

Behavior Genetics and the Within-Person Variability of Daily Interpersonal Styles: The Heritability of Flux, Spin, and Pulse

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Abstract

A classical twin study was used to estimate the magnitude of genetic and environmental influences on four measurements of within-person variability, namely dominance flux, warmth flux, spin, and pulse. Flux refers to the variability of an individual's interpersonal dominance and warmth. Spin measures changes in the tone of interpersonal styles, and pulse measures changes in the intensity of interpersonal styles. Daily reports of interpersonal styles were collected from 494 same-sex female twins (142 monozygotic pairs and 105 dizygotic pairs) over 45 days. For dominance flux, warmth flux, and spin, genetic effects accounted for a larger proportion of variance (37%, 24%, and 30%, respectively) than shared environmental effects (14%, 13%, and 0%, respectively), with the remaining variance due to the nonshared environment (62%, 50%, and 70%, respectively). Pulse appeared to be primarily influenced by the nonshared environment, although conclusions about the contribution of familial influences were difficult to draw from this study.

Keywords

behavior genetics, personality, interpersonal processes, individual differences, well-being

Individuals tend to behave in a fairly consistent manner. Your friend who is warm and friendly today will likely be warm and friendly tomorrow, just as your boss who is unpleasant and cranky today is likely to be unpleasant and cranky tomorrow (Soldz & Vaillant, 1999). This is not to imply that people never deviate from their typical interpersonal styles. In fact, some individuals express a fair amount of such behavioral deviations, whereas others express consistent interpersonal styles day after day (Baird, Le, & Lucas, 2006; Donahue, Robins, Roberts, & John, 1993; Eid & Diener, 2004; Fleeson, 2001). Although a growing body of research has examined important psychological (e.g., maladjustment, stress, etc.) correlates of such within-person variability, little is known about why some people express more variability in their daily interpersonal styles than others. In order to examine this issue, this study used a twin design to investigate possible genetic and environmental influences on within-person variability of daily interpersonal styles.

Both researchers and theorists have long examined the consistency (or lack of consistency) of behavior across contexts and daily situations (e.g., Allport, 1937; Mischel, 1968). Recent research indicates that it is possible to reliably assess individual differences in this within-person variability across time (Baird et al., 2006; Donahue et al., 1993; Eid & Diener, 2004; Fleeson, 2001). It appears, perhaps ironically, that

within-person variability can be thought of as a stable characteristic in much the same way as a personality trait. Personality researchers have been quick to incorporate within-person variability into many of their theories and models, with some noting, “cross-situational variability seems to be an essential expression of the enduring but dynamic personality system itself” (Mischel, Shoda, & Mendoza-Denton, 2002, p. 53).

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Psychological theories have generated contradictory predictions about within-person variability, with some suggesting maladjustment is related to being too rigid (i.e., low within-person variability; Bem, 1974; Leary, 1957; Paulhus & Martin, 1987), whereas others have stressed maladjustment is related to inconsistent behavioral styles (i.e., high within-person variability; Jourard, 1963; Main & Solomon, 1986; Maslow, 1968). Despite these opposing predictions, the majority of empirical research suggests that high levels of within-person variability are linked to low levels of adjustment (e.g., Block, 1961; Campbell, Assanand, & DiPaula, 2003; Donahue et al., 1993; Foltz, Barber, Weinryb, Morse, & Chittams, 1999; La Guardia, Ryan, Couchman, & Deci, 2000; Sheldon, Ryan, Rawsthorne, & Ilardi, 1997; Suh, 2002). For example, Moskowitz and Zuroff (2005) found that, across 20 days, individuals who displayed greater variability in their interpersonal styles tended to be more neurotic and disagreeable than individuals who displayed greater amounts of interpersonal stability. Given the link between within-person variability and psychological health, it is important to understand the reasons why some individuals might display more variability in their daily interpersonal styles than others.

Arguably, the most popular model of interpersonal styles (Hofstess & Tracey, 2005) is the interpersonal circumplex (IPC). The IPC was originally created by researchers at the Kaiser Foundation (Freedman, Leary, Ossorio, & Coffey, 1951; Leary, 1957) in an attempt to examine how interpersonal qualities are related to each other. The circumplex structure of the IPC implies that variables that measure interpersonal styles are arranged on the circumference of a circle oriented by the primary dimensions of dominant–submissive (i.e., dominance) and hostile–friendly (i.e., warmth). The exact number of possible interpersonal styles and their ordering have gone through a number of revisions by various researchers (e.g., Kiesler, 1983; Wiggins, 1982). Figure 1 displays the circular ordering of the eight-octant labels presented by Wiggins (1995).

