2020

Measuring Social Ecology: Comparing Perceptions Of Personal And Societal Relational Mobility In Japan And The United States

Caroline Mackenzie Jordan
William & Mary - Arts & Sciences, jordancaroline4@gmail.com

Measuring Social Ecology: Comparing Perceptions of Personal and Societal Relational Mobility in Japan and the United States

Caroline Mackenzie Jordan

Chesapeake, Virginia

Bachelor of Arts, University of Virginia, 2018

A Thesis presented to the Graduate Faculty of The College of William & Mary in Candidacy for the Degree of Master of Science

Psychological Sciences

College of William & Mary
August 2020

APPROVAL PAGE

This Thesis is submitted in partial fulfillment of
the requirements for the degree of

Master of Science

Caroline Jordan

Caroline Jordan

Approved by the Committee July 2020

Committee Chair or Co-Chair
Joanna Schug, Associate Professor, Psychological Sciences
College of William & Mary

Todd Thrash

Co-Chair
Todd Thrash, Professor, Psychological Sciences
College of William & Mary

Xiaowen Xu, Assistant Professor, Psychological Sciences
College of William & Mary

COMPLIANCE PAGE

Research approved by

Protection of Human Subject Committee

Protocol number(s): PHSC-2019-11-13-13981-jschug

Date(s) of approval: 11/29/2019

ABSTRACT

Relational mobility, i.e., the degree to which individuals are afforded opportunities to voluntarily form and terminate relationships in a given society, is proposed in previous research to underlie many cultural differences in psychology. However, questions remain about how to best measure the construct of relational mobility, and whether to consider relational mobility as a construct existing on the environmental or individual level. In this study, we test the measurement invariance of one proposed alternate measure, the personal mobility scale across the United States (n = 1,698) and Japan (n = 2,224). We then compare correlations between personal mobility and individual difference variables to the correlations between relational mobility and these traits within the US and Japan. Finally, within both countries we model the number of new acquaintances that participants report meeting as a function of their individual-level relational mobility and personal mobility, and their state or prefecture's average relational mobility using a series of multilevel negative binomial regressions.

In Study 1a, we found the personal mobility scale to be partially invariant across the United States and Japan. In Study 1b we found support for our hypothesis that the personal mobility scale is more closely associated with individual differences (e.g., extraversion, self-esteem, and popularity) than is the relational mobility scale. We found in Study 1c that even when accounting for an individual's personal mobility, the locality's average relational mobility significantly predicts how many new acquaintances participants met, providing evidence that the relational mobility scale does quantify the socioecological construct of relational mobility. Taken together, the results of these three studies support the use of the relational mobility scale over the personal mobility scale to measure the socioecological construct of relational mobility.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

This writer wishes to express her gratitude to Professor Schug for her guidance, patience, and critiques while overseeing this investigation. This research would not have been possible without her active engagement. The author would also like to thank Professor Thrash and Professor Xu for their thoughtful commentary, criticism, and involvement in this manuscript. The writer is also indebted to her family, friends, and cohort for their support and encouragement. This work was supported by a grant from the National Science Foundation (CAREER: The Social Ecology of Relational Mobility, award #1752941, PI: Joanna Schug) and an award from Mitsubishi Social Welfare Foundation to Kosuke Sato.

LIST OF TABLES

LIST OF FIGURES

Chapter 1

Introduction and Study Aims[1]

Many scholars have acknowledged how environments (Lewin, 1939) and cultures (Luria, 1928) shape human behavior. However, until recently factors like culture and social environments were historically ignored in mainstream psychological literature. Many psychological researchers continue to draw conclusions based on WEIRD (Western, Educated, Industrialized, Rich, and Democratic) participants (Arnett, 2008; Henrich et al., 2010). People in this WEIRD subpopulation consistently show divergent cognitions, perceptions, and behaviors from the rest of the world, thus poorly reflecting human diversity (Henrich et al., 2010). As a result, the generalizability of many studies is severely limited.

Fortunately, the lack of attention paid to cultural factors is beginning to change. With the field of cross-cultural psychology emerging in the 1970's, and gaining popularity in the 1990's (Oishi & Graham, 2010; Sweder & Sullivan, 1993), robust evidence has emerged showing that cultures differ across many realms including in the emotional, social, moral, and perceptual domains. More modern research has revealed consistent cross-cultural differences in constructs such as motivation for uniqueness (e.g., Kim & Markus, 1999), self-enhancement (e.g., Heine & Hammamura, 2007), and holistic or analytic cognitive processes (e.g., Nisbett et al., 2001; Uskul et al., 2008).

[1] This is a Master's Thesis project, and as such, results may be tentative. Please contact Caroline Jordan at cmjordan02@email.wm.edu or Joanna Schug at jschug@wm.edu before citing.

In light of the robust evidence that culture influences psychological processes, research has now turned attention to the question why such divergences exist, and through what mechanisms they operate (Heine & Norenzayan, 2006; Matsumoto & Yoo, 2006; Van de Vijver & Leung, 2000). Interpretations of such findings often center around differences in psychological attributes, such as self-construals (Markus & Kitayama, 1991) or the individualistic or collectivistic values within a society (Hui & Triandis, 1986). Although such explanations hold value in the literature, they can also suffer from shortcomings. Many of these frameworks explain one source of cultural variation in a psychological or behavioral process with another cultural difference in psychology or behavior, resulting in a tautological structure.

Socioecological approaches explore the bidirectional influences between natural and social habitats and individual's minds and behavior (Oishi & Graham, 2010). By linking cultural variation in psychological and behavioral processes to aspects of the macro-level society and environment in which individuals are embedded, socioecological approaches may provide more grounded mechanisms and explanations for observed cross-cultural differences (Oishi & Graham, 2010). Utilizing a socioecological perspective allows for researchers to capitalize on variation within societies and people, rather than such variability detracting from macro-level distinctions (Kesebir et al., 2010). Despite notable exceptions (e.g., Nisbett & Cohen, 1996; Yamagishi et al.,1998) this approach was largely underutilized until its recent increase in popularity (see Oishi & Graham, 2010 for a review; Rozin, 2003). These socioecological paradigms also have helped to explain findings regarding close relationships that seem paradoxical when accounted for by

other cross-cultural perspectives, such as societal values of individualism and collectivism (see Kito et al., 2017 for a review; Liu et al., 2020).

Socioecological approaches consider the mutual constitution between people and their environments, characterized by political, geographical, social, religious, and economic characteristics (Oishi & Graham, 2010). Importantly, a socioecological framework also addresses how individuals adapt their psychological tendencies and behaviors to their social environments to attain a desirable outcome (Kito et al., 2017; Yuki & Schug, 2012). When individuals exhibit overt patterns of behavior, feedback from others in their society affects how individuals adapt to the environment, or adopt certain behaviors to give them an advantage (Kito et al., 2017). Based on such feedback, individuals hold expectations and beliefs of future feedback and expected actions of others, and these patterns comprise the social "environment" (Yuki & Schug, 2012). The structure of incentives that individuals face in these environments, along with the structure of incentives that others face within society, collectively guide adaptive behavioral patterns (Yamagishi et al., 2008; Yuki & Schug, 2012), reinforcing the dynamic construction of social environments (Kito et al., 2017; Yamagishi et al., 2008; Yuki & Schug, 2012).

Relational Mobility

One socioecological construct influencing which strategies and behaviors are adaptive in a given context is relational mobility. Relational mobility is the extent to which individuals in a given society or context are presented with opportunities and choices to voluntarily form and terminate relationships (Yuki et al., 2007). In high relational mobility settings, relationships have a more flexible nature, and bonds reflect individual choices more so than in low mobility settings (Schug et al., 2009;

Yuki & Schug, 2012). That is, because people in contexts high in relational mobility have more options in relational partners, and are able to choose their own partners, their relationships are more likely to reflect their personal preferences. In contexts with lower relational mobility, the fixed nature of relationships and more stable interpersonal networks mean that relationships tend to reflect the influence of environmental affordances, rather than personal preferences (Yuki & Schug, 2020).

Perceptions of relational mobility vary cross-culturally, with North Americans, Western Europeans, and Latin Americans perceiving more opportunities to voluntarily dissolve and form ties, and therefore higher relational mobility (Thomson et al., 2018). In East and Southeast Asia, North Africa, and the Middle East, relationships are more difficult to enter into and to exit out of, indicative of lower relational mobility (Thomson et al., 2018). The flexible or fixed nature of relationships also varies within societies and across situations (Yuki et al., 2007). Higher relational mobility is reported in urban as compared to rural settings (Yamagishi et al., 2012), and on larger as compared to smaller college campuses (Bahns et al., 2012). Even within the same university setting, Sato and Yuki (2014) found that contextual differences of having abundant choice in forming relationships resulted in higher relational mobility among first-year as compared to second-year students. Individuals may also inhabit multiple social environments simultaneously, such as their college campus, state, region, and country, each of which provides differing amounts of relational mobility. Thus, relational mobility can refer to variation in opportunities to form and terminate social ties within and across social contexts.

Adaptive Tasks and Strategies Associated With Relational Mobility

Varying levels of relational mobility in an environment present different challenges to individuals, and thus prompt different tasks and strategies that serve to accomplish goals suited to the context (Kito et al., 2017). In a high relational mobility context, the most adaptive task for individuals is finding and securing relationships that are most beneficial to them, and minimizing the opportunity cost of time spent with ill-suited partners (Oishi et al., 2015). Strategies such as staying vigilant for potential new relationships, determining the desirability of a current partner, and being perceived as attractive by others help individuals form beneficial relationships (Oishi et al., 2015).

In settings or societies with low relational mobility, individuals should avoid the risk of social exclusion (Oishi et al., 2015). Since group memberships and relationships are more stable and impermeable to outsiders, if an individual is ostracized from their group, it would be difficult to find replacement partners (Oishi et al., 2015). In addition, people in low mobility societies have the task of remaining integrated in harmonious relationships, to minimize the risk of becoming trapped in unpleasant interactions (Kito et al., 2017). One strategy for success in these environments is avoiding offending others, even when this conflicts with personal preferences (Kito et al., 2017; Yamagishi et al., 2008).

Influences of Relational Mobility in Close Relationships

Applying a socioecological approach to the study of close relationships by considering relational mobility provides grounded explanations for many cross-cultural differences that seem contradictory with individual difference perspectives alone. For example, individuals holding more independent self-construals in individualistic societies such as the United States are proposed to value self-

expression, feel more agentic and distinct from others, and pursue their own goals (Markus & Kitayama, 1991). In contrast, those in collectivist cultures such as Japan with interdependent self-construals are thought to value connectedness and harmony, and promote others' goals (Markus & Kitayama, 1991). Given the variability in how constructs of collectivism and interdependence are applied, we use the terminology "collectivism-as-values approach" to refer to the general predictions that people in collectivist cultures should endorse collectivistic values, and thus prioritize ingroup relationships and harmonious interactions (see Liu et al., 2020).

Predictions generated from the collectivism-as-values approach often do not hold true. For instance, North Americans report more interpersonal closeness in their relationships than East Asians (Kashima et al., 1995; Uleman et al., 2000). Across both romantic and platonic relationships, American students are more willing than Japanese students to self-disclose information about themselves with others (Kito, 2005). European Americans, as compared to Asians and Asian Americans seek more emotional support from their friends, and experience greater benefit when they do so (Kim et al., 2006).

These patterns, whereby European Americans tend to report having closer personal relationships than East Asians and Asian Americans, seem paradoxical when viewed from such collectivism-as-values approaches but are rational when viewed as individuals adapting to characteristics of their environment, such as relational mobility. From an adaptationist perspective, the proactive patterns of relationality displayed by North Americans may be considered strategies to aid in fulfilling the adaptive task of acquiring and maintaining relationships. Sharing information with a partner that could damage one's own reputation or cause

embarrassment is both costly and risky, and as a result may serve as a costly signal (e.g., Spence, 1973) of one's commitment to the relationship (Schug et al., 2010). In high relational mobility settings, disclosures signal interest and commitment to partners, which reinforces closeness within the relationship, and helps to retain the partner (Yuki & Schug, 2012). However, for those in low relational mobility settings, such self-disclosures are largely unnecessary. If friends perceive that there are few viable alternatives to the current relationship, relationships are less fragile and do not need the reciprocity of sharing intimate information to reinforce closeness (Schug et al., 2010; Yuki & Schug, 2012).

