Abstract

Interactionist theories are considered to have resolved the classic person-situation debate by demonstrating that human behavior is most accurately described as a function of both personal characteristics as well as environmental cues. According to these theories, personality traits form part of the personal characteristics that drive behavior. We suggest that psychological theory stands to gain from also considering personality traits as an important environmental characteristic that shapes sociocultural norms and institutions, and, in turn, behavior. Building on research in geographical psychology, we support this proposition by presenting evidence on the relationship of individual and regional personality with spending behavior. Analyzing the spending records of 111,336 participants (31,915,942 unique transactions) across 374 Local Authority Districts (LAD) in the UK, we first show that geographic regions with higher aggregate scores on a given personality trait collectively spend more money on categories associated with that trait. Shifting the focus to individual level spending as our behavioral outcome ($N = 1,716$), we further demonstrate that regional personality of a participant's home LAD predicts individual spending above and beyond individual personality. That is, a person's spending reflects both their own personality traits as well as the personality traits of the people around them. We use conditional random forest predictions to highlight the robustness of these findings in the presence of a comprehensive set of individual and regional control variables. Taken together, our findings empirically support the proposition that spending behaviors reflect personality traits as both personal and environmental characteristics.

Keywords: personality; geographical psychology; interactionist theory; spending behavior; purchase decisions

Introduction

Consider two people, Michelle and Ben, who differ in their personality and live in two different cities. Michelle is introverted and lives in Liverpool. Ben is extraverted and lives in London. Michelle and Ben also differ in how they spend their money. While Michelle prefers to spend money on books and video games, Ben spends his money on concerts and in coffee shops. What is driving those differences in Michelle's and Ben's spending habits? Is it their individual personality or the social and geographical context they are embedded in?

The dilemma of Michelle and Ben illustrates one of the oldest debates in psychology (Bowers, 1973; Funder & Ozer, 1983; Kenrick & Funder, 1988; Mischel, 1968, 2009; Reis, 2008): is an individual's behavior determined by their individual characteristics or their environment? For decades, personality psychologists have advocated for the role of stable psychological traits in explaining behavior (Ozer & Benet-Martínez, 2006; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007; Soto, 2019), while social psychologists have argued for the importance of situational (Ross & Nisbett, 1991) and environmental factors (Barker, 1968; Bronfenbrenner, 1977). Acknowledging that human behavior exhibits both considerable stability over time and variability across situations (Fleeson & Noftle, 2008; Funder, 2006; Rauthmann et al., 2014) the debate has been considered resolved by interactionist theories postulating that human behavior (B) can be most accurately described as a function of both personal characteristics (P) as well as environmental cues (E):

$$B = f(P|E)$$

Following this resolution, there is now a shared understanding among personality and social psychologists that behavior is driven by an interaction of individual personality characteristics (P), on the one hand, and environmental factors (E), on the other (Lewin, 1935; Oishi, 2014). While this description has been helpful at bridging divides and recognizing the multiplicity of forces shaping our behaviors, the distinction may also be overly simplified and

restrictive. Specifically, we argue that psychological theory stands to gain from considering personality traits not only as a personal characteristic (P), but also an environmental factor (E).

Personality as a Factor of the Environment

Our proposition is based on a growing literature in geographic psychology suggesting that personality traits constitute meaningful constructs not only on the individual level but also at the level of geographic units. Evidence from large-scale surveys – in the hundreds of thousands and sometimes millions of respondents – has shown that personality traits are geographically clustered, e.g. at the level of postal sectors, cities and federal states (Allik et al., 2009; Ebert, Götz, Obschonka, Zmigrod, & Rentfrow, 2019; Götz, Ebert, & Rentfrow, 2018; Jokela, Bleidorn, Lamb, Gosling, & Rentfrow, 2015; Rentfrow, Gosling, & Potter, 2008; Rentfrow, Jokela, & Lamb, 2015). For example, areas along the US coasts are known to exhibit higher levels of openness to experience compared to areas located in the middle of the country (Rentfrow et al., 2008; Rentfrow, 2010). Furthermore, geographically-aggregated personality traits are found to be reliably associated with important social outcomes, such as well-being, social capital, voting behavior, crime rates, physical exercise, and wealth (Rentfrow & Jokela, 2016, Rentfrow et al., 2013; Obschonka et al., 2017).

From a purely psychometric perspective, regional personality represents the average personality traits of people living within a distinct area (Rentfrow, 2010). However, conceptually, regional personality has been argued to represent a regional construct that is greater than the sum of its parts. Specifically, regional personality may capture regional differences in culture (Obschonka, 2017), as defined by a connected set of ideas, practices and social institutions that coordinate the behaviors of a culture's members (Fiske, 2002; Morris, Chiu, & Liu, 2015; Oyserman, 2017). Measuring culture in terms of prevalent ideas and practices is consistent with a well-established research tradition using geographically aggregated personality differences to capture the emotional, cognitive and behavioural

features that characterize a cultural context (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950; Hofstede & McCrae, 2004; McCrae, 2000; Obschonka et al., 2018). For instance, pioneering work by McCrae and colleagues (Hofstede & McCrae, 2004; McCrae, 2001, 2002; McCrae et al., 2005) established nationally aggregated personality traits as robust and meaningful cultural constructs that reflect cross-national variation in cultural ideas and practices, such as egalitarianism or individualism.

At the same time, regional personality may also represent culture by reflecting differences in a region's institutional setting such as the availability of certain businesses or services (Rentfrow et al., 2008). From this institutional perspective, the individuals living in an environment shape this environment according to their ideals (Florida, 2014; Kitayama, Ishii, Imada, Takemura, & Ramaswamy, 2006; Santos, Varnum & Grossmann, 2017). For example, when more sociable and open individuals move to affluent urban areas (Jokela, 2020; Jokela, Elovainio, Kivimäki, & Keltikangas-Järvinen, 2008) this might eventually become reflected by the establishment of a higher number of bars or nightclubs in that area.

Taken together, regional personality can be understood as a reflection of regional culture that emerges through a self-reinforcing cycle of individual tendencies and environmental characteristics. Consistent with this conceptualization of regional personality, the theoretical framework of geographical psychology offers important insights into two different sociocultural processes through which regional personality may manifest - and affect individual behavior (Rentfrow et al., 2008).

First, regional personality can affect behavior through social influence. For example, if there is a high prevalence of a certain personality trait in a region, the behavioral tendencies associated with this trait not only occur more often in this region, but are likely to also gain higher social value and become generally more accepted (i.e., a sociocultural norm; Huggins & Thompson, 2019). This sociocultural norm will, in turn, affect the behaviors of all

individuals in the region through the mechanisms of social influence (Latané, Liu, Nowak, Bonevento & Zheng, 1995; Oishi, 2014). For instance, a regional norm of agreeableness might not only amplify the tendency of agreeable people to act according to their disposition (e.g., to donate more money to charity), but also stimulate those less agreeable people to behave in ways that are contrary to their natural disposition (e.g., to donate to charity at all). Applied to the case of Michelle and Ben, for example, Ben's tendency to spend his money on bars and coffee shops is likely to be explained by his extraverted personality, but also by the fact that he lives in an extraverted city in which acting in an extraverted manner (e.g., socializing in bars and coffee shops) is the accepted and encouraged sociocultural norm.

Second, regional personality may influence behavior through the affordances provided by institutions such as coffee shops, museums, or parks. Specifically, the social and cultural institutions in a place may impact their residents' behavior by shaping the opportunities and experiences available to them (Cohen, 1996; Nowak, Gelfand, Borkowski, Cohen, & Hernandez, 2016; Rentfrow et al., 2008; Triandis & Suh, 2002). For example, living in an area with many nightclubs and concert venues increases the likelihood of extraverted behaviors. The fact that Ben spends his money on concerts and in coffee shops, for example might not only be explained by his extraverted personality, but also by the fact that he lives in an extraverted city where there are plenty of opportunities to spend money on extraverted products and activities.

In summary, a large body of theory and research in geographical psychology suggests that personality traits can provide a valuable description of the variation between individuals but also of the variation between different geographic areas. In addition, it posits that there are different sociocultural processes through which geographically-aggregated personality in an area may affect the individual behavior of that area's residents. In other words, there is good reason to believe that individual behavior may not only be a function of individual but also regional personality.

Spending as a Function of Individual and Regional Personality

In this paper, we test the proposition that a person's behavior reflects both their own personality as well as the personality of their environment (i.e., the personality of those around them) by investigating people's spending choices. While most people will share a proportion of their spending (e.g., people need to fulfil basic needs such as buying groceries to eat and paying rent or a mortgage for a place to live), there is also substantial heterogeneity in people's choices. Indeed, even among the world's poorest, such as those living on less than $1 per day, there remains a considerable degree of variance in how they spend their money, including on discretionary items such as alcohol, tobacco and festivals (Banerjee & Duflo, 2007). The spending choices people make accumulate into a pattern of spending that is known to be a function of individual personality characteristics (Sirgy, 1985; Levy, 1959) as well as mechanisms of social influence and cultural affordances (Martineau, 1958; White & Argo, 2009).

Focusing on the impact of intrapersonal characteristics on discretionary spending, previous research has shown that people tend to spend money in a way that is aligned with their personality (Aaker, 1999, Govers & Schoormans, 2005; Matz, Gladstone, & Stillwell, 2016) and personal values (Hill & Howell, 2014). An extraverted person, for example, is more likely to spend money on social activities such as going to bars and restaurants, while an introverted person is more likely to spend money on books (Gladstone et al., 2019; Matz et al., 2016). This is because spending not only reflects functional need-fulfillment but also reflects who we are as individuals (self-congruity theory, Sirgy, 1985): We buy products not only for what they can do, but also for what they mean to us (Levy, 1959). Consistent with this idea, individuals high in extraversion, agreeableness and openness prefer to spend money on experiences (Howell, Pchelin, & Iyer, 2012; Mehmetoglu, 2012), whereas individuals low in agreeableness, conscientiousness and emotional stability prefer to spend money on possessions (Zhang, Howell, Caprariello, & Guevarra, 2014). Meanwhile, individuals high in

emotional stability and conscientiousness tend to save more money for retirement (Mosca & McCrory, 2016) and are less prone to excessive buying (Otero-López & Villardefrancos, 2013). In addition, people high in conscientiousness and low in extraversion are less likely to hold credit card debts (Brown & Taylor, 2014) and those high in emotional stability and low in agreeableness tend to borrow less money and have greater savings (Nyhus & Webley, 2001).

