75$ and for current family cohesion was $\alpha = .65$.

Personality

Neuroticism and extraversion were measured using a 9-item shortened form of the Eysenck Personality Inventory (Pedersen et al. 1988). The participants were instructed to judge whether a series of short statements was self-descriptive, responding either “yes” or “no.” A sample item for neuroticism is “Are often anxious.” A sample item for extraversion is “Like a lot of activity.” The internal consistency for neuroticism was $\alpha = .75$ and the internal consistency for extraversion was $\alpha = .66$ (Pedersen et al. 1988).

Agreeableness, conscientiousness, and openness were measured using shortened versions of the NEO-PI scales (Bergeman et al. 1993). The participants rated the degree to which statements they agreed to statements using a 5-point Likert using a 5-point Likert-type scale; anchored at 1 = exactly right and 5 = not right at all. The 8-item agreeableness scale (sample item: I try to be polite to everybody) has an internal consistency of $\alpha = .52$. The 10-item conscientiousness scale (sample item: I work hard to achieve my goals) has an internal consistency of $\alpha = .69$. The 25-item openness scale (sample item: I have a lively imagination) has an internal consistency of $\alpha = .77$.

Submitting the trait scores for the MZ twins to a factor analysis using principal axis factoring, the first factor had an eigenvalue of 1.04 and accounted for 20.80% of the variance between the trait scores. The loadings for the traits were as follows: neuroticism ($-.43$), extraversion (.88), agreeableness (.02), conscientiousness (.27), and openness (.13). The factor loadings were unusual, especially with respect to the high loading for extraversion, and maybe in part an effect of the low reliability of the measure of agreeableness.

Van der Linden, Te Nijenhuis, and Bakker (2010) conducted a meta-analysis of the intercorrelations of the Big Five traits. In doing so, they were able to estimate the true, corrected, factor loadings of each of the traits on the GFP based on 212 samples with a total of 114,117 participants, making the loadings from van der Linden et al. (2010) more representative and stable. In order to calculate a GFP from the meta-analytic factor loadings, the trait scores were first standardized (i.e., transformed into z scores) and then multiplied by the factor loading. Next, the resulting product for

neuroticism was subtracted from the sum of the products for openness, conscientiousness, extraversion, and agreeableness. Lastly, a correlation was calculated to check the degree of overlap between the two GFPs; $r(465) = .74$. While there is a great deal of overlap between the GFPs, the correlation indicates that there is substantially less than previous results indicating that GFPs based on various methods tend to correlate $r > .90$ (e.g., Loehlin and Horn 2012). Because the GFP based on the meta-analytic weights is thought to be a more reliable representation of the construct, the meta-analytic-weighted GFP was utilized.

Results

Preliminary, bivariate correlations using the full MZ sample were run. Of particular interest are the correlations between the measures of family cohesion (childhood and current) and personality. As seen in Table 1, save for openness and agreeableness, childhood family cohesion was correlated with the various personality traits in the expected direction. All of the correlations between present family cohesion and the various personality traits were significantly correlated in the expected direction.

The correlations between difference scores are presented in Table 2, with correlations for the MZ twins raised together presented above the diagonal and those correlations for the MZ twins reared apart beneath the diagonal. For the MZ twins raised together, differences in childhood family cohesion were positively associated with conscientiousness and the GFP. Current family cohesion was positively associated with conscientiousness, agreeableness, and GFP and negatively correlated with neuroticism. Looking beneath the diagonal, it can be seen that for MZ twins raised apart, differences in childhood family cohesion were not associated with any of differences in the personality indices. Differences in current family cohesion were positively correlated with extraversion and agreeableness.

As seen in Table 2, the correlation between the childhood family cohesion difference score and the GFP difference score for MZ twins raised together was $r(91) = .29$, while the correlation between these two variables for the MZ twins raised together was $r(54) = .05$. The absolute difference of .24 suggests that the association was stronger for the MZ twin pairs raised together, yet when using a r to z transformation, the difference between the two correlations did not reach significance $z = 1.41$, one-tailed, $p = .08$. This finding was reiterated by the results of a hierarchical regression predicting differences in the GFP. The interaction term, the product of rearing status (raised together or separately), and difference scores in family cohesion, entered in step 2 was not significant, $\Delta R^2 = .02$, $p = .07$.

