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Personality–Place Transactions: Mapping the Relationships Between Big Five Personality Traits, States, and Daily Places

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People actively select their environments, and the environments they select can alter their psychological characteristics in the moment and over time. Such dynamic person–environment transactions are likely to play out in the context of daily life via the places people spend time in (e.g., home, work, or public places like cafes and restaurants). This article investigates personality–place transactions at 3 conceptual levels: stable personality traits, momentary personality states, and short-term personality trait expressions. Three 2-week experience sampling studies (2 exploratory and 1 confirmatory with a total N = 2,350 and more than 63,000 momentary assessments) were used to provide the first large-scale evidence showing that people's stable Big Five traits are associated with the frequency with which they visit different places on a daily basis. For example, extraverted people reported spending less time at home and more time at cafés, bars, and friends' houses. The findings also show that spending time in a particular place predicts people's momentary personality states and their short-term trait expression over time. For example, people reported feeling more extraverted in the moment when spending time at bars/parties, cafés/restaurants, or friends' houses, compared with when at home. People who showed preferences for spending more time in these places also showed higher levels of short-term trait extraversion over the course of 2 weeks. The findings make theoretical contributions to environmental psychology, personality dynamics, as well as the person–environment transactions literature, and highlight practical implications for a world in which the places people visit can be easily captured via GPS sensors.

Keywords: Big Five, personality states, personality traits, person–environment transactions, places

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Spending time in different places is a core feature of daily life. In any given day, people make decisions about where to spend their time, such as choosing whether to spend time at home, at work, in a coffee shop, at a friend's house, or at the gym. Moreover, such place-visiting behavior is now routinely recorded by companies as a means of understanding people's preferences and for delivering targeted services (e.g., many mobile apps collect GPS data that is used to deliver location-based advertisements and information; Dhar & Varshney, 2011). Recently, such widespread behavioral tracking and psychological targeting practices have raised privacy concerns among researchers (e.g., Harari, 2020; Matz, Appel, & Kosinski, 2020) and the general public (e.g., Valentino-DeVries, Singer, Keller, & Krolik, 2018). Yet, it remains unclear to what extent the places people visit in daily life can reveal psychological information about them. For example, does knowing that a person tends to spend their time at home provide psychologically meaningful information about what they are like? To start investigating the relationship between people's psychological characteristics and the places they spend time in, here we address the following three research questions using data from three large-scale experience sampling studies: (Research Question 1) How are psychological traits related to the types of places a person spends time in? (Research Question 2) How does spending time in a place, in turn, relate to a person's psychological states in the moment? And (Research Question 3) how are preferences for spending time in particular places associated with a person's personality trait expression over time?

The dynamic interplay between individuals and their environmental contexts lies at the heart of theoretical and empirical work on person–environment transactions (Baumert et al., 2017; Oishi & Graham, 2010; Wrzus, Wagner, & Riediger, 2016). Much of the existing research in this domain to date has focused on (a) distal geographical environments such as countries or counties that capture places at a macro level (Rentfrow, Gosling, & Potter, 2008; Rentfrow, Jokela, & Lamb, 2015; Zimmermann & Neyer, 2014) or (b) the psychological characteristics of situations that might occur in different places rather than the specific places themselves (e.g.,

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OSF material: https://osf.io/8263p/ (the materials include the preregistration document, as well as data and scripts to reproduce the results).

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social situations might be associated with both a café and campus; Rauthmann et al., 2014; Rauthmann, Sherman, & Funder, 2015). However, very little is known about the role of everyday places as a type of proximal physical environment that shapes people's daily experiences. In this article, we integrate theoretical perspectives on environmental psychology (e.g., Canter & Craik, 1981; Russell & Ward, 1982; Stokols, 1978), person–environment transactions (e.g., Buss, 1987; Furr & Funder, 2018; Oishi & Graham, 2010; Wrzus et al., 2016), and personality dynamics (e.g., Fleeson, 2001; Fleeson & Jayawickreme, 2015) to investigate the extent to which personality and places may be influencing one another.

Specifically, we investigate how Big Five personality traits and states are related to the places people spend time in on a day-to-day basis. Using both exploratory and preregistered confirmatory analyses, we report findings from three large-scale samples of young adults (total $N = 2{,}350$) in which we leveraged experience sampling methods (ESMs; Shiffman, Stone, & Hufford, 2008) to obtain more than 63,000 momentary reports of places visited and personality state expression at various times of the day. Our findings show that Big Five personality traits predict the frequency with which individuals spent time in different places, and that the places they spent time in, in turn, predict their momentary personality states. Furthermore, we show that place preferences predict short-term personality trait expression over a 2-week period, suggesting that the places people tend to spend time in may also impact their more stable personality traits over time. Taken together, our findings make theoretical and empirical contributions to personality and person–environment research, and have practical implications for our understanding of what place data may reveal about people's psychological traits and states.

The Relationships Between People and Environments

The way that people interact with their physical environments has long been a topic of interest to social scientists spanning a range of disciplinary fields (e.g., psychologists, sociologists, architects; Canter & Craik, 1981; Lewin, 1935; Oldenburg, 1989; Russell & Ward, 1982). Within psychology, much of the existing person–environment research has focused on the extent to which a combination of personal and environmental factors shape human behavior (e.g., person–environment interactions, the person-situation debate; Buss, 1981). However, there is considerably less empirical research examining the covariation between people and environments themselves, a concept known as person–environment transactions (Magnusson, 1990; Wrzus et al., 2016):

$$P \sim E$$

This relative scarcity in research investigating the covariation between people and environments is despite the fact that researchers have suggested theoretical mechanisms for how personal characteristics and environments might influence each other (e.g., Asendorpf, 2009; Buss, 1987). On the one hand, individuals influence the situations they encounter by (a) actively selecting environments, (b) passively evoking certain environmental characteristics, and (c) actively changing or manipulating environments (Buss, 1987). On the other hand, the environments individuals encounter can alter their momentary psychological states and—over time—their psychological traits themselves (Asendorpf, 2009). Extraverts, for example, might be generally more inclined to spend time in places that facilitate socializing with others (e.g., a bar or a coffee shop) as opposed to less social places (e.g., one's home, a library). However, spending time in social places might also make people experience momentary increases in their extraversion states (e.g., being more talkative in the moment), and could even lead to changes in trait-level extraversion if people tend to spend much of their time in social places (Magidson, Roberts, Collado-Rodriguez, & Lejuez, 2014).

The Psychology of Places

Studying the relationship between personality and places is only promising to the extent that the places people spend time in (a) can be studied systematically and (b) are meaningful psychologically. The field of environmental psychology—"the branch of psychology concerned with providing a systematic account of the relationship between person and environment" (Russell & Ward, 1982, p. 652)—offers a valuable starting point for understanding and assessing places. According to environmental psychology perspectives, places can be defined as "the geographical and architectural context of behavior" (Stokols, 1981, p. 442) and may refer to any "psychological or 'perceived' unit of the geographical environment" (Russell & Ward, 1982, p. 654). Sociological perspectives add further nuance to this definition by outlining three defining features of places: geographic location, material form, and meaningfulness (Gieryn, 2000).

Traditionally, different types of places have been mostly described according to place categories (Russell & Ward, 1982). Place categories can range in size and level of granularity from nations, states, towns, and neighborhoods at a more macro level, to coffee shops, and even a specific corner in a specific restaurant at a more micro level. These categories can be organized in hierarchies (Mervis & Rosch, 1981) and operate on different levels of granularity, with the most specific place categories (e.g., table in the corner of a specific coffee shop) at the lowest level and the most general place categories (e.g., the United States as a nation, the continent of North America) at the highest level.

Past research has examined the relationships between people and places at different levels of the place hierarchy. This research includes, for example, investigations of how personality is expressed in countries and counties (Rentfrow et al., 2008, 2015). People have been shown to selectively move to geographic regions where there is a high density of people with similar psychological characteristics (e.g., political orientation; Motyl, Iyer, Oishi, Trawalter, & Nosek, 2014) and to experience higher levels of well-being when they live in places where they are surrounded by like-minded others (Bleidorn et al., 2016; Jokela, Bleidorn, Lamb, Gosling, & Rentfrow, 2015). In addition, research has shown that people manipulate their personal spaces (e.g., bedrooms and offices) in ways that convey accurate information about their personalities (Gosling, Ko, Mannarelli, & Morris, 2002). Moreover, research has investigated how spending time in different places (e.g., at home, work, or in a social environment) can influence people's psychological states (e.g., valence and arousal of moods; Sandstrom, Lathia, Mascolo, & Rentfrow, 2017). In a nutshell, the existing research to date suggests that places are not only psychologically meaningful, but also likely to be related to both people's psychological traits and states. However, the relationships between people's personalities and the places they spend time in each day

are not well understood and the few initial studies in this domain lack robust empirical evidence (we describe these studies in more detail in the Personality Dynamics in Daily Life section below).

In this article, we focus on the places that people visit on a day-to-day basis, and distinguish them from the other place categories by referring to them as *daily places*. Such daily places include proximal physical environments that people tend to spend time in like the home, the work place, a coffee shop, a restaurant, a store, or a gym. Daily places appear to be particularly meaningful in the context of understanding a person's everyday experiences and lifestyles in that they are often tied to specific behaviors and activities (Russell & Ward, 1982). For example, people go to a restaurant to eat, they go to a store to shop, and to a friend's house to socialize. It is therefore not surprising that when people recall and talk about their day, they often describe it in terms of the daily places they visited (e.g., "I spent time at home and at work today" or "I went to a café with friends yesterday").

Personality Dynamics in Daily Life

Recent theoretical advances in personality psychology have conceptualized personality as including both stable traits and more malleable momentary states that are expressed over time (e.g., Whole Trait Theory; Fleeson & Jayawickreme, 2015). The study of trait and state expression of personality over time is collectively referred to as *personality dynamics*.

