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RESEARCH ARTICLE

The Association of Perceived Neighborhood Safety and Inequality with Personality

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Abstract
The relationship between neighborhood quality and personality was explored using a large nationally representative sample of midlife adults, namely, the data from the Midlife in the United States Longitudinal Study of Health and Well-Being. A multilevel approach was used to track correlations between fluctuations in perceived neighborhood safety and inequality and personality across three points in time. As predicted from life history theory, personality fluctuated along with perceived neighborhood safety and inequality such that the general factor of personality decreased as neighborhood safety decreased and neighborhood inequality increased. In a second set of analyses, monozygotic twin difference scores were used to control for possible genetic confounds. It was found that the twin who reported the greatest neighborhood safety and least neighborhood inequality also had the highest general factor of personality. Future research could be directed at identifying and remediating the specific aspects of the neighborhood that may increase the risk of negative changes in functioning.

Keywords Big Five · General factor of personality · Life history theory · Monozygotic twins

Introduction

"Few men realize that their life, the very essence of their character, their capabilities and their audacities, are only the expression of their belief in the safety of their surroundings." (Conrad 1898, p. 150)

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Since the seminal book of Shaw and McKay (1942) on delinquency in urban areas, social scientists have shown interest in the possible effects of neighborhood quality on behavior. Indeed, an extensive review of studies shows that a wide range of problems are associated with living in a poor quality neighborhood (Leventhal and Brooks-Gunn 2000). One question related to that is whether environmental quality can influence personality. While it is widely acknowledged that the rank order of personality dimensions is relatively stable over time and that this stability increases with age, it has also been confirmed that personality changes do occur and that such changes reflect true effects and not only measurement error (Edmonds et al. 2008). Yet, despite the long tradition in neighborhood quality research, it was not until 2008 that Hart, Atkins, and Matsuba conducted the first large-sampled longitudinal study on neighborhood quality and fluctuations in personality. They found that when children moved to a lower-quality neighborhood, on average, they also displayed a shift away from resilient personality traits toward a less socially desirable personality. Similar results have subsequently been found for adolescent girls living in high-risk neighborhoods who were relocated to lower-risk neighborhoods (Kessler et al. 2014). Using a randomized study, they found that the housing intervention for families of adolescent girls reduced rates of conduct disorder and socially undesirable behavior. Note, however, that what is meant by socially undesirable behavior in the broader societal context may actually be quite functional in a dangerous neighborhood environment (e.g., Frankenhuis et al. 2016; Geronimus 1996).

Additionally, those who stayed in high-risk neighborhoods reported greater rates of post-traumatic stress disorder and depression. It remains to be tested, however, whether neighborhood quality may also affect personality change in adults. Accordingly, in the current study, we use a large representative sample that includes three measurement times spanning over 15 years, to examine whether fluctuations in perceived neighborhood quality are associated with fluctuations in personality among adults.

In addition, in testing the neighborhood-personality relations, we take into account the possibilities of genetic cofounding. More specific, individuals do not randomly sort themselves into environments (e.g., Scarr and McCartney 1983; Kendler and Baker 2007). The choice of where to live is informed by a variety of factors ranging from socioeconomic status to educational attainment and personality traits. The result of this selection process becomes an important point to consider, however, as virtually all of the factors that likely inform the choice of where to reside are, at least partly, heritable (Kendler and Baker 2007). In the absence of randomized trials, observational data—such as the data often used to study neighborhood effects—is useful for testing various hypotheses related to neighborhood influences, yet the associational nature of the data makes these studies vulnerable to genetic confounding (Barnes et al. 2014). In particular, given the general non-zero heritability for nearly all quantitative traits (Polderman et al. 2015), the association between neighborhood influences and personality traits could be affected, at least in part, by overlapping genetic influences that impact variation in both traits (Barnes et al. 2014; Sariaslan et al. 2013). To better account for the possibility of unmeasured confounding influences, we also examine neighborhood associations with personality controlling for genetic differences by focusing on a group of monozygotic (MZ) twins.

These genetically informed tests have important theoretical implications in identifying systematic environmental sources of personality differences and the underlying evolutionary mechanisms affecting such an association. In fact, the proportion of variance in personality traits not attributable to genetics or the shared family environment increases in adulthood (Briley and Tucker-Drob 2014) suggesting that the prospect of understanding the source of individual differences in personality increases with age. We propose that personality traits may partly reflect social strategies that are fitted to navigate the nuances of the immediate environment. To this end, personality differences are framed using a theory based in evolutionary principles that emphasizes the modification of individual differences in response to contextual forces.

Life History Theory

As evolutionary psychology emerged as a possible unifying meta-theoretical perspective in Psychology, the focus was on the application of basic evolutionary principles (e.g., natural and sexual selection) in order to understand universals in human cognition and behavior (Buss 1995; Miller 2000; Tooby and Cosmides 2015; Winegard et al. 2017). In general, individual differences were viewed as noise or to be addressed at a later point in time, after a foundational understanding was established. Recently, however, there is a waxing interest in evolutionary approaches to individual differences (e.g., Buss and Greiling 1999; Buss, and Hawley 2011). One such approach is based on life history (LH) theory (Stearns 1992; Wilson 1975).

LH theory states that while all organisms are driven toward survival and reproduction, the manner in which they allocate resources (e.g., calories, time, behavior) toward somatic effort (i.e., growth and ensuring their own survival) and reproductive effort (i.e., mating and caring for offspring) varies. Differences in said allocation are realized in LH strategies. A faster LH strategy implies allocating more resources toward courting and mating, while a slow LH strategy implies allocating more resources toward growth, development, and kin investment. LH theory also states that LH strategies reflect functional suites of traits that are coordinated toward the same goal. Hence, various markers of LH strategy such as length of gestation, parental investment, and senescence show substantial covariation across (as well as within) species (Promislow and Harvey 1990).