At the same time spending is also an inherently interpersonal, social behavior and - at least in part – performative. What people buy is not only guided by their own preferences, but also by cultural norms (de Mooij & Hofstede, 2002; Henry, 1967; Kacen & Lee, 2002), social expectations (Martineau, 1958; Mathews & Slocum, 1969; Rook & Fisher, 1995; van Kempen, 2004), status concerns (Brown, Bulte & Zhang, 2011; Martineau, 1958; Veblen, 1899), and people's social networks (Gärling, Kirchler, Lewis, & van Raaj, 2009; Sheth, 1967; Wang & Xiao, 2009). Spending can be used to satisfy social needs, such as reinforcing and expressing self-identity to others, and allowing one to differentiate oneself and to assert one's individuality (Ball & Tasaki, 1992; Belk, 1988; Fournier, 1998; Richins & Rudmin, 1994). Spending can also serve a social purpose by signaling one's ties to cultural groups and can help individuals connect with others by expressing their personal characteristics and adherence to social norms (Escalas & Bettman, 2003; Muniz & O'guinn, 2001). This in turn reduces the risk of social exclusion, and can strengthen an individual's sense of belonging to social groups (Escalas & Bettman, 2003, 2005; Fournier, 1998; Loveland, Smeesters, & Mandel, 2010; White & Argo, 2009). Taken together, the inherent social function of spending makes it subject to the powers of social influence (Argo, Dahl, & Manchanda, 2005; Ratner & Kahn, 2002; Zhang, Li, Burke, & Leykin, 2014) and therefore constitutes an ideal context for us to study the joint association of individual and ambient personality with individual behavior.

Current Research

In this paper, we test the impact of individual and regional personality as drivers of behavior in two steps. First, we analyze spending records from 111,336 participants (over 31 million unique transactions) to test whether spending behaviors (i.e., what people spend their money on) are regionally clustered and whether these regional clusters of spending are reliably predicted by regionally aggregated personality traits (H1). This step is necessary as examining the relationship between regional personality and spending behavior is only meaningful if people in different areas actually spend money differently. Second, we analyze individual personality and spending of 1,716 participants, to test whether regionally aggregated personality predicts individual spending behavior above and beyond individual personality (H2). The two hypotheses as well as the general analytical strategy were preregistered on OSF before data were analyzed (https://osf.io/hmn7d/?view_only=3fdd00344ae642bcaf47f56b90c5973a).

Methods

Participants and Measures

Spending behavior. To measure individual spending behavior, we used data collected in collaboration with a UK-based money management app between May 2016 and May 2017. The service provides users with an online dashboard of their finances by aggregating all debit (outgoing) and credit (incoming) transactions across a customer's bank accounts (e.g., checking accounts and credit cards). The platform tracks people's finances across all their accounts. Given that we are interested in spending decisions, we only analyzed debit (outgoing) transactions. These transaction records capture all purchases conducted via a customer's bank accounts over a period of twelve months, with every purchase being sorted into one of 279 spending categories (e.g. donations, communication, groceries, holidays). Together, these data cover individual spending decisions from 126,465 participants. To

reduce the complexity of the list of spending categories and to increase the robustness of our estimates, we excluded any category that had less than 10,000 transactions. Additionally, consistent with prior research (Matz et al., 2016), we excluded spending categories that did not allow for a clear interpretation (e.g. non-tagged spending, transfers or cash). After applying these steps, 120 different spending categories representing 31,915,942 spending decisions from 111,336 app users remained. Each app user, on average, spent a total sum £13,665 (approx. $18,808) in the 120 different categories. Comparing this number with official statistics (according to which each adult in the UK spends around £15,000 (approx. $20,645) per year[1]), suggests that our data captures most of the app users spending decisions. Online Supplement 1 provides an overview of all spending categories including their transaction counts, total sums spent, and the average sums spent per transaction.

Individual Personality Data. Of the 126,465 customers a subset of 2,193 participants consented to complete a short survey and to have their responses matched with their spending records for research purposes. The survey assessed individual personality using the BFI-10 (Rammstedt & John, 2007), a widely established, short measure of the Five Factor Model of personality (Digman, 1990; John & Srivastava, 1999). In our subsequent analyses, we only included participants who completed the full BFI-10, reported their age, and provided valid postcode information (i.e., indicated in which of the 10,814 UK postal sectors they reside). To ensure the robustness of our results, we further excluded participants who made less than 100 spending decisions and had spending in less than 10 different spending categories. This resulted in a final sample of 1,716 participants (12.94 % female, 43.36 % male, 43.71 % unknown gender; M_{age} = 38.14, SD_{age} = 11.49) and 1,701,256 transactions. To evaluate the representativeness of this personality subsample, we compared its basic spending metrics to the full sample of all banking app users. Banking app users with personality data

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[1]On average, each UK household has expenditures of £29,775 (approx. $40,981) per year (Office for National Statistics, 2019). With an average household consisting of two adults, this equals annual expenditures of £14,887 (approx. $20,490) per capita.

engaged in more transactions (average 560 vs. 464 per person) and spent more money per transaction (£56,69 vs. £45,14). However, the spending patterns in both samples were very similar. Specifically, the spending shares per category in the personality subsample and the full sample were almost perfectly correlated ($\beta = .94$, $p < .001$, 95% CI [.87, 1.00]). Accordingly, the personality subsample represented the full sample of all banking app users reasonably well.

Regional Personality Data. To measure regional personality, we used the Big Five personality scores from 386,375 participants (64.07 % female, 35.92% male; $M_{age} = 35.98$, $SD_{age} = 13.86$), of the BBC Lab dataset (Rentfrow et al., 2015). The BBC Lab dataset was collected in an online survey promoted by the BBC via multiple media channels (e.g. websites, radio, and television) between November 2009 and April 2011. Personality was assessed using the Big Five Inventory (BFI-44; John & Srivastava, 1999) and participants reported the postal sector of their current residence. This postcode information was subsequently used to aggregate individual level responses to the level of 380 Local Authority Districts (LADs). LADs represent standard administrative spatial entities[2] for local governments and have been used in previous work looking at regional variation in psychological phenomena across the UK (Matz & Gladstone, 2018; Obschonka et al., 2015; Rentfrow et al. 2015).

Ethics Statement. We received ethical approval from the university IRB board at the third author's institution [masked for review] to analyze the spending and individual personality data from the spending dataset (protocol number masked for review). The collection of the openly available BBC Lab dataset, which we used to calculate regional personality estimates, was approved by the Psychology Research Ethics Committee of the University of Cambridge in October 2007.

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[2] In England, LADs cover London boroughs, metropolitan districts, unitary authorities, and non-metropolitan districts. In Wales they represent unitary authorities, and in Scotland they represent council areas.

Prototypical Personality Spending Categories

To identify the degree to which spending categories are associated with each personality trait, we analyzed the data of the 1,716 participants for which individual personality scores were available. In a first step, we calculated each spending category's relative share of the total amount of money a person had spent. For example, we calculated the relative amount a person had spent on books compared to their overall spending. We then z-standardized personality and spending scores across participants and correlated each personality trait with the spending proportions for each spending category. This approach resulted in a total of 600 correlations (5 personality traits x 120 categories). For each trait, we identified the 10 spending categories that showed the strongest positive correlations and the 10 spending categories that showed the strongest negative correlations. From the resulting list of 20 spending categories per trait, we filtered out any correlations that were not significant at an α-level of 0.1, to omit irrelevant correlations. Overall, this procedure led to a set of $17 - 20$ associated spending categories for each trait (see Figure 1).

Many of these spending-personality pairings are consistent with those reported in previous research, which was based on an alternative but comparable dataset and used raters to assess the personality of spending categories (Matz et al., 2016). For example, our findings that open-minded people spent more on flights and photography, extraverted people spent more on dining and drinking and agreeable people spent more on gifts and donations, are consistent with the prior results based on personality ratings of spending categories. Other associations we found would not have been expected a priori by the research team (e.g. agreeable people spending more on eyecare and extraverted people spending less on water bills). However, interestingly, even some of these more unexpected associations were consistent across datasets (e.g. neurotic people spending less on mortgage payments). While this suggests a fair amount of profile stability across different datasets and methods, we should be cautious in interpreting these recurrent unexpected patterns in light of issues

surrounding multiple testing (Shaffer, 1995). That said, although our purely data-driven

approach might add random noise to the personality profiles of spending categories (and

therefore make our estimates of effect sizes more conservative), we argue that it is superior to

subjective ratings of spending categories that might be systematically biased by people's

stereotypical notions of personality trait expressions in spending.

To capture the degree to which a person's spending behavior is prototypical for a

given trait (e.g., how extraverted their spending is), we calculated an overall metric by

summing each individual's z-scores for their spending in the positively related spending

categories and subtracting the summed z-scores of the negatively related spending categories.

For all traits, this prototypical spending score showed a normal distribution across participants

(see histograms in Online Supplement 2) and correlated significantly with participants' self-

reported personality (openness $r = .19$, $p < .001$, 95% CI [.14, .24]; conscientiousness $r = .21$,

$p < .001$, 95% CI [.16, .26]; extraversion $r = .22$, $p < .001$, 95% CI [.17, .27]; agreeableness r

$= .21$, $p < .001$, 95% CI [.16, .26]; neuroticism $r = .22$, $p < .001$, 95% CI [.18, .27]). Finally,

we computed prototypical spending scores in the above described manner for the full sample

of 111,336 participants (i.e., also for the participants for whom no personality information
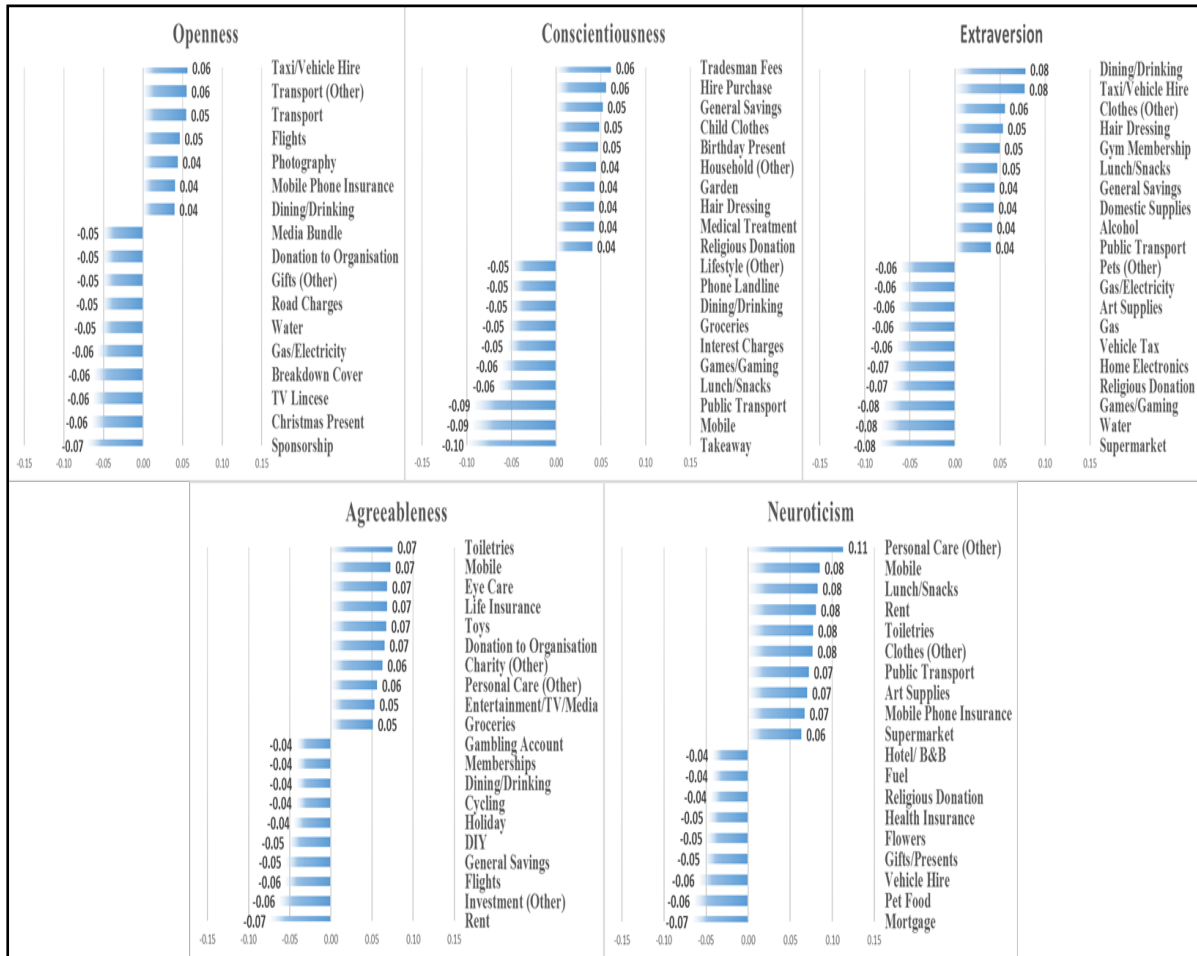
was available).