Personality traits have been conceptualized as relatively stable dispositions that reflect an individual's characteristic pattern of thinking, feeling, and behaving (Matthews, Deary, & Whiteman, 2003). Among all personality models currently in use, the Big Five model of personality is the most prominent (Goldberg, 1999; McCrae & John, 1992). It posits five continuous personality traits: openness to experience (open-minded vs. traditional), conscientiousness (disciplined vs. disorganized), extraversion (outgoing vs. reserved), agreeableness (compassionate vs. antagonistic), and neuroticism (emotionally unstable vs. stable). Decades of research have linked the five personality traits to a broad variety of behaviors and preferences such as music preferences (Rentfrow & Gosling, 2003), vocational interests (Barrick, Mount, & Gupta, 2003), political attitudes (Caprara & Zimbardo, 2004), and life outcomes (for a comprehensive overview see Ozer & Benet-Martínez, 2006).

Shifting to the dynamic aspects of personality, the notion of personality states has gained traction in the wake of the person situation debate (Fleeson, 2004). In an attempt to reconcile seemingly contradictory findings from personality and social psychology, researchers have suggested that even though people have relatively stable personality tendencies (traits), their expression of these traits in the moment (states) can vary depending on the specific situational context (e.g., Fleeson, 2004; Fleeson & Noftle, 2008). Fleeson (2001), for example, proposed that personality traits are best described not as a single score, but as a density distribution of personality states. According to this conceptualization, an individual might have a general tendency to behave in an extraverted way. This tendency reflects a high extraversion trait level and a high distribution mean when the states are measured over time. However, the same individual might act more or less extraverted than their mean level depending on the situation they are in (represented by variability in the distribution of extraversion states around the mean in different situational contexts).

Research in this domain has started to examine the dynamic relationships between personality traits, states, and situations in daily life. This work has shown, for example, that traits are associated with the types of situations people come into contact with and their construal of those situations (Rauthmann, Sherman, Nave, & Funder, 2015). To date, however, research examining personality dynamics and situational contexts have primarily emphasized the importance of subjective psychological characteristics of situations (e.g., how a person perceives the situation they are in), as opposed to the more objective cues that describe situations (see Rauthmann et al., 2015 for a discussion). Although this line of research offers its own valuable contribution with regards to situation perception, we argue that removing objective situational cues—such as daily places—from the research agenda is limiting because places reflect a meaningful and intuitive unit of analysis that represent people's everyday physical environments. More importantly, these days, place information is routinely tracked, modeled, shared and sold (e.g., via GPS data collected from mobile phones; Do & Gatica-Perez, 2014), without an understanding of the types of personal information that may be inferred from such place data. Consequently, we argue for and present here a more systematic assessment of the role of objective daily places as a situational factor that may be influenced by personality traits and, in turn, affect personality states and trait expression over time. By mapping the relationships between personality traits, states, and daily places, our research contributes to the theoretical understanding of personality dynamics in daily life.

Personality Traits and Daily Places

We are aware of only a couple of studies that have examined the relationships between people's personality traits and the places they visit (Mehl, Gosling, & Pennebaker, 2006; Sandstrom et al., 2017). Using the electronically activated recorder (EAR) to collect location data, for example, Mehl and colleagues examined the relationships between self-reported personality traits and preferences for spending time in different places (e.g., preference for spending time at home, or in public places; Mehl et al., 2006). Their findings suggest that the Big Five personality traits are indeed associated with students' preferences for spending time in different places. For example, conscientious individuals spent more time in public places, and agreeable people spent less time at home. Similar effects are reported in the online supplemental material of Sandstrom et al. (2017) who found that spending time at home was negatively related to conscientiousness and positively related to neuroticism. Moreover, time spent in social places was positively related to extraversion, such that people who were more extraverted were found to spend more time in social places compared with people who were less extraverted.

Personality States and Daily Places

Although there is evidence suggesting that daily places influence people's psychological states with regard to affect and mood (Chow et al., 2017; Sandstrom et al., 2017), there is almost no research exploring the effects of places on personality states. To the best of our knowledge there is only one study ($N = 69$) that includes a brief analysis of how personality states fluctuate across home versus work versus social places (reported in the supple-

mental materials of Sandstrom et al., 2017). The findings suggested no differences with regards to state-level openness, conscientiousness, extraversion, and agreeableness across the three place types of home, work, and social places. The only significant effect showed that participants reported higher neuroticism on average while being at work compared with social places.

Although these studies provide initial evidence for the role of personality traits in the selection of daily places, as well as the possible influence of daily places on personality states, they are generally limited by the use of a small number of broad place categories (e.g., home, work, social places) and/or the use of small data sets. We overcome these limitations by extending the different types of places studied to capture a comprehensive range of 12 specific daily places (e.g., cafes, bars, stores, religious institutions) and by conducting our analyses in a large dataset consisting of three samples (N = 2,350 across samples). Furthermore, we explicitly integrate the interplay between personality traits, states, and places into a single, comprehensive research agenda that highlights the psychological significance of daily places for understanding personality dynamics in daily life.

The Present Research

To understand the relationships between personality and daily places, we examined the following three research questions using experience sampling methods. First, are stable personality traits associated with the places people visit in daily life? To examine RQ1, we tested the extent to which young adults' Big Five personality traits relate to the frequency with which they visit a comprehensive list of 12 different daily places. Second, are the places people spend time in associated with their momentary personality states? To examine RQ2, we tested whether spending time in a particular place is related to young adults' more malleable momentary personality states. Third, are preferences for spending time in different places associated with people's personality traits over time? To examine RQ3, we tested whether the proportion of time young adults' spend in different places predicts their short-term personality trait expression (as measured by the average of their personality state density distributions over the course of 2 weeks), over and above their one-time stable trait ratings.

We addressed these research questions in a series of exploratory analyses using data collected from two large and independent samples of college students (exploratory Samples 1 and 2), and subsequently replicated our findings using a set of preregistered analyses on a third student sample (confirmatory Sample 3; see OSF page: https://osf.io/8263p/). Given that each of the samples may have their own limitations and potential biases, we present and interpret the results for our research questions by reporting the pooled effects across the three samples in the main text of the article. However, the findings for the exploratory samples as well as the preregistered replication results from the confirmatory analyses are reported separately in the online supplemental materials.

Ethics Approval

This research was based on analyses of archival data and was approved for use by the Institutional Review Board at Stanford University (Protocol No. 54300) and the Office of Research Support and Compliance at The University of Texas at Austin (Protocol No. 2012–07–0064).

Method

We describe the methodology for all three samples in the section below. All samples were collected as convenience samples in the context of an ongoing class assignment. Unless specified otherwise, the measures and procedures were the same across all three samples. In taking a personality dynamics approach, we focus on three conceptualizations of personality: stable traits (assessed via one time survey reports), momentary states (assessed via repeated experience sampling reports), and short term personality trait expression (assessed by computing the mean of each trait's density distribution over a 2-week period). All data and code needed to reproduce the analyses are published on our project's OSF page (https://osf.io/8263p/).

Parts of the data reported in this article (personality traits) have been published in Harari et al. (2019). Our article substantively differs from the previously published research using these data in its focus on places (rather than social behaviors) as well as its focus on both personality traits and states. Neither the place data nor the personality states data have been published previously.

Participants and Procedure

Exploratory Samples 1 and 2. Participants in Samples 1 and 2 were 1,196 students (Sample 1: mean age = 18.83, age SD = 2.04, 62% female) and 708 students (Sample 2: mean age = 18.79, age SD = 2.82, 64% female) who were enrolled in a large online psychology course at a university in the United States during 2015 and 2016. As part of the broader course activities, students could volunteer to complete a broad array of psychological measures in exchange for personalized feedback about their responses. Here we used data collected from the sociodemographic and personality trait questionnaire (see the Measures section below).

We also used experience sampling data that were collected as part of a course assignment about self-tracking, which aimed to provide students with insights into their lifestyles and college adjustment. Experience sampling (or, ecological momentary assessments, EMAs) enable researchers to study psychological experiences in real time, on a continuous level and in a setting of high ecological validity (ecological momentary assessments, EMAs). In both samples, students could voluntarily choose to complete the self-tracking assignment using one of three tracking modalities: (a) e-mailed surveys sent out via Qualtrics, (b) survey notifications sent via a mobile app, or (c) filling out a handwritten journal to track their responses to the survey questions (an option provided for those students who did not want to collect and share any data). Here we report on data collected from the students who used the e-mail and mobile app tracking modalities. The main incentive for students to opt in to the e-mail and mobile app tracking modalities was that they received personalized feedback reports visualizing their tracked data (e.g., responses to the surveys) at the end of the tracking period.

In Sample 1, we sent out experience sampling surveys to students two times a day (at 11 a.m. and 8 p.m.) for 14 days of self-tracking. In Sample 2, we sent out experience sampling surveys to students four times a day (at 12 p.m., 3 p.m., 6 p.m., and 9 p.m.) for 14 days of self-tracking.

Confirmatory Sample 3. Participants in Sample 3 were 446 students (Sample 3: mean age = 18.93, age SD = 1.56, 62% female) who were enrolled in the same online psychology course

in the United States during 2017. As part of the broader course activities, students could choose to complete the survey measures (sociodemographic and personality questionnaires) and could complete the self-tracking assignment using e-mails, a mobile app, or a handwritten journal. Here we report on data collected from the students who used the e-mail and mobile app tracking modalities. In Sample 3, we sent out experience sampling surveys to students four times a day (at 12 p.m., 3 p.m., 6 p.m., and 9 p.m.) for 14 days of self-tracking.

Measures

The measures used in the analyses can be separated into (a) one-time surveys that were collected once during the semester and (b) repeated experience-sampling surveys that were collected for 2 weeks during the semester. Below we describe the survey items in more detail for the one-time (sociodemographic variables, personality traits) and the repeated experience sampling surveys (personality states, places visited). Unless indicated otherwise, the measures were the same across all three samples.

Personality traits. We used the well-established Big Five Inventory (BFI; John & Srivastava, 1999) to measure participants' personality in terms of the five traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism. Participants indicated their agreement with 44 statements (e.g., "I am someone who is curious about many different things") using a 5-point Likert scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*). With internal consistencies ranging from Cronbach's alpha $\alpha = .77$ to $\alpha = .87$, scale reliabilities were found to be acceptable to good in all three samples (average α in Sample 1 = 0.82 [SD = 0.03], average α in Sample 2 = 0.82 [SD = 0.04], average α in Sample 3 = 0.82 [SD = 0.03]).

Personality states. The experience sampling surveys included five questions aimed at measuring participants' personality state expression at the momentary level. We operationalized the momentary level in two ways, asking participants to report on their experience (a) during the past hour or (b) during the past 15 min.