Next, the possibility that the GFP mediates childhood and current family cohesion was examined. The weak correlation between childhood and current family cohesion in the MZ twins raised together appears to preclude mediation, yet the steps prescribed for testing mediation at quantpsy.org (Preacher and Leonardelli 2010-2018) were still followed. The results of the Sobel test for mediation were not significant, Sobel test statistic = 1.63, $p = .10$.

Discussion

Recently, Dunkel et al. (2018) found that MZ differences in adult personality were significantly correlated with differences in the recollection of maternal and paternal affection. For example, the twin reporting higher parental affection also had the higher GFP. This finding was replicated in the current study using recollections of childhood family cohesion in MZ twins raised together. On average, the twin reporting greater family cohesion also had the higher GFP. While, the MZ difference scores methodology has the benefit of controlling for genetic confounds, a significant correlation between difference scores is not simply interpreted.

Table 1 Bivariate correlations between family cohesion (childhood and present) and indices of personality

	1	2	3	4	5	6	7
1. Childhood cohesion	–						
2. Present cohesion	.29***	–					
3. Openness	.05	.15**	–				
4. Conscientiousness	.14**	.19***	.02	–			
5. Extraversion	.16***	.13**	.16**	.20***	–		
6. Agreeableness	.09	.34***	–.16***	.19***	–.03	–	
7. Neuroticism	–.12**	–.17**	.04	–.14**	–.35***	–.07	–
8. GFP	.22***	.36***	.27***	.64***	.64***	.42***	–.62***

$N = 379-560$

** $p < .01$; *** $p < .001$

Table 2 Bivariate correlations between difference scores for family cohesion (childhood and present) and difference scores for the indices of personality

	1	2	3	4	5	6	7	8
1. Childhood cohesion	–	.06	.20	.27**	.17	.11	–.00	.29**
2. Present cohesion	.13	–	.14	.32**	–.03	.36**	–.26*	.42***
3. Openness	–.03	–.26	–	.11	.04	–.15	.09	.27**
4. Conscientiousness	.17	.18	.18	–	.07	.24*	.02	.61***
5. Extraversion	–.09	.31*	.08	.06	–	.04	–.29***	.56***
6. Agreeableness	–.05	.33*	.06	–.03	–.03	–	–.08	.52***
7. Neuroticism	.07	.06	.08	–.25	–.41***	.03	–	–.56***
8. GFP	.05	.31	.40**	.65***	.51***	.40**	–.57***	–

Reared together correlations are above the diagonal and reared apart are below. *N* pairs reared together = 78–131. *N* pairs reared apart = 36–79

* $p < .05$; ** $p < .01$; *** $p < .001$

Using the SATSA data to examine the heritability of recollections of the childhood familial environment, Plomin et al. (1988) concluded that siblings raised in the same family either experience *or* remember things quite differently. This led Plomin et al. (1988) to “... suggest that subjective perceptions may be important in terms of long-term effects on personality and adjustment later in life, even if they do not relate to objective observations (p. 744).” The absolute level of parental affection or family cohesion that is experienced could lead to a higher GFP; more cohesion produces a higher GFP. Alternatively, the relative level of experienced affection or cohesion may drive the effect (e.g., being favored or disfavored by a parent).

In the current investigation, we tested these two possibilities by contrasting difference scores of MZ twins reared together with the difference scores of MZ twins reared apart. It was reasoned that if the effect is due to the absolute level of family cohesion experienced, then the differences in family cohesion reported between MZ twins should appear in both pair types (reared together and reared apart). If, however, the effect is due to the relative level of cohesion, then the effect should only be seen in MZ twins reared together. It was found that differences in perceptions of childhood family cohesion of MZ twins were associated with differences in the GFP, but only for MZ twins raised together. Differences in perceptions in family cohesion between MZ twins raised apart were unrelated to personality differences. This suggests that the relative or comparative experiences of aspects of the familial environment, such as differential parenting (Jenkins, Rasbash, and O’Connor 2003), are more strongly associated with differences in personality between MZ twins than absolute levels of parental behavior.