Figure 1. Overview of the prototypical spending categories for each personality dimension. Numbers indicate standardized Pearson correlation coefficients between personality and spending category.

Results

Regional Personality Predicts Regional Spending (H1)

To lay the foundation for our subsequent analyses, we first tested whether regions scoring high (or low) on a certain trait show more (or less) spending on categories that are prototypical for that trait. We measured regional personality using the LAD Big Five personality estimates from the BBC lab dataset described above. We captured regional prototypical spending by using the postcode information provided in the previously described individual level spending data to aggregate each trait's prototypical spending indicator to the LAD level. To ensure sufficiently precise regional spending estimates, we followed previous research using aggregate personality measures (Matz & Gladstone, 2018) and only included

regions with at least 50 banking app users ($N = 374$ out of 380 LADs)[3]. The correlation

between the number of app users and inhabitants in a region was .73 ($p < .001$, 95% CI [.67,

.81]) suggesting that our data was numerically representative across regional populations.

In a first analytic step, we mapped out the spatial distributions for both regional

personality and regional prototypical spending (Figure 2) using Actor-Based Clustering

(Buecker, Ebert, Götz, Entringer, & Luhmann, 2020; Brenner, 2017; Ebert, Gebauer et al.,

2019). Actor-Based Clustering is a statistical approach that utilizes the finest geographical

information available to reveal areas where high/low values of a variable cluster

geographically (see Online Supplement 3 for further details). In our case, this was the postal

sector ($N=10,814$) in which a person lives. Our use of Actor Based Clustering extends

approaches taken in previous research in geographic psychology by omitting aggregating data

to a higher spatial level first. For example, previous research on regional personality

differences in the U.K. (Rentfrow et al., 2015) has assessed clustering patterns on the level of

380 LADs. Consequently, the spatial distribution of personality could only vary between

those 380 geographical units, disguising the variation within the LADs. By contrast, our

approach utilizes much finer geographical units (i.e., 10,814 postal sectors instead of 380

LADs). As such, distributional patterns can emerge from the data without being constrained

by the boundaries of geographical units coarser than postal codes.

The maps presented in Figure 2 provide insights into the spatial distribution of

personality (upper row) and spending (lower row). Our Actor-Based Clustering approach

reveals spatial patterns of personality that would be disguised using conventional clustering

approaches. For example, our map clearly captures the sphere of influence of the UK's capital

London, where a distinct circular shape emerges in the South East across most of the maps.

Comparing the upper with the lower part of Figure 2 illustrates that the clusters found for

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[3] We also repeated our aggregate level analyses using more conservative inclusion threshold of 100 and 250
banking app user per region that lead to identical results (see Online Supplement 4).

regional personality and the patterns for personality-related regional spending show a substantial convergence that is clearly visible in the overlap in color distributions. In other words, the regions that score high (vs. low) on a given personality trait also tend to score high (vs. low) on that trait's prototypical spending. The effects are strongest for the traits of extraversion and openness, for which we find clear geographical clusters of highly prototypical spending in and around Metropolitan London, as well as clusters of low (i.e., introverted and less open) spending to the north of London, in the Southwest, Wales and the North of England. For agreeableness, we find significant hotspots of prototypical agreeable spending in Southern Wales as well as in pockets of Northern England and Scotland, while low, disagreeable spending clusters in Metropolitan London and further north in East Anglia. For conscientiousness, high prototypical spending clusters in the southernmost parts of England, the North of England and the English Midlands, while low, unconscientious spending strongly clusters in Southern Wales and parts of Scotland. For neuroticism, high prototypical spending clusters in pockets of Scotland, Southern Wales and the English Midlands, while low, emotionally stable spending primarily clusters around London.
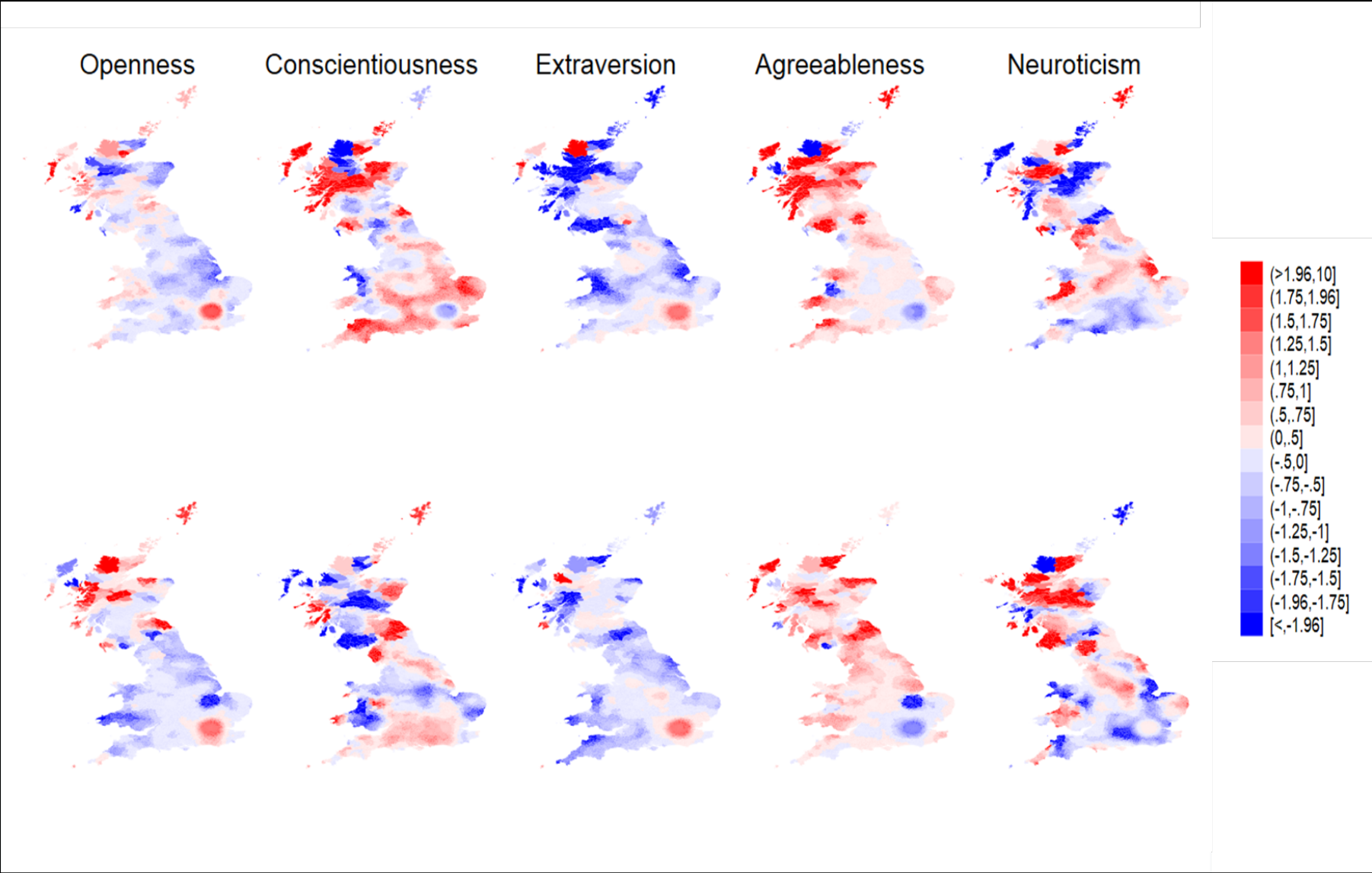
Figure 2. Spatial distribution of regional personality (upper row) and regionally aggregated prototypical spending (lower row). Legend indicates personality scores z-standardized across postal sectors.

While the maps in Figure 2 provide initial descriptive evidence for an overlap between regional personality and personality-related spending, we capture this relationship more objectively by calculating the zero-order correlations between the two variables on the aggregated LAD level ($N = 374$). We find a significant positive relationship between regional personality and spending for all Big Five personality traits (Table 1, column 1). These correlations were medium-sized for openness ($r = .34$, $p < .001$, 95% CI [.25, .44]), extraversion ($r = .47$, $p < .001$, 95% CI [.38, .56]), agreeableness ($r = .33$, $p < .001$, 95% CI [.23, .42]) and neuroticism ($r = .34$, $p < .001$, 95% CI [.24, .43]) and small for conscientiousness ($r = .17$, $p < .01$, 95% CI [.07, .27]).

When conducting analyses with spatial data, it is important to account for the fact that spatial autocorrelation (i.e., neighboring LADs exhibiting more similar values than non-neighboring LADs) among error terms can lead to biased estimates and an increased chance of Type I errors (Arbia, 2014; Haining, 2010). We therefore estimated the spatial autocorrelation among error terms and found significant positive spatial autocorrelation of small to medium sized magnitude for four of the five traits (Table 1, column 2). For these four traits (all except for conscientiousness), we fitted additional models that included spatially lagged scores of the dependent variable as an additional predictor (Ebert, Gebauer et al., 2019). Including these spatial lags successfully captured any existing spatial dependencies among error terms (Table 1, column 4). Comparisons of the effect sizes of both models show that our results remain stable when controlling for spatial autocorrelation (Table 1, column 3). However, ignoring spatial dependencies would lead to an overestimation of the true effect sizes of up to 27% (Table 1, column 5). Taken together, these findings provide support for our first hypothesis that *regionally aggregated personality scores predict regionally aggregated spending on associated personality-related purchase categories* for all Big Five personality traits.