It is possible to define a person's interpersonal style on a given day by using the primary dimensions of warmth and dominance as a Cartesian coordinate system (Markey & Markey, 2011). As seen in Figure 1, based on a person's daily levels of warmth and dominance, his or her interpersonal style can be defined in terms of both its angular location (θ) around the IPC and its vector length (VL) from the center of the IPC. Angular location provides information about the predominant tone that characterized that person's interpersonal style for a given day (e.g., gregarious extroverted, warm agreeable, etc.), whereas VL indicates the intensity with which the interpersonal style was manifested (Gurtman & Balakrishnan, 1998). Figure 1 displays daily interpersonal styles for a hypothetical person on a Monday and Tuesday. On Monday, this person expressed fairly strong (VL was large) interpersonal behaviors related to being assured-dominant ($\theta = 87^\circ$). However, on Tuesday, the intensity of this person's behaviors decreased (VL was small) and they behaved in a gregarious extroverted manner ($\theta = 45^\circ$).

Daily reports of participants' interpersonal styles can be used to assess four measurements of within-person variability, namely dominance flux, warmth flux, spin, and pulse. Dominance flux

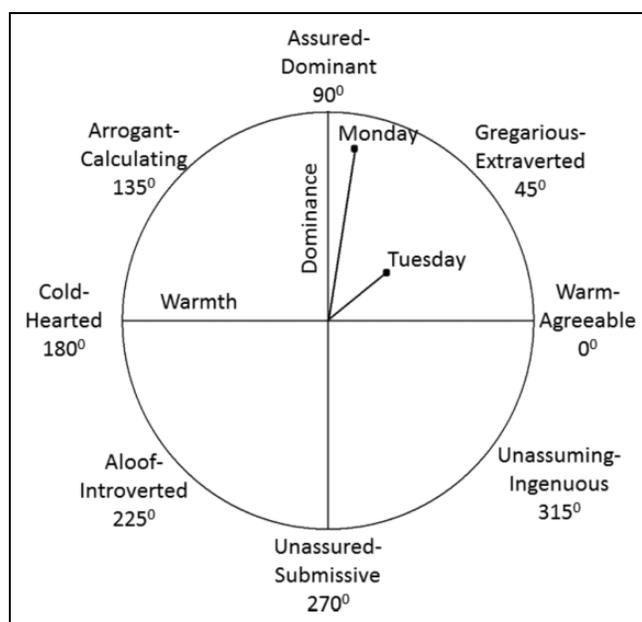


Figure 1. The interpersonal circumplex. Displayed within the circumplex are the daily interpersonal styles of a hypothetical person on Monday and Tuesday.

and warmth flux represent the average daily variability a person expresses in his or her dominant and warm interpersonal styles across a set number of days. This is arguably the most common assessment of within-person variability (cf., Fleeson, 2001) and can be examined by simply computing the standard deviation (*SD*) of an individual's daily reports of dominance and warmth (Moskowitz & Zuroff, 2004). In addition to dominance flux and warmth flux, the circular structure afforded by the IPC allows for the examination of spin and pulse (Moskowitz & Zuroff, 2004). Spin quantifies the variance displayed in an individual's daily angular locations, reflecting changes in the tone of one's interpersonal style (e.g., changing from being gregarious extroverted one day to acting in a cold-hearted manner the next). For example, consider Person A, who across 5 different days showed great fluctuations in his or her daily interpersonal styles (see Figure 2). The variance displayed in these daily angular locations is greater than the variance displayed in the daily angular locations of Person B who behaved in a more consistent manner across these 5 days. In this manner, spin is analogous to the variability of the angular locations of an individual's styles across a set number of days. The more variability a person displays in his or her daily interpersonal styles, the greater the spin.

Pulse provides an additional method for assessing within-person variability with the IPC. Whereas spin is focused on tonal changes of interpersonal style, pulse is focused on changes in the intensity of one's daily style. As seen in Figure 3, Person C tended to act extroverted each day, but the intensity of his or her daily styles varied greatly from one day to the next. In contrast, Person D also tended to behave extroverted across these days, but the intensity of his or her daily style was fairly constant. In this example, Person C exhibited greater amounts of pulse than Person D.