An additional extension of the previous work was the inclusion of a measure of adulthood family relationship quality. Correlating MZ difference scores has the limitations inherent in correlation research designs, primarily the inability to establish causation. However, by including a measure of adult family relations, the mediation model derived from an attachment/

LH account (Belsky et al. 1991; Verhage et al. 2016) could be tested. From this perspective, familial experiences in childhood sway development trajectories toward a slow (high GFP) or fast (low GFP) LH strategy which is then transmitted intergenerationally via the level of parental sensitivity. However, support for this model was not found as childhood and adulthood family cohesion were not significantly correlated and the Sobel test of mediation was not significant. This non-significant association between differences in childhood and current family cohesion is suggestive of an alternative dynamic. Yet, for the full sample (non-difference scores) and for differences in MZ twins raised together, the GFP was significantly associated with both childhood and current cohesion. These results suggest that the GFP independently acts to color individual’s views of relationships. This is consistent with another suggestion by Plomin et al. (1988) that self-report measures of family environment are themselves measures of personality. On the other hand, this interpretation is not consistent with the null findings for the MZ twins reared apart.

Strengths, Limitations, and Future Directions

One strength is that the analyses represent an attempt at replication of previous results, a task that has been increasingly stressed in the field (Asendorpf et al. 2013). More notably, the study took advantage of a unique and rare sample, MZ twins reared apart. Yet, this strength is also the primary limitation of the study; due to the rarity of the sample, it is also small. The small sample size reduced the power to reject the null hypothesis, increasing type II error. Speculating as to how this may have impacted results is potentially hazardous. Thus, the results were mixed in that differences in past family cohesion were only significantly associated with differences in the GFP for MZ twins reared together, yet the correlation was not significantly different than that for MZ twins reared apart. A second clear limitation of the study is the reliance on a retrospective measure of childhood family environment. For a more valid assessment of the hypotheses, such as the proposed

mediation model, a longitudinal design beginning with assessments of the family environment during actual childhood is needed.

The results from the full sample and difference scores for MZ twins reared together suggest that the GFP influences views of family cohesion, but this possibility leaves questions unresolved. What, then, is the cause of the initial differences in the GFP between individuals and twins? It could be that, MZ twins reared together are driving the differences based upon their need for individuation. Alternatively, happenstance occurrences (e.g., being a victim of crime) or more chronic environmental differences (e.g., residing in a dangerous neighborhood) that occur later in development may impact differences in how relationships, including those in the past, are viewed.

And, if as the results suggest, for MZ twins reared together, differential parenting is accounting for some of the difference in the GFP between twins, then what is the root cause of the differential parental treatment? Here, we speculate that slight differences in temperament between twins may lead to differential treatment by parents that, in turn, may cause the amplification of these slight temperamental differences. It may be fruitful to examine the development of parenting and temperamental differences between twins starting at a younger age to see what factors (e.g., health as measured by indices such as birth weight) may account for either or both differences. Might the healthier twin out compete his or her sibling garnering more parental investment? This parental investment could, in turn, be transformed into somatic effort. This dynamic is similar to hypotheses concerning how birth order impacts parental investment and sibling differences in personality (Sulloway 2001). Additionally, the outcompeting twin may receive additional benefits simply by winning the competition, which over time may become embedded as a higher GFP (Briffa, Sneddon, and Wilson 2015). Lastly, we would like to reiterate a call for the further use of genetically informed studies, and the MZ difference method in particular (Barbaro et al. 2017; Fearon, Shmueli-Goetz, Viding, Fonagy, and Plomin 2014), in understanding the impact of family dynamics on individual differences.

Compliance with Ethical Standards

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

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