It was recognized that while humans reside decidedly on the slower end of the LH strategy continuum at the species level, there is an additional intriguing possibility that individual variation in LH strategy undergirds variation across a number of psychological (Belsky et al. 1991; Draper and Harpending 1982) and cognitive domains (Ellis et al. 2017; Frankenhuis et al. 2016). Belsky et al. (1991) exhibited this possibility using two developmental prototypes, namely, a fast and slow LH strategy, respectively. Biometric markers of a fast LH strategy include hastened development, younger age of sexual initiation, more frequent short-term pair bonds, reduced parental care, and earlier senescence. Biodemographic indicators for a typical slow LH strategy include an extended juvenile period, delayed sexual initiation, the formation of long-term pair bonds, intensive parental care, and a longer lifespan.

As alluded to, functionality is maximized when the allocation of resources coalesces to form a coherent LH strategy that is also inclusive of a constellation of behavioral and psychological differences (i.e., psychometric differences). In one of the earliest and most comprehensive tests of this proposal, it was found that a large set of individual differences scales (e.g., family support, altruism) covaried such that they revealed a single common factor explained over 70% variance in the measures (Figueredo et al. 2004).

Personality and LH Theory

Figueredo et al. (2004) extended the idea of unity across psychological characteristics to personality variation, in particular the Big Five personality traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism, which they argued were expected to cohere in such a way as to form a general factor of personality (GFP). Indeed, factor-analyzed trait scores revealed the higher-order GFP composed of openness, conscientiousness, extraversion, and agreeableness and low levels of neuroticism. Hence, an individual who possesses a high GFP would be tolerant, forthright, personable, and emotionally stable. In essence, however, Figueredo et al. (2004) was reasserting an idea with origins dating back to the formal study of individual differences in personality. Galton's (1884) analysis of the synonymous nature of trait adjectives suggested a GFP reflective of character (Dunkel and Van der Linden 2017; Tucker-Drob et al. 2016). To date, the extraction of a GFP from personality trait scales has been replicated using a multitude of personality scales (e.g., Loehlin 2012; Musek 2007; Rushton and Irwing 2011; Van der Linden et al. 2010). For an example of a counter view of the GFP, see Revelle and Wilt (2013). Importantly, Figueredo et al. (2004, 2006) interpreted the GFP through a LH theory lens with the GFP being a facet of an even broader slower LH strategy. In support of this position, Figueredo et al. found that the slow LH strategy factor and the GFP correlated at $r = 0.69$. This association has been replicated using assorted measures (e.g., Dunkel and Decker 2010).

It is also worth noting that prior to research on the GFP, Digman (1997) found that the Big Five created two higher-order factors composed of agreeableness, conscientiousness, and emotional stability (the inverse of neuroticism) on the one hand and extraversion and openness on the other hand. Digman (1997) labeled the first factor (alpha) and the second factor (beta), yet these factors are now more often referred to as stability and plasticity (e.g., DeYoung 2006), with stability representing an individual's proclivity for stability and structure and plasticity representing the desire for exploration and growth.

The components of plasticity and stability have also been posited to partly reflect LH strategies. While stability primarily aligns with a slow LH strategy, the relationship between plasticity and LH is thought to be more complex (Del Giudice 2012, 2014; Manson 2017). Extraversion and openness, in particular, compose plasticity, and they themselves are composed of various dimensions—some of which are associated with a slow LH strategy (e.g., intellect, a facet of openness) as well as other aspects that are associated with both a slow and a fast LH strategy (e.g., imagination, a facet of openness). Yet, a GFP and plasticity/stability account of how LH strategy and personality are related is not necessarily at odds. For example, in one study (Dunkel et al. 2018), it was found that when controlling for GFP variance, the association between LH strategy and stability remained positive (suggesting that the additional unique stability variance reflected a slow LH strategy), while the association between LH strategy and plasticity became negative (suggesting that the unique plasticity variance more largely reflected a fast LH strategy).

Sources of Variance in LH Strategy

Ellis et al. (2009) argued that at least two distinct domains of ecological stressors exist that influence the development of LH strategies. The first is e*nvironmental harshness*, defined as the level of extrinsic morbidity or mortality present at the population-level, independent of age and/or health status (Charnov 1991). Environmental harshness has been predominantly operationalized through perception or exposure to violence (Brumbach, Figueredo, & Ellis, 2009) or indicators of low financial or socioeconomic status (e.g., Belsky et al. 2012; Sung et al. 2016). *Environmental unpredictability* is conceptualized as the variance and fluctuation of extrinsic morbidity-mortality present within the environment. The present study focuses on two indicators of environmental harshness and unpredictability: neighborhood safety (the extent to which one perceives a level of threat) and neighborhood inequality (the level to which the neighborhood has lower-quality housing, facilities, and infrastructure), indicating a lower socioeconomic area. Heightened danger, coupled with lower access to resources, signifies that investing time and resources to assure long-term benefits (i.e., greater socioemotional skills for navigating a complex social environment; Flinn 2006) would be an unwise survival and reproductive strategy. As such, traits should develop in a manner that maximize the skills needed to overcome *immediate* ecological problems and successfully survive and reproduce. This would mean that harsh environments should result in more opportunistic/antagonistic social strategies (e.g., Belsky et al. 1991; Frankenhuis et al. 2016).