Table 1

Regional Level Association between Personality and Prototypical Spending

Trait	Before Controlling for Spatial Lags		After Controlling for Spatial Lags		
	(1) Personality - Spending Correlation	(2) Spatial Auto-correlation	(3) Personality-Spending Correlation	(4) Spatial Auto-correlation	(5) Over-estimation (1) vs. (3)
Openness	.34*** [.25, .44]	.09**	.31*** [.21, .40]	-.02	9.7%
Conscientiousness	.17** [.07, .27]	.04	/	/	/
Extraversion	.47*** [.38, .56]	.24***	.37*** [.29, .45]	-.02	27.0%
Agreeableness	.33 *** [.23, .42]	.13***	.27*** [.18, .37]	-.02	22.2%
Neuroticism	.34*** [.24, .43]	.07*	.32*** [.23, .42]	-.01	6.3%

Note. 95% confidence intervals in brackets. $N = 374$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. If no spatial autocorrelation is present, conventional correlational approaches yield unbiased estimates (with respect to spatial dependencies). In such cases, conventional correlational approaches are the more parsimonious way to present a relationship between two or more variables. Therefore, we did not fit a spatial regression model for the trait conscientiousness.

Regional Personality Predicts Individual Spending Above and Beyond Individual Personality (H2).

In the second analysis, we tested whether regionally aggregated personality scores predict prototypical individual level spending above and beyond individual personality. For this purpose, we used the subset of 1,716 participants for which individual spending and personality information was available. Specifically, we employed multilevel analyses (individuals nested in 336 LADs) to regress prototypical individual level spending on individual personality, gender, age and total spending amount (level 1 predictors) and aggregated personality (level 2 predictor). We *z*-standardized all non-binary predictors (i.e., all except gender) and specified random intercepts and random slopes for individual personality.

The results are displayed in Table 2. As hypothesized, regional personality positively predicted prototypical spending above all individual level predictors for all Big Five traits. The size of these effects was largest for extraversion (β = .16, p < .001, 95% CI [.11, .22]), less pronounced for agreeableness (β = .10, p < .001, 95% CI [.05, .14]) and openness (β = .08, p < .001, 95% CI [.04, .12]), and smallest for conscientiousness (β = .06, p < .01, 95% CI [.02, .10]) and neuroticism (β = .05, p < .05, 95% CI [.00, .10]). These results support our second hypothesis that regionally aggregated personality scores predict individual spending on associated purchase categories above and beyond individual level personality for all of the Big Five personality traits.

In addition to participants' individual personality, their age and total spending were also found to be significantly related to prototypical spending behaviors, while their gender was not. Specifically, older people spent a larger proportion of their money on categories that are prototypically agreeable (β = .13, p < .001, 95% CI [.09, .18]) and conscientious (β = .11, p < .001, 95% CI [.06, .15]), but less on prototypically neurotic (β = -.21, p < .001, 95% CI [-.26, -.17]), extraverted (β = -.19, p < .001, 95% CI [-.24, -.15]) and open (β = -.13, p < .001, 95% CI [-.17, -.08]) categories. People who spend more money overall also tend to spend more on categories that are prototypically conscientious (β = .21, p < .001, 95% CI [.16, .26]), open (β = .15, p < .01, 95% CI [.02, .11]), and extraverted (β = .06, p < .01, 95% CI [.02, .11]), but less on categories that are prototypically agreeable (β = -.15, p < .001, 95% CI [-.20, -.11]) and neurotic (β = -.12, p < .001, 95% CI [-.17, -.08]).

Table 2

Multilevel Regression Results of Individual and Regional Personality on Prototypical Spending

DV: Prototypical Spending	Openness		Conscientiousness		Extraversion		Agreeableness		Neuroticism	
	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction
Individual Personality	.17*** [.12, .23]	.16*** [.11, .22]	.18*** [.13, .23]	.19*** [.13, .24]	.18*** [.13, .22]	.18*** [.13, .23]	.19*** [.14, .24]	.20*** [.15, .25]	.19*** [.14, .24]	.19*** [.14, .24]
Regional Personality	.08*** [.04, .12]	.08*** [.04, .12]	.06** [.02, .10]	.06** [.02, .10]	.16*** [.11, .22]	.17*** [.11, .22]	.10*** [.05, .14]	.10*** [.06, .14]	.05* [.00, .10]	.05* [.00, .10]
Gender: Male	.11 [-.03, .25]	.11 [-.03, .26]	-.08 [-.23, .06]	-.08 [-.23, .06]	-.05 [-.19, .09]	-.05 [-.19, .09]	-.06 [-.21, .08]	-.06 [-.21, .08]	-.11 [-.25, .03]	-.11 [-.25, .03]
Gender: Unknown	.02 [-.13, .16]	.02 [-.12, .16]	-.12 [-.26, .02]	-.12 [-.26, .02]	.02 [-.12, .15]	.02 [-.12, .15]	.13 [-.01, .27]	.13 [-.01, .27]	-.01 [-.15, .13]	-.01 [-.15, .13]
Age	-.13*** [-.17, -.08]	-.13*** [-.17, -.08]	.11*** [.06, .15]	.11*** [.06, .15]	-.19*** [-.24, -.15]	-.19*** [-.24, -.15]	.13*** [.09, .18]	.13*** [.09, .18]	-.21*** [-.26, -.17]	-.21*** [-.26, -.17]
Total Spending	.15*** [.11, .20]	.15*** [.11, .20]	.21*** [.16, .25]	.21*** [.16, .25]	.06** [.02, .11]	.06** [.02, .11]	-.15*** [-.20, -.10]	-.15*** [-.20, -.10]	-.12*** [-.17, -.08]	-.12*** [-.17, -.08]
Interaction Ind. X Reg. Personality		.02 [-.02, .06]		.01 [-.03, .06]		-.01 [-.05, .03]		.02 [-.02, .07]		-.01 [-.07, .04]
Intercept	-.11 [-.24, .02]	-.11 [-.24, .02]	.11 [-.01, .24]	.11 [-.01, .24]	-.08 [-.21, .04]	-.08 [-.21, .04]	.02 [-.10, .15]	.02 [-.10, .15]	.05 [-.07, .17]	.05 [-.07, .17]
Intercept Variance	.03	.02	.01	.01	.06	.06	.01	.01	.00	.00
Slope Variance	.04	.04	.01	.01	.01	.01	.01	.01	.01	.01
With. - Betw. Variance	.85	.85	.86	.86	.78	.78	.88	.88	.86	.86
N Level-1:	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716
N Level-2:	336	336	336	336	336	336	336	336	336	336

Note. 95% confidence intervals in brackets; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Previous research suggests that the degree to which individuals feel compelled to adhere to socio-cultural norms varies, and for some this is more important than others (Snyder & Fromkin, 1977). Therefore, we tested whether the link between regional personality and spending is particularly strong for people scoring high or low on a given trait. As evident in Table 2 (in the columns marked 'Interaction' for each trait), we find no cross-level interaction between regional and individual personality. This suggests that regional personality scores appear to only have a main effect on the spending behavior of all individuals within a region. However, in light of recent simulation-based evidence (Arend & Schäfer, 2019), it is possible that the absence of interaction effects could also be due to a lack of statistical power, as detecting cross-level interactions requires substantially higher numbers of level 1 and level 2 units than detecting main effects (Mathieu, Aguinis, Culpepper, & Chen, 2012). [4]

Finally, we went beyond our preregistered analyses and applied additional robustness checks. Given that regional personality differences are known to covary with other regional characteristics (Obschonka et al., 2015; Rentfrow et al. 2008; Rentfrow et al., 2015) – such as economic indicators, demographic composition and urbanity – we tested the extent to which our results would be robust against adding these characteristics as additional predictors. In conceptual equivalence to prior research (e.g., Wei et al., 2017), we employed conditional random forest models (Strobl, Malley, & Tutz, 2009) to explore which individual and regional characteristics were practically relevant predictors of individual spending. Through a multitude of permutations, conditional random forest models assess the relative importance of each predictor by exploring all possible relationships between the predictors (e.g., age, individual personality, urbanity) and the criterion of personality-related spending (IJzerman et al., 2018). Unaffected by nonlinearity, higher-order interactions, correlated predictors, or heterogeneity, conditional random forests are highly accurate in identifying predictors that

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[4] We additionally used Response Surface Plots (Shanock, Baran, Gentry, Pattison, & Heggestad, 2010) to visually explore potential interaction effects between individual and regional personality. These Response Surface Plots are provided in Online Supplement 5.