Taken together, these findings indicate the robust ability of relational mobility as a socioecological factor to account for observed patterns of cultural differences across domains of cognitions, emotions, and interpersonal relationships. The framework of relational mobility offers adaptive explanations and mechanisms even for findings such as interpersonal closeness, which seem to contradict predictions derived from the predominant individualist or collectivist societal values of countries. However, social environmental factors can be difficult to quantify, as they are often construed on an ecological level, or as an equilibrium state between micro level individual behavior and macro level social systems (e.g., Cohen, 2001; Yamagishi et al., 2008). As a result, measuring relational mobility using traditional self-report methods can be challenging, and thus far very few studies have sought to compare methods to measure relational mobility.

Measurement of Relational Mobility

The socio-ecological construct of relational mobility is typically assessed via the Relational Mobility Scale, which quantifies individuals' perceptions of the

relational mobility within their environment (Thomson et al., 2018; Yuki et al., 2007). Participants report how much opportunity and choice they perceive others in their social environments have to voluntarily form and dissolve relationships using 12 items (see Appendix B for the full scale).

The Relational Mobility Scale was deliberately designed to assess participants' perceptions of the relational mobility of their environment, rather than their own personal mobility, for several reasons. First, from a theoretical standpoint, relational mobility is fundamentally an ecological level construct, rather than an individual difference variable. Although people within a given social environment will likely report differing levels of relational mobility, this variation should theoretically be due to differing social networks and group memberships, rather than to an individual difference in psychological traits *per se*. Measuring relational mobility as participants' perceptions of their environment can help researchers avoid individual differences in traits such as wealth, attractiveness, and extraversion (Kito et al., 2017; Thompson et al., 2018; Yuki et al., 2007).

Second, measuring relational mobility as participants' perceptions of their society may also help to alleviate concerns that cultural differences in self-enhancement may confound participants' reports of relational mobility. Previous research has found robust differences between North Americans and East Asians in their tendency to view and present themselves in a positive light. For instance, in a meta-analysis, Heine & Hammamura (2007) showed that self-enhancement, or the motivation and tendency to view oneself positively, was present for Americans, but not for East Asians. As one's perception of how easy it would be for themselves personally to meet new people and form new relationships may be related to how

desirable or attractive they feel they are, given prior research on self-enhancement, it is likely that North Americans will be more likely to self-enhance than East Asians. Measuring participants' perceptions of relational mobility in their society thus limits the influence and nonequivalence that self-enhancement may introduce to the measure (Kito et al., 2017; Thompson et al., 2018; Yuki et al., 2007).

Importantly, this method of measuring relational mobility relies on perceptions of the potential for mobility (i.e., opportunities to enter into and exit from relationships) in one's society, rather than quantifying the degree to which people actually form and terminate relationships. While ecological or national markers of objective mobility, such as divorce rates, job turnover rates, or residential mobility (e.g., Thomson et al., 2018) correlate with relational mobility on a societal level, they are not useful in predicting behavior on an individual level. Perhaps more importantly, such markers of actual movement between relationships may fail to reflect the role of choice, in the sense that opportunities to enter into and exit from relationships may not directly correspond with decisions to enter into or exit from relationships. Macro-level indices such as job turnover and residential mobility in many cases do not reflect individuals' personal choices to move to a new job or location, but may reflect external forces. For instance, if an employer is mandating an employee's move, the employee's friend using relational investment behaviors such as increasing intimacy through disclosing secrets will not help them convince their friend to stay and maintain their relationship (Schug et al., 2010; Thomson et al., 2018). For this reason, communities and areas higher in geographical or residential mobility (i.e., military) are not necessarily higher in relational mobility (Thomson et al., 2018; see Oishi & Talhelm, 2012 for a review of a related construct, residential

mobility). Likewise, although macro-level indices such as divorce rates should correspond with relational mobility on a societal level, individuals who are happy in their relationships will likely stay with their partners even in high relational mobility contexts with many opportunities to find other partners. Thus, macro-level indicators such as divorce rates are not good predictors of individual level behavior.

Quantifying the amount of relational mobility in an environment via perceptions of others' relational choices rather than societal level markers of mobility, also increases sensitivity to subtle variations within societies (Yuki et al., 2007). There are finer micro-societies surrounding each individual within a country, since no two people interact with exactly the same network of acquaintances. As previously discussed, relational mobility can vary among dimensions of geography (Yamagishi et al., 2012), size of school (Bahns et al., 2012) and even sociocultural adaptation (Zhang & Li, 2014), representing these finer micro-societies that may differ from the society at large. These distinctions are a valuable source of information, and also account for some of the individual-level variation in how people perceive their society's relational mobility. Previous work on cultural differences has also found that perceptions of one's social environment sometimes do a better job of predicting behavioral outcomes compared to measures of an individuals' personally held values (Chiu et al., 2010; Zou et al., 2009). In the case of collectivistic values, for instance, participants' perceptions of intersubjective values (the extent to which they believe other people in their society endorse collectivistic values) outperform measures of the degree to which they personally endorse collectivism (Hashimoto & Yamagishi, 2015). Therefore, collectivistic behavior can be maintained in a society even when most people personally endorse individualistic values, provided that they believe that

others in their society expect collectivistic behavior (Hashimoto & Yamagishi, 2015). This research indicates that some measurements of cultural constructs are more suited to measurement as perceptions of external context, rather than endorsement of personal values or traits.

Alternate Methods of Assessing Relational Mobility

Previous research has shown that the Relational Mobility Scale, which measures participants' perceptions of the mobility of others in their society, appears to capture meaningful variation in relational mobility across societies. Thomson et al. (2018) surveyed 16,939 adults in 39 countries, finding that perceptions of the potential for relational mobility, measured by the Relational Mobility Scale, correlate with historical antecedents (farming vs. herding and pathogen prevalence). Perceptions of relational mobility also perform better than macro-level indicators (i.e., divorce rates) and individual level mobility (i.e., the number of new acquaintances met in the past month) in predicting relational investment behaviors such as intimacy or general trust (Thomson et al., 2018). Furthermore, participants within countries tended to agree with each other about the average relational mobility within their country, evidenced by high intraclass correlation (Thomson et al., 2018), supporting the assumption that people can recognize others' ability to leave and form relationships.

Thus far no research has explicitly examined whether measuring relational mobility as participants' perceptions of their environment is indeed superior to measuring participants' perceptions of their own personal mobility. As described above, the Relational Mobility Scale was designed by Yuki, Schug, and colleagues (Schug et al., 2009; Yuki et al., 2007) to assess participants' perceptions of their

environment in order to minimize the potential for confounds related to individual differences in attractiveness and self-enhancement. The extent to which these confounds are actually alleviated when measuring relational mobility as participants' perceptions of their environment vs. perceptions of their own mobility has yet to be tested. The following studies attempt to do so.

Study Aims and Hypotheses

In **Study 1a**, we will evaluate the Personal Mobility Scale as an alternate tool for evaluating the socioecological construct of relational mobility. We anticipate that the Personal Mobility Scale will represent an important extension of the Relational Mobility Scale. Centering ratings around the individual's opportunities to leave and form relationships, rather than around the chances of others in the environment may present an alternative way to measure the construct of relational mobility. Although the Relational Mobility Scale has been found to hold partial scalar invariance across countries (Thomson et al., 2018), the Personal Mobility Scale has not been previously validated across cultures. We will first conduct a series of analyses to determine the cross-cultural measurement invariance of the Personal Mobility Scale. Although the application of measurement invariance analysis is still relatively rare in cross-cultural studies, it is a necessary component to establishing validity (Boer et al., 2018). If a scale does not hold a basic level of invariance across cultures, comparisons based on the scale are invalid (Boer et al., 2018).

Following this measurement invariance model, we will then investigate how the Personal and Relational Mobility Scales are associated with a host of individual difference variables in **Study 1b**. One rationale for utilizing the Relational Mobility Scale is that it should reduce the impact of confounds reflecting factors that make

individuals more or less desirable as relational partners, relative to the Personal Mobility Scale. However, to our knowledge, the extent to which the Relational Mobility Scale corresponds with individual differences in desirability, as well as with individual difference traits, has not yet been tested. We hypothesize that personal mobility will be positively correlated with indices that reflect one's desirability as an interaction partner, such as popularity, physical attractiveness, and self-esteem to a greater degree than relational mobility. We also expect that personality traits such as Extraversion will also correlate more strongly with personal mobility relative to relational mobility.

After examining whether the Personal Mobility Scale is more closely related to interpersonal confounds, we compare how the Personal and Relational Mobility Scales predict outcomes related to how often individuals report meeting new acquaintances in **Study 1c.** Theoretically, personal mobility and relational mobility both influence how many new acquaintances one encounters. However, we expect that relational mobility should best predict outcomes when modeled on a regional level, rather than as an individual-level predictor. Since the construct of relational mobility refers to a socioecological context, perceptions of relational mobility aggregated within each locality should predict outcomes for individuals within that state or prefecture better than each individuals' own perceptions. We test this hypothesis with a multilevel model, estimating the number of new acquaintances participants report meeting over the past week, month, and three months. We model relational mobility and personal mobility as individual-level predictors, as well as each locality's average of relational mobility as a Level 2 variable. The results of this

study provide evidence regarding the conceptualization of relational and personal mobility as regional as compared to individual-level constructs.

Chapter 2

Study 1a Method

American participants were recruited through Amazon Mechanical Turk (*n* = 1,927) and Japanese participants were recruited via a Japanese marketing firm, Cross Marketing (*n* = 2,224). Participants were similar in age between the US (*M* age = 38.13) and Japan (*M* age = 43.00). In the United States, 39% of participants identified as male and 60% of participants identified as female. In Japan, 48% of participants identified as male and 51% of participants identified as female. See Table 1 for information on participant demographics. All participants received equitable payment for completing a series of online survey measures. Japanese items were available for the Relational and Personal Mobility Scales (Yuki et al., 2007). These scales were developed concurrently in English and Japanese by a team of Japanese-English bilinguals who screened translations for cross-cultural salience and consistency in meaning. Translations were confirmed via back-translations and committee discussion.

Table 1
Participant Demographics

Measure	Japan		US		
	n	%	*n*	%	$\chi^2(1)$
Marital Status					3767***
Single	1971	92.58	1473	89.93	
Married	158	7.42	165	10.01	
Gender					26.77***
Male	1034	48.57	657	40.11	
Female	1095	51.43	981	59.90	

Note. *p < .05, **p < .01, ***p < .001

Study 1a Measures

Participants completed the 12-item Relational Mobility Scale (Yuki et al., 2007) to assess the degree to which participants perceive that individuals are free to leave and form relationships in the environment. Participants were instructed to indicate their agreement that statements describe similarly-aged people in their society, such as friends at school, or colleagues in their workplace from 1 (*strongly disagree)* to 6 (*strongly agree)*. Prior studies have shown that two factors compose the relational mobility construct; one representing the ability to meet new people, with items such as “They (the people around you) have many chances to get to know other people”. The other factor corresponds to the level of choice to make new bonds, using items such as “They are able to choose the people whom they interact with in their daily life“ (Thomson et al., 2018).

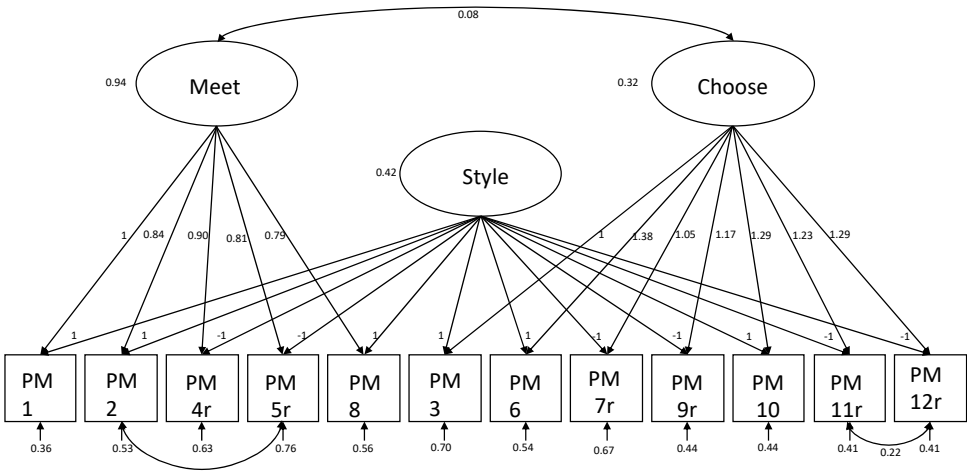
Participants also completed the 12-item Personal Mobility Scale (Yuki et al., 2007). The Personal Mobility Scale is an adaptation of the Relational Mobility Scale,

derived by changing the reference group from others to oneself. In this scale, participants were asked how accurately the same 12 items described themselves personally, rather than others in their environments.