Although the conceptual underpinnings of LH were arrived at by imagining adaptively relevant environments, they still have contemporary application (Irons 1990). For example, Wilson and Daly (1997) analyzed the stark differences in homicide rates and early pregnancy between different Chicago neighborhoods. The precariousness of life (i.e., life expectancy) was an excellent predictor of each variable. Lower life expectancies were associated with greater homicide rates and early age of first pregnancy. These differences in homicide rates and age of first pregnancy may be representative of a constellation of behaviors (e.g., drug use, early pregnancy, poor eating habits) reflecting future discounting (Pepper and Nettle 2017), which we argue itself is reflective of a fast LH strategy. Such an argument was put forward by Nettle (2010) who examined differences between residents of English neighborhoods in a suite of LH strategy indices (e.g., maternal age at reproduction). As predicted, residents of higher quality neighborhoods exhibited a slower LH strategy. Further support for the association between neighborhood environment and LH strategy was recently found by Johnsen et al. (2017) who found that neighborhood safety was associated with both psychometric (mini-*K* score) and biometric (age of first sex) indices of LH strategy. Though tentative, what these studies suggest is that varying ecological conditions may exert their influence on developmental outcomes (personality traits, behavior, etc.) by regulating the LH strategies of the individuals residing in the area. Social scientists have long emphasized the importance of environmental effects for behavioral outcomes (e.g., Sampson et al. 1997), especially neighborhood effects; however, they have generally failed to offer a more concrete pathway for how such effects might influence individuals. As we have discussed above, LH theory provides a possible mechanism for how environmental adversity might translate to individual level variation in impulse control, aggression, and other phenotypes that are relevant in the social sciences.

In early models of LH development, the first 5 to 7 years of life were viewed as a sensitive period for the establishment of a trait-type LH strategy (e.g., Belsky et al. 1991; Ellis et al. 2003). Buss and Greiling (1999) refer to models emphasizing the importance of the early environment in setting LH strategies as early environmental calibration models. Contemporary models take a more dynamic view with continued development of LH strategy occurring at least into the second decade of life (Del Giudice 2009; Del Giudice and Belsky 2011; Dunkel et al. 2015; Dunkel and Lukaszewski 2015; Ellis et al. 2012) and variance around the set point resulting in modifications in state-type LH strategy behaviors (e.g., Dunkel et al. 2010; Griskevicius et al. 2011). These models—suggesting situational calibration of life history traits—are referred to as enduring situational evocation models (Buss and Greiling 1999).

From the perspective of enduring situational evocation models, protracted exposure to environmental cues of harshness and unpredictability would result in a reliable change in LH strategy traits. Relevant to this possibility are studies of neighborhood effects. O'Brien and Wilson (2011) found that individuals could accurately predict the actual level of prosociality reported by residents of a neighborhood based on pictures of the neighborhood structures. In a second study, they found that participants varied their level of cooperation in a prisoner's dilemma game based upon the perceived residential neighborhood of the other player. Participants acted more cooperatively when they were led to believe they were playing with someone who resided in a neighborhood with greater upkeep. Nettle et al. (2014) not only found that, compared to affluent neighborhoods, residents of low SES and high-crime neighborhoods expressed lower trust and higher paranoia but also found that a brief visit to the neighborhoods by student volunteers elicited changes in trust and paranoia that paralleled that of the residents. It is possible that if the volunteer students moved to one of the aforementioned neighborhoods, their temporary shifts in paranoia and stress would become dispositional. Distrust and paranoia may also have consequences in terms of pragmatic social issues such as law enforcement. For example, Kruger et al. (2015) employed data from a community-wide survey of a county in Michigan to illustrate that slower LH strategy was associated with more positive perceptions of the police (as measured via procedural justice and police legitimacy) even after controlling for demographic characteristics. Overall, the findings of these three studies highlight that community characteristics and individual differences in LH strategy can interact to potentially influence dispositional traits.

Methodological Note and Hypotheses

Conclusions drawn from the associations between the qualities of neighborhoods and the LH indices of the residents are limited because the causal arrow could point in either or both directions (Barbaro et al. 2017; Barnes et al. 2014; Nettle 2010). Neighborhoods may help to directly sculpt LH strategies and/or individuals with varying LH strategies may sort themselves willfully or by necessity into certain geographic locations (Scarr and McCartney 1983). While experimental methods overcome these limitations to establish causation (e.g., Nettle et al. 2014), they are limited to small samples and, more importantly, might document only transitory shifts in behavior or perspective.

The current investigation utilizes methods that help to address at least some of these limitations. First, we use data that allow the tracking of both the qualities of the neighborhood and personality across three points in time. If aspects of the neighborhood environment are associated with (and perhaps impacting) fluctuation in LH strategy, then it is expected that neighborhood changes will coincide with fluctuations in LH strategy. Additionally, we employ a genetically informed design. Segregation into neighborhoods based on heritable LH characteristics is one possible reason for an association between neighborhood qualities and LH strategy. Yet, this genetic confound can be controlled for by comparing differences between monozygotic (MZ) twins, given that MZ twins share largely the same distinguishing DNA and, by definition, are exposed to the same shared environmental factors. As a result, any difference between them should most likely be due to non-genetic factors including the environment. Thus, if neighborhood characteristics impact personality, then differences between MZ twin pairs in their assessments of their neighborhoods should correlate with differences between the twins on indices of LH strategy (e.g., the GFP).

We hypothesize that perceived neighborhood safety and inequality provide signals of environmental harshness and predictability and will be associated with personality in a manner reflective of the established ecological effects on LH strategy. High levels of perceived neighborhood safety should be associated with relatively high levels of openness, conscientiousness, agreeableness, extraversion, and a low level of neuroticism. Alternatively, high levels of perceived unsafety and neighborhood inequality should show a mirror image of the associations with personality. In as much as a specific pattern emerges, we suggest that perceived neighborhood safety and inequality may primarily affect personality via the GFP, although it is not presumed that this is the only effect of perceived neighborhood safety and inequality have on personality. For example, we speculate that when controlling for the GFP, perceived neighborhood safety will be positively associated with stability, but negatively associated with plasticity. Predictions for the analyses examining the longitudinal and twin data follow from those predictions for the cross-sectional data.