meaningfully contribute to the outcome variable (i.e., individual spending). Using this methodology, we tested the practical relevance of regional personality for the prediction of individual spending when considering four sets of potential confounds. First, we considered whether a region represents an urban or rural living environment (i.e., classification of LADs in predominantly urban, urban with rural parts, and predominantly rural). Second, we considered a region's economic situation (i.e., unemployment rate and regional income). Third, we considered a region's demographic composition (i.e., share of females and median age). Fourth, we included a region's population density as a variable that is frequently used to cover a broad array of infrastructural and labor market characteristics across regions (Ebert, Götz et al., 2019; Obschonka et al., 2015). Capitalizing on the unique ability of machine learning to uncover generalizable patterns in complex data (Mullainathan & Spiess, 2017), the results reaffirmed regional openness, extraversion and agreeableness as relevant predictors for individual spending behavior that is prototypical for these traits. In contrast, regional conscientiousness received only limited support and neuroticism was not identified as a practically meaningful predictor (see Figure 3).
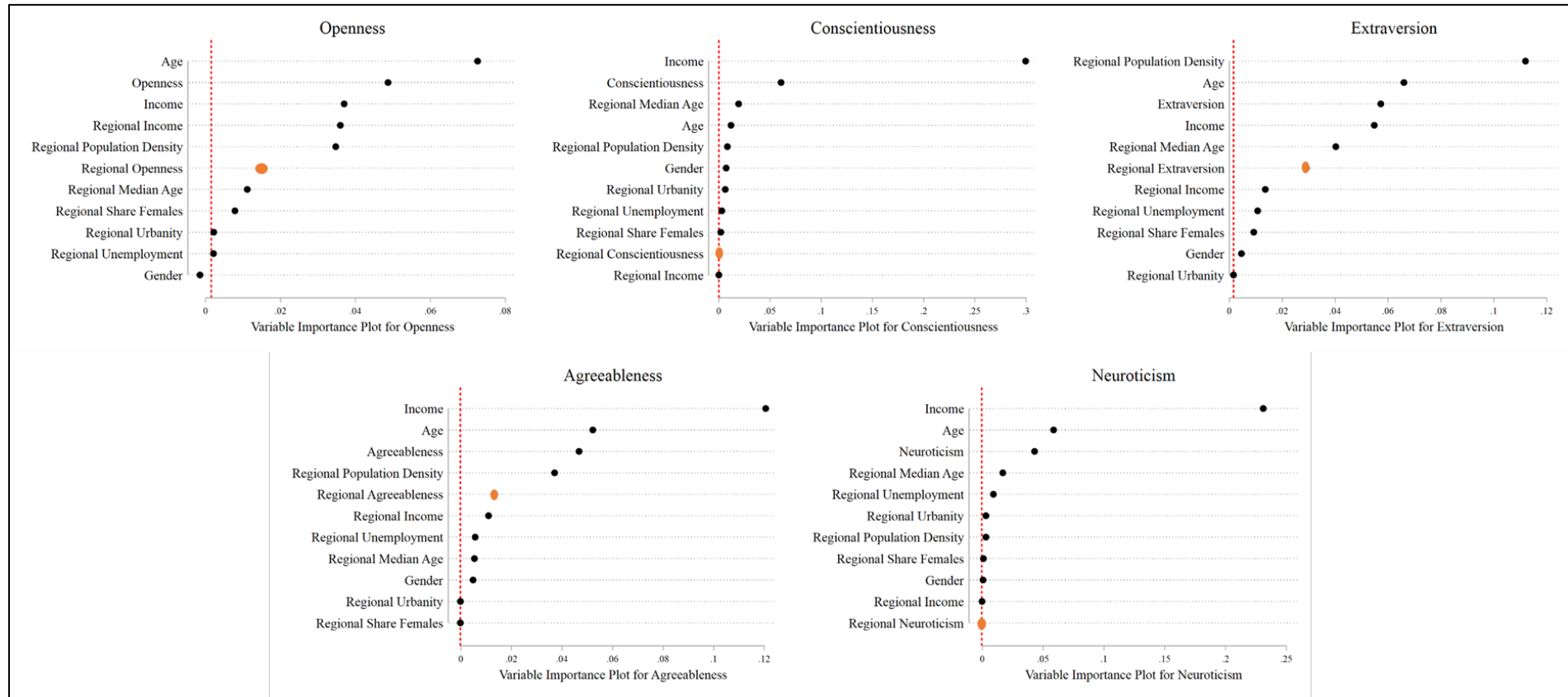
Figure 3. Variable importance plots. The importance values for regional personality are marked in orange color. Variable importance values (on the x-axis) represent a relative ranking of predictor importance and hence serve for comparison purposes only and cannot be interpreted on their own. Values exceeding the red dashed vertical line (representing the smallest positive variable importance value or the absolute value of the most negative predictor), are highly unlikely to be random noise. Predictors with higher variable importance values are considered more important than those with lower variable importance values.

In addition to testing regional personality against a multitude of alternative predictors, we also tested the extent to which our results are robust against alternative empirical specifications. First, we tested whether our findings generalize to other geographical units beyond the LAD-level. We repeated our main analyses testing the relationship between regional personality and individual spending across the level of 167 NUTS-3[5] regions instead of 336 LADs (see Online Supplement 6). The findings replicated openness, conscientiousness, extraversion, and agreeableness, but not neuroticism. Second, we tested whether our findings are robust to different measures of prototypical spending. We repeated our main analysis based on a spending measure in which the contribution of each spending category is weighted according to that category's correlation with the corresponding personality trait (see Online Supplement 7). Similar to the previous robustness check, we find that regional personality emerges as a significant predictor for all traits but neuroticism. Third, individual personality (BFI-10) and regional personality (BFI-44) were measured using two different diagnostic tools. Therefore, we tested whether our results were robust to using the same diagnostic tool for both individual and regional personality. We repeated our main analyses using regional personality score based only on those ten items of the BFI-44 that are also included in the BFI-10 (see Online Supplement 8). Again, we find that all relationships between regional personality and individual-level spending replicated, except for neuroticism. Taken together, across all robustness checks, for those traits for which we find robust evidence before (i.e., openness, extraversion, and agreeableness) regional personality significantly predicts individual spending above and beyond individual personality.

Discussion

There is broad consensus among psychologists that human behavior is determined by a combination of personal characteristics and environmental factors ($B = f(P|E)$; Lewin,

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[5] In England, NUTS-3 regions cover counties, unitary authorities, or districts of which some are grouped. In Wales they represent groups of unitary authorities, and in Scotland they represent groups of council areas.

1935). Within the context of such interactionist theories, personality traits are traditionally considered a personal characteristic (P). In the present study, we propose to revisit this restrictive view by providing empirical evidence that behavior reflects personality as both a personal characteristic (P) and – in the form of regionally-aggregated traits – an environmental characteristic (E). We use spending as our behavioral outcome of interest and demonstrate that individual spending not only reflects our own personality, but also the personality of those around us. More specifically, through adding a psycho-geographical perspective we were able to show that (1) spending behaviors (i.e., what people spend their money on) are regionally clustered and meaningfully related to regionally aggregated personality and (2) that regional personality is associated with individual spending behavior above and beyond individual personality. The latter effects were strongest and most robust for the traits of openness, extraversion, and agreeableness, persisting in the presence of a conservative set of individual and regional controls.

The present study drew from two sources of big data to investigate how individual spending behavior is a reflection of both individual and regional personality. Specially, personality scores for 386,375 UK residents were aggregated to produce reliable regional personality estimates, while over 30 million spending transactions for 111,336 people were analyzed to examine individual purchasing decisions. By extracting spending directly from objective transaction records, we were able to overcome shortcomings of prior research that has assessed purchase behaviors via self-reports (Aaker, 1999; Huang et al., 2012; Sirgy, 1985) making the findings prone to various biases, such as consistency motives, inaccurate memory recall or common-method variance (Podsakoff & Organ, 1986; Schwarz, 1999). Moreover, our transaction data was pooled from multiple bank accounts, hence capturing a more comprehensive proportion of people's finances than previous research that relied on information from single bank accounts (Matz et al., 2016). In conjunction with a conservative analysis strategy, preregistered analytical procedures and additional cross-validation through

powerful ensemble learning algorithms, our results provide robust evidence in a setting of high external validity.

Ample evidence demonstrates that the Big Five personality traits differ substantially with regards to their visibility (Vazire, 2010; Rohrer, Egloff, Kosinski, Stillwell, & Schmukle, 2018; Watson, Hubbard, & Wiese, 2000). One plausible explanation for the lack of consistent effects for neuroticism may therefore lie in the trait's low observability. As a prerequisite for regional personality and hence regional sociocultural norms to affect individual behavior, individuals need to be able to detect regional social norms in order to act concordant with them. Trait extraversion, characterized by overt social behaviors, is considered the most readily observable, whereas neuroticism, as an intrapsychic trait, is notoriously difficult to detect (Funder & Doboroth, 1987; John & Robins, 1993). Hence, the fact that our results show the strongest impact for regional extraversion and no effect for neuroticism might, at least in part, be driven by differences in people's ability to identify (and then act in accordance with) regional social norms for the respective traits due to differences in their observability.

In contrast, conscientiousness is usually viewed as more visible on an inter-individual level (John & Robins, 1993). However, it has been suggested that its observability might stem primarily from how people create their environments and less from actual behavior (Connelly & Ones, 2010), which might impair its detectability as part of a behavioral regional social norm. Lending support to this idea, it has been shown that on the regional level, conscientiousness appears to be less salient than the other Big Five traits (Rogers & Wood, 2010; Wood & Rogers, 2011). Consistent with that, on the national level, the agreement scores between aggregated country mean scores and observer ratings are lower for conscientiousness than for the other Big Five traits (Terracciano et al., 2005). Hence, it might be difficult for inhabitants to identify regional social norms for both conscientiousness and neuroticism and act in accordance with them. Moreover, similar to neuroticism,

conscientiousness is as an inward rather than outward facing trait, which may be generally less conducive to social influence (John & Srivastava, 1999; Trapnell & Campbell, 1999).

Limitations and Future Research

The current study has a number of limitations that should be addressed by future research. First, future research should seek to solidify the generalizability of our findings: while both our samples moved beyond traditional WEIRD student samples (Medin, 2017, Gurven, 2018) to capture British society more holistically, our findings are clearly limited to the cultural context of a Western, industrialized and democratic society. Consistent with the recent push for more inclusive and culturally diverse social scientific research (Brady, Fryberg, & Shoda, 2018; Henrich, Heine, & Norenzayan, 2010), the present results should therefore be replicated in other, traditionally under-researched populations. In so doing, it would be especially interesting to investigate whether the impact of regional personality on individual behavior is even more pronounced in collectivist cultures, which put higher value on conformity, inter-connectedness, and sensitivity to social cues (Kitayama, Park, Sevincer, Karasawa, & Uskul, 2009; Markus & Kitayama, 1991; Triandis, 1989). Likewise, although both our samples drew from the general UK population, our findings should be consolidated in a more representative sample that is immune to self-selection sampling biases. Aside from cultural and demographic generalizability, as the present study focused on spending as a specific case of a multifaceted and consequential human behavior (Dunn, Aknin, & Norton, 2008; Gladstone et al., 2019), future work may seek to replicate the present findings for other behavioral outcomes (e.g., in the political or health domain).

Second, we acknowledge the possibility of reference-group effects in the self-assessments underlying our regional personality measures (Heine, Lehman, Peng, & Greenholtz, 2002). That is, the comparability of personality measures across regions might be compromised due to differences in the implicit cultural standards that people refer to when

answering self-report questionnaires (Peng, Nisbettt, & Wong, 1997). For instance, in a non-industrious culture, a person who meets deadlines 75% of the time may rate themselves as rather conscientious (Wood, Brown, Maltby, & Watkinson, 2012). However, they might be less likely to see themselves that way in an industrious culture, as the cultural standard of conscientiousness relative to which they report their personality would be different.

Importantly, however, while there is evidence from the national level showing that conscientiousness is prone to such biases (Heine, Buchtel, & Norenzayan, 2008), there is no evidence for distorting impact of reference-group effects on any other Big Five personality trait (Oishi & Roth, 2009). Moreover, reference-group effects are less of a concern when comparing regions within nations (rather than nations to one another) as people of a particular nationality share implicit cultural standards to evaluate themselves against (Heine et al., 2008; Rentfrow, 2010). Finally, the introduction of reference-group effects would, in fact, make it harder for us to detect any regional-level effects as it would restrict the variation in regional personality. Given that we find medium-sized, robust effects the reference-group effect might be of minor concern in the context of this analysis.

Third, the fact that stereotypical spending profiles and individual personality were derived from the same dataset, creates some degree of dependency between the two measures and might have led to a possible overestimation of the effects of individual personality vis à vis regional personality (Kriegeskorte, Lindquist, Nichols, Poldrack, & Vul, 2010). However, as with possible reference-group effects mentioned above, such a bias would in fact make it harder for us to find any evidence for effects of regional personality beyond individual personality, thus adding to the conservativeness of our test and hence the confidence in its outcome.