In the following analyses, we assume the two- factor structure of relational mobility replicates in the Personal Mobility Scale and we test the appropriateness of this assumption cross-culturally (see Figures 1 and 2 for factor loadings in both countries). The Relational Mobility Scale has good reliability in our samples in both the United States (α = .86) and Japan (α = .85). The reliability of the Personal Mobility Scale is also adequate across the United States (α = .88) and Japan (α = .72).

Figure 1

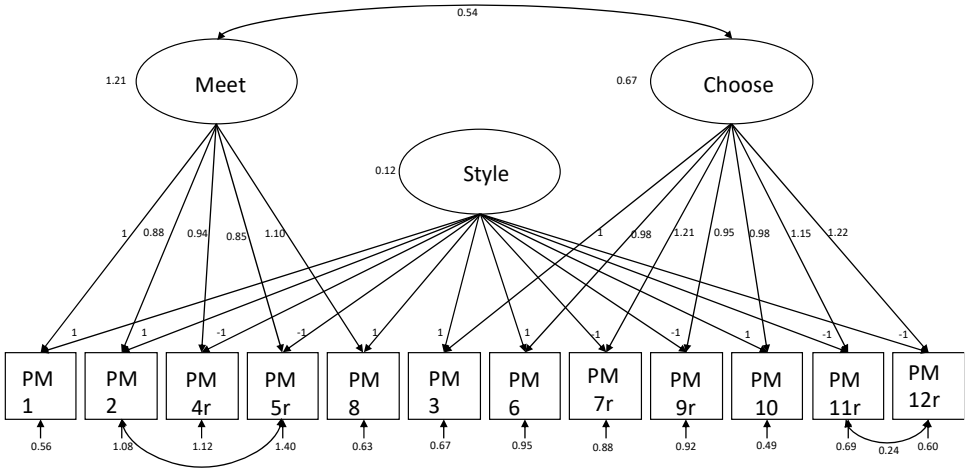
Confirmatory Factor Analysis of the Personal Mobility Scale in Japan



Note: All modeled covariances and path coefficients are significant ($p < .05$). Parameter estimates are unstandardized.

Figure 2

Confirmatory factor analysis of the Personal Mobility Scale in the United States



Note: All modeled covariances and path coefficients are significant ($p < .05$). Parameter estimates are unstandardized.

Study 1a Results

We conducted multigroup confirmatory factor analyses (MGCFA) to examine measurement invariance of the Personal Mobility Scale across Japan and the United States. We conducted these analyses in Mplus 8.2, using the free baseline approach (Stark et al., 2006) to test the fit of a series of models increasingly restricted by cross-group equality constraints (Kline, 2016, p. 399). We follow the commonly-practiced recommendation and test for configural, metric, scalar, and strict invariance in order (Vandenberg & Lance, 2000). In order to correct for multivariate skewness (Mardia Skewness = 4979.59, $p < .001$) and nonnormality (Mardia Kurtosis = 160.71, $p < .001$), we used the multiple least squares robust estimation method (MLR) available in Mplus. MLR estimation produces robust chi-square fit indices, which do not follow a typical chi-square distribution. Due to both this alternative distribution, and the chi-square difference test's sensitivity to sample size

(Chen, 2007; Cheung & Rensvold, 2002), we do not apply a chi-square difference test to the nested models. Instead we use the Bentler Comparative Fit Index (CFI), the Standardized Root Mean Square Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA) as fit statistics, following Chen's (2007) recommended cut-offs for each step of model comparison. For these cut-offs and all following analyses, the asterisk (*) before fit index names denote that indices are based off of the robust chi-square value. The recommended cutoff values are Δ*CFI < .010, Δ*SRMR < .030, Δ*RMSEA < .015 for metric as compared to configural invariance; Δ*CFI < .010, Δ*SRMR < .010, Δ*RMSEA < .015 for scalar as compared to metric invariance (Chen, 2007).

Before examining measurement invariance of the Personal Mobility Scale, we first conducted a confirmatory factor analysis (CFA) model examining the factor structure of personal mobility. As discussed, prior studies have established a two-factor model for the Relational Mobility Scale (Thomson et al., 2018). Conceptually, we would expect the same structure to emerge for personal mobility. Following previous work, we modeled two correlated factors of "meeting" and "choosing". We also correlated the errors of two pairs of items. In both pairs, the same statements are worded positively in one item and negatively in the other item. We also modeled a method factor, "style", representing acquiescent response bias. In order to assess the fit of this two-factor model at the individual level, we used a pooled dataset, forcing cases from Japan and the United States to equally influence the covariance matrix (Thomson et al., 2018). This overall "culture-free" model showed good fit, S-B $\chi 2$ = 206.115*, p < 0.001, df = 50, *CFI = .995, *$SRMR$ = .040, *$RMSEA$ = .027

(90% *CI* = .024, .031), allowing us to continue testing the invariance of this model across countries.

We first test a configural invariance model through specifying the same two-factor, 12-indicator CFA model of personal mobility for samples in both countries, while allowing free estimation of all parameters. This model shows acceptable fit with the observed data, S-B $\chi 2$ = 931.648, $p < 0.001$, *df* = 100, **CFI* = .947, **SRMR* = .049, **RMSEA* = .063 (90% *CI* = .060, .067), allowing us to retain the hypothesis of configural invariance. We conclude the factors of "meeting" and "choosing" are both manifested cross-culturally, though possibly in different ways (Kline, 2016, p. 397). These fit statistics served as a baseline for testing changes with increasingly restricted models

The next of these models assessed metric invariance through imposing an equality constraint on the unstandardized coefficient of each indicator of personal mobility between countries. We do not impose equality constraints on the style factor in the following analyses. This model showed acceptable fit, S-B $\chi 2$ = 1069.019, $p < 0.001$, *df* = 110, **CFI* = .939, **SRMR* = .064, **RMSEA* = .065 (90% *CI* = .061, .068). We compared this model's fit with the model for configural invariance, and found the change in fit statistics to be within the acceptable range, meaning the constructs are manifested the same way across the United States and Japan (Kline, 2016, p. 397). This finding also provides initial evidence that there is not a non-uniform extreme response bias influencing responses to the scale (Thomson et al., 2018).

We then tested the hypothesis of strong or scalar invariance, which means participants in each country use the response scale in the same manner (Kline, 2016, p. 398), by testing models with equal intercepts across groups. Comparison of

this initial strong invariance model (S-B $\chi 2$ = 2051.645*, p < 0.001, df = 122, *CFI = .877, *$SRMR$ = .198, *$RMSEA$ = .087 (90% CI = .084, .091) with the metric invariance model revealed changes in fit indices outside acceptable limits. We then proceeded to test for partial scalar invariance, by iteratively relaxing equality constraints on items showing the greatest variance across Japan and the United States (Steenkamp & Baumgartner, 1998). Removing the equality constraint on items 1, 2, 3, 6, 8, 10, 11, and 12 greatly improved the model's fit (S-B $\chi 2$ = 1190.739*, p < 0.001, df = 114, *CFI = .931, *$SRMR$ = .075, *$RMSEA$ = .067 (90% CI = .064, .071). Overall, we interpret the change in fit statistics between the partial scalar invariance model and the metric invariance model as within acceptable limits[2]. This model still contains two items (4, 5) loading onto the "meeting" factor and two items (7, 9) loading onto the "choosing" factor that have equality-constrained intercepts across samples. Therefore, we can make valid comparisons between samples using the latent factors (Van de Schoot et al., 2012).

We continued with a test of invariance of latent factor variances across counties by imposing equality restraints on the "meet" and "choose" factor variances. This model showed acceptable fit (S-B $\chi 2$ = 1300.420, p < 0.001, df = 116, *CFI = .924, *$SRMR$ = .089, *$RMSEA$ = .070 (90% CI = .067, .074). The change in fit statistics between this model and that for scalar invariance were within the accepted standards. Finally, we tested the equality of residual variances for items that showed scalar invariance (items 4, 5, 7, 9). This model (S-B $\chi 2$ = 1607.618, p < 0.001, df

[2] The change in the SRMR was .11, outside the bounds of Cheung's (2007) recommendation of a .10 change. Given that the other two fit statistics' changes are within acceptable range, we interpret partial scalar invariance at this step.

= 120, **CFI* = .905, **SRMR* = .104, **RMSEA* = .077 (90% *CI* = .074, .081) showed changes in fit from the scalar invariance model beyond accepted standards. Fit statistics for all models are in Table 2.

Table 2

Comparison of Fit Indices in Models Fitted to Personal Mobility Measurement Invariance

Model	S-B χ^2		RMSEA		CFI	SRMR	ΔRMSEA	ΔCFI	Δ SRMR
	Value	*df*	Value	95% CI					
Factor structure in pooled data	206.11	50	.027	[.024, .031]	.995	.040	—	—	—
Model 1 (configural Invariance)	931.65	100	.063	[.060, .067]	.947	.049	—	—	—
Model 2 (metric invariance)	1069.01	110	.065	[.061, .068]	.939	.064	.002	.008	.015
Model 3a (total scalar invariance)	2051.65	122	.087	[.084, .091]	.877	.198	.022	.062	.134
Model 3b (partial scalar invariance)	1190.74	114	.067	[.064, .071]	.931	.075	.002	.008	.011
Model 4 (latent factor invariance)	1300.42	116	.070	[.067, .074]	.924	.089	.002	.008	.011
Model 5 (residual invariance)	1607.62	120	.077	[.074, .081]	.905	.104	.010	.026	.029

Note. Change in fit statistics are relative to Model 1 (Baseline). Model 5 only restricted residual variances for items found invariance in Model 3b. S-B = Satorra-Bentler scaled χ^2; RMSEA = root-mean-square error of approximation; CI = confidence interval; CFI = comparative fit index; SRMR = standardized root mean square residual.

Study 1a Discussion

The results of this study suggest that the Personal Mobility Scale may provide important information regarding the measurement and predictive utility of relational mobility. To our knowledge, no other research has yet tested measurement invariance of the Personal Mobility Scale. In this study, we retained the hypothesis of configural invariance, finding evidence that the two-factor structure of the Relational Mobility Scale is replicated within the Personal Mobility Scale across the United States and Japan. This precludes the possibility of construct bias, and allows for discussion of the construct between cultures (Davidov et al., 2014; Steenkamp & Baumgartner, 1998). We also retained the hypothesis of metric invariance, meaning that factor loadings are equal across the two countries, and observed difference scores can be compared across populations (Davidov et al., 2014; Steenkamp & Baumgartner, 1998). We did not retain a full scalar invariance model, instead finding support for a partial invariance model. Full scalar invariance would allow for meaningful comparisons of raw scores, since participants with the same level of the latent variable would have the same observed score across countries (Davidov et al., 2014; Steenkamp & Baumgartner, 1998).

Noninvariant or partially invariant findings are common, but guidelines for how to proceed in light of such findings remain unclear and guided by researcher discretion (Putnick & Bornstein, 2016; Steenkamp & Baumgartner, 1998). Many published measurement invariance articles do not report results for scalar or uniqueness invariance (Vandenberg & Lance, 2000), and this standard of strict invariance is particularly difficult to meet particularly in cross-cultural research (Van

De Schoot et al., 2015). A lack of scalar invariance may reflect a systematic response bias between groups, but these differences in intercepts could also reflect variability in response thresholds that are attributable to group differences (Vandenberg & Lance, 2000). If the latter is the case, and one group is hypothesized to have a higher latent score, scalar invariance testing may be unnecessary (Vandenberg & Lance, 2000). Although there may be differences in the country-level personal mobility scores, we chose to undertake this scalar invariance test to account for systematic response biases.

After establishing partial scalar invariance, we found that the variances of the "meeting" and "choose" factors were invariant across cultures. This step in testing is a common pre-condition to testing for uniqueness invariance of item residuals (Vandenberg & Lance, 2000). This finding also indicates that the two samples both used equal ranges of the "construct continuum" to respond to the items reflecting personal mobility (Vandenberg & Lance, 2000), and suggests a lack of uniform extreme style bias (Cheung & Rensvold, 2000). We did not find evidence for strict or uniqueness invariance, though this level of invariance is not necessary to interpret differences in latent means across groups (Putnick & Bornstein, 2016; Steenkamp & Baumgartner, 1998).