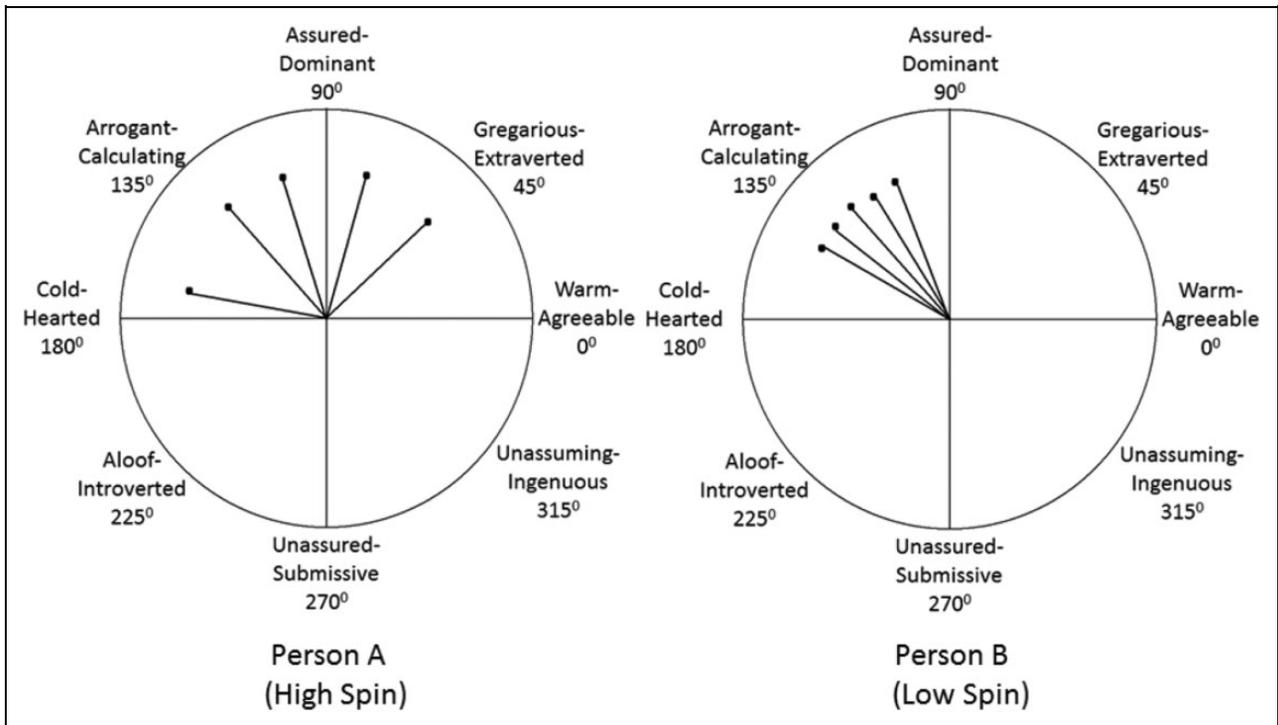


Figure 2. Daily interpersonal styles of two hypothetical individuals across five days. Person A exhibits high levels of spin whereas Person B exhibits low levels of spin.