Fourth, future research should aim to disentangle the psychological mechanisms through which regional personality affects individual behavior. In keeping with the processes described in the introduction, on the one hand, it is plausible that regional personality drives

individual behavior through the development of sociocultural behavioral norms (Huggins & Thompson, 2019) which are transmitted through social influence (Kitayama, Conway, Pietromonaco, Park, & Plaut, 2010; Latané et al., 1995; Oishi, 2014; Rentfrow, 2010). On the other hand, regional personality may also impact individual personality through institutional factors, such as the availability of thrift shops, concert venues or hip cafés (Oishi, 2015) which shape behavioral affordances (Rentfrow et al., 2008). Consistent with the understanding of regional personality as a reflection of culture that emerges through a self-reinforcing cycle of individual tendencies and environmental characteristics, the resulting opportunities for self-expression might attract like-minded individuals to move to such places (Jokela et al., 2008), where they can spend their money and – more generally – behave in close alignment with their personality (Jokela et al., 2015). While our results are theoretically compatible with each of the afore-mentioned processes, we were unable to tease apart their respective impact due to the limitations imposed by the cross-sectionality of the data. In addition to disentangling processes, it is important to assess the boundary conditions of these processes. As such, future research should examine which individual and regional factors promote or hinder the transmission of regional personality's effects on behavior.

Finally, and relatedly, a major limitation of the current investigation is the reliance on data from a cross-section in time, which limits our ability to test whether region-level personality changes (rather than just covaries with) individual-level spending decisions. While conducting an experiment would be the ideal method for testing our causal hypothesis, both regional and individual personality cannot be manipulated and randomly assigned in a realistic, experimental design. Therefore, in the absence of manipulation and randomization, future research should focus on collecting longitudinal data on individuals' spending, combined with information on their personality as well as the regions they move to over time. By analyzing changes in spending within-person, it would be possible to allow the effect of regional personality to vary while holding constant the effect of an individual's personality.

While this does not provide direct causal evidence, it would help to control for some time-invariant unobserved confounds. However, even with longitudinal data, it is impossible to eliminate endogenous effects entirely. Moving homes, for example, is often caused by changes in life circumstances (e.g., divorce, marriage, childbirth, social care needs; Clark, 2016), which are also likely to influence spending.

Implications

Notwithstanding the limitations of our study, our findings have at least three important implications. First, they contribute to the scientific literature by attesting to the unique power of geographic context in explaining crucial individual behavioral outcomes. Put differently, adopting a psycho-geographical lens (Rentfrow et al., 2008; Rentfrow, 2010) and paying attention to socioecological factors (Oishi, 2014) may fruitfully complement existing individual difference approaches and offer fresh perspectives on a whole range of relevant human behaviors. As such, our findings do not only contribute to a better understanding of spending behavior, but to the emerging field of geographical psychology. Specifically, we show that regional personality does not only bear on an individual's psychological adjustment and physical health (Bleidorn et al., 2016; Ebert, Gebauer, Talman, & Rentfrow, 2020; Götz et al, 2018) but also on an individual's behavior. On a more general theoretical level, we further argue that our results offer good reason to reassess the role of personality in widely used interactionist accounts of behavior. Specifically, we suggest that construing personality as both an individual and environmental level characteristic, rather than just the former, is a more adequate representation of how it relates to behavior.

Second, from a methodological standpoint, using sound theory to guide big data applications may offer a way to fully capitalize on existing research and actually fuel new theory development rather than overreliance on atheoretical, purely data-driven approaches (Bleidorn, Hopwood, & Wright, 2017; Kosinski & Behrend, 2017; Lazer, Kennedy, King, &

Vespignani, 2014). As such, rather than producing theory with little or uncertain predictive power or focusing exclusively on prediction without any theory (Yarkoni & Westfall, 2017), informed big data analytics may offer an effective way to integrate prediction and explanation into an iterative process that advances precise psychological assessment and theory building (Bleidorn & Hopwood, 2018). Lending support to this approach, the present study showcases theory-driven big data analytics. Guided by a theoretically derived conceptualization of personality as an environmental characteristic, our results feed back into the theoretical understanding of the determinants of human behavior.

Third, our findings can also inform practitioners in a wide area of fields, including marketers who communicate with customers differentially based on where they live. For example, our findings suggest that companies implementing psychologically-targeted advertisements (Matz, Kosinski, Nave, & Stillwell, 2017) should consider taking into account not only the personal characteristics of their individual customers but also the personal characteristics of the region in which that customer lives. While marketers have long used geographic targeting to segment customer audiences (Kahle, 1986), and geographic segmentation still has an important role even in online commerce (Bell, 2014), using geographic personality could yield additional insights that go above and beyond broader sociodemographic characteristics of the region (e.g. average household income). More specifically, marketers looking to maximize the effectiveness of their advertisements might be better-off targeting not just a group of extraverts, for example, but a group of extraverts who live in an extraverted county or city.

Conclusions

Widely accepted interactionist theories posit that behavior is a product of the interplay of personal and environmental characteristics (Lewin, 1935; Oishi, 2014). Herein, the role of personality has commonly been restricted to that of a personal characteristic. In this article, we argued that this view ignores the role of ambient personality as a crucial environmental

characteristic and thus likely fails to recognize personality's full potential to understand human behavior.

Using the case of spending decisions as an illustration, we combined various sources of big data and diverse analytic techniques to show that spending decisions are not just reflections of people's individual personalities, but also of the regionally aggregated personalities of the places they live in. In other words, what we do reflects not only our own personality, but also the personalities of those around us.

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Supplementary Materials for

Spending reflects not only *who we are* but also *who we are around*:

The joint effects of individual and geographic personality on consumption

Online Supplement 1

Table S1.

List of Spending Categories.

Category	Transaction Count	Total Sum Spent (in £1,000)	Average Sum Spent per Transaction in £	Category	Transaction Count	Total Sum Spent (in £1,000)	Average Sum Spent per Transaction in £
Alcohol	140,441	3,568	25.40	Household (Other)	165,268	11,100	67.16
Art Supplies	31,689	581	18.33	Insurance (Other)	304,821	17,500	57.41
Beauty Products	19,033	533	28.02	Interest Charges	427,428	12,000	28.07
Birthday Presents	19,265	788	40.90	Investment (Other)	65,942	85,500	1,296.59
Book/Magaz./Newsp.	382,113	4,394	11.50	Kitchen/Househ. Appli.	11,358	1,536	135.27
Breakdown Cover	19,848	701	35.31	Life Insurance	294,055	14,300	48.63
Broadband	87,899	2,748	31.27	Lifestyle (Other)	302,426	3,946	13.05
Charity (Other)	43,184	911	21.10	Lunch/Snacks	2,100,000	13,800	6.57
Child Clothes	12,138	431	35.54	Media Bundles	280,860	15,200	54.12
Childcare Fees	13,727	3,235	235.65	Medical Treatment	23,454	1,517	64.69
Children (Other)	103,976	5,534	53.22	Memberships	18,599	659	35.44
Children Club Fees	18,868	910	48.24	Mobile Phone	885,555	31,100	35.12
Christmas Presents	21,386	740	34.60	Mobile App	765,712	5,493	7.17
Cinema	208,527	3,298	15.82	Mobile Phone Insurance	22,246	236	10.60
Clothes (Other)	30,957	1,057	34.15	Mortgage	243,582	200,000	821.08
Clothes	948,759	40,500	42.69	Museum/Exhibition	15,416	318	20.62
Concert/Theatre	48,787	3,141	64.37	Music	147,906	1,623	10.97
Cycling	31,192	1,815	58.17	Office Supplies	15,456	709	45.90
Dental Insurance	18,287	468	25.58	Parking	336,421	2,406	7.15
Dental Treatment	36,435	2,916	80.03	Personal Care (Other)	702,546	10,400	14.80
Dining/Drinking	2,400,000	39,400	16.42	Personal Electronics	22,852	970	42.45
Dining/Going Out	58,797	1,302	22.14	Pet Food	12,958	438	33.79
DIY	291,069	12,500	42.95	Pet Insurance	92,781	2,315	24.96
Domestic Supplies	20,146	797	39.57	Pets (Other)	58,274	1,421	24.39
Donation Organisation	164,947	2,038	12.36	Phone Landline	115,982	5,410	46.64
Dry Cleaning/Laundry	17,241	479	27.76	Photography	13,040	528	40.50
Electricity	37,428	2,159	57.69	Postage/Shipping	64,934	1,767	27.22
Enjoyment	26,533	672	25.34	Public Transport	2,000,000	29,000	14.50
Entertainment/TV/Media	12,823	293	22.85	Religious Donation	10,333	1,245	120.45
Eye Care	62,672	2,567	40.95	Rent	115,416	77,700	673.22
Flights	103,404	20,300	196.32	Road Charges	39,562	317	8.01
Flowers	13,066	594	45.48	Saving Other Goal	11,061	3,639	328.97
Food/Groceries	59,826	1,426	23.84	Service/Parts/Repairs	84,330	5,163	61.22
Fuel	1,300,000	39,500	30.38	Shoes	48,111	2,554	53.09
Furniture	147,611	9,813	66.48	Software	56,452	1,205	21.35
Gambling	331,959	6,718	20.24	Sponsorship	32,513	872	26.82
Gambling Account	201,000	7,428	36.96	Sport Club Membersh.	12,055	492	40.79
Games/Gaming	99,842	1,795	17.98	Sports Equipment	12,350	767	62.09
Garden	39,661	2,085	52.57	Stationery	17,544	252	14.34
Gas	56,481	3,277	58.02	Supermarket	5,400,000	109,000	20.19
Gas/Electricity	349,898	28,500	81.45	Takeaway	479,099	8,884	18.54

General Savings	438,727	155,000	353.29	Tax Payment	151,831	165,000	1,086.73
Gifts (Other)	188,644	4,018	21.30	Taxi	272,312	3,555	13.05
Gifts/Presents	24,004	933	38.85	Taxi/Vehicle Hire	13,952	191	13.70
Going Out (Other)	22,810	580	25.43	Tobacco	13,672	255	18.64
Groceries	3,800,000	73,600	19.37	Toiletries	163,664	2,411	14.73
Gym Membership	175,949	6,756	38.40	Toys	54,459	1,725	31.68
Hair Dressing	70,228	3,001	42.73	Tradesman Fees	14,375	5,539	385.35
Health Insurance	50,325	2,378	47.25	Transport	16,899	511	30.22
Hire Purchase	42,953	12,500	291.02	Transport (Other)	16,749	996	59.47
Hobbies (Other)	75,907	3,232	42.57	TV License	241,487	4,322	17.90
Hobbies/Activities	13,365	427	31.92	TV Movie Packages	282,832	2,869	10.15
Hobby Supplies	10,488	387	36.87	Vehicle Hire	42,602	2,526	59.30
Holiday	75,105	14,300	190.40	Vehicle Insurance	189,757	16,200	85.37
Home	12,487	1,936	155.02	Vehicle Purchase	11,979	7,303	609.63
Home/Garden	220,113	20,000	90.86	Vehicle Tax	210,048	6,294	29.96
Home Appliance Insura.	192,000	2,809	14.63	Vet	18,197	1,321	72.61
Home Electronics	80,690	9,022	111.81	Water	482,928	19,600	40.59
Home Insurance	62,249	2,401	38.58	Webhosting	68,862	1,354	19.66
Hotel/B&B	212,377	20,500	96.53	Zoo/Theme Park	21,303	648	30.44
				Total Sum	**31,915,942**	**1,521,593**	

Note. £1,000 corresponded to approx. $1,376 during the data collection period 2016/2017.