To test these hypotheses, we used data from the Midlife in the United States Longitudinal Study of Health and Well-Being (MIDUS; Brim et al. 1995–1996) in which a large nationally representative sample of middle-aged adults were administered an assortment of biopsychosocial measures and subsequently retested at two points in time several years later. We examine the full sample using a multilevel approach to examine if changes in perceived neighborhood safety and inequality coincide with fluctuations in personality. We adopt a multilevel analysis approach given that variables such as neighborhood and personality contain a stable between-person component as well as within-person fluctuations. In the context of the present study, the within-person fluctuations are particularly relevant because we test whether differences in neighborhood over time are accompanied with differences in personality in the expected direction. Second, besides testing within-person fluctuations over time in the entire sample, we also focus on differences in MZ twins (via difference scores), thereby controlling for any potential confounding effects of shared genetic and shared non-genetic factors. We include various levels of personality measures. Specifically, we take into account the Big Five dimensions but also incorporate stability and plasticity as two higher-order factors directly above the Big Five and the GFP at the highest level of the hierarchy. The latter construct is deemed particularly relevant as the GFP has been considered as an indicator of LH strategy.

Method

Participants

MIDUS is an ongoing longitudinal study designed to measure the influence of psychosocial factors on age-related health outcomes in middle-aged adults (Brim et al. 1995–1996). The first wave of data (MIDUS I) was collected in 1995–1996 with a total sample of 7108 participants (52% female) between the ages of 20 and 75 ($M = 46.35$; $SD = 13.00$). In 2004 data for a follow-up and extension of the first wave of data collection was initiated (MIDUS II; Ryff et al., 2004–2006). MIDUS II included 4963 of the original participants (53% female), now 28 to 84 years of age ($M = 55.43$; $SD = 12.45$). In 2013 a third wave of data collection was initiated (MIDUS III; Ryff et al., 2013–2014). MIDUS III included data from 3294 of the original MIDUS I participants (55% female). The age of the MIDUS III participants ranged from 39 to 93 ($M = 63.64$; $SD = 11.35$). The vast majority (90.7) of the sample was white, and 5.2% identified as black. Other ethnicity/groups comprised the remaining 4.1% of the sample.

Measures

From a LH perspective, environmental harshness and (un)predictiveness are two major environmental characteristics related to LH strategy. In terms of subjective experience, those two characteristics can be assumed to translate into the perception of environmental safety and quality, which indicates resource availability. The MIDUS data contains two subjective measures that give a sense of those characteristics, namely, neighborhood safety and inequality.

Perceived Neighborhood Safety

Perceived neighborhood safety was measured using the four item "Perceived Neighborhood Quality/Health" scale. Participants were instructed to indicate how much each of the following four statements describes his or her situation using a four-point Likert-type scale. The four statements or items were as follows: (1) I feel safe being out alone in my neighborhood during the daytime; (2) I feel safe being out alone in my neighborhood at night; (3) I could call on a neighbor for help if I needed it; and (4) People in my neighborhood trust each other. The internal consistency for the scale was $\alpha = 0.68$ in MIDUS I, $\alpha = 0.64$ in MIDUS II, and $\alpha = 0.65$ in MIDUS III.

Perceived Neighborhood Inequality

Perceived neighborhood inequality was measured using the MIDUS "Perceived Inequality in Home" scale (Ryff et al. 1999). Participants were instructed to indicate how much each of the following six statements describes his or her situation using a six-point Likert-type scale. The six statements or items were as follows: (1) Most people live in a better neighborhood than I do; (2) I do not like to invite people to my home because I do not live in a very nice place; (3) It feels hopeless to try and improve my home or neighborhood situation; (4) I live in as nice a home as most people; (5) I am proud of my home; and (6) I feel very good about my home and neighborhood. The last three items (4–6) were reverse scored. The internal consistency for the scale was $\alpha = 0.80$ in MIDUS I, $\alpha = 0.78$ in MIDUS II, and $\alpha = 0.78$ in MIDUS III.

Personality Traits

Participants rated the degree to which a set of adjectives described them using a four-point Likert-type scale anchored from *a lot* to *not at all*. The items for each of the Big Five personality traits and the corresponding internal consistency for each of the scales were as follows: openness scale items (creative, imaginative, intelligent, curious, broad-minded, sophisticated) and internal consistencies (MIDUS I $\alpha = 0.77$; MIDUS II $\alpha = 0.77$; MIDUS III $\alpha = 0.77$), conscientiousness scale items (organized, responsible, hardworking, careless-reversed scored, thorough-added in MIDUS II) and internal consistencies (MIDUS I $\alpha = 0.58$; MIDUS II $\alpha = 0.68$; MIDUS III $\alpha = 0.69$), extraversion scale items (outgoing, friendly, lively, active, talkative) and internal consistencies (MIDUS I $\alpha = 0.78$; MIDUS II $\alpha = 0.76$; MIDUS III $\alpha =$ 0.76), agreeableness scale items (helpful, warm, caring, soft-hearted, sympathetic) and internal consistencies (MIDUS I $\alpha = 0.80$; MIDUS II $\alpha = 0.80$; MIDUS III $\alpha = 0.77$), and neuroticism scale items (moody, worrying, nervous, calm-reverse scored) and internal consistencies (MIDUS I $\alpha = 0.74$; MIDUS II $\alpha = 0.74$; MIDUS III $\alpha = 0.71$). The scales have undergone extensive psychometric testing and exhibit factor invariance across several age groups (Zimprich et al. 2012).

Unit-weighted measures of stability and plasticity for each wave were also calculated. First, the Big Five traits were standardized (i.e., transformed to *z*-scores). Stability was calculated by summing the standardized values for conscientiousness and agreeableness and subtracting the standardized value of neuroticism. Plasticity was calculated by summing the standardized scores for extraversion and openness.