Future research should investigate sources of noninvariance or item bias, and model them on both individual and country levels, such as with multiple indicators-multiple causes model (Davidov et al., 2014). Finally, the use of newer methods such as Bayesian Structural Equation Modeling, which allow for small differences rather than imposing strict equality across parameters, may help establish approximate measurement invariance (Davidov et al., 2014). Overall, we

believe this study represents an important first step in validating the use of an alternate measure of the socioecological construct of relational mobility.

Chapter 3

Study 1b

As discussed, one rationale for using the Relational Mobility Scale rather than measuring individuals' own ability to leave and form relationships is that individual differences, as well as self enhancement bias, may be more represented in an individual's assessment of their own personal mobility. Although the Personal Mobility Scale may be an alternative method of assessing societal relational mobility, if it is associated with individual difference variables to a greater degree than is the Relational Mobility Scale, this would warrant caution in using it to assess a socioecological characteristic. That is, the Personal Mobility Scale might reflect a participant's popularity or attractiveness, rather than the relational mobility of their environment. However, to our knowledge the assumption that personality and individual difference variables are more closely associated with the Personal Mobility Scale than the Relational Mobility Scale has yet to be tested. Further, since some personality and individual differences vary cross-culturally, the associations between these constructs and personal mobility may vary between countries. If we do not find evidence that personal mobility is associated with these individual difference variables, perhaps the assumptions cautioning against the use of personal mobility as a metric of societal relational mobility are unfounded. If personal mobility is associated with traits such as popularity, self-esteem, and personality, this would provide evidence in favor of using the Relational Mobility Scale rather than the Personal Mobility Scale to measure the socioecological characteristic.

We expect that personal mobility should be positively correlated with each of the individual difference variables included in this study. The first of these individual differences we test is self-esteem, or one's overall sense of one's worthiness as a person, or their self-liking and self-competence (Schmitt & Allik, 2005), which may also reflect the extent to which they feel they are valuable relational partners (Kirkpatrick & Ellis, 2001; Leary & Baumeister, 2000). People who perceive themselves as having more chances to leave and form relationships likely also have a higher self-esteem. We hypothesize that personal mobility will be positively correlated with both popularity and physical attractiveness, as those who report higher popularity or greater physical attractiveness should have a greater ability to voluntarily form and dissolve relationships. Finally, we expect that the personality variables of Extraversion and Agreeableness will be positively correlated with personal mobility. Extraversion is a fundamental personality trait defined by reward sensitivity and sociability (Lucas et al., 2000), which often manifests in cheerfulness, gregariousness, and high-energy sociability (Back et al., 2011). People high in Extraversion have larger peer networks and spend more time in general social interactions than do people lower in Extraversion (Back et al., 2011; Selfhout et al., 2010). People higher in Extraversion should also report having more opportunities to form and dissolve friendships at will (higher personal mobility). Trait agreeableness is exemplified in warmness, compassion, and reflects the desire to maintain harmony in relationships (McCrae, & John, 1992). As agreeable people tend to be more likeable (Van der Linden et al., 2010), and are selected by others more often to be friends than those lower in the trait (Selfhout et al., 2010), we expect that trait Agreeableness will positively correlate with personal mobility.

Study 1b Method

We examine the within-country correlations between personal mobility, relational mobility, self-esteem, popularity, physical attractiveness, Extraversion, and Agreeableness using the Study 1a data. Participants completed the 10-item Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965) to assess global self-esteem. Participants indicated their agreement with statements such as “I feel like I have a number of good qualities” from 1(*strongly disagree*) to 7(*strongly agree*). The reliability of the RSES is adequate across the United States (α = .93) and Japan (α = .84), and has been validated in both countries (e.g., Mimura & Griffiths, 2007; Schmitt & Allik, 2005). We measured both popularity and physical attractiveness with 1-item questions of “I feel that I'm more popular than other people are” and “I feel that I have a more attractive physique than other people do”. Participants indicated their agreement with these statements from 1(*strongly disagree*) to 7(*strongly agree*). We administered the Ten Item Personality Inventory, which has been validated in the US and in Japan (Gosling et al., 2003; Oshio et al., 2014) to assess personality traits. Participants reported the extent to which they possess sets of traits, such as “Extraverted, enthusiastic” and “Sympathetic, warm”, from 1(*strongly disagree*) to 7(*strongly agree*). In our samples, the 2-item Extraversion factor of the TIPI had acceptable reliability across the United States (α = .74) and poor reliability in Japan (α = .48). The 2-item Agreeableness component of the TIPI had poor reliability in both American (α = .44) and Japanese (α = .13) samples. Descriptive statistics for all variables used in Studies 1a, 1b, and 1c are in Table 3.

Table 3
Means and Standard Deviations of Variables

Measure	Japan		US		
	M	*(SD)*	*M*	*(SD)*	*t*
Relational Mobility Scale	3.43	(0.70)	4.22	(0.73)	33.41***
Personal Mobility Scale	3.37	(0.61)	4.10	(0.89)	23.87***
Acquaintances met (past week)	0.26	(0.75)	1.21	(1.59)	22.25***
Acquaintances met (past month)	0.81	(1.84)	3.01	(3.53)	22.95***
Acquaintances met (three months)	1.90	(4.14)	6.10	(7.13)	21.28***
Self-esteem	3.98	(0.89)	5.32	(1.32)	36.00***
Popularity	3.07	(1.40)	3.02	(1.62)	-1.05
Physical attractiveness	2.98	(1.41)	3.33	(1.68)	6.88***
Extraversion	3.60	(1.19)	3.57	(1.72)	-0.64
Agreeableness	4.51	(0.96)	5.37	(1.25)	23.44***

Note. *$p < .05$, **$p < .01$, ***$p < .001$. *t*-values obtained from independent-means t-tests, assuming unequal variances.

Study 1b Results

Given our findings in Study 1a of the Personal Mobility Scale's partial scalar invariance, we utilized within-country comparisons rather than correlating variables using a pooled dataset. Within each country, we correlated relational mobility and personal mobility with self-esteem, popularity, physical attractiveness, Extraversion, and Agreeableness. In Japan, the individual difference variables were all significantly and positively correlated with personal mobility, and all but one correlation had at least a moderate effect size. Relational mobility also positively correlated with the

individual differences in Japan, although effect sizes were much smaller. No correlations were above a small effect size. We then examined whether each pair of partially overlapping correlation coefficients were significantly different in magnitude[3].

We compared the correlations between relational mobility and an individual difference variable (e.g., Extraversion) with that of personal mobility and that same individual difference variable. The correlation coefficients between personal mobility and self-esteem, popularity, physical attractiveness, and Extraversion were all significantly different than the correlations between relational mobility and these variables, indicating a higher magnitude of association between personal mobility and the individual differences variables in Japan. However, for trait Agreeableness correlations with personal and relational mobility did not differ significantly.

In the United States, personal mobility was also positively and significantly correlated with all individual difference variables of self-esteem, popularity, physical attractiveness, Extraversion, and Agreeableness. The correlation coefficients between personal mobility and self-esteem, popularity, physical attractiveness, Extraversion, and Agreeableness were all significantly different than the correlations between relational mobility and these variables, indicating a higher magnitude of association between personal mobility and the individual differences variables in the US. See Table 4 for coefficients and confidence intervals within both the United States and Japan.

[3] We utilized the cocor package in R, which simultaneously runs several tests comparing the magnitude of correlations, some of which use the Fisher r-to-z transformation (see Diedenhofen & Musch, 2015 for equations). For each pair of correlations we compared, all ten tests resulted in the same conclusions.

Table 4

Intercorrelations for Study Variables Disaggregated by Country

Variable	1	2	3	4	5	6	7
1. Relational mobility	—	0.04 [.00, .08]	.05* [.01, .09]	.12** [.08, .16]	.09** [.05, .13]	0.02 [-.02, .07]	.10** [.06, .14]
2. Personal mobility	.66** [.63, .68]	—	.39** [.36, .43]	.31** [.27, .35]	.22** [.18, .26]	.42** [.39, .46]	.10** [.06, .14]
3. Self-esteem	.31** [.27, .35]	.48** [.45, .52]	—	.48** [.45, .51]	.36** [.32, .39]	.45** [.42, .49]	.31** [.27, .34]
4. Popularity	-0.08** [-.13, -.04]	.15** [.10, .20]	.20** [.16, .25]	—	.71** [.69, .73]	.44** [.40, .47]	.11** [.07, .15]
5. Physical Attractiveness	-.08** [-.13, -.03]	.11** [.06, .15]	.24** [.19, .28]	.60** [.57, .63]	—	.29** [.25, .33]	.02 [-.02, .06]
6. Extraversion	.15** [.10, .20]	.40** [.36, .44]	.33** [.29, .37]	.39** [.35, .43]	.24** [.19, .28]	—	-.03 [-.07, .01]
7. Agreeableness	.21** [.17, .26]	.27** [.22, .31]	.38** [.34, .42]	-.02 [-.07, .02]	.01 [-.03, .06]	.13** [.08, .18]	—

Note. The results for the Japanese sample (n = 2224) are shown above the diagonal. The results for the United States sample (n = 1698) are shown below the diagonal. Values in brackets indicate the 95% confidence interval.

*p < .05, **p < .01

Study 1b Discussion

Measuring societal relational mobility via the Relational Mobility Scale has been proposed to limit the influence of individual differences in characteristics such as personality and attractiveness that may be more likely to relate to the Personal Mobility Scale (Thomson et al., 2020; Yuki et al., 2007). However, the extent to which participants' evaluations of their personal mobility are actually more correlated with individual differences than are their reports of relational mobility has not yet been evaluated, and the generalizability of these relationships between countries is also unclear.

Overall, we found support for our hypotheses that the Relational Mobility Scale is less closely related to the individual differences in personality, popularity, and attractiveness than is the Personal Mobility Scale. Testing the assumption that personal mobility is more closely linked to individual differences than is relational mobility clarifies whether centering evaluations around others in the participants' environments, rather than around the participants themselves effectively reduces confounds. One critique of the Relational Mobility Scale is that it measures aggregates of individual differences, rather than a socioecological characteristic. By comparing correlates of the personal and Relational Mobility Scales, we found evidence that relational mobility is somewhat associated with the individual difference variables, but to a lesser degree than personal mobility. This indicates that the two scales do not both capture variations in individuals' personal mobility. We did not hypothesize finding that the magnitude of correlation between relational mobility and Agreeableness would not be different from the correlation between personal mobility and Agreeableness within Japan. Since Agreeableness predicts one's

attractiveness as a relational partner, but not at zero acquaintance (Back et al., 2011), the trait may not influence perceptions of personal mobility as much as a trait predicting friendship formation, such as Extraversion. We also did not anticipate the small but inverse correlation between relational mobility and popularity and relational mobility and physical attractiveness in the US. We do not interpret these relationships, but future research may further investigate these patterns.

We do caution against overinterpretation of these findings for a few reasons. First, there may be differences between countries in how individual differences are construed, manifested, and reported. For example, the utility and origins of self-esteem may differ between countries (Heine et al., 1999), and Japanese participants report lower self-esteem than do American participants (Schmitt & Allik, 2005). This may be partially due to Japanese participants' reduced willingness to endorse extremes on a scale and less clarity on how to evaluate their own self-esteem (Schmitt & Allik, 2005). We do not aim to explain any such differences between countries, and do not make direct comparisons between the US and Japan on these measures. For this reason, our within-country comparisons are a strength, as we find evidence that for people in each country, personal mobility is more closely correlated with the individual differences. Another limitation is the low reliability of some measures, coupled with the single-item measures of popularity and physical attractiveness, which may not hold cross-culturally equivalence. Future research could investigate convergent validity of these findings using methodologies other than self-reports, such as peer-nominated popularity.

When taken together, these correlations indicate that personal mobility is closely and positively associated with individual differences in personality, self-

esteem, popularity, and attractiveness across both the United States and Japan. Comparing the personal and Relational Mobility Scales allows us to conclude that the Relational Mobility Scale does not strictly measure individual differences in relational opportunities, and that using this scale rather than the Personal Mobility Scale limits the influence of some individual difference variables. This study indicates that personal mobility is not a socioecological construct, but may still be a valuable tool to control for individual differences when examining the impact of societal relational mobility.