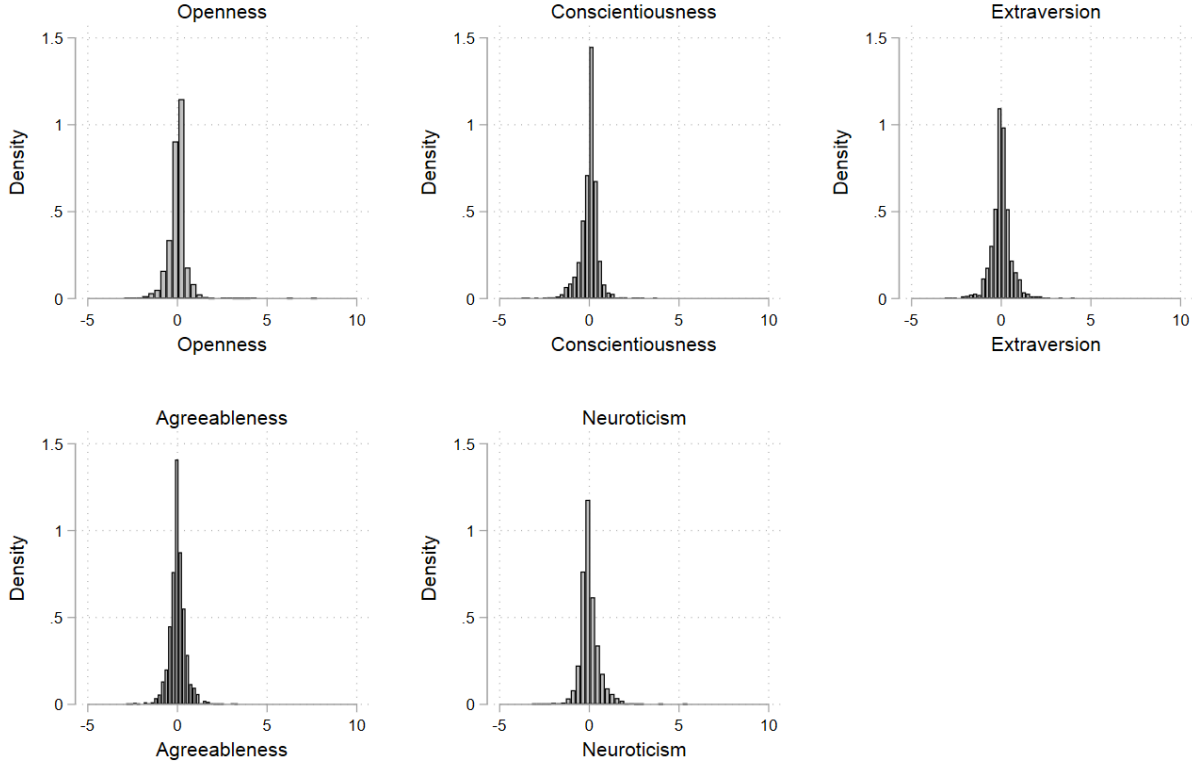**Online Supplement 2**

Figure S2. Histograms of prototypical spending scores (*N* = 1,716).

Online Supplement 3

Actor-Based Clustering Methodology

Actor-Based Clustering is a newly developed mapping approach that utilizes the most

fine-grained spatial information available (i.e., in which of the 10,814 UK postal sectors our

participants live) and then depicts spatial patterns at this level without aggregating data to a

higher spatial level (Brenner, 2017; Ebert, Gebauer et al., 2019). The core component of

Actor-Based Clustering is that for each spatial entity (i.e., a postal sector in our study) an

aggregate score is not only based on the observations within that entity (i.e., personality and

personality-prototypical spending within that postal sector), but on all observations within the

sample. Importantly, in this calculation, not all observations contribute equally, but are

weighted according to their physical distance to the reference postal sector. More specifically,

persons that are close to the reference postal sector receive a greater weight than persons that

are further away. To generate these spatial weights, we first calculated the geographical

coordinates of each postal sector's centroid. Next, we calculated the beeline distances

between all 11,165 × 11,165 pairs of postal sector centroids. To transform these distances into

weights, we used a log-logistic distance decay function that is given by:

$$f(d) = \frac{1}{1 + \left(\frac{d}{r}\right)^s}$$

where d denotes the distance. The parameter r denotes the distance at which the decay

function reaches a value of ½ and s determines the slope of the decay with distance. We

aimed to represent the interaction radius that is available for a person on a daily basis. Studies

show that commuting or travelling for short-term activities is perceived as cumbersome if it

exceeds 60-70 minutes one-way (Ahmed & Stopher, 2014), which roughly translates into an

equivalent kilometer distance (Phibbs & Luft, 1995). We therefore set $r = 30$ kilometers, so

that people nearby receive a weight of nearly one, people with a distance of 30 kilometers

receive a weight of 0.5 and people further away than 60 kilometers receive a weight nearing

zero (see plot of decay function in Figure S3). We repeated this procedure for each postal

sector and finally *z*-standardized the obtained postal sector estimates to ease interpretation of
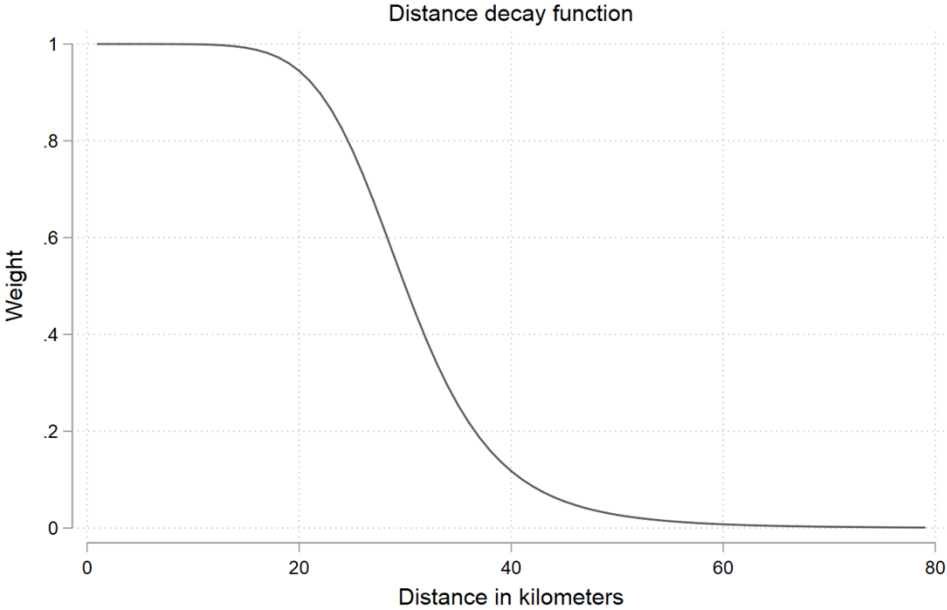
the map.

Figure S3. Distance decay function depicting the weight assigned to participants' personality
and spending scores when computing postal sector level aggregates as a function of
participants' distance to that postal sector.

Online Supplement 4

Table S4.1.

Regional Level Association between Personality and Prototypical Spending for regions with at least 100 banking app users.

| Trait | Before Controlling for Spatial Lags | | After Controlling for Spatial Lags | | |
	(1) Personality - Spending Correlation	(2) Spatial Auto- correlation	(3) Personality- Spending Correlation	(4) Spatial Auto- correlation	(5) Over- estimation (1) vs. (3)
Openness	.38*** [.28, .48]	.11**	.33*** [.24, .43]	-.02	15.2%
Conscientiousness	.19** [.09, .30]	.03	/	/	/
Extraversion	.50*** [.41, .59]	.25***	.39*** [.31, .48]	-.04	28.2%
Agreeableness	.34 *** [.24, .44]	.13***	.28*** [.18, .38]	-.03	21.4%
Neuroticism	.35*** [.25, .45]	.08*	.34*** [.24, .44]	-.01	2.9%

Note. 95% confidence intervals in brackets. $N = 339$, $^{*} p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$

Table S4.2.

Regional Level Association between Personality and Prototypical Spending for regions with at least 250 banking app users.

Trait	Before Controlling for Spatial Lags		After Controlling for Spatial Lags		
	(1) Personality - Spending Correlation	(2) Spatial Auto-correlation	(3) Personality-Spending Correlation	(4) Spatial Auto-correlation	(5) Over-estimation (1) vs. (3)
Openness	.51*** [.37, .64]	.23**	.40*** [.28, .53]	-.08	27.5%
Conscientiousness	.27** [.12, .42]	.07	/	/	/
Extraversion	.56*** [.44, .69]	.35***	.43*** [.33, .54]	-.07	30.2%
Agreeableness	.42 *** [.28, .56]	.20***	.37*** [.24, .50]	-.04	13.5%
Neuroticism	.45*** [.31, .58]	.19**	.43*** [.30, .56]	-.03	4.7%

Note. 95% confidence intervals in brackets. $N = 169$, [*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Online Supplement 5

Response Surface Plots

      We employed Response Surface Plots (Shanock, Baran, Gentry, Pattison, & Heggestad, 2010) to exploratorily visualize possible interaction effects between individual and regional personality that could not be detected in our main analyses due to a lack of statistical power (see Arend & Schäfer, 2019; Mathieu, Aguinis, Culpepper, & Chen, 2012). The Response Surface Plots could help illustrate whether the effect of regional personality could be more or less pronounced for individuals who score high or low on the corresponding Big Five traits. Visual inspections of the plots (see Figure S5) tentatively suggest that regional personality may be particularly relevant for the spending behavior of people low in extraversion and high in agreeableness. This aligns well with research showing that low extraversion and high agreeableness are markers of communal personalities, which are generally more prone to sociocultural influences than agentic personalities (Gebauer et al., 2014).
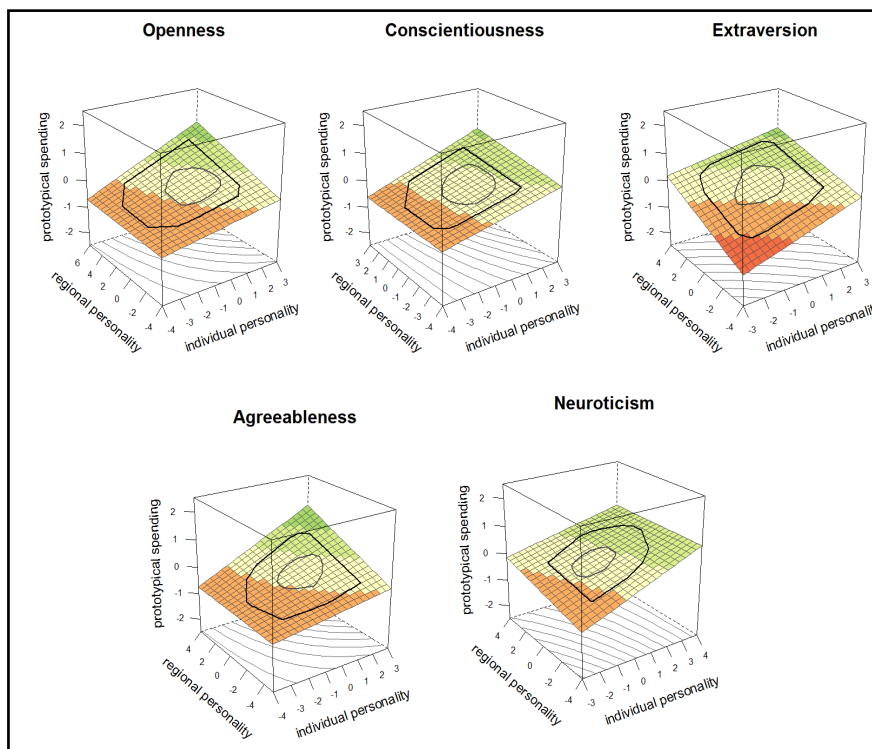

Figure S5. Response Surface Plots exploring interactions between individual and regional personality on prototypical spending. Black shapes on the surface are so-called bagplots indicating the distribution of our data (50% of all data points are in the inner region, 50% in the outer region).