Exploratory samples. In Sample 1, participants were asked about their Big Five personality state expression during the past hour using a 5-item survey. Specifically, participants were asked: "During the past HOUR, I would describe myself as . . ." and were asked to rate the extent to which they agreed or disagreed with following: "Quiet?" (extraversion – reversed), "Compassionate, has a soft heart?" (agreeableness), "Disorganized?" (conscientiousness – reversed), "Emotionally stable, not easily upset?" (neuroticism – reversed), and "Having little interest in abstract ideas" (openness – reversed). The items were rated on a Likert scale using a 5-point Likert scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*).

In Sample 2, participants were asked about their Big Five personality state expression during the past hour using a 5-item survey ("During the past HOUR . . ."). Specifically, participants were asked: "How quiet were you?" (extraversion – reversed), "How considerate and kind were you?" (agreeableness), "How lazy were you?" (conscientiousness – reversed), "How anxious and easily upset were you?" (neuroticism), and "How curious were you?" (openness). The items were rated on a Likert scale using a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*).

Confirmatory sample. In Sample 3, participants were asked about their Big Five personality state expression during the past 15 min using the same 5-item survey that was administered to Sample 2.

Places visited. The experience sampling surveys also included a question about the places which participants had spent time in. The dropdown list of places participants could choose from included the following 12 places: bar/party, café/restaurant, campus, fraternity/sorority, a friend's house, gym, home (dorm, apartment), library, religious facility, store/mall, work, vehicle (it also included a category "None of the above/Other" which was omitted for the purpose of our analyses). The 12 places were chosen to capture a pragmatic yet relatively comprehensive list of places students might visit throughout the day. Given that participants responded "Other" in only about 4% of the cases (Sample 1: 5%, Sample 2: 3%, Sample 3: 3%), the list seems exhaustive enough to capture the most important and prevalent places visited on a day-to-day basis. To remove participants with few observations and bolster the robustness of our findings, we excluded all participants who had responded to fewer than 10 surveys during the study period.

Exploratory samples. Responses in Sample 1 were recorded in a "check-all-that-apply" format such that participants could indicate that they had been in more than one place in the last hour. In total, the 1,196 participants responded to 29,731 experience sampling surveys (M = 20 experience sampling surveys per person), indicating the places they had spent time in.

Responses in Sample 2 were recorded in a single choice format, asking participants about the place they had spent *most* of their time in during the past hour. In Sample 2, the 708 participants responded to 19,087 experience sampling surveys (M = 30 experience sampling surveys per person), indicating the places they had spent time in.

Confirmatory sample. Responses in Sample 3 were also recorded in a single choice format (as was done in exploratory Sample 2), asking participants about the place they had spent *most* of their time in during the past 15 min. The 446 participants responded to 14,573 experience sampling surveys (M = 35 experience sampling surveys per person) indicating the places they had spent time in.

Results

The results presented below are based on the pooled Samples 1–3. Each set of analyses included sample fixed effects to account for any heterogeneity in the outcome measures across the samples. A comprehensive set of separate exploratory results (from Samples 1 and 2) and preregistered confirmatory results (from Sample 3) can be found in the online supplemental materials.

What Places Did Participants Spend Time In?

Figure 1 provides an overview of the relative frequencies of places visited across samples (see Figure S1 in the online supplemental materials for a breakdown within each samples). Students spent most of their time at home, followed by the campus, and cafés/restaurants. In contrast, only a small proportion of students reported to have spent time in religious facilities or in bars/parties.

Table 1 displays zero-order correlations between personality traits and average personality states across all samples (exploratory

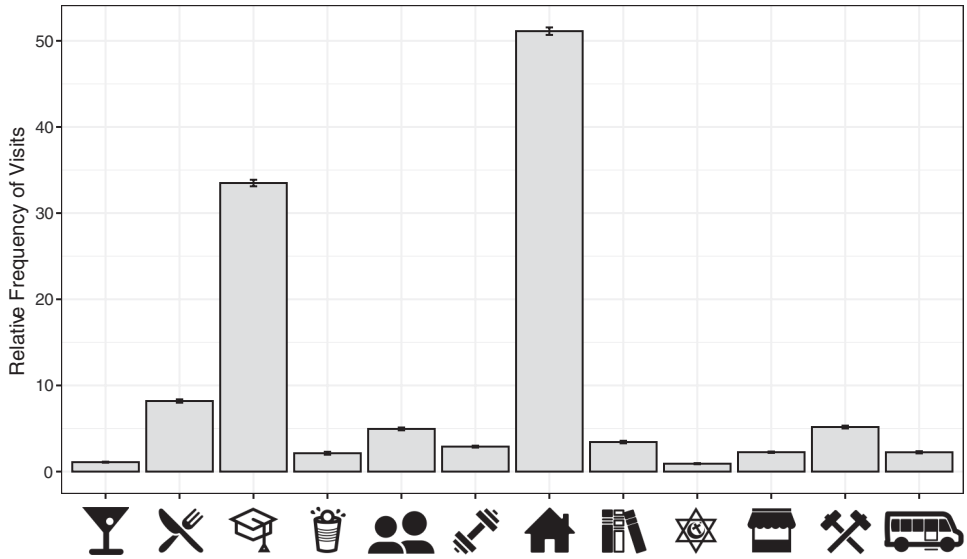

Figure 1. Frequency of place visits across pooled Samples 1–3 (error bars represent between-person standard errors). The symbols on the *x* axis represent, from left-to-right, bar/party, café/restaurant, campus, fraternity/sorority, friend's house, gym, home, library, religious institution, store, work, and vehicle.

and confirmatory, see Tables S1–S5 in the online supplemental materials for a breakdown of correlations between traits and average states across all 12 locations). In line with theoretical understanding of personality state distributions (Fleeson, 2001), the one-time measures of personality traits are positively correlated with the respective short-term personality traits as measured via their average state scores ($\bar{r} = .36$). That is, a person scoring high on the extraversion trait is likely to experience a higher mean level of extraverted personality states throughout the 2 weeks of the study period. However, the magnitude of the observed correlations suggests that the state ratings capture unique variance in personality expression, beyond what is captured by trait ratings.

RQ1: Do Personality Traits Predict the Places People Visit in Daily Life?

To investigate the question of how people's relatively stable personality traits influence the frequency with which they visit different places, we first counted the number of times a participant reported spending time in each of the 12 places. For example, we counted how often a participant reported that they had spent time at home or in a café/restaurant, to obtain an overall sum count representing the number of times they reported spending time at home or in a café/restaurant during the 14-day tracking period.

For each of the places, we then regressed the place count (dependent variable) on the Big Five personality traits as measured by the BFI (independent variables). We used a series of negative binomial regression (NBR) models, which are the recommended type of generalized linear model for count variables (Gardner, Mulvey, & Shaw, 1995). Given that the number of experience sampling surveys completed varied across participants, we also included the number of total places reported per participant as a covariate in the models. To control for variation in responses that might be due to unique features of the samples (e.g., data being collected across different years, different seasons), we also controlled for the sample fixed effects in all analyses (i.e., for RQ1–RQ3). Taken together, we examined the data from 2,331 participants (See Figure S2 in the online supplemental materials for distributions of all variables).

Table 2 displays the results of the negative binomial regression analyses for the pooled sample (see Table S6 in the online supplemental materials for results of the exploratory and preregistered confirmatory analyses). Significant effects highlighted in bold were preregistered based on the analyses of Samples 1 and 2, and those highlighted in black or gray replicated in the confirmatory Sample 3. Given that our confirmatory dataset was significantly smaller than the exploratory one, we counted an effect as having replicated if the regression coefficients were (a) significant and/or (b) not significantly smaller than those obtained in the exploratory analyses when testing for coefficient equivalence (Paternoster, Brame, Mazerolle, & Piquero, 1998). Of the 17 preregistered relationships, seven replicated meeting both criteria, and the remaining 10 effects replicated meeting the criterion of equivalent coefficients. It is important to note, however, that despite not being statistically different from the preregistered coefficients, some of the coefficients obtained in the confirmatory sample are very small with regard to effect sizes (see bottom half of Table S6 in the online supplemental materials). We highlight effects that replicated using the significance criterion in black and the ones that replicated using the equivalence criterion in gray. Figure 2 illustrates the regression coefficients of the negative binomial regression analyses visually (see Figure S3 in the online supplemental materials for a breakdown across samples).

The Big Five traits significantly predicted the frequency with which participants had visited different places above and beyond baseline for nine of the 12 places ($p < .05$). The places

Table 1
Means, Standard Deviations, and Correlations With Confidence Intervals of Personality Traits and Average Personality States for the Pooled Samples 1–3

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
Trait personality											
1. Openness	3.60	0.62									
2. Conscientiousness	3.48	0.64	.03 [−.01, .07]								
3. Extraversion	3.13	0.82	.19** [.15, .23]	.18** [.14, .22]							
4. Agreeableness	3.75	0.62	.09** [.05, .13]	.26** [.22, .30]	.17** [.13, .21]						
5. Neuroticism	3.03	0.76	−.09** [−.13, −.04]	−.27** [−.31, −.23]	−.28** [−.32, −.24]	−.26** [−.30, −.22]					
Average state personality											
6. Openness	2.82	0.80	.31** [.28, .35]	.02 [−.02, .06]	.09** [.04, .13]	.00 [−.04, .05]	−.03 [−.08, .01]				
7. Conscientiousness	3.47	0.65	.03 [−.02, .07]	.41** [.37, .44]	.13** [.09, .17]	.19** [.15, .23]	−.22** [−.26, −.18]	.03 [−.01, .07]			
8. Extraversion	2.76	0.58	.03 [−.01, .07]	.12** [.08, .16]	.36** [.33, .40]	.15** [.11, .19]	−.11** [−.15, −.07]	.13** [.09, .17]	.22** [.18, .26]		
9. Agreeableness	3.44	0.75	.08** [.04, .12]	.19** [.14, .23]	.13** [.09, .17]	.34** [.30, .37]	−.10** [−.14, −.06]	.23** [.19, .27]	.17** [.13, .21]	.12** [.08, .16]	
10. Neuroticism	2.15	0.72	.01 [−.03, .05]	−.18** [−.22, −.14]	−.07** [−.11, −.02]	−.18** [−.22, −.14]	.37** [.33, .41]	.26** [.22, .30]	−.36** [−.39, −.32]	−.04 [−.08, .00]	−.14** [−.18, −.09]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation.
** $p < .01$.