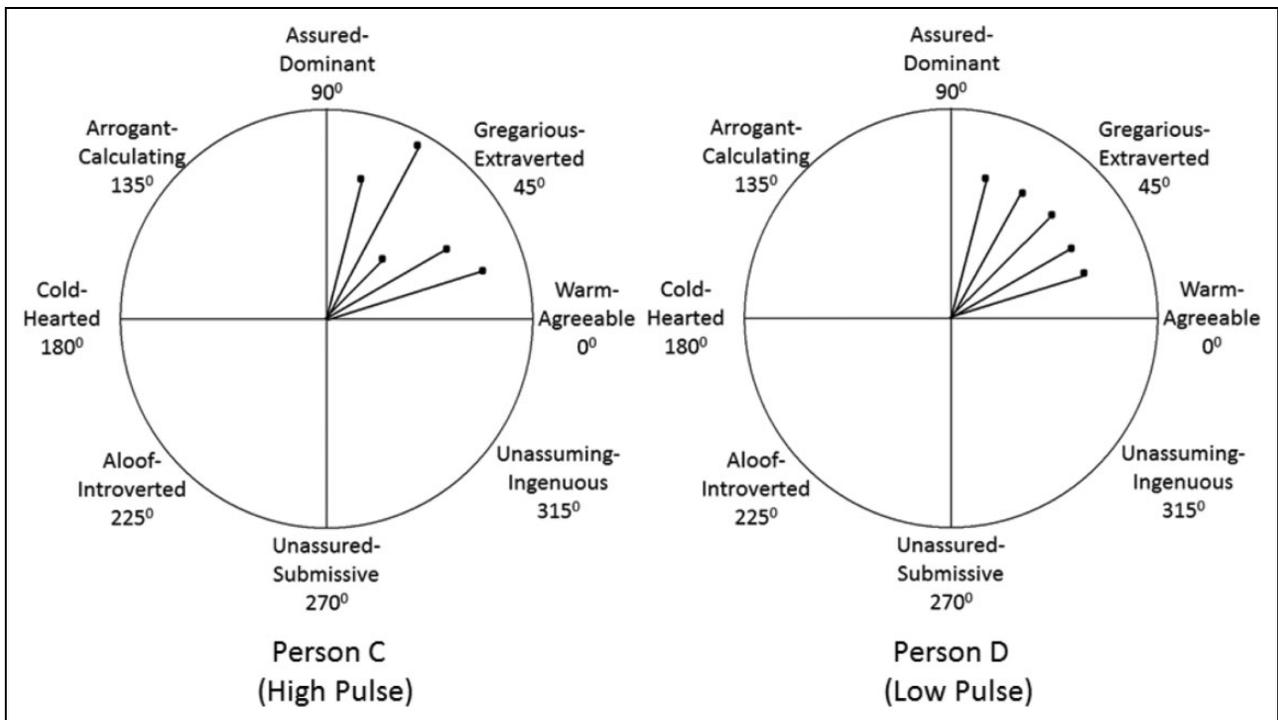


Figure 3. Daily interpersonal styles of two hypothetical individuals across five days. Person C exhibits high levels of pulse whereas Person D exhibits low levels of pulse.

Although past research suggests that within-person assessments of variability, like dominance flux, warmth flux, spin, and pulse, are important predictors of negative outcomes, less

is known about the sources of such variability. Behavior genetics research suggests that genetic influences significantly contribute to between-person variation in stable personality traits, with

heritability estimates typically ranging from 40% to 50%. The remaining variance in personality traits is most often attributed to environmental effects that are unique to each member of a twin pair. (Bouchard, 2004; Keller, Coventry, Heath, & Martin, 2005). However, no studies have examined the relative contribution of genetic and environmental influences to the within-person variability assessments of dominance flux, warmth flux, spin, and pulse. Such research could contribute to understanding how within-person interpersonal patterns affect daily functioning. For instance, research revealing heritable risk factors for eating disorders for females during adolescence (Klump, McGue, & Iacono, 2000) led to the investigation of ovarian hormones as potential mechanisms that mediate this increase (Klump, Keel, Sisk, & Burt, 2010). Likewise, determining the causal factors associated with interpersonal patterns may pave the way for research critical to understanding how these patterns contribute to social dysfunction.

This study used a classical twin study to investigate familial influences on measures of interpersonal variability and to examine whether these influences are more likely to be genetic or environmental in origin. Twin studies compare the similarity of monozygotic (MZ) twins, who share 100% of their genes, to dizygotic (DZ) twins, who share an average of 50% of their segregating genetic material. Using this design, individual differences on the dimensions of within-person variability can be separated into the following components: additive genetic effects, dominant genetic effects, shared environmental effects, and nonshared environmental effects. Additive genetic effects are genetic influences on a trait due to the additive effects across multiple genetic loci. Dominant genetic effects represent the interaction of genetic effects at the same locus. The shared environmental effects refer to all nongenetic sources of variance that are common to members of the same family (e.g., socioeconomic status, parental divorce, etc.), which make twins similar to each other. Nonshared environmental effects refer to all nongenetic sources of variance that are unique to each twin (e.g., accidents, random experiences, etc.), which make them differ from their co-twin. Therefore, the aim of this study was to examine the relative contribution of additive genetic, dominant genetic, shared environmental, and nonshared environmental factors on the within-person variability dimensions of dominance flux, warmth flux, spin, and pulse using daily reports of interpersonal styles in a sample of twins.

Method

Participants and Procedures

Data were collected from 512 same-sex female twins. However, 18 participants (3%) were excluded from the following analyses because either they or their twin failed to provide at least 10 days of data. The final sample consisted of 494 same-sex female twins (142 MZ pairs and 105 DZ pairs) between the ages of 15 and 25 years ($M = 18.11$; $SD = 2.22$) from the Michigan State University Twin Registry (MSUTR). The MSUTR consists of several different projects; participants

for this study were drawn from the *Twin Study of Hormones and Behavior Across the Menstrual Cycle*. Participants for the parent study were recruited using birth record methods previously described (for details, see Burt & Klump, 2013 and Klump & Burt, 2006) and the response rate for this ongoing study is currently 54% (for additional information concerning the response rates in this study, readers should contact Dr. Kelly Klump). The parent study consisted of daily data collection for 45 consecutive days as well as three in-person assessments, and participants were compensated up to US\$170. Daily behavioral data were collected each evening (after 5:00 p.m.) via an online questionnaire or using preprinted scantron forms. On average, each participant provided 41.75 ($SD = 7.26$) daily reports of their interpersonal styles for a total of 20,629 daily reports of the IPC dimensions of warmth and dominance.