Chapter 4

Study 1c

Having obtained evidence of the personal mobility's scale partial invariance from Study 1a, as well as evidence for its correlation with individual difference variables in Study 1b, we now examine how both scales predict an outcome associated with societal relational mobility. Utilizing the Study 1a and 1b data, we examine how both personal mobility (as a level 1 predictor) and relational mobility (as both level 1 and level 2 predictors) influence how many new acquaintances participants report meeting over the past week, month, and 3 months. We cannot assume that the personal mobility scale measures the two factors of "meet" and "choose" with equal precision across the United States and Japan, due to the lack of strict invariance. Therefore, we do not compare standardized coefficients between these countries in the following analyses (Davidov et al., 2014; Steenkamp & Baumgartner, 1998), and instead only conduct within-country analyses.

Study 1c Method

In order to model how an environment's level of relational mobility predicts outcomes within these countries, we treat our participants as nested within their state (US) or prefecture (Japan). Therefore, we used a series of multilevel models to account for the degree of non-independence that results from individuals sharing physical proximity.

Power calculations for multilevel models are complex, with multiple factors influencing such calculations (Scherbaum & Ferreter, 2009). Snijders (2005) recommends maximizing the number of upper-level units, as this is a strongly influential determinant of power in multilevel models. We follow the previous research and judgement of Nezlek et al. (2019) and only include Level-2 units with at least 10 participants. Although 10 is a somewhat arbitrary number, this represents a compromise between maximizing the number of states and prefectures included, and maintaining reliable estimates for each of these units. We also excluded 53 participants in the US sample and 95 participants in the Japanese sample for exceeding cut off criterions on the Mahalanobis distance on the dependent variables of meeting new acquaintances in the past week, month, and three months (Lüdecke et al., 2020).

In the following analyses, American participants (n = 1,638) are located in 33 different states (M participants per state = 49.64). Japanese participants (n = 2,129) are located in all 47 prefectures (M participants per prefecture = 45.3). Participants answered three questions regarding the number of new acquaintances and/or friends they had made in the past week, month, or three months. These serve as our outcome variables in the following analyses. Participants also completed the Relational and Personal Mobility Scales described in Study 1a. We conceptualize our

data as participants nested within locations (states for the US and prefectures for Japan). Since we only have samples from two countries, we do not incorporate this distinction into a higher level in this hierarchy. Rather, we analyze each model with both countries separately. The ability to make meaningful inferences from within-country comparisons is a strength of socioecological frameworks (Kesebir et al., 2010). Within-country comparisons will also ameliorate confounding factors between countries that may contribute to differences in how often participants report meeting new acquaintances.

The construct of relational mobility refers to an attribute of the surrounding environment, so we average individuals' perceptions of relational mobility within each unit and model this predictor on the state or prefecture level (Level 2). Since this measure represents an aggregation of individual-level scores, we follow the recommendation of Nezlek (2012), and model the state or prefecture averages of these scores as a Level 2 variable, meaning it will be the same for all members of that locality. Since there is still variability in relational mobility scores within states or prefectures, we also model each individual's perception as a Level 1 variable (Cohen et al., 2015, pp. 564; Nezlek, 2012). Because personal mobility captures individual variations in freedom to leave and form relationships, we only treat this as a Level 1 variable predicting individual outcomes within each higher-level unit.

Study 1c Results

We first examined the distribution of the number of new acquaintances that participants report meeting over various time frames of one week, one month, and three months. The modal response for new acquaintances met over the past week and month was zero, in both the American and Japanese samples. We found

evidence of overdispersion, meaning the variance of how many acquaintances participants met was greater than the mean (Cohen et al., 2015, pp. 530). In order to model this overdispersion, and avoid inflating parameter significance values (Cohen et al., 2015, pp. 530), we compared both negative binomial (NB) and Poisson error structures. See Figures 3 and 4 for theoretical density distributions of how many friends and/or acquaintances American and Japanese participants met in the past week. The negative binomial model assumes a Poisson distribution of count data, but also applies a new distribution of variance of the residuals (Cohen et al., 2015, p. 531). This negative binomial model estimates variance from both the expected rate, as in the Poisson distribution, and from a second source of variance in the rate parameter change across individuals, which allows for greater variance than in the standard Poisson distribution (Cohen et al., 2015, pp. 531).

Figure 3

Density distributions of how many acquaintances American participants met

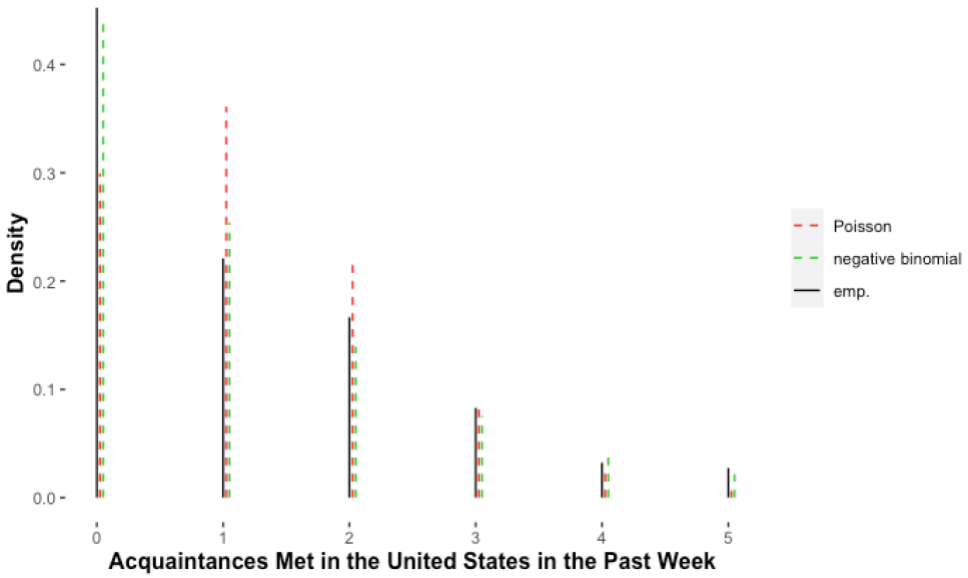
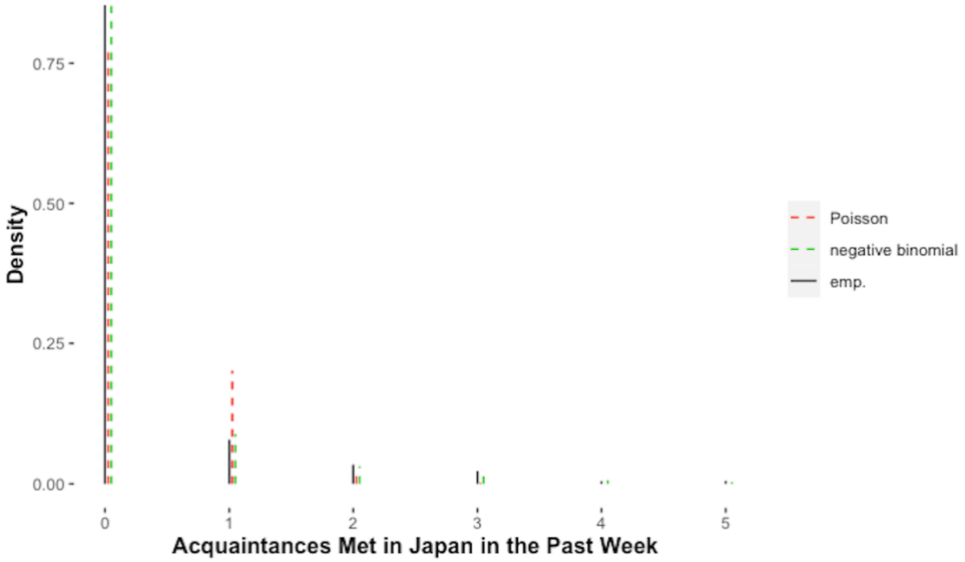


Figure 4

Density distributions of how many acquaintances Japanese participants met



In order to confirm the negative binomial model was the best distribution for both samples of data, we compared deviance resulting from Poisson and NB distributions in modeling the number of acquaintances encountered over the past week without any predictors. The negative binomial model resulted in lower deviance indicated by the AIC and BIC, than the deviance resulting from a Poisson model in both US and Japanese samples. We utilized the glmmTMB package in R, with the parameterization specifying that variance increases quadratically with the mean as ($\sigma 2 = \mu(1 + \mu/\theta)$, with $\theta > 0$) (Brooks et al., 2017).

We also found evidence for zero-inflation, or the presence of excess zeros underpredicted by a standard Poisson or negative binomial distribution in samples from both countries, using the “performance” package in R (Lüdecke et al., 2020), as

there is no current implementation of Vuong's test for zero inflation in non-nested models in R (Bolker, 2020). The zero-inflated distribution assumes that there are two sources of zero counts (He et al., 2014). Structural zeros arise from individuals who will always report meeting zero new acquaintances, whereas sampling zeros reflect a zero due to the sampling distribution, which could have been a nonzero number (He et al., 2014). The zero-inflated model negative binomial resulted in lower deviance compared to both the standard negative binomial model and the zero-inflated Poisson model.

Unconditional Model – US

We first ran an unconditional or null model predicting the number of new friends and/or acquaintances participants reported meeting over the past week, with only an intercept, and predicting the zero-inflation model from all predictors equally. Research and guidance are scarce for the best practices for partitioning variance in multilevel models for overdispersed count data (Leckie et al., 2019). We interpret the variance partition coefficient (VPC), or the ratio of the estimated between-states variance to the total residual variance, as how influential clusters are on the findings (Leckie et al., 2019). Under these conditions, the VPC is equal to the intraclass correlation (ICC), or the expected correlation between two individuals from the same state (Leckie et al., 2019). The ICC = .018, indicating a low correlation in expected responses between two individuals from the same state. Although this estimated ICC is low, the theoretical rationale for modeling variations in relational mobility between and within states is strong enough to continue treating our data as nested.

This null model estimates the overall log-count of meeting a new acquaintance in the past week as 0.36, which is the fixed intercept. The incidence

rate ratio (IRR), or the average participant's expected rate for meeting new acquaintances in the past week is 1.44. The variance of the deviation of individual-specific intercepts from the overall intercept is 0.02, which is also the level 2 random intercept variance (Sommet & Morselli, 2017). The zero-inflated model specifies the likelihood of a structural or extra zero on the outcome variable (Brooks, 2017). See Table 5 for fit information and parameter estimates of both the count and zero-inflated models.

Table 5
Model Parameters for How Many Acquaintances Met in the Past Week (US)

	Null		Random Intercept		Random Slope of Personal Mobility	
Fixed Effects	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	0.36***	0.07	0.46***	0.11	0.43***	0.12
Personal mobility			0.26***	0.06	0.29***	0.06
Relational mobility (Level 1)			-0.10	0.06	-0.11	0.06
Relational mobility (Level 2)			0.80*	0.37	0.76*	0.37
Gender[a]			-0.04	0.06	-0.04	0.06
Age			-0.002	0.002	-0.002	0.00
Marital status[b]			0.080	0.10	0.08	.10
Random Effects Variance Components						
Intercept	0.02 (0.15)		0.02 (0.13)		0.03 (0.17)	
Personal mobility					0.01 (0.10)	
Zero-Inflated Model						
Intercept	-1.60***	0.33	-1.67 ***	0.29	-1.70 (0.30)***	
Personal mobility			-1.22***	0.21	-1.20 (0.21)***	
Model Fit						
AIC	4974.20		4826.4		4827.1	
BIC	4995.80		4885.8		4897.4	
Dispersion	1.97		2.47		2.47	

Note. Standard deviations in parentheses. [a]Male = 0, Female = 1, [b]Single = 0, Married = 1
*$p < .05$, **$p < .01$, ***$p < .001$

Random Intercept Models - US

Next, we added in our predictors to the multilevel negative binomial model. We include relational mobility as a predictor on both level 1 and level 2, and personal mobility on level 1. We also control for the marital status, age, and gender of participants in all following analyses. Level-1 predictors were group-mean centered, representing an individual's deviation from the state or prefecture average. Level-2 predictors were grand-mean centered.

By comparing deviance of random intercept models in both countries, we determined personal mobility better predicted structural zeros than (a) all parameters equally, (b) relational mobility at either level, or (c) gender, age, and marital status. Therefore, for all following analyses we use this zero-inflated negative binomial distribution, with personal mobility predicting the presence of structural zeros, to account for our overdispersed count data with excess zeros.