Table 2
Results of Negative Binomial Regression Analyses of Place (Dependent Variable) on the Big Five Personality Traits (Independent Variables) for the Pooled Samples 1–3

	O			C			E			A			N			
Variable	*B*	*SE*	β (ΔIR)	*B*	*SE*	β (ΔIR)	*B*	*SE*	β (ΔIR)	*B*	*SE*	β (ΔIR)	*B*	*SE*	β (ΔIR)	Δ Baseline
Bar/Party	.024	.052	.040 (2.4)	.028	.053	.047 (2.8)	**.326****	.054	.543 (38.5)	−.072	.053	−.119 (−6.9)	−.043	.055	−.071 (−4.2)	44.95, $p < .001$
Café/Rest.	.006	.022	.003 (0.6)	−.008	.023	−.004 (−0.8)	**.098*****	.023	.047 (10.3)	.046†	.023	.022 (4.7)	.001	.024	.001 (0.1)	27.28, $p < .001$
Campus	−.008	.011	−.001 (−0.8)	**.046*****	.012	.009 (4.7)	.022†	.012	.004 (2.2)	.014	.012	.003 (1.4)	−.002	.012	.000 (−0.2)	28.64, $p < .001$
Fraternity	**−.227****	.077	−.107 (−20.3)	.083	.080	.039 (8.7)	**.557*****	.081	.262 (74.5)	−.092	.079	−.043 (−8.8)	.071	.082	.033 (7.4)	50.11, $p < .001$
Friend	.033	.033	.016 (3.4)	−.048	.034	−.023 (−4.7)	**.148*****	.034	.071 (16.0)	.021	.035	.010 (2.1)	.024	.035	.012 (2.4)	23.00, $p < .001$
Gym	**−.130*****	.040	−.098 (−12.2)	**.134****	.041	.101 (14.3)	**.103***	.041	.078 (10.8)	**−.080**†	.041	−.060 (−7.7)	**−.181*****	.042	−.137 (−16.6)	58.39, $p < .001$
Home	−.007	.009	−.001 (−0.7)	−.005	.009	−.001 (−0.5)	**−.070*****	.009	−.009 (−6.8)	−.020*	.009	−.003 (−2.0)	−.005	.010	−.001 (−0.5)	77.85, $p < .001$
Library	−.066	.044	−.035 (−6.4)	**−.099***	.046	−.052 (−9.4)	.017	.046	.009 (1.7)	.028	.046	.015 (2.8)	−.008	.047	−.004 (−0.8)	7.23, $p = .204$
Religion	.010	.066	.013 (1.0)	−.054	.069	−.070 (−5.3)	−.066	.069	−.086 (−6.4)	.146*	.070	.188 (15.7)	−.042	.070	−.053 (−4.1)	5.80, $p = .326$
Store	.004	.034	.004 (0.4)	.010	.035	.011 (1.0)	−.004	.036	−.004 (−0.4)	.082	.036	.087 (8.5)	**.160*****	.036	.170 (17.4)	22.61, $p < .001$
Work	**.235*****	.068	.134 (26.5)	.120†	.070	.068 (0)	−.053	.070	−.031 (−5.2)	**−.119**†	.070	−.068 (−11.2)	.055	.072	.031 (5.7)	15.34, $p = .009$
Vehicle	.003	.030	.002 (0.3)	.040	.031	.023 (4.1)	−.004	.031	−.002 (−0.4)	.039	.031	.022 (4.0)	**.082***	.032	.046 (8.5)	8.06, $p = .153$

Note. $N = 2{,}331$. Significant effects highlighted in bold were preregistered based on the analyses of Samples 1 and 2, and those highlighted in gray or black replicated in the confirmatory Sample 3. All analyses control for the total number of places per participant and sample fixed effects. Δ Baseline = Loglikelihood ratio test for nested model comparison ($df = 5$) indicates whether the model including the Big Five explains significantly more variance than the baseline model with the total number of places and sample fixed effects alone. ΔIR = percentage change in the incidence rate in the dependent variable for a one unit change in the independent variable (effect size measure for negative binomial regression calculated as $(e^B - 1) \times 100$.
† $p < .1$. * $p < .05$. ** $p < .01$. *** $p < .001$.

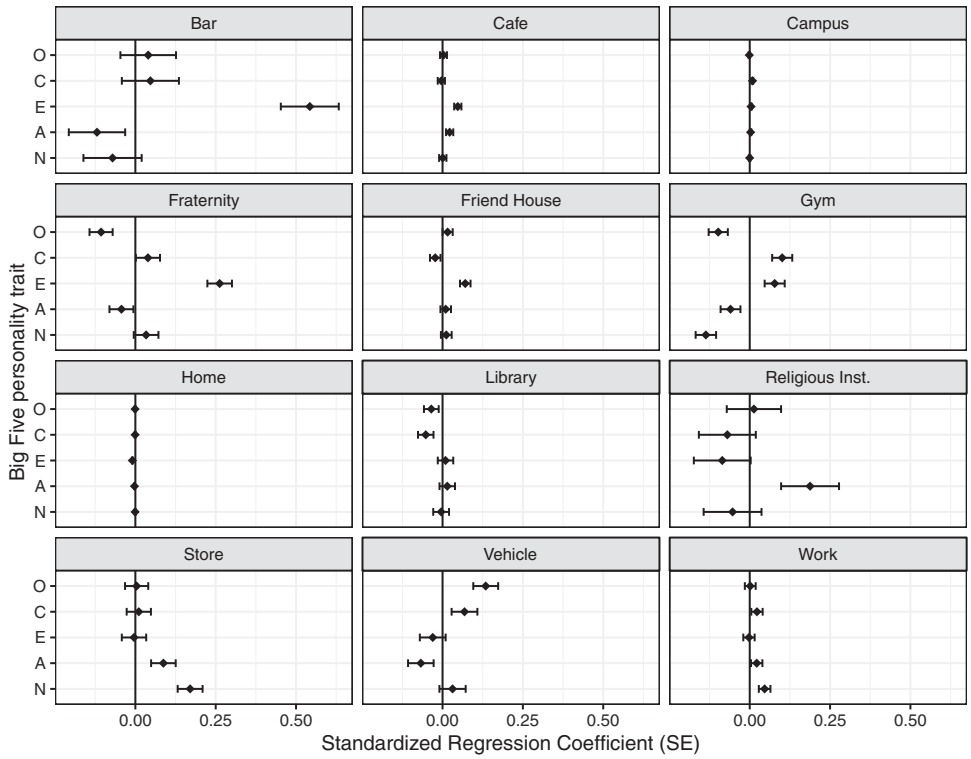

Figure 2. Standardized regression coefficients Beta (error bars represent standard error) from negative binomial regression analyses predicting the frequency of place visits from the Big Five personality traits in pooled Samples 1–3. All analyses control for the total number of EMA and sample fixed effects.

that could be best explained by personality traits included home, gym, and fraternity/sorority. In contrast, the places that were least explained by personality traits were library, vehicle, and religious institution.

Among the five personality traits, extraversion was found to be most predictive of spending time in different places. Participants higher in extraversion spent more time in bars/parties, cafés/restaurants, on campus, at fraternities/sororities, at friend's houses, and at the gym, but spent less time at home, compared with participants lower in extraversion. Participants higher in openness to experience spent less time at fraternities/sororities and at the gym, compared with participants lower in openness. Participants higher in conscientiousness spent more time on campus, at the gym, and at work, but less time in the library, compared with participants lower in conscientiousness. Participants higher in agreeableness spent less time at the gym and at home, but more time at cafés/restaurants, at religious institutions, and in stores, compared with participants lower in agreeableness. Finally, participants higher in neuroticism spent less time at the gym, and spent more time in stores and in transit, compared with participants lower in neuroticism.

RQ2: Do Places Predict People's Momentary Personality States?

To understand how spending time in different places affects people's personality states, we regressed the personality state (dependent variable) on 12 dummy-coded place variables, using home as the reference category (see Figure S4 in the online supplemental materials for distributions of all variables). We chose the "home" place as our reference category for two reasons. First, "home" is the place in which students reported being in most frequently, and to which they presumably returned each day. As such it can serve as a reasonable baseline with which visiting other places can be compared. Second, compared with other places in our dataset, "home" is a meaningful baseline for nonstudents, making it easier to speculate how the effects might generalize to other populations.

Given the nested structure of our data, we used multilevel modeling to account for the fact that our data points are not independent (Raudenbusch & Bryk, 2002). That is, for each participant p in our sample we have multiple data points i relating the place in which they had spent time during the 14 days to their momentary personality state (p.state).[1]

In addition to the dummy-coded place variable predictors, we also included the time of day (morning: 6 a.m.–12 p.m., afternoon: 12 p.m.–6 p.m., evening: 6 p.m.–12 a.m., night: 12 a.m.–6 a.m., with the reference category being afternoon), time of the week

[1] Participants in Sample 1 could report having spent time in more than one place during the past hour, so for the Sample 1 analyses we used each of the places as an individual entry. For example, if a participant had indicated he or she had spent time in both the gym and the library, we would have used the same personality state measures in two separate rows dedicated to each of the places. On average, participants in Sample 1 reported having spent time in 1.5 places per experience sampling survey.

(weekday vs. weekend, reference category being weekday), and sample fixed effects as control variables to account for effects of time and any unique sample characteristics. Taken together, we examined 60,784 observations from 2,320 participants. Formally, our model can be specified as follows:

$$
\begin{aligned}
p.state_{ip} = {} & \beta 0 + \beta 1 * dummy\_place1_{ip} + \ldots \\
& + \beta 11 * dummy\_place11_{ip} \\
& + \beta 12 * dummy\_morning_{ip} \\
& + \beta 13 * dummy\_evening_{ip} + \beta 14 * dummy\_night_{ip} \\
& + \beta 15 * dummy\_weekend_{ip} \\
& + \beta 16 * dummy\_sample2_{p} \\
& + \beta 17 * dummy\_sample3_{p} + u_{0p} + \in_{ip}
\end{aligned}
$$

where p = participants, i = observations, $\beta 0$ = random intercept across individuals (grand mean), $u_{0\ p}$ = participant-level random residual with a normal distribution, $\in_{ip}$ = within-participant random residual at the observation level with a normal distribution.