Measurements

Daily reports of interpersonal styles. Each evening, participants were asked to rate how they generally behaved with others on that day using a single 10-point Likert-type item to assess their dominance–submission as well as a single item to assess their warmth–coldness. For each item, participants were provided with specific definitions of the poles for each dimension. As would be expected based on the IPC structure, responses on these 2 items were almost orthogonal across daily reports ($r = .11$). In order to compute spin and pulse scores, dominance and warmth scores were ipsatized across participants.

Dominance flux and warmth flux. Participant's dominance flux and warmth flux represent the amount of variation in daily reports of these dimensions and are assessed by computing the *SD* of each participant's daily reports of dominance and warmth (Moskowitz & Zuroff, 2004). Therefore, a low dominance flux or warmth flux score indicate a participant displayed similar levels of dominance or warmth across the 45 days. A high dominance flux or warmth flux scores indicates a participant displayed pronounced levels of variability of dominance or warmth across the 45 days.

Spin. For each individual, spin quantifies the variability in the angular locations of a person's interpersonal styles across a given number of days. Computations for spin and pulse were derived from Mardia's (1972) formulas for the circular *SD* and mean. The amount of spin exhibited by a given individual can be computed using the formula (Moskowitz & Zuroff, 2004; Wright, Pincus, Conroy, & Hilsenroth, 2009):

$$\text{Spin} = \cos^{-1} = \left(\frac{\sum \cos(\theta_{\bar{d}} - \theta_d)}{n} \right) \times \frac{180}{\pi},$$

where

$$\theta_d = \tan^{-1} \left(\frac{\text{DOM}}{\text{WRM}} \right) \times \frac{180}{\pi},$$

$$\theta_{\bar{d}} = \tan^{-1} \left(\frac{\sum \sin \theta_d}{\sum \cos \theta_d} \right) \times \frac{180}{\pi}.$$

In the formulas mentioned previously, θ_d is the angular location for an individual on a given day, dominance (DOM) is the amount of interpersonal dominance reported on this day, warmth (WRM) is the amount of interpersonal warmth reported on this day, and $\theta_{\bar{d}}$ is the mean daily angular locations for a given person. In this manner, spin is similar to the variability of the angular locations of an individual's styles across a set number of days.

Pulse. For each individual, pulse quantifies the variability in the intensity of interpersonal styles across a given number of days. The amount of pulse exhibited by a given individual can be computed using the formula (Moskowitz & Zuroff, 2004; Wright et al., 2009):

$$\text{Pulse} = \frac{\sum (VL_d - VL_{\bar{d}})^2}{n},$$

where

$$VL_d = \sqrt{(\text{DOM}^2 + \text{WRM}^2)}.$$

In the formulas mentioned previously, VL_d is the VL for an individual on a given day. $VL_{\bar{d}}$ is the mean VL of an individual, DOM is the amount of interpersonal dominance, and WRM is the amount of interpersonal warmth reported on this day. Thus, pulse is the variance of an individual's VLs across a set number of days.

Statistical Analyses

Twin intraclass correlations were calculated separately for MZ and DZ twins to provide an initial indication of the relative contribution of genetic and environmental influences on dominance flux, warmth flux, spin, and pulse. Additive genetic effects (A) are implied when the MZ twin correlation is approximately double the DZ twin correlation, as MZ twins share approximately twice the genetic material as DZ twins. Dominant genetic effects (D) are indicated if the MZ correlation is more than double the DZ correlation, given that dominant influences serve to reduce the similarity of DZ twins who do not share 100% of their genetic material. Shared environmental influences (C) are suggested when the MZ correlation is less than twice that of the DZ twins because these are, by definition, factors that make twins similar to one another. As such, their effect is not expected to differ by twin type. Finally, nonshared environmental influences (E) are inferred to the extent that the MZ correlation is less than 1.0 and/or both twin correlations are small and nonsignificant.

The structural equation modeling program Mx (Neale, Boker, Xie, & Maes, 2003) was used to perform biometric model fitting analyses in order to estimate the magnitude of additive genetic, dominant genetic, shared environmental, and nonshared environmental influences on dominance flux, warmth flux, spin, and

Table 1. Twin Correlations.