To calculate the GFP, the Big Five scale totals were factor-analyzed using principal axis factoring, and the first unrotated factor was extracted using the regression method (see also Van der Linden et al. 2010). For MIDUS I, the first factor had an eigenvalue of 1.66 and accounted for 33.15% of the variance among the scales. The factor loadings for each of the Big Five scales were as follows: openness (0.61), conscientiousness (0.43), extraversion (0.80), agreeableness (0.63), and neuroticism (− 0.26). For MIDUS II, the first factor had an eigenvalue of 1.65 and accounted for 33.00% of the variance among the scales. The factor loadings for each of the Big Five scales were as follows: openness (0.66), conscientiousness (0.46), extraversion (0.76), agreeableness (0.58), and neuroticism (− 0.28). For MIDUS III, the first factor had an eigenvalue of 1.66 and accounted for 33.15% of the variance among the scales. The factor loadings for each of the Big Five scales were as follows: openness (0.69), conscientiousness (0.48), extraversion (0.75), agreeableness (0.59), and neuroticism (− 0.23).

Results

Longitudinal Sample

Zero-order correlations between perceived neighborhood safety, inequality, and personality are provided in Table 1. The table shows that perceived neighborhood safety and inequality were negatively correlated. Perceived neighborhood safety was positively correlated with openness, conscientiousness, extraversion, agreeableness, plasticity, stability, and the GFP and negatively correlated with neuroticism. Perceived neighborhood inequality was negatively correlated with openness, conscientiousness, extraversion, agreeableness, plasticity, stability, and the GFP and positively correlated with neuroticism. Comparing the MIDUS I to MIDUS III showed that there was no differential attrition on the GFP, $t(6259) = 1.06$, $p = 0.29$. For the neighborhood measures, however, participants who dropped out scored higher on perceived neighborhood inequality, $t(6251) = 6.41$, $p < 0.001$, Cohen's $d = 0.16$, and lower on perceived neighborhood safety, $t(6250) = 6.72$, $p < 0.001$, Cohen's $d = 0.19$.

For the next phase of the analysis, we used a multilevel approach to examine the correlation between fluctuations in perceived neighborhood safety and inequality and personality. However, as sex and ethnicity showed low but relevant correlations with various personality variables, we decided to first create new variables of personality in which sex and ethnicity were controlled for (by saving the residuals). Such an approach also deals with any possible invariance of personality on sex and ethnicity over the different waves. Several of the ethnic groups were very small (e.g., 0.6% of the sample). Therefore, we decided to include only the group of Whites and Blacks, which together comprised 95.9% of the sample.

The multilevel approach is appropriate in research designs in which the data are nested. In this instance, the data consisted of two levels whereby the different times of measurements (*N* ranges from 12,447 to 12,996 data points) are nested within individuals (*N* ranges from 6101to 6155 respondents). This approach allows for correlations to be addressed in two different, yet equally meaningful, ways: Relationships take into account either comparisons between different scores of the same person (i.e., within-person level) or comparisons between different persons (i.e., between-person-level). The most relevant test in the present study is at the within-level that examines whether *fluctuations* in neighborhood safety and inequality are accompanied with *fluctuations* in personality in the hypothesized direction. Before calculating within-level correlations, we used MLwiN to calculate the initial intraclass correlations (ICCs) for the study's variables. The ICC's show

Table 1 Zero-order correlations between perceived neighborhood safety and inequality and personality traits in the full sample

	Time 1		Time 2		Time 3	
	Safety	Inequality	Safety	Inequality	Safety	Inequality
Time 1						
Openness	0.12	− 0.14	0.12	− 0.14	0.10	− 0.11
Conscientiousness	0.17	− 0.26	0.17	− 0.21	0.14	− 0.19
Extraversion	0.19	− 0.20	0.16	− 0.17	0.15	− 0.17
Agreeableness	0.10	− 0.14	0.11	− 0.12	0.06	− 0.10
Neuroticism	− 0.21	0.21	− 0.18	0.19	− 0.16	0.15
Plasticity	0.18	− 0.20	0.16	− 0.18	0.14	− 0.17
Stability	0.23	− 0.30	0.23	− 0.26	0.19	− 0.22
GFP	0.22	− 0.25	0.20	− 0.22	0.17	− 0.20
Time 2						
Openness	0.10	− 0.14	0.15	− 0.17	0.11	− 0.15
Conscientiousness	0.14	− 01.21	0.18	− 0.25	0.14	− 0.20
Extraversion	0.18	− 0.21	0.19	− 0.20	0.15	− 0.17
Agreeableness	0.10	− 0.15	0.14	− 0.16	0.07	− 0.11
Neuroticism	− 0.18	0.19	− 0.18	0.20	− 0.19	0.18
Plasticity	0.16	− 0.20	0.20	− 0.21	0.15	− 0.19
Stability	0.20	− 0.27	0.24	− 0.30	0.19	− 0.24
GFP	0.19	− 0.25	0.24	− 01.26	0.17	− 0.22
Time 3						
Openness	0.09	− 0.12	0.12	− 0.15	0.14	− 0.16
Conscientiousness	0.13	− 0.19	0.12	− 0.18	0.15	− 0.20
Extraversion	0.17	− 0.18	0.16	− 0.20	0.20	− 0.20
Agreeableness	0.06	− 0.13	0.09	− 0.14	0.10	− 0.14
Neuroticism	− 0.15	0.18	− 0.17	0.18	− 0.19	0.21
Plasticity	0.15	− 0.17	0.16	− 0.20	0.20	− 0.21
Stability	0.17	− 0.25	0.19	− 0.25	0.22	− 0.27
GFP	0.16	− 0.21	0.18	− 0.23	0.22	− 0.24

$N = 2493–6215$. All correlations $p < 0.01$

whether there are sufficient levels of variance at the within-person level (i.e., time of measurement).