The results are displayed in the top half of Table 3 (the results broken down into exploratory and confirmatory analyses can be found in Table S7 in the online supplemental materials). Significant effects highlighted in bold were preregistered based on the analyses of Samples 1 and 2, and those highlighted in gray or black replicated in the confirmatory Sample 3. To facilitate readability of tables and focus on the effects of interest, the coefficients for our control variables (time of day, day of the

Table 3

Results of Multilevel Regression Analyses of Big Five Personality States (Dependent Variable) on Dummy-Coded Places (Top) on Dummy-Coded Places and Previous Personality States at t − 1 (Bottom, Independent Variables) for Pooled Samples 1–3

	O			C			E			A			N		
Variable	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β
Prediction of personality states (N = 2,320, observations = 60,784)															
Bar/Party	**.190*****	.045	.014	**.634*****	.048	.046	**1.529*****	.059	.096	**.273*****	.043	.021	**−.185*****	.044	−.014
Café/Rest.	**.169*****	.017	.034	**.521*****	.018	.103	**1.103*****	.022	.188	**.360*****	.016	.075	**−.172*****	.017	−.036
Campus	**.307*****	.010	.110	**.567*****	.011	.203	**.439*****	.013	.135	**.182*****	.010	.068	**.049*****	.010	.019
Fraternity	**.179*****	.035	.018	**.387*****	.038	.040	**.843*****	.045	.074	**.308*****	.033	.033	−.016	.035	−.002
Friend	**.185*****	.022	.029	**.270*****	.023	.043	**1.059*****	.028	.144	**.357*****	.021	.059	**−.116*****	.021	−.019
Gym	**−.063***	.027	−.008	**.943*****	.029	.116	**.651*****	.035	.069	**.175*****	.026	.023	**−.170*****	.027	−.022
Library	**.384*****	.025	.052	**.546*****	.027	.075	−.011	.033	−.001	**.122*****	.024	.018	**.186*****	.025	.027
Religion	**.448*****	.046	.032	**.789*****	.050	.056	**.723*****	.061	.044	**.653*****	.044	.049	**−.255*****	.046	−.019
Store	**.190*****	.030	.021	**.768*****	.032	.084	**1.082*****	.039	.101	**.341*****	.029	.039	**−.099*****	.030	−.011
Work	.005	.031	.001	**.856*****	.034	.095	**1.050*****	.041	.100	**.610*****	.030	.071	−.017	.031	−.002
Vehicle	.028	.021	.004	**.409*****	.023	.066	**.698*****	.027	.096	**.196*****	.020	.033	.007	.021	.001
Δ Baseline	1145.00, $p < .001$			4150.70, $p < .001$			5134.9, $p < .001$			1353.5, $p < .001$			342.25, $p < .001$		
Max VIF	1.11			1.12			1.19			1.11			1.11		
Prediction of personality states controlling for previous personality states at $t - 1$ (N = 1,140, observations = 17,454)															
Bar/Party	.462***	.102	.028	1.247***	.112	.071	1.503***	.128	.079	516***	.104	.029	−.247**	.093	−.017
Café/Rest.	.237***	.036	.042	.903***	.039	.154	1.278***	.044	.202	.629***	.036	.106	−.227***	.032	−.045
Campus	.408***	.021	.139	.849***	.022	.275	.365***	.025	.109	.332***	.021	.106	.077***	.019	.029
Fraternity	.355***	.073	.033	.636***	.079	.057	.882***	.089	.073	.595***	.074	.052	−.113†	.066	−.012
Friend	.264***	.042	.041	.396***	.046	.059	1.085***	.052	.149	.512***	.043	.075	−.040	.038	−.007
Gym	−.080	.052	−.010	1.580***	.057	.181	.514***	.065	.055	.440***	.053	.050	−.300***	.047	−.040
Library	.509***	.044	.077	.761***	.047	.110	−.121*	.053	−.016	.262***	.044	.037	.207***	.040	.035
Religion	.703***	.096	.046	1.089***	.104	.067	.878***	.119	.050	.710***	.097	.043	−.216*	.087	−.016
Store	.272***	.058	.029	1.154***	.063	.118	1.190***	.072	.113	.533***	.059	.054	−.104*	.053	−.012
Work	−.048	.061	−.005	1.117***	.065	.116	1.070***	.074	.103	.871***	.061	.090	−.001	.055	.000
Vehicle	−.170***	.046	−.024	.598***	.050	.079	.533***	.057	.065	.204***	.046	.027	.090*	.042	.014
Previous O	.268***	.007	.270	—	—	—	—	—	—	—	—	—	—	—	—
Previous C	—	—	—	.220***	.007	.222	—	—	—	—	—	—	—	—	—
Previous E	—	—	—	—	—	—	.224***	.007	.222	—	—	—	—	—	—
Previous A	—	—	—	—	—	—	—	—	—	.290***	.007	.290	—	—	—
Previous N	—	—	—	—	—	—	—	—	—	—	—	—	.357***	.007	.355
Δ Baseline	600.52			2423.4, $p < .001$			1661.2, $p < .001$			762.31, $p < .001$			178.09, $p < .001$		
Max VIF	1.13			1.19			1.28			1.13			1.17		

Note. The analyses in the top half are based on Samples 1–3, the ones in bottom are based on Samples 2 and 3. Significant effects highlighted in bold were preregistered based on the analyses of Samples 1 and 2, and those highlighted in gray or black replicated in the confirmatory Sample 3. The reference category is *Home*. All models control for time of day (morning, afternoon, evening, night), time of week (weekend versus weekday), and sample fixed effects. Δ Baseline: χ^2 test for nested model comparison (df = 11) indicates whether the model including the dummy-coded place variable explains significantly more variance than the baseline model, which includes the time of day and weekday controls in the first analysis (top) and significantly more variance than the baseline model, which includes time of day, weekday. and the previous personality state at $t - 1$ (bottom). Max VIF = highest variance inflation factor.

† $p < .1$. * $p < .05$. ** $p < .01$. *** $p < .001$.

week, and sample) are not displayed in Table 3 but are instead presented in Table S8 in the online supplemental materials. Figure 3 illustrates the regression coefficients of the multilevel regression analyses visually (see Figure S5 in the online supplemental materials for a breakdown across samples, and Figure S6 in the online supplemental materials for an illustration of person-centered state means across places that are independent of the home category).

Overall, places predicted personality states above and beyond the baseline models for all five personality states ($p < .05$). The momentary personality state that was most strongly affected by the place participants were in was extraversion. In contrast, the momentary personality state that was least affected by place was neuroticism. Compared with when they spent time at home, participants reported to feel more open-minded when they spent time in bars/parties, cafés/restaurants, on campus, at fraternities/sororities, at a friend's house, in the library, in religious facilities, and in stores/malls. In contrast, they felt less open-minded when they spent time at the gym. Students also reported feeling more conscientious, more extraverted, and more agreeable when they spent time in any of the places, compared with when they spent time at home (note that the question for conscientiousness state was disorganized or lazy which many people may associate with home). The only place where people felt as extraverted as they did at home was the library. Finally, participants reported feeling less neurotic in bars/parties, cafés/restaurants, at friend's houses, at the gym, in religious facilities, and in stores/malls, compared with when they spent time at home. However, students reported to feel more neurotic when they spent time on campus and in the library, compared with when they spent time at home.

It is possible that a person's personality state at $t - 1$, which precedes the place visited, may have influenced both the place a person chose to spend time in and their personality state rating at time t. For example, a person might feel extraverted around noon and therefore decide to visit a coffee shop between 1 and 3 p.m., and then feel extraverted again at 3 p.m. after having spent some time in the coffee shop. Our main interest here is to understand whether spending time in the coffee shop is related to the person's extraversion level at 3 p.m. However, without controlling for the extraversion state at noon, any effect we observe may be driven by the person's extraversion level at noon, which could explain both their choice of visiting the coffee shop and their continued higher level of extraversion at 3 p.m. To alleviate the concern that our findings might not be capturing theorized effects of places on personality states, we repeated the analyses using a more conservative modeling approach by controlling for the personality state at $t - 1$ (p_state_previous). We restricted the time interval that has passed between $t - 1$ (previous EMA) and t (current EMA) to four hours. That is, we only use the previous personality state as an additional predictor of their current state, if the two incidences t and $t - 1$ occurred in a relatively narrow window of time. Restricting the dataset to these instances reduces the total number of observations to 17,454, and the total number of participants to 1,140. This more conservative model can be formally specified as follows:

$$\begin{aligned} p.state_{ip} = {} & \beta 0 + \beta 1 * dummy_{place1_{ip}} + \ldots + \beta 11 * dummy_{place11_{ip}} \\ & + \beta 12 * p_{state_{previous_{ip}}} \\ & + \beta 13 * dummy\_morning_{ip} \\ & + \beta 14 * dummy\_evening_{ip} \\ & + \beta 15 * dummy\_night_{ip} \\ & + \beta 16 * dummy\_weekend_{ip} \end{aligned}$$

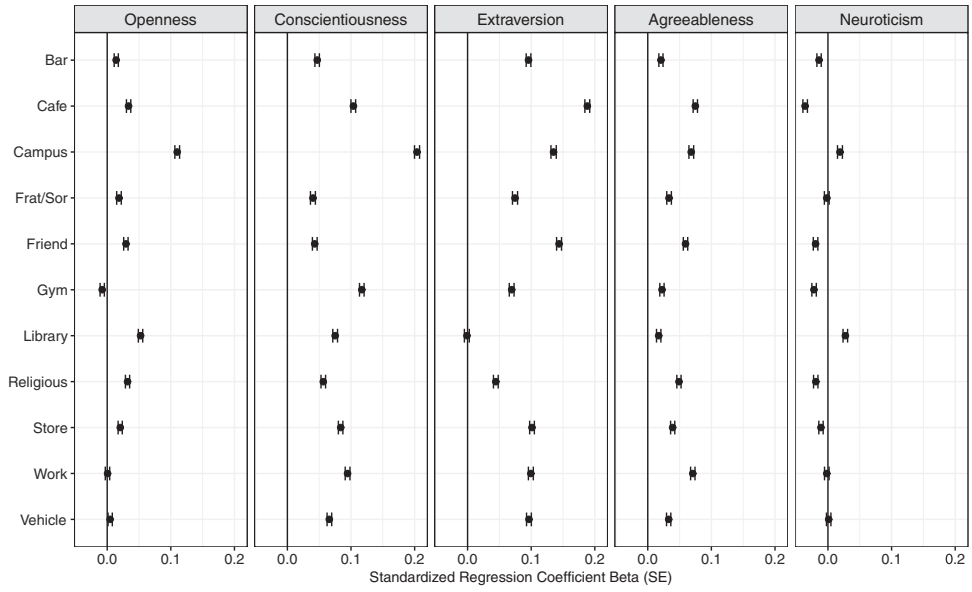

Figure 3. Standardized regression coefficients β (error bars represent standard error) from multilevel regression analyses predicting momentary personality states from dummy-coded places (with "Home" as the reference category) in pooled Samples 1–3.

$$+ \beta 17 * dummy\_sample2_p$$
$$+ \beta 18 * dummy\_sample3_p + u_{0p} + \in_{ip}$$

The results are displayed in the bottom half of Table 3 (the results broken down into exploratory and confirmatory analyses can be found in Table S9 in the online supplemental materials). As before, significant effects highlighted in bold were preregistered based on the analyses of Samples 1 and 2, and those highlighted in gray and black replicated in the confirmatory sample.