	MZ twins ($N = 142$ pairs)	DZ twins ($N = 105$ pairs)	Z	p
Dominance flux	.53 (.43, .61)	.29 (.14, .43)	2.24	.01
Warmth flux	.40 (.30, .50)	.24 (.10, .36)	1.37	.08
Spin	.32 (.19, .43)	.09 (−.06, .23)	1.85	.03
Pulse	.36 (.23, .48)	.25 (.11, .38)	0.93	.18

Note. MZ = monozygotic; DZ = dizygotic. Z = fisher r-to-z transformation test of equality. p Value for one-tailed test examining whether the MZ correlation is larger than the DZ correlation. Ninety-five percent boot-strapped confidence intervals for correlations presented in parentheses.

pulse. Notably, dominant genetic and shared environmental effects cannot be estimated in the same model when examining only MZ and DZ reared-together twins. Therefore, in order to determine whether dominant genetic or shared environmental factors were more important for inclusion, we estimated two "full models" for each variable: ACE (additive genetics, common environment, unique environment) and ADE (additive genetics, dominance effects, unique environment) models. Nested models were fit and compared to the full models: AE (constraining C to 0) and CE (constraining A to 0) compared to ACE model; AE (constraining D to 0) compared to ADE model.¹ Comparisons between nested models were made by calculating a χ^2 test of model fit computed by taking the difference in negative twice the log-likelihood ($-2\ln L$) between the full model and each of the nested submodels. Nonsignificant χ^2 values indicate that dropping parameters from the full model does not provide a significantly worse fit to the data, and the more parsimonious submodel should be retained. Akaike Information Criterion (AIC; $\chi^2 - 2df$) was also used to compare full and nested models as well as to compare the unnested ACE and ADE models. AIC is a measure of model parsimony and is lower/more negative in the most parsimonious model.

Results

Twin intraclass correlations are presented in Table 1. Virtually all of these correlations are statistically significant, indicating the presence of familial aggregation for measures of within-person variability in interpersonal behavior. With regard to the source of the familial aggregation, higher MZ than DZ twin correlations suggest the presence of genetic influences on all variables. Dominant genetic effects appear to be important for spin, given an MZ correlation that is more than double the DZ correlation. In contrast, shared environmental influences may be relevant for dominance flux, warmth flux, and pulse, as the MZ correlations were less than double the DZ correlations for these three variables. Finally, nonshared environmental influences also contribute to these variables, as MZ correlations were significantly less than 1.0.

Before conducting the twin model fitting analyses, descriptive statistics for dominance flux, warmth flux, spin, and pulse were examined (see Table 2). As can be seen, means and variances for MZ and DZ twins were similar across all the variables with one

Table 2. Means and Variances by Zygosity.

	Mean				Variance			
	MZ	DZ	t (df)	p	MZ	DZ	F (df)	p
Dominance flux	1.30	1.29	0.18 (492)	.85	0.36	0.30	1.15 (1, 492)	.28
Warmth flux	1.36	1.34	0.49 (492)	.62	0.37	0.32	1.28 (1, 492)	.26
Spin	50.87	48.61	1.19 (492)	.23	438.20	429.76	0.44 (1, 492)	.51
Pulse	0.50	0.50	0.04 (492)	.96	0.039	0.026	6.21 (1, 492)	.01

Note. MZ = monozygotic; DZ = dizygotic; SD = standard deviation. Independent t-tests were used to compare the equality of means of MZ and DZ twins; Brown-Forsythe tests were used to compare the equality of variances of the MZ and DZ twins.

Table 3. Parameter Estimates and Test Statistics for Biometric Twin Models.

	Standardized Parameter Estimates				Test Statistics			
	a ²	c ² /d ²	e ²	b	-2lnL (df)	Δ-2lnL (df) ^a	p ^b	AIC ^c
Dominance Flux								
ACE	.37 (0, .60)	.13 (0, .47)	.50 (.39, .62)	–	5.37 (6)	–	–	–6.63
ADE	.51 (0, .61)	0 (0, .56)	.49 (.39, .60)	–	5.83 (6)	–	–	–6.17
AE	.51 (.39, .61)	–	.49 (.39, .60)	–	5.83 (7)	0.46 (1)/0 (1)	.50/.99	–8.17
CE	–	.44 (.33, .53)	.56 (.47, .70)	–	8.75 (7)	3.38 (1)	.07	–5.25
Warmth Flux								
ACE	.24 (0, .50)	.14 (0, .43)	.62 (.50, .75)	–	2.82 (6)	–	–	–9.81
ADE	.39 (0, .50)	0 (0, .47)	.61 (.49, .73)	–	3.27 (6)	–	–	–8.73
AE	.39 (.26, .51)	–	.60 (.49, .73)	–	3.27 (7)	0.45 (1)/0 (1)	.50/.99	–10.73
CE	–	.34 (.22, .44)	.66 (.56, .78)	–	3.99 (7)	1.17 (1)	.28	–10.01
Spin								
ACE	.30 (0, .43)	0 (0, .28)	.70 (.57, .84)	–	2.29 (6)	–	–	–9.71
ADE	.07 (0, .43)	.25 (0, .45)	.68 (.55, .83)	–	1.93 (6)	–	–	–10.07
AE	.30 (.16, .43)	–	.70 (.57, .84)	–	2.29 (7)	0 (1)/0.36 (1)	.99/.55	–11.71
CE	–	.23 (.10, .34)	.77 (.66, .89)	–	5.31 (7)	3.02 (1)	.08	–8.69
Pulse								
ACE	0 (0, .42)	.32 (0, .43)	.68 (.56, .79)	–	12.03 (6)	–	–	0.03
ADE	.34 (0, .45)	0 (0, .41)	.66 (.54, .79)	–	14.03 (6)	–	–	2.03
ACE + b	.11 (0, .43)	0 (0, 1.0)	.89 (0, 1.0)	.12 (–2.67, .23)	11.64 (4)	–	–	3.64
AE	.34 (.21, .45)	–	.66 (.54, .79)	–	14.03 (7)	2.00 (1)/0(1)	.16/.99	0.03
CE	–	.32 (.21, .43)	.68 (.57, .79)	–	12.03 (7)	0 (1)	.99	–1.97
AE + b	.11 (0, .43)	–	.89 (.57, 1.0)	.12 (–0.03, .23)	11.64 (5)	0 (1)	.99	1.64