First we tested the random intercept model. See table 5 for parameter estimates. In this model, individuals' personal mobility significantly predicted the number of friends they reported meeting over the past week. Perceptions of relational mobility aggregated on a state level did significantly predict this outcome, whereas on the individual level, perceptions of relational mobility did not predict how many new acquaintances participants met.

We also tested a random-slope model, in which the slope of personal mobility could vary between states. When modeling this random slope parameter, the same predictors of personal mobility and level-2 relational mobility remained significant. However, this model did not significantly reduce deviance compared to the random intercept model. We dropped the random effect parameter to preserve parsimony,

prevent overparameterization of data, and allow for interpretable estimates (Bates, 2008), retaining the random intercept estimation as our final model.

We repeated this same series of analyses for the other two dependent variables (acquaintances met over the past month and past three months). We found a similar pattern of results, with personal mobility significantly predicting the number of friends met both over timeframes. In both of these models, the individual perceptions of relational mobility (level 1) were non significant in predicting the log-counts of new friends, while the state-level measures of relational mobility (level 2) remained significant as predictors. Full parameter estimations for each outcome we modeled are reported in tables 6 and 7. In table 6, we do not present fit indices for the null model predicting friends and/or acquaintances, due to model convergence issues. This was resolved upon entering predictors and specifying that only personal mobility predicts the zero-inflation part of the model. Similarly, we do not present error estimates or significance values in table 7 for the random slope model due to singular fit when estimating the random slope parameter. We consider the random intercept model as final for both outcomes of friends met in the past month and three months.

Table 6
Model Parameters for How Many Acquaintances Met in the Past Month (US)

	Null		Random Intercept		Random Slope	
Fixed Effects	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	1.10	0.03***	1.09***	0.10	1.07***	010
Personal mobility			0.41***	0.05	0.42***	0.05
Relational mobility (Level 1)			-0.03	0.05	-0.04	0.05
Relational mobility (Level 2)			0.76**	0.29	0.67*	0.30
Gender[a]			0.005	0.05	0.004	0.5
Age			-0.0003	0.002	-0.00007	0.002
Marital status[b]			0.11	0.09	0.11	0.9
Random Effects Variance Components						
Intercept	0.00 (.00)		0.01 (0.07)		0.01 (0.11)	
					0.01 (0.08)	
Zero-Inflated Model						
Intercept	-17.20	1646.0	-3.17 (0.42)***		-3.17 (0.43)***	
Personal mobility			-1.36 (0.24)***		-1.34 (0.24)***	
Model Fit						
AIC			7163.60		7164.9	
BIC			7223.00		7235.1	
Dispersion	1.01		1.48		1.49	

Note. Standard deviations in parentheses. Due to model convergence problem, fit indices not available for null model. [a]Male = 0, Female = 1, [b]Single = 0, Married = 1
*p < .05, **p < .01, ***p < .001

Table 7

Model Parameters for How Many Acquaintances US Participants Met in the Past Three Months (US)

	Null		Random Intercept		Random Slope of Personal Mobility	
Fixed Effects	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	1.81***	0.03	1.83***	0.09	-1.82	
Personal mobility			0.44***	0.04	0.45	
Relational mobility (Level 1)			-0.03	0.05	-0.03	
Relational mobility (Level 2)			0.80**	0.25	0.78	
Gender[a]			0.03	0.05	0.03	
Age			-0.003	0.002	-0.003	
Marital status[b]			0.10	0.08	0.10	
Random Effects Variance Components						
Intercept	0.00 (0.00)		0.00 (0.00)		0.002 (0.05)	
Personal mobility					0.003 (0.06)	
Zero-Inflated Model						
Intercept	-19.32	0.99	-4.53***	0.82	-4.54	
Personal mobility			-1.52***	0.39	-1.52	
Model Fit						
AIC	9462.9		9244.0		9247.4	
BIC	9484.5		9303.4		9317.6	
Dispersion	0.946		1.19		1.19	

Note. Standard deviations in parentheses. [a]Male = 0, Female = 1, [b]Single = 0, Married = 1. Estimates not presented in random slope model are due to model convergence issue.
*p < .05, **p < .01, ***p < .001

Although the problems of overdispersion and excess zeros are less pronounced when modeling the number of new friends met over a longer period of time (as evidenced by the lower dispersion parameters in tables 6 and 7), and higher mean counts, we retain the zero-inflated portion of the model for consistency. We did run models without this zero-inflated parameter, and the patterns of predictor significance remained consistent.

Unconditional Model - Japan

We test an unconditional or null model for the Japanese data, predicting the number of new friends participants reported meeting over the past week, with only an intercept. The ICC = .014, indicating a low correlation in expected responses between two individuals from the same state. However, for the stated theoretical reasons, we continue treating individuals as nested within prefectures. This null model estimates the overall log-count of meeting a new acquaintance in the past week as 0.07, which is the fixed intercept. The incidence rate ratio, or the average participant's expected rate for meeting new acquaintances in the past week is 1.07. The variance of the deviation of individual-specific intercepts from the overall intercept is 0.02, which is also the level 2 random intercept variance (Sommet & Morselli, 2017). See table 8 for fit information and parameter estimates of this model.

Random Intercept Models - Japan

Next, we added in level 1 predictors of relational mobility and personal mobility, and the level 2 predictor of state-averaged relational mobility. We also control for marital status, age, and gender of participants. First we tested the random intercept model. See table 8 for parameter estimates.

Again, we determined that personal mobility better predicted structural zeros than (a) all predictions equally, (b) relational mobility at either level, or (c) gender, age, and marital status. In equations predicting both acquaintances met in the past month and the past three months, individual perceptions of relational mobility also predicted the presence of structural zeros. However, modeling this additional predictor did not change the significance of any predictors in the conditional portion of these models.

Table 8

Model Parameters for How Many Acquaintances Met in the Past Week (Japan)

	Null		Random Intercept		Random Slope of Personal Mobility	
Fixed Effects	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	0.07	0.14	0.53*	0.23	0.49*	0.24
Personal mobility			0.25*	0.11	0.17	0.12
Relational mobility (Level 1)			0.23**	0.08	0.25**	0.08
Relational mobility (Level 2)			0.28	0.67	0.43	0.72
Gender[a]			-0.14	0.12	-0.15	0.12
Age			-0.01	0.005	-0.01*	0.005
Marital status[b]			-0.17	0.21	-0.15	0.21
Random Effects Variance Components						
Intercept	0.02 (0.13)		0.03 (0.17)		0.04 (0.20)	
Personal mobility					0.05 (0.22)	
Zero-Inflated Model						
Intercept	1.14***	0.17	1.18***	0.16	1.16***	0.16
Personal mobility			-0.79***	0.15	-0.85***	0.16
Model Fit						
AIC	2537.5		2467.0		2468.9	
BIC	2560.1		2529.3		2542.6	
Dispersion	3.36		4.97		5.52	

Note. Standard deviations in parentheses. [a]Male = 0, Female = 1, [b]Single = 0, Married = 1

*p < .05, **p < .01, ***p < .001

To maintain consistency and aid in interpretability, we only use personal mobility to predict structural zeros, to account for our overdispersed count data with excess zeros in the following analyses. We ran a series of random-intercept models, and then added the random slope variance parameter of personal mobility, allowing the effect of personal mobility to vary between prefectures. This random slope parameter produced a singular fit in one outcome (acquaintances met over the past week). In the other two outcomes the parameter was estimable, but only significantly reduced deviance as compared to the random intercept model in one outcome (acquaintances met over the past three months). Therefore, we do not model the random slope variance, and consider the random intercept models as final for all three outcomes.

When predicting the number of friends met over the past week, month, and three months, individual-level ratings of personal mobility significantly predict these outcomes. Individual-level perceptions of the environment's relational mobility also significantly predict the log-count of new acquaintances across the three time spans. Overall, we find evidence that perceptions of relational mobility aggregated on the prefecture level (level 2) also predicted the log-count of new friends encountered, with a few exceptions. The model predicting friends met in the past week presented one such diversion from this pattern, with this level 2 relational mobility a nonsignificant predictor. Additionally, prefecture-level relational mobility is a marginally significant predictor in the model representing the time frame of the past month. Tables 9 and 10 show fit information and parameter estimates for the models predicting acquaintances encountered over the past month and three months, respectively.

Table 9
Model Parameters for How Many Acquaintances Met in the Past Month (Japan)

	Null		Random Intercept		Random Slope of Personal Mobility	
Fixed Effects	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	0.55***	0.11	1.00***	0.19	0.94***	0.20
Personal mobility			0.39***	0.08	0.36**	0.11
Relational mobility (Level 1)			0.26***	0.08	0.27***	0.08
Relational mobility (Level 2)			1.15t	0.60	1.36*	0.63
Gender[a]			-0.17	0.10	-0.16	0.10
Age			-0.01	0.004	-0.01	0.004
Marital status[b]			0.12	0.16	0.15	0.16
Random Effects Variance Components						
Intercept	0.05 (0.21)		0.04 (0.21)		0.03 (0.17)	
Personal mobility					0.06 (0.25)	
Zero-Inflated Model						
Intercept	0.20	0.17	0.24	0.15	0.25	0.15
Personal mobility			-0.91***	0.13	-0.91***	0.14
Model Fit						
AIC	4695.3		4555.7		4556.3	
BIC	4718.0		4618.0		4630.0	
Dispersion	0.82		0.99		1.04	

Note. Standard deviations in parentheses. [a]Male = 0, Female = 1, [b]Single = 0, Married = 1
*p < .05, **p < .01, ***p < .001, tp < .06

Table 10
Model Parameters for How Many Acquaintances Met in the Past Three Months (Japan)

	Null		Random Intercept		Random Slope of Personal Mobility	
Fixed Effects	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	0.87***	0.14	1.40***	0.19	1.27***	0.19
Personal mobility			0.45***	0.08	0.52***	0.11
Relational mobility (Level 1)			0.43***	0.07	0.45***	0.07
Relational mobility (Level 2)			1.54**	0.56	1.57***	0.58
Gender[a]			-0.21*	0.09	-0.19*	0.09
Age			-0.01**	0.004	-0.01*	0.004
Marital status[b]			0.13	0.17	0.17	0.17
Random Effects Variance Components						
Intercept	0.04 (0.19)		0.04 (0.20)		0.03 (0.18)	
Personal mobility					0.13 (0.37)	
Zero-Inflated Model						
Intercept	-1.25*	0.57	-0.75***	0.22	-0.76***	0.23
Personal mobility			-0.86***	0.14	-0.83***	0.15
Model Fit						
AIC	6888.6		6738.1		6730.7	
BIC	6911.3		6800.4		6804.3	
Dispersion	0.33		0.48		0.50	

Note. Standard deviations in parentheses. [a]Male = 0, Female = 1, [b]Single = 0, Married = 1
*p < .05, **p < .01, ***p < .001

Study 1c Discussion

Previous research has established the broad impact of relational mobility on behaviors and beliefs in close relationships. However, questions remain regarding the extent to which the relational mobility scale quantifies the intended socioecological construct, rather than aggregates of individual difference. Little research has compared how an individual's perceptions of their environment's relational mobility versus locality-averaged perceptions of relational mobility predict outcomes. Further, despite the theoretical reasons for avoiding capturing personal-level attributes in measures of relational mobility, there is value in controlling for such a measure of personal mobility, as well as comparing its influence with that of relational mobility.

Thomson and colleagues (2018) found that on a country level, higher perceptions of relational mobility positively correlate with the number of acquaintances met in the past month. However, we are not aware of research investigating whether this relationship replicates within-countries or over time frames shorter or longer than one month. Further, although people should be able to recognize and report the relational mobility of their environment reasonably well (Yuki et al., 2007), since individuals each are surrounded by unique micro-societies, there is individual-level variation in perceptions of relational mobility. The extent to which individual versus locality-aggregated perceptions of relational mobility differ in their predictive utility are still unclear.

In this study, we found support for the hypothesis that personal mobility robustly predicts the number of new acquaintances participants met in both the United States and Japan, across the past week, month, and three months.

Individual-level perceptions of environmental relational mobility did not significantly predict the retrospective reports of new friends in the US across any length of time, but it did predict these outcomes for Japanese participants. We also found overall support for the hypothesis that locality-aggregated relational mobility (states in the US, and prefectures in Japan) would significantly predict the number of new acquaintances encountered. Despite a few exceptions to this pattern in Japan, relational mobility as a level 2 predictor predicted these outcomes, even when controlling for individual-level perceptions of this environmental characteristic.