Table 2 displays the within- and between-level correlations for the full sample. The ICCs ranged from 0.50 to 0.71 which implies that 29 to 50% of the variance in the neighborhood and personality variables is due to within-person fluctuations. This finding underscores the relevance of distinguishing between within- and between-person correlations. First, Table 2 shows that, similar to the correlations in Table 1, at the between-person level (below the diagonal), measures of perceived neighborhood safety and inequality were related to personality in the expected directions. Specifically, neighborhoods perceived as safer and more equitable were generally associated with more socially desirable scores on each of the personality dimensions. For neuroticism, this implies a

Table 2 Between (below diagonal) and within (above diagonal) person correlations controlling for ethnicity and sex

	ICC	1	2	3	4	5	6	7	8	9	10
1. N-safety	0.53		**− 0.34**	**0.09**	**0.05**	**0.08**	**0.05**	**− 0.06**	**0.10**	**0.08**	**0.10**
2. N-inequality	0.50	− 0.55		**− 0.07**	**− 0.09**	**− 0.06**	**− 0.06**	**0.08**	**− 0.07**	**− 0.11**	**− .10**
3. Openness	0.67	0.15	− 0.18		0.24	0.45	0.35	− 0.11	0.85	0.36	0.71
4. Conscientiousness	0.62	0.22	− 0.30	0.33		0.23	0.23	− 0.13	0.28	0.69	0.47
5. Extraversion	0.68	0.25	− 0.25	0.53	0.30		0.44	− 0.12	0.85	0.40	0.85
6. Agreeableness	0.63	0.17	− 0.19	0.38	0.29	0.54		− 0.08	0.47	0.66	0.68
7. Neuroticism	0.62	− 0.22	0.24	− 0.18	− 0.23	− 0.19	− 0.11		− 0.14	− 0.61	− 0.25
8. Plasticity	0.71	0.23	− 0.24	0.86	0.36	0.88	0.53	− 0.21		0.44	0.92
9. Stability	0.65	0.30	− 0.35	0.43	0.75	0.49	0.67	− 0.65	0.52		0.71
10. GFP	0.70	0.30	− 0.31	0.74	0.52	0.90	0.71	− 0.32	0.94	0.75	

ICC intraclass correlations, *N* neighborhood. Above the diagonal = within-persons multilevel correlation ($N = 12{,}966$ to 13,538); correlations ≥ 0.020 are significant at $p < 0.01$. Below the diagonal = between-person correlations ($N = 6360$ to 6412); correlations ≥ 0.025 are significant at $p < .01$. The most relevant correlations for the study are in bold face reversed pattern with higher scores relating to lower perceived neighborhood quality.

The most relevant correlations for the present study are the within-person level (above the diagonal)—based on person-mean centered values—which are indicated in bold in Table 2. Although those correlations were generally lower than at the between-person level, they clearly show that fluctuations in perceived neighborhood safety and inequality over time were associated with fluctuations in personality in the expected direction. For example, fluctuations in perceived neighborhood safety and inequality correlated with fluctuations in the GFP at 0.10 and − 0.10, respectively. This indicates that at times when participants reported an improvement in their perception of neighborhood quality, they also scored more favorably (i.e., more socially desirable) on personality and vice versa. Table 2 also shows that the measures of perceived neighborhood safety and inequality were relatively strongly (negatively) correlated (− 0.55). In order to analyze the neighborhood and personality relationship by taking into account their overlap, we used within-person regression analysis. In this analysis, we regressed fluctuations in perceived neighborhood safety and inequality on fluctuations in the GFP. This showed that the two neighborhood measures explained a significant level of variance in the GFP (adjusted $R^2 = 0.014$, $F = 83.35$, $p < 0.001$). The beta's were 0.11 and − 0.12 (both $ps < 0.01$) for perceived neighborhood safety and inequality, respectively, further confirming that an increase (or decrease) in perceived neighborhood quality is associated with an increase (or decrease) in the GFP.

In order to test the robustness of the above-reported findings, we also conducted parallel analyses in which we operationalized the GFP as a latent factor. Moreover, we tested the results controlling for socioeconomic status (SES). The findings from these analyses can be found in the supplementary material. Overall, they show that despite the different analytic approach, the results remain highly similar and the conclusions identical. For example, the multilevel structural equation model with the latent GFP had an excellent fit and confirmed, at the within-person level, that changes in neighborhood quality are accompanied with significant changes in personality, mainly residing in the GFP.

From Table 2, it can be inferred that the relationship between perceived neighborhood quality and personality occurred at each level of personality measurement, that is, at the level of the Big Five, the Big Two (i.e., plasticity and stability), and the GFP. However, as lower-order personality measures consist of the shared variance represented in higher-order constructs as well as their unique variance, we considered it informative to differentiate higher-order versus lower-order effects.

Therefore, we again calculated the multilevel correlations between the Big Five and the Big Two, but this time controlling for the GFP (i.e., the residuals). These correlations are presented in Table 3. As can be seen, overall, the strength of correlations was reduced and sometimes the correlations even switched sign. For openness, the trait's unique variance was positively correlated with safety, while its relationship with inequality became null. Fluctuations in conscientiousness remained negatively correlated with fluctuations in inequality. Fluctuations in extraversion actually switched direction, becoming positively correlated with fluctuations in inequality and negatively correlated with fluctuations in safety. The associations with agreeableness remained null for safety and became null for inequality. Fluctuations in neuroticism remained both positively correlated with fluctuations in perceived safety and negatively correlated with fluctuations in perceived inequality. Most pertinent to the hypotheses, when controlling for the GFP, the association between perceived neighborhood inequality and plasticity turned positive, while for stability it was not attenuated. When controlling for the GFP, the associations between perceived safety became null for both plasticity and stability.