Note. -2lnL = -2 times log likelihood; df = degrees of freedom; AIC = Aikake Information Criteria; A = additive genetic effects; C = shared environmental effects; E = non-shared environmental effects; D = dominance genetic effects; SD = standard deviation. 95% confidence intervals for variance estimates are presented in parentheses. Best-fitting model is indicated by bold type.

^aWhen two values are present, the first Δ-2lnL(df) reflects the comparison of the AE model to the ACE model, and the second indicates the comparison of the AE model to the ADE model.

^bWhen two values are present, the first p value reflects the comparison of the AE model to the ACE model, and the second indicates the comparison of the AE model to the ADE model.

^cAll AICs were calculated by taking the difference in -2lnL values between a baseline, unrestricted model (i.e., a model that freely estimates variances, covariances, and means) and all other models. 2lnL(df) for baseline dominance flux model: 1339.80 (484); 2lnL(df) for baseline warmth flux model: 1366.94 (484); -2lnL(df) for baseline spin model: 1382.59 (484); -2lnL(df) for baseline pulse model: 1361.87 (484).

exception. MZ twins displayed greater variability in pulse scores than DZ twins. The greater MZ compared to DZ variance for pulse is consistent with sibling cooperation effects (i.e., greater variability in interpersonal intensity in Twin 1 is associated with greater variability in interpersonal intensity in Twin 2). Sibling cooperation mimics the shared environment in twin models, although shared environmental effects do not result in MZ/DZ variance differences (Neale & Maes, 2004). Therefore, an additional set of twin models was run for pulse that included a sibling interaction parameter (b).

Twin model fitting analyses supported initial impressions from the twin correlations (see Table 3). Between-person variance in dominance flux and warmth flux appears to be accounted for by a combination of additive genetic, shared environmental, and nonshared environmental effects. The AE model was best fitting for both of these variables, although power to detect the presence of shared environmental effects was limited. Results from the ACE model indicate that genetic effects account for a relatively larger proportion of variance (24–37%) than shared environmental effects (13–14%), with

the remainder due to the nonshared environment (50–62%). For spin, the ADE model fit better (i.e., had a lower AIC value) than the ACE model, indicating that dominant genetic effects are more important than shared environmental effects for spin. Dominant additive genetic effects appear to account for more variance than additive genetic effects (see Table 3), although this study is underpowered to disentangle these two sources of genetic variance. Overall, genetic effects account for approximately 30% of the variance in spin, with the remainder being due to the nonshared environment (70%).

For pulse, the best-fitting model was the CE model, as additive genetic effects were estimated at zero in the full ACE model. Notably, an absence of genetic influences would not be predicted from the twin correlations for pulse and, taken together with the relatively poor fit of the ACE model to the data ($\Delta\chi^2$ compared to the baseline model: 12.03; $\Delta df = 6$; $p = .06$) as well as differences in pulse variability between MZ and DZ twins, an additional set of models was examined which included a sibling interaction parameter (b). These models provided evidence for the presence of sibling cooperation effects ($b = .12$) rather than the shared environment, as C was estimated at zero and the $AE + b$ model fit better than the $ACE + b$ model (see Table 3). Genetic contributions to pulse were minimal ($A = 11\%$), with the majority of the variance being accounted for by the nonshared environment ($E = 89\%$). However, the sibling interaction model continued to provide a poor fit to the data relative to a baseline model, which freely estimated means, variances, and covariances ($\Delta\chi^2 = 11.64$; $\Delta df = 5$; $p = .04$). Therefore, conclusions about familial contributions to pulse are difficult to draw from this study.