Overall, the effects remained largely robust against controlling for the previous personality state, suggesting that the place participants spent time in was indeed related to their subsequent personality states. That is, places were still found to significantly predict personality states above and beyond previous state ratings for all of the Big Five states, with most of the observed individual effects of places on personality states reaching similar levels with regard to effect sizes.

RQ3: Do Place Preferences Predict People's Short-Term Personality Traits Over Time?

We conducted a final set of analyses to investigate whether spending time in different places might lead to changes in people's personality traits over time (i.e., changes in personality expression beyond those captured by momentary personality states).[2] The aim of this third set of analyses is to highlight the incremental role of places in influencing somewhat malleable short-term personality traits. To examine this possibility, we aggregated the personality state reports across the 14 days to obtain a short-term trait measure for each of the Big Five domains (Fleeson, 2001; see Figure S7 in the online supplemental materials for distributions of all variables). We used these short-term personality traits to test whether place preferences (the proportion of place visits for each specific place category relative to the total number of EMAs) predicted people's short-term personality traits, over and above their general trait ratings (personality score obtained from the one-time BFI measure). That is, we ran linear regression analyses which regressed the short-term traits (the average level of each personality state over the 2-week period) on the place preferences (the proportions of EMAs spent in each place over the 2-week period). For example, we regressed participants' average extraversion state reported over the course of 2 weeks onto the proportions of EMAs in each location as well as their stable extraversion trait score as measured by the BFI. Consequently, our findings indicate to which extent spending more time in cafes and restaurant, for example, can explain people's average extraversion state above and beyond people's self-reported BFI extraversion score.

The results are displayed in Table 4 (the results broken down into exploratory and confirmatory analyses can be found in Table S10 in the online supplemental materials). Figure 4 illustrates the regression coefficients of the regression analyses visually (see Figure S8 in the online supplemental materials for a breakdown across samples).

Overall, the place preferences predicted short-term personality traits above and beyond the stable BFI measure of the same personality trait for four of the five traits ($p < .05$). We observed a similar pattern of relationships once again, with short-term extraversion being the personality trait that was most strongly affected by place tendencies. Participants reported higher average levels of extraversion during the course of the 2-week period if they spent more time in bars/parties, cafes/restaurants, stores, on campus, and at friend's houses, compared with those who spent less time in these places. However, participants reported lower average levels of extraversion if they had spent more time at home and in the library during the 2-week period. In addition, participants reported higher average levels of conscientiousness if they had spent more time in the gym and on campus, but less time at home or the library. Participants also reported higher levels of agreeableness if they had spent more time on campus and in transit. Finally, participants reported higher average levels of neuroticism if they had spent more time at fraternities/sororities, friend's houses, and the library.

Discussion

How do personality traits influence the types of places in which people spend time? And how does spending time in a particular type of place influence people's personality states, and personality traits over time? This study investigated the relationships between people's personalities and the places they spend time in on a daily basis. We presented the first large-scale in situ study examining the relationships between daily places and people's Big Five traits and states using experience sampling surveys in three large samples (total $N = 2{,}350$). Our findings showed that relatively stable personality traits predicted the frequency with which people spent time in different places, and that spending time in different places, in turn, predicted people's momentary personality states and short-term personality traits over time. We replicated our findings across multiple samples using preregistered analyses, highlighting the robustness of the observed effects. Below we discuss the results against the backdrop of the existing theoretical and empirical literature on person–environment transactions and personality dynamics. We conclude with a description of the limitations of the current research and an outline for future directions.

Relationships Between People's Personalities and Daily Places

For each of the Big Five dimensions, we discuss (a) the effects of dispositional traits on place visits, (b) the effects of places visited on momentary personality states, and (c) the effects of place preferences on short-term personality trait expression over time. Our trait level findings extend past research (Mehl et al., 2006; Sandstrom et al., 2017) by using larger samples and examining a more comprehensive list of psychologically meaningful places. Our state level findings are the first to establish reliable effects of places on personality expression at the momentary state level and short-term trait level. Previous initial work exploring personality state change observed no effects of being at work or social places on personality states, compared with being at home (see the online supplemental materials; Sandstrom et al., 2017). In general, we observed the strongest relationships between personality and places for extraversion, highlighting the unique role of

[2] This set of analyses was conducted in response to a suggestion by an anonymous reviewer. Consequently, we did not preregister expected effects for this set of analyses, but we felt the findings were compelling and merit being included in the main article to provide a more complete understanding of the relationships between personality and places.

Table 4
Results of Linear Regression Analyses Predicting Average Personality States (Short-term Personality Traits) From the Percentages of Place Visits Across the Pooled Samples 1–3

	O			C			E			A			N		
Variable	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β	*B*	*SE* (*B*)	β
Bar/Party	−.254	.567	−.009	−.016	.483	.391	1.636***	.425	.078	.900	.567	.033	.190	.507	.007
Café/Rest.	−.023	.172	−.003	.023	.146	−.001	.776***	.129	.124	.058	.172	.007	−.006	.154	−.001
Campus	.074	.095	.017	.133†	.078	.003	.170*	.070	.053	.158†	.095	.038	−.001	.085	.000
Fraternity	.038	.197	.004	−.285†	.167	.037	−.112	.148	−.015	−.164	.197	−.017	.432*	.176	.047
Friend	.331	.206	.032	−.230	.174	−.035	.395*	.153	.053	−.021	.206	−.002	.503**	.184	.054
Gym	−.093	.280	−.006	.753**	.239	−.027	.263	.209	.024	−.007	.280	.000	−.377	.252	−.028
Home	.002	.092	.001	−.327***	.075	.062	−.415***	.067	−.149	−.169†	.092	−.047	−.085	.082	−.024
Library	.175	.214	.015	−.328†	.182	−.104	−.338*	.160	−.042	.037	.214	.004	.577**	.191	.057
Religion	.831†	.482	.032	.684†	.412	−.036	.423	.361	.023	.185	.483	.008	−.737	.431	−.031
Store	−.062	.415	−.003	.048†	.355	.032	1.478***	.311	.095	.348	.415	.017	.366	.372	.019
Work	.122	.248	.009	.257	.210	.003	.384*	.185	.042	.238	.248	.020	.274	.221	.024
Vehicle	.084	.202	.008	.073	.172	.025	.018	.151	.002	.600**	.202	.063	−.410*	.180	−.045
BFI-O	.406***	.024	.316	—	—	—	—	—	—	—	—	—	—	—	—
BFI-C	—	—	—	.395***	.020	.009	—	—	—	—	—	—	—	—	—
BFI-E	—	—	—	—	—	—	.216***	.014	.307	—	—	—	—	—	—
BFI-A	—	—	—	—	—	—	—	—	—	.403***	.024	.337	—	—	—
BFI-N	—	—	—	—	—	—	—	—	—	—	—	—	.355***	.017	.374
Δ Baseline	7.75, $p = .804$			54.96, $p < .001$			194.70, $p < .001$			27.86, $p = .006$			41.16, $p < .001$		
Max VIF	1.25			1.26			1.26			1.25			1.25		

Note. $N = 2{,}184$. Δ Baseline = F test for nested model comparison ($df = 11$) indicates whether the model including the Big Five explains significantly more variance than the baseline model with the respective BFI personality traits (BFI-OCEAN) and sample fixed effects alone. Effects highlighted in gray and black replicated in the confirmatory sample. Max VIF = highest variance inflation factor.
† $p < .1$. * $p < .05$. ** $p < .01$. *** $p < .001$.

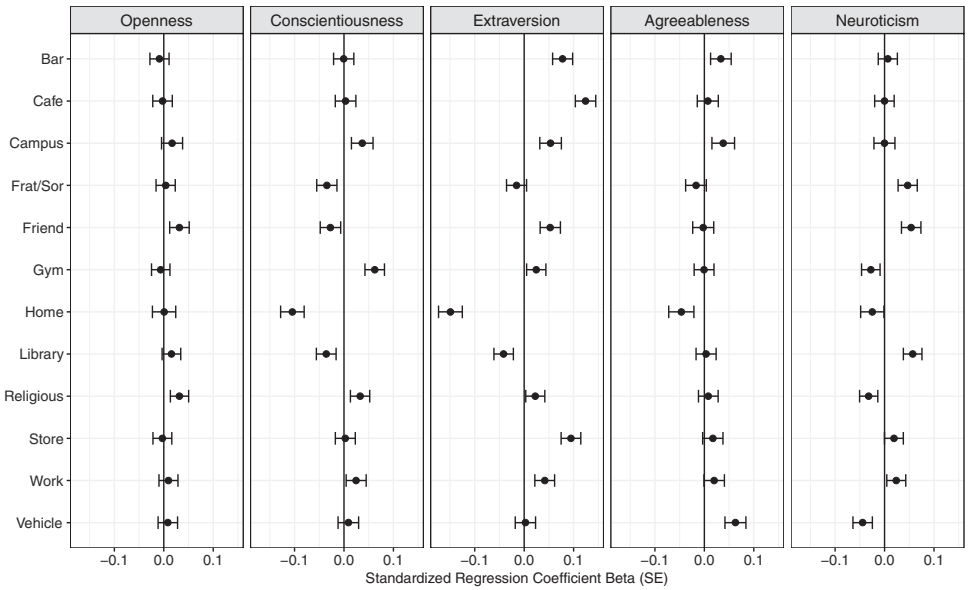

Figure 4. Standardized regression coefficients β (error bars represent standard error) from linear regression analyses predicting short-term personality traits from the percentage of time spent in each place over the course of 2 weeks in pooled Samples 1–3. All analyses control for the individual's personality trait as measured by the Big Five Inventory and sample fixed effects.

this personality dimension for understanding person–environment transactions in the context of daily life. Below we interpret the findings for each of the Big Five in turn, contextualizing the interpretations with reference to previous work on personality dynamics and person–environment transactions.