We conclude that locality-aggregated measures of relational mobility predict whether individuals made new friends or acquaintances better than individual level perceptions of how freely others in their environment can leave and form relationships. This finding provides evidence supporting the conceptualization of relational mobility as a socioecological, rather than an individual-level characteristic. These results also indicate the importance of considering and controlling for individual-level personal mobility in predicting how many new friends people encounter. Since personal mobility is dependent to some degree on the environment's relational mobility, we believe that both constructs should be considered in tandem. Representing both of these constructs allows us to conclude that the relational mobility scale's influence is best assessed on the environmental and not individual level, and that personal mobility exerts influence on interpersonal encounters, even when accounting for both environmental and individual-level perceptions of relational mobility.

Limitations and Future Directions

Although we believe this study provides new evidence that the relational mobility scale exerts influence on the environmental level, several factors may limit generalizability. One potential issue is that the item measuring the number of new friends and/or acquaintances met may have been interpreted differently across countries, given that the definitions of the terms “friend” and “acquaintance” are not identical in English and Japanese. Although we model these occurrences within-country and therefore do not make comparisons between the countries, further research should examine potential differences in how participants respond to questions regarding meeting new acquaintances.

Additionally, participants’ retrospective reporting how many new acquaintances they encountered in a given period of time may be prone to memory biases. Although we removed data from participants who reported inflated counts on all three outcomes, memory biases could either over inflate or depress the reported counts. Since this was a cross-sectional survey, we cannot establish whether the act of meeting new people actually alters perceptions of one’s own personal mobility, or perceptions of the broader environment’s relational mobility. A reciprocal relationship between these variables is likely to exist, such that people may base their evaluations of their personal ability to form new relationships off of past experiences of actually meeting new friends. Since participants respond to the scale about potential, rather than actual opportunities, we do not believe a reinforcing relationship between personal mobility and encounters with new friends poses a threat to validity.

We believe that one of our study’s strengths lies in using a multilevel structure to represent the influence of the locality-averaged relational mobility, while

controlling for both individual's perceptions of this construct and their personal mobility at the lower level. In the future, such data may be modeled through alternate techniques that can better handle the presence of outliers, along with overdispersion and excess zeros, such as the variance shift model for count data (Gumedze & Chatora, 2014).

We did not draw the conclusion that individual-level relational mobility reliably predicts interpersonal outcomes differentially in Japan than in the United States. However, given the pattern of findings, in which level-1 relational mobility significantly predicted encountering acquaintances only in Japan, and not in the US, this may be a question meriting further research. Overall, these analyses indicate that higher relational mobility within a locality reliably predicts the number of new friends individuals within that state or prefecture encounter, even controlling for their personal mobility and individual-level perceptions of relational mobility.

Chapter 5

Overall Discussion

Though the construct of relational mobility robustly predicts behaviors and beliefs in close relationships, and accounts for many observed cross-cultural differences in this domain, questions remain about how to quantify the construct. These studies provide evidence that one proposed alternate measure, the Personal Mobility Scale, demonstrates partial measurement invariance across the United States and Japan. In comparing personal mobility's correlations with individual differences to those of relational mobility's correlations with the same variables, we found that personal mobility was more closely related to Extraversion, self-esteem, attractiveness, and popularity. When controlling for this measure of personal mobility,

we found that state or prefecture-level relational mobility still predicted how many new friends participants met, whereas individual-level perceptions of relational mobility did not consistently predict this outcome. This provides evidence that relational mobility is best evaluated as a locality-level construct, and not as an individual difference variable. Further, the predictive utility of personal mobility indicates that this variable should be considered in tandem with relational mobility. We interpret these findings as supporting the idea of controlling for individual-level personal mobility in evaluations of relational mobility's influences.

Study 1a extends relational mobility measurement properties to the Personal Mobility Scale, finding evidence of the same two-factor structure and partial measurement invariance that emerged in the Relational Mobility Scale (Thomson et al., 2018). Studies 1b and 1c clarify the relationship between relational and personal mobility, first iterated by Yuki et al. (2007).

Study 1b supports one rationale for using the Relational Mobility Scale rather than the Personal Mobility Scale to measure the socioecological construct, finding that the Relational Mobility Scale is less associated with individual differences in self-esteem, popularity, attractiveness, and some personality traits than is personal mobility. Study 1c extends earlier findings linking relational mobility to the number of new friends and/or acquaintances met on a country-level (Thomson et al., 2018).

The use of multilevel models to disentangle the influence of relational mobility between individual-level and state or prefecture-level from personal mobility was a strength of our study, as was the within-country design. These features give us greater confidence that the relational mobility scale is measuring a socioecological characteristic of environments surrounding individuals, rather than either aggregated

individual differences or other differences between cultures. Despite these strengths, the inclusion of only two countries in these models does limit our interpretation (Boer et al., 2018; van de Vijver & Leung, 2000). Future research should seek to expand the countries represented in this model to broaden generalizability. Specifically, these findings should be replicated in other countries with differing levels of relational mobility, such as Latin American countries, which often rank highly in relational mobility, but display anomalous patterns in behaviors and beliefs regarding interpersonal relationships (Thomson et al., 2018).

Overall, our study supports the conceptualization of relational mobility as a construct measuring environmental characteristics, and not solely individual differences. Given the recent rise in popularity of socioecological approaches (Oishi & Graham, 2010), a greater understanding of the measurement properties of the Relational and the Personal Mobility Scale is essential. Although relational mobility is hypothesized to exert effects at the environmental level, our study provides evidence that these locality-averaged perceptions of relational mobility more consistently predict outcomes, even when controlling for personal mobility. A more detailed understanding of the measurement properties and predictive utility of the Personal Mobility Scale allows for investigation of whether the Relational Mobility Scale actually assesses a socioecological construct. Together, these two studies provide evidence supporting validity of both the Relational and Personal Mobility Scales.

Appendix A

Supplemental Analyses

We anticipate a reader asking the question of whether a level-2 personal mobility variable would predict meeting new friends in the same way as locality-aggregated relational mobility. In other words, does level-2 relational mobility still predict meeting new friends when accounting for level-2 personal mobility? This question may provide further evidence regarding if relational mobility does in fact measure an environmental trait, and not aggregates of individuals' personal mobility. This supplemental section addresses this anticipated question. Analyses described in this section were not a priori hypothesis nor were they main aims of our study. However, we believe that addressing this question adds value to our study and better informs the future directions for research incorporating relational mobility.

In answering this question of whether level-2 personal mobility predicts how often respondents encounter new friends and/or acquaintances, we first briefly describe the relevant theoretical background. Unlike relational mobility, personal mobility is not a socioecological construct and does not measure an environmental characteristic. Although personal mobility is an individual-level construct, a locality-averaged measure of personal mobility may also hold meaning. Personal mobility aggregated at the state or prefecture level may reflect regional differences in how attractive and desirable people consider themselves as relational partners.

Although the construct of personal mobility may hold meaning at the locality level, we did not incorporate level-2 personal mobility into our main study for several reasons. Our first reason was on a theoretical basis. Individual-level personal mobility should predict meeting new friends more strongly than personal mobility

aggregated by prefecture or states. The purpose of Study 2 was to compare level-1 and level-2 measures of relational mobility with individual-level personal mobility to clarify whether the Relational Mobility Scale captures the intended socioecological construct, or instead reflects aggregates of individuals' personal mobility. By controlling for level-1 personal mobility in our analyses, we addressed the question of whether a region's relational mobility predicts the number of friends a participant met above and beyond an individual's own ability to leave and form relationships. We did not ask the question of whether a region's aggregated personal mobility also predicted the number of acquaintances met over the past week, month, or three months, as analyzing personal mobility at a state or prefecture level was not a main goal of our study.

Although we do not adopt this research question as an aim of our study, we do consider it a valid question that may be raised in response to Study 2. Therefore we modeled personal mobility on the environmental level to test whether this variable significantly predicts meeting new acquaintances when controlling for individual-level personal and relational mobility, as well as environmental relational mobility and demographic factors. We ran a set of three models in both the US and in Japan, predicting new acquaintances met over the past week, month, and three months. We utilized a series of multilevel negative binomial regression models, using the same data and methodology presented in Study 1c.

Results indicate that level-2 personal mobility does not significantly predict these outcomes of meeting new friends and/or acquaintances. Across all three outcomes in the United States, level-2 personal mobility did not predict meeting new friends, although individual-level personal mobility continued to significantly predict

these encounters. However, in all three models state-level relational mobility became a nonsignificant predictor of meeting new people.

In Japan, this level-2 personal mobility variable also did not significantly predict the number of new friends or acquaintances individuals encountered. In these three models, the addition of the prefecture-level personal mobility predictor did not change the results presented in Study 1c. Overall, individual-level personal mobility and relational mobility, as well as prefecture-level relational mobility all still predicted the outcomes.

Taken together, the supplemental models provide evidence that personal mobility is best measured as an individual-level characteristic and not as an environmental variable. Results of these models also indicate that there may be differences between the US and Japan in how level-2 relational mobility predicts meeting new acquaintances, when accounting for level-2 personal mobility. Since this question was not a research aim of our study, we do not draw conclusions based on this and do not provide post-hoc explanations for these findings. Future research may investigate whether there are differences in the predictive utility of region-level relational mobility when controlling for regional personal mobility, and what such differences mean. Overall, we believe that our supplementary models provide additional evidence to support the use of personal mobility as a level-1 measure of how much opportunity and choice people have to form and dissolve their relationships.

Appendix B

Relational Mobility Scale

Participant instructions: How much do you feel the following statements accurately describe people around you, who are about the same age as yourself (friends and acquaintances in your school, colleagues in your workplace, residents in your town, etc.) in the society in which you live? Regarding those people around you, please indicate to what extent you agree or disagree with the following statements. “Groups” in some items refer to collections of people who either are related to each other, or who share the same goals, such as friendship groups, hobby groups, sports teams, and companies.

1. They (the people around you) have many chances to get to know other people.
2. It is common for these people to have a conversation with someone they have never met before.
3. They are able to choose the people whom they interact with in their daily life.
4. There are few opportunities for these people to form new friendships. (R)
5. It is uncommon for these people to have a conversation with people they have never met before. (R)
6. If they did not like their current groups, they would leave for better ones.
7. It is often the case that they cannot freely choose who they associate with. (R)
8. It is easy for them to meet new people.
9. Even if these people were not completely satisfied with the group they belonged to, they would usually stay with it anyway.(R)

10. They are able to choose the groups and organizations they belong to.
11. Even if these people were not satisfied with their current relationships, they would often have no choice but to stay with them. (R)
12. Even though they might rather leave, these people often have no choice but to stay in groups they don't like. (R)

Appendix C

Personal Mobility Scale

Participant Instructions: How much do you feel the following statements accurately describe yourself? Regarding yourself, please indicate to what extent you agree or disagree with the following statements. "Groups" in some items refer to collections of people who either are related to each other, or who share the same goals, such as friendship groups, hobby groups, sports teams, and companies.

and companies.

1. I have many chances to get to know other people.
2. It is common for me to have a conversation with someone I have never met before.
3. I am able to choose the people whom they interact with in their daily life.
4. There are few opportunities for me to form new friendships. (R)
5. It is uncommon for me to have a conversation with people I have never met before. (R)
6. If I did not like my current groups, I would leave for better ones.
7. It is often the case that I cannot freely choose who I associate with. (R)
8. It is easy for me to meet new people.
9. Even if I was not completely satisfied with the group I belonged to, I would usually stay with it anyway.(R)
10. I am able to choose the groups and organizations I belong to.
11. Even if I was not satisfied with my current relationships, I would often have no choice but to stay with them. (R)

12. Even though I might rather leave, I often have no choice but to stay in groups I don't like. (R)

References

Arnett, J. J. (2008). The neglected 95%: Why American psychology needs to become less American. *American Psychologist*, *63*(7), 602–14.

Back, M. D., Schmukle, S. C., & Egloff, B. (2011). A closer look at first sight: Social relations lens model analysis of personality and interpersonal attraction at zero acquaintance. *European Journal of Personality*, *25*(3), 225-238

Bahns, A. J., Pickett, K. M., & Crandall, C. S. (2012). Social ecology of similarity: Big schools, small schools and social relationships. *Group Processes & Intergroup Relations*, *15*(1), 119-131.