Online Supplement 6

Table S6.

Multilevel Regression Results of Individual and Regional Personality at the NUTS-3 level on Prototypical Spending

DV: Prototypical Spending	Openness		Conscientiousness		Extraversion		Agreeableness		Neuroticism	
	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction
Individual Personality	.17*** [.11, .23]	.17*** [.11, .22]	.19*** [.14, .24]	.19*** [.14, .24]	.17*** [.13, .22]	.18*** [.13, .23]	.19*** [.14, .24]	.21*** [.16, .26]	.19*** [.14, .24]	.19*** [.14, .24]
Regional Personality	.10*** [.06, .15]	.11*** [.06, .15]	.04* [.00, .09]	.04 [-.00, .08]	.20*** [.14, .25]	.20*** [.15, .25]	.11*** [.07, .15]	.12*** [.08, .16]	.02 [-.03, .07]	.02 [-.03, .07]
Gender: Male	.11 [-.03, .25]	.11 [-.03, .26]	-.08 [-.22, .06]	-.08 [-.22, .06]	-.04 [-.18, .10]	-.04 [-.18, .10]	-.06 [-.21, .08]	-.06 [-.20, .08]	-.11 [-.25, .03]	-.11 [-.25, .03]
Gender: Unknown	.01 [-.13, .16]	.02 [-.12, .16]	-.11 [-.25, .03]	-.12 [-.26, .02]	.02 [-.11, .16]	.02 [-.11, .16]	.13 [-.01, .27]	.13 [-.01, .27]	-.01 [-.15, .13]	-.00 [-.14, .14]
Age	-.12*** [-.16, -.07]	-.12*** [-.16, -.07]	.11*** [.07, .16]	.11*** [.07, .16]	-.18*** [-.23, -.14]	-.18*** [-.23, -.14]	.13*** [.08, .18]	.13*** [.08, .18]	-.22*** [-.26, -.17]	-.22*** [-.26, -.17]
Total Spending	.15*** [.11, .20]	.15*** [.11, .20]	.21*** [.16, .25]	.21*** [.16, .25]	.06** [.02, .11]	.06** [.02, .11]	-.15*** [-.20, -.10]	-.15*** [-.20, -.10]	-.12*** [-.17, -.08]	-.12*** [-.17, -.08]
Interaction Ind. X Reg. Personality		.02 [-.03, .06]		.03 [-.01, .08]		-.02 [-.06, .02]		.05* [.01, .09]		.01 [-.04, .07]
Intercept	-.11 [-.24, .02]	-.11 [-.24, .02]	.09 [-.04, .21]	.09 [-.04, .21]	-.11 [-.23, .02]	-.10 [-.23, .02]	.02 [-.11, .14]	.02 [-.11, .14]	.06 [-.07, .18]	.05 [-.07, .18]
Intercept Variance	.02	.02	.01	.01	.04	.04	.00	.00	.00	.00
Slope Variance	.03	.03	.01	.01	.00	.00	.01	.00	.01	.01
With. - Betw. Variance	.86	.86	.86	.87	.80	.80	.88	.89	.86	.86
N Level-1:	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716
N Level-2:	167	167	167	167	167	167	167	167	167	167

Note. 95% confidence intervals in brackets; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Supplement 7

Table S7.

Multilevel Regression Results of Individual and Regional Personality on Weighted Prototypical Spending

DV: Prototypical Spending	Openness		Conscientiousness		Extraversion		Agreeableness		Neuroticism	
	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction
Individual Personality	.17*** [.12, .23]	.16*** [.11, .22]	.18*** [.13, .23]	.19*** [.13, .24]	.19*** [.14, .23]	.18*** [.13, .23]	.22*** [.17, .27]	.20*** [.15, .25]	.18*** [.13, .23]	.19*** [.14, .24]
Regional Personality	.09*** [.05, .12]	.08*** [.04, .12]	.07*** [.03, .12]	.06** [.02, .10]	.16*** [.11, .22]	.17*** [.11, .22]	.07** [.03, .11]	.10*** [.06, .14]	.04 [-.01, .09]	.05* [.00, .10]
Gender: Male	.11 [-.03, .25]	.11 [-.03, .26]	-.06 [-.19, .08]	-.08 [-.23, .06]	-.04 [-.17, .10]	-.05 [-.19, .09]	-.09 [-.23, .05]	-.06 [-.21, .08]	-.15* [-.28, -.01]	-.11 [-.25, .03]
Gender: Unknown	.02 [-.12, .16]	.02 [-.12, .16]	-.10 [-.23, .04]	-.12 [-.26, .02]	.04 [-.09, .18]	.02 [-.12, .15]	.12 [-.03, .26]	.13 [-.01, .27]	-.04 [-.18, .10]	-.01 [-.15, .13]
Age	-.15*** [-.19, -.10]	-.13*** [-.17, -.08]	.14*** [.09, .18]	.11*** [.06, .15]	-.18*** [-.23, -.14]	-.19*** [-.24, -.15]	.10*** [.06, .15]	.13*** [.09, .18]	-.20*** [-.25, -.16]	-.21*** [-.26, -.17]
Total Spending	.18*** [.14, .23]	.15*** [.11, .20]	.23*** [.19, .28]	.21*** [.16, .25]	.08*** [.04, .13]	.06** [.02, .11]	-.12*** [-.16, -.07]	-.15*** [-.20, -.10]	-.18*** [-.23, -.14]	-.12*** [-.17, -.08]
Interaction Ind. X Reg. Personality		.02 [-.02, .06]		.01 [-.03, .06]		-.01 [-.05, .03]		.02 [-.02, .07]		-.01 [-.07, .04]
Intercept	-.11 [-.24, .02]	-.11 [-.24, .02]	.10 [-.03, .22]	.11 [-.01, .24]	-.10 [-.23, .02]	-.08 [-.21, .04]	.02 [-.10, .15]	.02 [-.10, .15]	.08 [-.05, .20]	.05 [-.07, .17]
Intercept Variance	.03	.02	.02	.01	.07	.06	.01	.01	.01	.00
Slope Variance	.03	.04	.01	.01	.01	.01	.02	.01	.03	.01
With. - Betw. Variance	.84	.85	.83	.86	.78	.78	.88	.88	.80	.86
N Level-1:	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716
N Level-2:	336	336	336	336	336	336	336	336	336	336

Note. 95% confidence intervals in brackets; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Supplement 8

Table S8.

Multilevel Regression Results of Individual and Regional Personality Measured via BFI-10 on Prototypical Spending

DV: Prototypical Spending	Openness		Conscientiousness		Extraversion		Agreeableness		Neuroticism	
	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction	Main Effects	Interaction
Individual Personality	.17*** [.12, .23]	.17*** [.11, .22]	.18*** [.13, .23]	.19*** [.14, .24]	.18*** [.14, .23]	.18*** [.13, .23]	.19*** [.15, .24]	.21*** [.16, .26]	.19*** [.14, .24]	.19*** [.14, .24]
Regional Personality	.07** [.03, .11]	.11*** [.06, .15]	.07** [.03, .11]	.04 [-.00, .08]	.15*** [.09, .20]	.20*** [.15, .25]	.09** [.03, .14]	.12*** [.08, .16]	.01 [-.04, .05]	.02 [-.03, .07]
Gender: Male	.11 [-.03, .25]	.11 [-.03, .26]	-.08 [-.22, .06]	-.08 [-.22, .06]	-.05 [-.19, .09]	-.04 [-.18, .10]	-.07 [-.21, .08]	-.06 [-.20, .08]	-.11 [-.25, .03]	-.11 [-.25, .03]
Gender: Unknown	.01 [-.13, .15]	.02 [-.12, .16]	-.12 [-.26, .02]	-.12 [-.26, .02]	.02 [-.12, .15]	.02 [-.11, .16]	.13 [-.01, .27]	.13 [-.01, .27]	-.01 [-.15, .14]	-.00 [-.14, .14]
Age	-.13*** [-.18, -.08]	-.12*** [-.16, -.07]	.10*** [.06, .15]	.11*** [.07, .16]	-.19*** [-.23, -.14]	-.18*** [-.23, -.14]	.14*** [.09, .19]	.13*** [.08, .18]	-.22*** [-.26, -.17]	-.22*** [-.26, -.17]
Total Spending	.15*** [.11, .20]	.15*** [.11, .20]	.21*** [.16, .25]	.21*** [.16, .25]	.07** [.02, .11]	.06** [.02, .11]	-.15*** [-.19, -.10]	-.15*** [-.20, -.10]	-.12*** [-.17, -.08]	-.12*** [-.17, -.08]
Interaction Ind. X Reg. Personality		.02 [-.03, .06]		.03 [-.01, .08]		-.02 [-.06, .02]		.05* [.01, .09]		.01 [-.04, .07]
Intercept	-.09 [-.22, .03]	-.11 [-.24, .02]	.12 [-.01, .24]	.09 [-.04, .21]	-.09 [-.21, .04]	-.10 [-.23, .02]	.01 [-.12, .14]	.02 [-.11, .14]	.05 [-.07, .18]	.05 [-.07, .18]
Intercept Variance	.03	.02	.01	.01	.07	.04	.02	.00	.00	.00
Slope Variance	.04	.03	.01	.01	.00	.00	.01	.00	.01	.01
With. - Betw. Variance	.85	.86	.85	.87	.78	.80	.88	.89	.86	.86
N Level-1:	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716
N Level-2:	336	336	336	336	336	336	336	336	336	336

Note. 95% confidence intervals in brackets; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.