Table 3 Between (below diagonal) and within (above diagonal) person correlations after controlling for the general factor of personality

	1	2	3	4	5	6	7	8	9
1. N-safety		**0.51**	**0.02**	**− 0.01**	**− 0.02**	**− 0.00**	**− 0.03**	**0.00**	**0.01**
2. N-inequality	− 0.56		**0.00**	**− 0.04**	**0.05**	**− 0.00**	**0.05**	**0.04**	**− 0.06**
3. Openness	− 0.06	0.06		− 0.16	− 0.46	− 0.26	0.10	0.70	0.31
4. Conscientiousness	0.08	− 0.16	− 0.11		− 0.39	− 0.14	− 0.01	− 0.48	0.57
5. Extraversion	− 0.01	0.06	− 0.44	− 0.47		0.37	0.20	0.28	− 0.58
6. Agreeableness	− 0.07	0.06	− 0.34	− 0.09	0.06		0.14	− 0.55	0.35
7. Neuroticism	− 0.15	0.15	0.06	− 0.07	0.25	0.21		0.25	− 0.64
8. Plasticity	− 0.07	0.11	0.78	− 0.45	.22	− 0.60	0.24		− 0.77
9. Stability	0.12	− 0.17	− 0.29	0.63	− 0.65	0.32	− 0.63	0.76	

N neighborhood. Above the diagonal = within-persons multilevel correlation ($N = 12{,}966$ to 13,538); correlations ≥ 0.020 are significant at $p < 0.01$. Below the diagonal = between-person correlations ($N = 6360$ to 6412); correlations ≥ 0.025 are significant at $p < 0.01$. The most relevant correlations for the study are in bold face

Twin Sample

For the current investigation, only monozygotic (MZ) twin pairs were used. Zygosity was determined by self-report of phenotypic similarity on a number of characteristics (e.g., eye color), whether or not the twin pairs were often mistaken for each other and whether the twin pair had ever undergone testing or been informed by a physician that they were identical twins. MIDUS I included data for 349 monozygotic (MZ) twin pairs (698 individuals; 53.3% female).

One twin in each pair was randomly assigned as twin 1 and the other as twin 2. For each of the variables, differences scores were calculated by subtracting the value from twin 2 from that of twin 1. The intrapair correlations for the study variables are presented in Table 4. The bivariate correlations for the neighborhood difference scores and the personality difference scores can be seen in Table 5. The results generally mirror those found in the full sample. Difference scores in perceived neighborhood safety were positively correlated with differences in openness, extraversion, agreeableness, plasticity, stability, and the GFP and negatively correlated with differences in neuroticism. Differences in perceived neighborhood safety were not correlated with differences in conscientiousness. Differences in perceived neighborhood inequality were negatively correlated with differences in openness, plasticity, stability, and the GFP and positively correlated with differences in neuroticism. Statistically significant relationships were not found for differences in conscientiousness, extraversion, and agreeableness.

Next, a series of partial correlations were calculated between the neighborhood difference scores and the individual trait and plasticity and stability difference scores while controlling for the GFP. Because the GFP represents the shared variance among the traits, controlling for it allows for the examination of the association of the trait's unique variance with other variables. If the association between personality and other variables is primarily at the level of the GFP, then it is expected that the association between the individual trait and the other variables will be substantially reduced when controlling for the GFP. As seen in Table 6, this was the pattern that was found. When controlling for differences in the GFP, all of the correlations between differences in the neighborhood indices and differences in the trait scores were no longer significant.

Table 4 Intrapair correlations between monozygotic twins on the study variables

Variable	r_{MZ}
Neighborhood safety	0.35
Neighborhood inequality	0.33
Openness	0.42
Conscientiousness	0.47
Extraversion	0.45
Agreeableness	0.35
Neuroticism	0.52
Plasticity	0.43
Stability	0.45
GFP	0.46

$N = 314–323$

Table 5 Bivariate correlations of MZ differences scores between perceived neighborhood safety and inequality and personality traits

	Neighborhood perception	
	Safety	Inequality
Openness	0.20***	− 0.19**
Conscientiousness	0.09	− 0.09
Extraversion	0.18**	− 0.11
Agreeableness	0.18**	− 0.11
Neuroticism	− 0.12*	0.12*
Plasticity	0.22***	− 0.17**
Stability	0.19**	− 0.16**
GFP	0.23***	− .17**

N pairs = 310. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Discussion

The neighborhood in which one resides provides important social information. Using the theoretical framework of LH theory, it can further be discerned which aspects of the neighborhood environment might be most salient (i.e., cues to harshness and predictability) and the manner in which they may impact personality. There is an accumulating cache of evidence that safety and inequality are especially important features of the neighborhood that appear to impact LH strategy (e.g., Frankenhuis et al. 2016). Taking the perspective that

Table 6 Partial correlations (controlling for the GFP) of MZ differences scores between perceived neighborhood safety and inequality and personality traits

	Neighborhood perception	
	Safety	Inequality
Openness	0.05	− 0.10
Conscientiousness	0.02	− 0.02
Extraversion	− 0.08	0.10
Agreeableness	0.02	0.01
Neuroticism	− 0.08	0.08
Plasticity	0.01	− 0.04
Stability	0.05	− 0.06

N pairs = 307. All correlations $p > 0.05$

the GFP is partially a function of LH strategy, it was predicted that fluctuations in perceived neighborhood safety and inequality would be associated with fluctuations in personality that largely reflect variation at the level of the GFP. It was hypothesized that increases in safety and decreases in inequality across time would be associated with corresponding increases in the GFP. The proposed hypotheses were supported by the full data sample across the three time points. Importantly, the fluctuations in the GFP in relation to fluctuations in neighborhood quality remain robust over the various statistical approaches we applied. That is, the conclusions remained identical regardless of whether we applied multilevel correlations, regressions, or structural equation modeling.