Openness

RQ1. Trait-level openness to experience was negatively associated with spending time in sororities and fraternities and in the gym, and positively associated with spending time at work. These findings are in line with the description of openness as a trait that describes how intellectual, imaginative, and curious a person tends to be (McCrae & John, 1992). It would seem that people low on openness would be attracted to spending time in places like fraternities and sororities, and gyms because such places offer the types of activities that people who are more conventional and traditional might seek out (e.g., organized and structured activities for socializing and exercising). The positive association with openness and work is less straightforward to explain because we did not have any further information on what type of work students sought out. However, one could speculate that a willingness to actively seek out work experiences might be a signal of openness itself. In contrast to past work, we did not observe an association between trait openness and spending more time in restaurants, bars/parties, and coffee shops (Mehl et al., 2006).

RQ2. Compared with when they were at home, people felt more open-minded when having spent time in bars/parties, cafés/restaurants, on campus, in fraternities, at a friend's house, in the library, in religious institutions, and in stores, but less open-minded when having spent time in the gym. Among the strongest effects are those found for campus and the library, which aligns with the intellectual nature of universities being designed to foster learning and curiosity. Additionally, students felt more open-minded when spending time in social environments (e.g., fraternities and sororities, friend's house, cafés/restaurants, bars/parties) suggesting that social places are experienced as stimulating curiosity and interests in abstract ideas, compared with spending time at home. Interestingly, the effects of fraternities/sororities on openness states are opposed to the effect of trait-level openness on the likelihood of visiting this place. That is, although open-minded people are less likely to visit fraternities and sororities, spending time in those places generally increases state-level openness within those individuals who do go there. Work did not significantly impact students' level of openness compared with home, indicating that—unlike university institutions—students' openness to experience levels did not vary across their home and workplaces.

RQ3. Openness to experience was the only personality trait for which people's place preferences for any of the 12 places observed was not significantly related to their short-term trait level expression.

Conscientiousness

RQ1. Trait-level conscientiousness was positively related to spending time on campus, in the gym, and at work, but negatively related to spending time in the library. The positive associations with campus and work are in line with the description of conscientious people as being hardworking and productive (McCrae & John, 1992). Our results fit prior research findings showing that conscientiousness is related to spending more time at work (Sandstrom et al., 2017) and in public places (Mehl et al., 2006); however, we did not observe an effect of conscientiousness on spending less time at home as observed in these past studies. Similarly, the association with conscientiousness and spending time in the gym aligns with the description of conscientious people

as being self-disciplined (McCrae & John, 1992) as well as prior research showing that conscientiousness is related to better physical health (Goodwin & Friedman, 2006) and health behaviors (Jackson et al., 2010). The only relationship that appears to be rather counterintuitive is the negative association between conscientiousness and spending time in the library. One potential explanation for this finding might be that highly conscientious students are more efficient in their work style or prefer to study from other places (e.g., home, a café) and therefore do not spend as much time in the library as their low-conscientiousness counterparts. Of course, it may also be the case that highly conscientious students are less likely to look at their emails or phones—and therefore answer experience sampling surveys—when they are at the library.

RQ2. Compared with when at home, people felt more conscientious in all other places. The finding that students feel lazier and disorganized at home, compared with when they are out in public, aligns with the assumption that home constitutes a refuge for most people, a place to regain energy and relax after work or on the weekend. Moreover, the places that had the strongest effects on conscientious state levels were the gym and work, both places that require a substantial amount of engagement in self-discipline via mental or physical activities.

RQ3. People reported higher levels of conscientiousness across the 2-week period when having spent more time in the gym. This finding might indicate that realizing one's intentions to exercise regularly invokes a positive feedback loop whereby people who are more conscientious are more likely to go to the gym in the first place (see RQ1), which—in turn—increases their self-efficacy und perceived self-control (McAuley & Blissmer, 2000). In contrast, spending more time at home decreased people's levels of short-term conscientiousness. This finding can be better understood when considering that the personality state question was framed as "lazy" or "disorganized." College students who spend a considerable amount of time at home rather than on campus might feel lazier than their fellow students who regularly attend classes and engage in on-campus activities, which might reduce their perception of self-efficacy and reliability.

Extraversion

RQ1. Trait-level extraversion was positively related to spending time in bars/parties, cafés/restaurants, fraternities/sororities, on campus, at a friend's house, and the gym and negatively related to spending time at home. These findings capture the characterization of extraverts as outgoing, sociable, active, and energetic (McCrae & John, 1992), highlighting their need for social activities, and excitement. In addition, the findings are in line with previous research suggesting that extraverts engage in more social activity and derive greater enjoyment from those activities than introverts do (e.g., conversations, calls, texts; Breil et al., 2019; Harari et al., 2019), which has been attributed, in part, to their elevated levels of reward-sensitivity (Lucas, Diener, Grob, Suh, & Shao, 2000). Our findings support and extend past research that found extraverts to spend more time in social places (Sandstrom et al., 2017).

RQ2. Compared with when at home, students also felt more extraverted in all places except for the library. These findings seem to be best explained by the unique nature of home as the place of quiet refuge, where most people spend a large proportion of their time alone or with a small number of close friends and family members. Given that most libraries require students to be quiet and work on their own, rather than engage with other people, it appears sensible that people feel equally extraverted in the library as they feel at home. In line with the social setting, we found that bars/parties, cafés/restaurants, and a friend's house were the places with the strongest effect on students' extraversion states at the momentary level.

RQ3. Across all five personality traits, short-term extraversion levels were most strongly associated with people's place preferences. People reported higher levels of extraversion across the 2-week period when having spent more time in bars/parties, cafes/restaurants, on campus, in stores and at work. In contrast, they reported lower levels of short-term extraversion when having spent more time at home and in the library. These findings are consistent with literature suggesting that people enjoy social interactions more than they anticipate (Sandstrom & Dunn, 2014). For example, introverts might not necessarily seek out social situations, but when they do so, they might come to realize the positive impact on their mood and not only feel more positive and optimistic after a while, but also feel more social themselves. As we outline in the next section, these findings have implications for the design of volitional personality change interventions in future research.

Agreeableness

RQ1. Trait-level agreeableness was positively related to spending time in cafés/restaurants, in religious institutions, and in stores and negatively related to spending time at home and in the gym. These findings are in line with previous work showing that agreeable people spend less time inside their apartment, and more time in social and public places (Mehl et al., 2006; Sandstrom et al., 2017). Similar to extraversion, the positive association with cafés/restaurants and the negative association with home might be explained by the social nature of agreeable people who can be described as warm and compassionate (McCrae & John, 1992). In addition, agreeableness has been found to be related to religiosity in prior research (Saroglou, 2002), explaining the relationship between agreeableness and spending more time in religious institutions. Finally, the negative relationship between agreeableness and the gym could be explained by the fact that many types of sports are competitive in nature, a characteristic that is associated with low levels of agreeableness (McCrae & John, 1992).

RQ2. Compared with when at home, students felt more agreeable in all places. This might be explained by the fact that the majority of daily places usually involve activities and social interactions with other people, which may elicit increased levels of compassion, kindness, and consideration. Past research has shown that interactions with weak ties leads to greater feelings of happiness and belonging (Sandstrom & Dunn, 2014), suggesting that positive social interactions are likely to trigger states of higher agreeableness. In line with the prosocial nature of many religions, students felt most agreeable when spending time in religious institutions, presumably because they are engaged in prosocial and reflective activities that encourage kindness and compassion.

RQ3. People reported higher levels of agreeableness across the 2-week period when having spent more time on campus and in transit. The relationship between agreeableness and spending more time on campus is likely explained by the social nature of college

campuses, which encourage students to interact and engage with each other. It is less clear why spending time in transit should make people feel more agreeable over time. One potential explanation is that students are in transit to visit family and friends rather than staying at home or on campus. For example, a previous study found that agreeable people tend to use public transportation apps more frequently (Stachl et al., 2017), perhaps because they do not mind sharing public transportation with other people. However, this explanation remains highly speculative and would have to be explored in more detail by future research.

Neuroticism

RQ1. Trait-level neuroticism was negatively associated with spending time in the gym and positively related to spending time in transit (vehicle) and in stores. In contrast to previous studies, we did not observe relationships between neuroticism and spending time at home and/or at work (Sandstrom et al., 2017). The negative association of neuroticism and the gym is in line with prior research showing that emotional stability is associated with higher levels of exercise (Lochbaum, Litchfield, Podlog, & Lutz, 2013), and could be additionally explained by the fact that neurotic people might avoid environments that lend themselves to social comparison more than emotionally stable people (Buunk, Van der Zee, & VanYperen, 2001). In addition, the association could also be driven by reverse causality, whereby people who exercise regularly become more emotionally stable over time (Folkins & Sime, 1981). The positive relationship between neuroticism and stores remains puzzling. In fact, past research shows that neurotic people tend to spend less money than their emotionally stable counterparts (Weston, Gladstone, Graham, Mroczek, & Condon, 2018). At this point we can only speculate that spending money might function as a way for neurotic people to regulate their emotions and make them feel good in the moment, or that it could be an expression of neurotic people finding it harder to decide on the spot and therefore visiting stores more often.