Discussion

Some individuals display remarkable consistency in their daily behaviors, whereas others exhibit great variability in how they act one day to the next. The importance of understanding the consistency of interpersonal styles has been demonstrated by a multitude of studies linking within-person variability to assessments of maladjustment (e.g., Block, 1961; Campbell et al., 2003; Donahue et al., 1993; Foltz et al., 1999; La Guardia et al., 2000; Moskowitz & Zuroff, 2005; Sheldon et al., 1997; Suh, 2002). Despite the importance of understanding within-person variability, little research has examined why some individuals might display more variability in their daily interpersonal styles than others. In an effort to address this gap in the literature, this study examined the relative influence of genetic and environmental factors on four assessments of within-person variability, namely dominance flux, warmth flux, spin, and pulse.

To estimate the degree of genetic and environmental influence on within-person variability, a classical twin study was employed. Consistent with the notion that genetic influences are salient for within-person variability, twin intraclass correlations revealed that MZ twins were more similar to one another than DZ twins in terms of dominance flux, warmth flux, and spin. Biometric model fitting analyses indicated that genetic effects

accounted for a larger proportion of variance in dominance flux, warmth flux, and spin (37%, 24%, and 30%, respectively) than shared environmental effects (14%, 13%, and 0%, respectively), with the remainder due to the nonshared environment (62%, 50%, and 70%, respectively). Taken together, results suggest that within-person variability in interpersonal behavior is accounted for by genetic factors, and the magnitude of these effects is only slightly lower than genetic estimates for stable personality traits.

To our knowledge, this is the first study to examine the relative contribution of additive genetic, dominant genetic, shared environmental, and nonshared environmental factors to within-person variability in interpersonal styles. However, the findings from this study should be tempered with an understanding of its limitations. It is unclear how much the similarity found between the variability of daily reports of MZ twins occurred due to their desire to present their behavior as similar each day. Future researchers might overcome this concern by controlling for the possibility that MZ twins simply desire to appear to be more consistent a DZ twins. Additionally, due to the longitudinal nature of the study, the survey used to measure daily reports of warmth and dominance was necessarily brief. Future researchers wishing to replicate these findings should consider employing a more extensive assessment of daily interpersonal reports which assess each of the octants of the IPC (cf., Markey & Markey, 2009). Further, this study exclusively employed self-report data to measure daily interpersonal styles. It would be interesting to examine whether or not the results found in this study generalize to daily observations, other reports of daily behavior, or even interactions on social media.

Importantly, our sample size was relatively small for a twin study examining within-person variability, limiting our ability to distinguish between additive genetic, dominant genetic, and shared environmental effects. Our model for pulse also did not provide a good fit to the data; thus, conclusions about familial contributions to pulse are difficult to draw from this study. Additional studies with larger samples will help to both increase statistical power, allowing for a better chance of replicating these results (Brandt et al., 2014) and provide more precise estimates of genetic and environmental effects for within-person variability. Finally, because estimates of genetic and environmental influences derived from twin studies are population-dependent, our results may not replicate beyond samples of late adolescent and young adult female twins. Further, restrictions in the genetic and/or environmental heterogeneity of the sample directly impacts the estimated proportions of variance accounted for by genetic and environmental factors. Thus, our specific findings are best interpreted as reflecting the distribution of genotypes and environmental variations in the sample studied.

In spite of these limitations, this study provides insight into the genetic and environmental influences on daily variability of interpersonal styles. Although there is a long history of debate about the role of personality traits and social situations in determining behavior, this research suggests that genetic variability may account for a great deal of variability in both

of these predictors (cf., Fleeson, & Nofle, 2009). Genetic influences appear to contribute to individuals' personalities as well as the consistency with which these personalities are manifested as behaviors. It is hoped that in the future researchers will employ the methodology used in this study to not only better understand patterns of individual variability related to life events or hormonal changes (Bisconti, Bergeman, & Boker, 2006; Markey & Markey, 2011) but investigate the importance of genetic influences among other assessments of within-person variability (Baird et al., 2006; Donahue et al., 1993; Eid & Diener, 2004; Fleeson, 2001). Such research might help illuminate possible genetic mechanisms for low levels of psychological adjustment, given the link between within-person variability and various negative outcomes.

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Note

1. DE models are infrequently examined in behavior genetics studies given that the presence of dominant genetic effects in the absence of additive genetic effects is theoretically unlikely (McGue & Christensen, 1997). Therefore, DE models were not run in this study.

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