To test the hypothesis that associations between the aspects of the neighborhood and personality were primarily at the level of the GFP, subsequent analyses were conducted in order to contrast the bivariate associations with fluctuations while controlling for the shared variance among the separate personality traits (i.e., the GFP). Reductions in the strength of the correlations between fluctuations in perceived neighborhood safety and neighborhood inequality and individual traits indicated the relative prominence of the GFP. Although it should also be noted that many associations remained significant, thus, fluctuations in aspects of the neighborhood are not solely a function of fluctuations in the GFP. Most relevant to the hypotheses, when controlling for the GFP, the association between fluctuations in perceived neighborhood inequality and fluctuations in plasticity became significantly positive. These findings are consistent with predictions derived from LH theory and posited by Del Giudice (2012, 2014) that the facets composing plasticity are mixed, some are aligned with a slower LH strategy, and some are aligned with a faster LH strategy. In interpreting the present findings, it is relevant to emphasize that the results were obtained, controlling demographic variables.

The main findings using the full sample were buttressed by analyses examining differences between MZ twins. Differences between twins' appraisals of neighborhood safety and inequality were such that the twin who reported greater neighborhood safety also reported higher Big Five trait scores for openness, extraversion, and agreeableness and lower scores for neuroticism, while higher levels of inequality were associated with greater neuroticism and lower openness. At the level of the meta-traits, differences in perceived neighborhood safety were positively correlated with differences in plasticity, stability, and the GFP, while differences in perceived neighborhood inequality were negatively correlated with each of the meta-traits. When controlling for differences in the GFP, the correlations between the aspects of the neighborhood and the other traits became null. These findings are consistent with predictions concerning the relative importance of the GFP. However, contrary to predictions, when controlling for the GFP, the unique variance for plasticity did not become negatively correlated with safety and positively correlated with inequality. A potential reason for this finding is the influence of shared genetic and shared non-genetic factors that impact the nexus of neighborhood and personality.

Research Implications and Limitations

While the findings may be an important contribution to individual difference research, there are possible larger implications of these results. Research has found that features of neighborhood disadvantage have been linked to a range of negative health and well-being outcomes (e.g., Kwon et al. 2019). While several pathways have been suggested, such as decreased investment in somatic effort (i.e., greater risk-taking and self-medication, decreased health-maintaining behavior), it is also possible that sustained evoked physiological responses from and responding to stressful life experiences encountered in harsh and unpredictable environments may be another mechanism (Cabeza de Baca et al. 2016; Ellis et al. 2013).

Indeed, there is no shortage of evidence suggesting robust correlations between a person's ambient environment and numerous key outcomes. To date, however, two important aspects have remained less clear. The first is the problem of a theoretical framework that can accommodate both environmental and biological explanations for how extraneous factors impact behavioral and psychological outcomes in human beings (Barbaro et al. 2017). LH theory provides such a mechanistic pathway and can provide more specific and parsimonious predictions compared with other theoretical models. For example, LH theory would predict that much of the effects of neighborhoods on personality would occur at the level of the GFP, which was supported in the present study. In contrast, with other models that assume relatively independent personality dimensions, it will be more difficult to explain how neighborhood quality would have such a general effect on personality, or otherwise it would require specific predictions for each separate dimension. This should not be taken as the absence of neighborhood effects on more fine-grained personality facets. A LH perspective may also be applied to make more pointed and specific predations (e.g., Del Giudice 2012, 2014). This has the potential for being an interesting avenue for future research but would take a more extensive measure of personality than that utilized in the current investigation.

Second, outside of randomized controlled trials, work in this area has been constrained by the ability to fully address confounding factors, including genetic effects, which may inform selection into certain environments, including neighborhoods. We attempted to address this concern by also analyzing data from MZ twins included in the MIDUS sample. Despite some departure from our original predictions, a correlation remained between personality and neighborhood characteristics, even when genetically sensitive design was utilized.

There were several limitations to the study. While fluctuations between perceived neighborhood safety and inequality correlated with fluctuations in personality, the effects sizes were small, similar in magnitude as found by Sariaslan et al. (2013). And despite attempts to oversample particular demographic categories, it is likely that individuals (e.g., those without phones or stable residence) in the least safe and desirable neighborhoods are underrepresented. Lastly, the subjective reports of neighborhood quality were not cross-validated with objective measures of neighborhood quality.

Taking all these limitations into account, future research could employ experimental methods similar to those used by Nettle et al. (2014). Participants could be randomly assigned to be transported to neighborhoods of varying quality and then administered a battery of personality measures. The experimental methods are indicative of cause and effect, crime and income records could be used to establish objective neighborhood criteria, and more detailed and precise personality changes could be assessed via the use of more extensive measures.

Conclusions

Although interest in the link between personality and neighborhood quality goes back decades, to the best of our knowledge, the present study is the first to test neighborhood-personality fluctuations in multiple measures that span 15 years and contain adults as participants. In addition, by analyzing a subsample of MZ twins, we controlled for genetic confounding. The results first show that, as would be expected, a relatively large proportion of one's personality (e.g., Edmonds et al. 2008) as well as the neighborhood one lives in is (relatively) stable over time. More importantly, however, there is also relevant fluctuation, and at times when the neighborhood is perceived as safer and more equitable, participants also reported more prosocial personality profiles. In addition, the relation between personality and neighborhood remains even when only considering MZ twins who are (almost) 100% genetically identical.

Overall, these findings contribute to knowledge about the range of environmental factors that potentially influence personality. The theoretical contribution of the present study may focus on the use of the LH theory framework to explain how such influences are brought about. Appropriate questions (Zietsch and Sidari in press) have arisen concerning both the manner in which LH strategy has been conceptualized to explain individual differences and environmental effects (specifically those related to the neighborhood) and said strategies. It is our hope that these results add further clarification.

Specifically, a faster LH strategy suggests a reaction to environmental threat by, in its most extreme form, a shift toward an attitude of living each day as if it is your last. Being exposed to cues of inequality and danger may indeed have such an effect. The positive note of this is that neighborhood quality is a factor that can be modified and improved. Thus, the present findings may also provide guidance as to ways of enhancing personality functioning and quality of life.

Compliance with Ethical Standards

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

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