RQ2. Compared with when at home, students felt less neurotic when spending time in bars/parties, cafés/restaurants, at friends' places, in the gym, in a religious institution, or in a store, but more neurotic when spending time on campus and in the library. These findings are aligned with the fact that social interactions are known to reduce anxiety and stress, while academic institutions—with a high pressure to perform—typically elicit higher levels of anxiety and stress. The strongest relationships were found for religious institutions, which results in the biggest drop in neuroticism compared with people's home baseline. Conceptually, our findings are in line with past initial work in this domain that showed people felt more neurotic at work, compared with when in social places (Sandstrom et al., 2017).

RQ3. People reported higher levels of neuroticism across the 2-week period when having spent more time at fraternities/sororities, at a friend's house, or in the library. The association with fraternities and sororities might partly be driven by the fact that such organizations offer a lot of opportunity for social comparison and group pressure, with some research finding averse physical and mental health effects of fraternity/sorority rituals such as hazing (Collins & Liu, 2014; Nuwer, 2001). Similarly, spending more time in the library may increase academic pressure for students, and focus their time on performance rather than social activities. In contrast, the relationship between spending more time at friends' houses and higher levels of short-term trait neuroticism is counterintuitive, given that there is a large body of research supporting the mental health benefits of social relationships (e.g., Cohen, 2004). Future research is needed to further explore this relationship by better understanding which aspects of spending time at a friend's place might result in these findings.

Implications for Understanding Person–Environment Transactions in Daily Life

Our findings contribute to the theoretical understanding of person–environment transactions and personality dynamics by highlighting the relationships between daily places—a type of situational cue that reflects a person's environmental context—and people's personality traits and states. Whereas previous research has focused on specific situational characteristics, such as the psychological features of the situation (e.g., DIAMONDS, Rauthmann et al., 2014) or broader distinctions between different types of situational classes (e.g., home vs. work. vs. social places; Sandstrom et al., 2017), our findings provide a more in-depth analysis of a very fundamental level of situational cues: the specific types of places in which people spend time on a day-to-day basis. As such, our findings provide a baseline for investigating person–environment transactions in the context of daily places, which can subsequently be complemented by an understanding of more specific situational characteristics that may be driving changes in personality states (e.g., how does spending time in a café for intellectual vs. dating purposes impact people's state levels of extraversion).

In addition, our findings shed light on how people and environments may be influencing each other (P $\sim$ E). Understanding person–environment transactions is important because it permits an investigation of the underlying mechanisms that have been suggested to operate in the context of person–environment interactions (i.e., selection, manipulation, evocation, adaptation; Asendorpf, 2009; Buss, 1987). For example, our findings on the relationships between personality traits and the frequency with which people visit different places provide initial support for the notion of selection. Based on their psychological dispositions, people may be selectively seeking out places that are aligned with their own characteristics and that are able to fulfill certain psychological needs associated with those characteristics (e.g., going to a bar is likely to satisfy an extravert's need for stimulation and social interaction). In addition, our findings on the effects of places on personality states provide evidence supporting the mechanism of adaptation and environmental influence. That is, depending on the places people spend time in (e.g., a bar vs. home), they might feel more or less extraverted in that environment.

Our findings also have implications for our understanding of personality change processes during young adulthood (e.g., Roberts & Mroczek, 2008; Roberts, Wood, & Caspi, 2008) and point to new directions for the development of volitional personality change interventions (Hudson, Briley, Chopik, & Derringer, 2019; e.g., Hudson & Fraley, 2015). For example, our state level findings indicate that the places people choose to spend time in may influence their personality expression in the moment. Individuals

who want to engage in volitional personality change may be able to harness such information to select environments that facilitate psychological states they would like to experience (e.g., purposefully spending time outside the home to feel more sociable and organized, spending time in social places to feel less anxious). Moreover, the place preference findings suggest that spending more or less time in certain places over time may have more lasting effects on personality traits. Such information could be used to develop personality change interventions that target changes in one's environment as a means of promoting situational contexts that facilitate trait change (e.g., encouraging people to spend more time in social places over long periods of time so that they encounter more people and have more opportunities for social interaction).

Limitations and Future Directions

Our study has a number of important limitations. First, we used three student samples from the same university in the United States, which limits the generalizability of our findings to people from non-WEIRD societies (i.e., Western, educated, industrial, rich, democratic; Henrich, Heine, & Norenzayan, 2010). As the daily routines of students may differ quite substantially from those of other segments of society (e.g., because their lives revolve around a university campus and might be less structured than those of individuals with nine-to-five jobs), it is possible that the patterns between personality and places observed here will not show the same effects in samples with other demographic characteristics. Future research should aim to replicate the relationships reported in this paper in other, more representative, and non-WEIRD adult samples.

Second, although we were able to classify most places an individual had visited (less than 5% of the experience sampling surveys indicated "other" as the location choice), the experience of a particular place category is unlikely to be constant across individuals and time, and individuals may be drawn to places based on various ambiance factors (e.g., perceived physical or psychological qualities of a place, perceived typical-patron personalities, likely patron activities; Graham & Gosling, 2011). That is, some coffee shops might be very quiet and therefore attract more introverted people and elicit introverted states, whereas others might be very lively and therefore attract more extraverted people and elicit extraverted states. Likewise, people might have different interpretation of categories such as campus, which partially overlapped with other categories such as library or fraternity. Finally, one person's home—the reference category which we compared other places against when studying their effects on personality states—might fulfill a very different purpose from another person's home, and therefore constitute a different baseline of comparison. Thus, more research is needed to understand the unique factors of the home as a psychologically meaningful place that warrants further attention in empirical research (Graham, Gosling, & Travis, 2015). Future research should build on our work to examine the extent to which people's experiences and general ambience factors are relatively reliable across daily place categories. That is, additional work is required to investigate the extent to which different places—in particular the home place—vary in their form (e.g., ambiance, social company) and function (e.g., a place for relaxation vs. work) in people's daily lives.

Third, despite the fact that our analyses revealed consistent relationships between places and personality expression, the causality of these effects remains suggestive. Although we assessed momentary personality states as a function of spending time in a place leading up to the assessments, it is possible that lower or higher levels of personality states influence the selection of those places to begin with. For example, a person who was feeling more extraverted than usual might be more likely to decide to spend time in a bar. It is likely that the direction of these effects goes both ways. Our exploratory secondary analyses in RQ2 partly address and alleviate this concern by showing that spending time in a particular location predicts subsequent personality states, even when controlling for the previous personality state. However, future research should test the directionality of the effect more directly, for example by experimentally assigning people to spend time in different places.

Fourth, although we broadened the number of daily place categories compared with previous research and assessed place visits multiple times a day using experience sampling (rather than broad retrospective self-reports), we are unable to capture the full complexity and nuance of daily places. Future research could address this issue by drawing on recent technological developments (e.g., smartphones or other wearable devices) that make it easier to capture information about both people and their environments passively and unobtrusively (Harari et al., 2016). Many companies and institutions routinely collect location information about individuals, for example via smartphone applications that access GPS sensors (Valentino-DeVries, 2018). Future research could explore how psychological and behavioral information from smartphones (e.g., surveys, sensor data, metadata) can be combined with place information (via GPS data) to understand people's behavior in context (Harari, Müller, & Gosling, 2018). For instance, GPS data are often collected in the form of latitude–longitude coordinates that must be processed to generate semantically meaningful information by translating coordinates into place labels similar to the ones used in the present research (e.g., restaurant, bar, store). This labeling process allows researchers to passively observe place visits without requiring people's self-reports, and to do so at a more granular level and with more unique place categories (e.g., the Google Places API returns a possible list of over 75 place type labels). By using intensive, objective, and unobtrusive measures of the real-world places that people visit each day, such research would permit insights into precisely how and when places interact with people's psychological traits and states.

Moreover, although GPS data could provide opportunities for researchers to uncover more nuanced relationships between people and their everyday environments, our findings also have practical implications for individuals, businesses, and society that reach far beyond the academic context. In marketing contexts, for example, location information obtained from GPS records is used to tailor advertisements to a person's physical location (e.g., receiving a coupon when entering a store; Dhar & Varshney, 2011). Such contextualized advertising strategies are shown to be effective in driving consumer attitudes and purchasing decisions (Molitor, Reichhart, Spann, & Ghose, 2019; Unni & Harmon, 2007), and typically occur based on physical location alone (e.g., person visits café). However, past research suggests that tailoring advertising to individual personality leads to higher consumer engagement as measured by clicks and purchases (Matz, Kosinski, Nave, & Still-

well, 2017), suggesting that location data could be useful above and beyond contextual targeting. Not only could marketers infer people's personality traits from their place routines, but they could further customize advertising based on the inferred traits or states of the targeted individual. For example, an extraverted person might be more receptive to personality-matched advertising when they are in an extraverted place that highlights and reinforces their extraverted state.

At the individual and societal level, our findings have implications for informational privacy given the common data practice of digital technologies (e.g., smartphones, wearables, apps) collecting individual location information nearly continuously via GPS sensors (Harari, 2020; Matz et al., 2020). Specifically, our findings shed light on the privacy implication that simply knowing a person's place history based on their mobility patterns may reveal diagnostic personality information. Further research is needed to determine the extent to which place data can be used to predict people's intimate psychological traits, and could therefore pose a potential threat to people's privacy (see Kosinski, Stillwell, & Graepel, 2013 for an empirical illustration and discussion of this topic in the context of Facebook Likes). In the meantime, individuals who are concerned about their location privacy are encouraged to take control of the location tracking settings on their mobile devices (e.g., King, 2019) so that they may exercise some control over who has access to their personal location data.

Conclusion

People's psychological dispositions and momentary states interact with the environments they spend time in. Historically, it has been difficult to study person–environment transactions in the context of daily life. Here, we used self-tracking technologies (e.g., mobile app and e-mail-based experience sampling surveys) in a series of large-scale studies to provide an initial window into the relationships between people's personalities and the daily places they spend time in. Our study builds on theoretical work that conceptualizes personality dimensions at both the trait and state level to show how places influence personality expression in daily life. Taken together, our findings suggest that the places people visit on a day-to-day basis are intricately linked to both their personality traits and states. People's stable Big Five traits were related to the places they spend time in, which in turn were related to how people expressed their Big Five states in the moment and over time. A better understanding of how people's psychology is connected to the physical spaces they inhabit will enable individuals to make the most of their daily experiences by helping them to select environments that fit their dispositions and elicit the psychological states they desire.

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