Bates, D. (2008, August 7). *Fitting Linear Mixed-Effects Models Using the lme4 Package in R.* [PowerPoint Slides]. University of Wisconsin - Madison and R Development Core Team. http://pages.stat.wisc.edu/~bates/PotsdamGLMM/LMMD.pdf

Boer, D., Hanke, K., & He, J. (2018). On detecting systematic measurement error in cross-cultural research: A review and critical reflection on equivalence and invariance tests. *Journal of Cross-Cultural Psychology*, *49*(5), 713-734.

Bolker, B. (2020, January 9). *GLMM FAQ.* Github. https://bbolker.github.io/mixedmodels-misc/glmmFAQ.html

Brooks, M. E., Kristensen, K., van Benthem, K. J., Magnusson, A., Berg, C. W., Nielsen, A., ... & Bolker, B. M. (2017). Modeling zero-inflated count data with glmmTMB. *BioRxiv*, 132753.

Brooks, M.E. (2017). Appendix B: Salamander example comparing GLMMs, zero-inflated GLMMs, and hurdle models. BioRxiv, 132753-2.

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(3), 464-504.

Cheung, G. W., & Rensvold, R. B. (2000). Assessing extreme and acquiescence response sets in cross-cultural research using structural equations modeling. *Journal of Cross-Cultural Psychology*, *31*(2), 187-212.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233–255.

Chiu, C. Y., Gelfand, M. J., Yamagishi, T., Shteynberg, G., & Wan, C. (2010). Intersubjective culture: The role of intersubjective perceptions in cross-cultural research. *Perspectives on Psychological Science*, *5*(4), 482-493

Cohen, D. (2001). Cultural variation: considerations and implications. *Psychological Bulletin*, *127*(4), 451-4711.

Cohen, P., West, S. G., & Aiken, L. S. (2015). *Applied multiple regression/correlation analysis for the behavioral sciences*. D. Riegert (Ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Davidov, E. Meuleman, B., Cieciuch, J., Schmidt, P., & Billiet, J. (2014). Measurement equivalence in cross-national research. *Annual Review of Sociology,* 40, 5565.

Diedenhofen, B., & Musch, J. (2015). Cocor: A comprehensive solution for the statistical comparison of correlations. *PloS one*, *10*(4): e0121945.

Gosling, S. D., Rentfrow, P. J., & Swann, W. B., Jr. (2003). Ten-Item Personality Inventory [Database record]. Retrieved from PsycTESTS. doi: https://dx.doi.org/10.1037/t07016-000

Gumedze, F. N., & Chatora, T. D. (2014). Detection of outliers in longitudinal count data via overdispersion. *Computational Statistics & Data Analysis*, *79*, 192-202.

Hashimoto, H., & Yamagishi, T. (2015). Preference-expectation reversal in the ratings of independent and interdependent individuals: A USA–Japan comparison. *Asian Journal of Social Psychology*, *18*(2), 115-123

He, H., Tang, W., Wang, W., & Crits-Christoph, P. (2014). Structural zeroes and zero-inflated models. *Shanghai Archives of Psychiatry*, *26*(4), 236-242.

Heine, S. J., & Hamamura, T. (2007). In search of East Asian self-enhancement. *Personality and Social Psychology Review*, *11*(1), 4-27.

Heine, S. J., & Norenzayan, A. (2006). Toward a psychological science for a cultural species. *Perspectives on Psychological Science 1*(3), 251-269.

Heine, S. J., Lehman, D. R., Markus, H. R., & Kitayama, S. (1999). Is there a universal need for positive self-regard?. *Psychological Review*, *106*(4), 766.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2-3), 61–135. doi:10.1017/S0140525X0999152X

Hui, C. H., & Triandis, H. C. (1986). Individualism-collectivism: A study of cross-cultural researchers. *Journal of Cross-Cultural Psychology*, *17*(2), 225-248.

Kashima, Y., Yamaguchi, S., Kim, U., Choi, S. C., Gelfand, M. J., & Yuki, M. (1995). Culture, gender, and self: A perspective from individualism-collectivism research. *Journal of Personality and Social Psychology*, *69*(5), 925-937.

Kesebir, S., Oishi, S., Spellman, B. (2010). The socio-ecological approach can turn variance among populations from a liability to an asset [Commentary]. *Brain and Behavioral Sciences, 33,* 96-97.

Kim, H. & Markus, H. R. (1999) Deviance or uniqueness, harmony or conformity? A cultural analysis. *Journal of Personality and Social Psychology, 77*(4), 785– 800.

Kim, H.S., Sherman, D.K., Ko, D., & Taylor, S.E. (2006). Pursuit of comfort and pursuit of harmony: Culture, relationships, and social support seeking. *Personality and Social Psychology Bulletin, 32*(12), 1595-1607.

Kirkpatrick, L. A., & Ellis, B. J. (2001). An evolutionary-psychological approach to self-esteem: multiple domains and multiple functions. In G. J. O. Fletcher & M. S. Clark (Eds.), *Blackwell handbook of social psychology: Interpersonal processes* (pp. 411-436). Oxford, UK: Blackwell Publishers.

Kito, M. (2005). Self-disclosure in romantic relationships and friendships among American and Japanese college students. *The Journal of Social Psychology*, *145*(2), 127-140.

Kito, M., Yuki, M., & Thomson, R. (2017). Relational mobility and close relationships: A socioecological approach to explain cross-cultural differences. *Personal Relationships*, *24*(1), 114-130.

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford publications.

Leary, M. R., Baumeister, R. F. (2000). The nature and function of self-esteem: Sociometer theory. *Advances in Experimental Social Psychology, 32,* 1–62

Leckie, G., Browne, W., Goldstein, H., Merlo, J., & Austin, P. (2019). Variance partitioning in multilevel models for count data. *arXiv preprint arXiv:1911.06888*.

Lewin, K. (1939). Field theory and experiment in social psychology: Concepts and methods. *American Journal of Sociology*, *44*(6), 868-896.

Liu, S. S., Shteynberg, G., Morris, M. W., Yang, Q., & Galinsky, A. D. (2020). How Does Collectivism Affect Social Interactions? A Test of Two Competing Accounts. *Personality and Social Psychology Bulletin*, 1-15.

Lucas, R. E., Diener, E., Grob, A., Suh, E. M., & Shao, L. (2000). Cross-cultural evidence for the fundamental features of extraversion. *Journal of personality and social psychology*, *79*(3), 452-468.

Lüdecke, D., Makowski, D., Waggoner, P., & Patil, I. (2020). *performance: Assessment of Regression Models Performance.* R package version 0.4.5. https://CRAN.R-project.org/package=performance

Luria, A. R. (1928). The problem of the cultural behavior of the child. *The Pedagogical Seminary and Journal of Genetic Psychology*, *35*(4), 493-506.

Markus, H.R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98,* 224–253

Matsumoto, D., & Yoo, S. H. (2006). Toward a new generation of cross-cultural research. *Perspectives on Psychological Science*, *1*(3), 234-250.

McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, *60*(2), 175-215.

Mimura, C., & Griffiths, P. (2007). A Japanese version of the Rosenberg Self-Esteem Scale: Translation and equivalence assessment. *Journal of psychosomatic research*, *62*(5), 589-594.

Nezlek, J. B. (2012). Multilevel modeling for psychologists. In H. Cooper (Ed.) *APA Handbook of Research Methods in Psychology, Data Analysis and Research Publication* **(**Vol. 3., pp 219-241). American Psychological Association.

Nezlek, J. B., Newman, D. B., Schütz, A., Baumeister, R. F., Schug, J., Joshanloo, M., ... & Gorbaniuk, O. (2019). An international survey of perceptions of the 2014 FIFA World Cup: National levels of corruption as a context for perceptions of institutional corruption. *PLoS One*, *14*(9), e0222492.

Nisbett, R. & Cohen, D. (1996). *Culture of Honor: The Psychology of Violence in the South*. Westview Press.

Nisbett, R. E., Peng, K., Choi, I., and Norenzayan, A. (2001) Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review, 108*, 291–310.

Oishi, S., & Graham, J. (2010). Social ecology: Lost and found in psychological science. *Perspectives on Psychological Science*, *5*(4), 356-377.

Oishi, S., & Talhelm, T. (2012). Residential mobility: What psychological research reveals. *Current Directions in Psychological Science*, *21*(6), 425-430.

Oishi, S., Schug, J., Yuki, M. & Axt, J.R. (2015). The psychology of residential and relational mobilities. In M. Gelfrand, C.Y. Chiu & Y.Hong (Eds.), *Advances in Culture and Psychology* (pp. 221-272). Oxford University Press.

Oshio, A., Abe, S., Cutrone, P., & Gosling, S. D. (2014). Further validity of the Japanese version of the Ten Item Personality Inventory (TIPI-J). *Journal of Individual Differences*.

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, *41*, 71-90.

Rosenberg, M. (1965). Rosenberg Self-Esteem Scale [Database record]. Retrieved from PsycTESTS. doi: https://dx.doi.org/10.1037/t01038-000

Rozin, P., Kabnick, K., Pete, E., Fischler, C., & Shields, C. (2003). The ecology of eating: smaller portion sizes in France than in the United States help explain the French paradox. *Psychological Science*, *14*(5), 450-454.

Sato, K., & Yuki, M. (2014). The association between self-esteem and happiness differs in relationally mobile vs. stable interpersonal contexts. *Frontiers in Psychology*, *5*, 1113

Scherbaum, C. A., & Ferreter, J. M. (2009). Estimating statistical power and required sample sizes for organizational research using multilevel modeling. *Organizational Research Methods*, *12*(2), 347-367.

Schmitt, D. P., & Allik, J. (2005). Simultaneous administration of the Rosenberg Self-Esteem Scale in 53 nations: exploring the universal and culture-specific features of global self-esteem. *Journal of Personality and Social Psychology*, *89*(4), 62-642.

Schug, J., Yuki, M., & Maddux, W. (2010). Relational mobility explains between-and within-culture differences in self-disclosure to close friends. *Psychological Science*, *21*(10), 1471-1478. doi:10.1177/0956797610382786

Schug, J., Yuki, M., Horikawa, H., & Takemura, K. (2009). Similarity attraction and actually selecting similar others: How cross-societal differences in relational mobility affect interpersonal similarity in Japan and the USA. *Asian Journal of Social Psychology*, *12*(2), 95-103.

Selfhout, M., Burk, W., Branje, S., Denissen, J., Van Aken, M., & Meeus, W. (2010). Emerging late adolescent friendship networks and Big Five personality traits: A social network approach. *Journal of Personality*, *78*(2), 509-538

Shweder, R. A., & Sullivan, M. A. (1993). Cultural psychology: Who needs it?. *Annual Review of Psychology*, *44*(1), 497-523.

Snijders, T. A.B. Power and sample size in multilevel linear models. (2005). In: B.S. Everitt and D.C. Howell (eds.), *Encyclopedia of Statistics in Behavioral Science*. (Vol. 3, pp. 1570–1573). Wiley.

Sommet, N., & Morselli, D. (2017). Keep Calm and Learn Multilevel Logistic Modeling: A Simplified Three-Step Procedure Using Stata, R, Mplus, and SPSS. *International Review of Social Psychology*, *30*, 203-218.

Spence, M. (1973). Job market signaling. *The Quarterly Journal of Economics,.87*(3), 355-374.

Stark, S., Chernyshenko, O. S., & Drasgow, F. (2006). Detecting differential item functioning with confirmatory factor analysis and item response theory: Toward a unified strategy. *Journal of Applied Psychology*, *91*(6), 1292.

Steenkamp, J. B. E., & Baumgartner, H. (1998). Assessing measurement invariance in cross-national consumer research. *Journal of Consumer Research, 25*(1), 78-90.

Thomson, R., Yuki, M., Talhelm, T., Schug, J., Kito, M., Ayanian,...Visserman, M. L. (2018). Relational mobility predicts social behaviors in 39 countries and is tied to historical farming and threat. *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.1713191115

Uleman, J. S., Rhee, E., Bardoliwalla, N., Semin, G., & Toyama, M. (2000). The relational self: Closeness to ingroups depends on who they are, culture, and the type of closeness. *Asian Journal of Social Psychology*, *3*(1), 1-17.

Uskul, A. K., Kitayama, S., & Nisbett, R. E. (2008). Ecocultural basis of cognition: Farmers and fishermen are more holistic than herders. *Proceedings of the National Academy of Sciences*, *105*(25), 8552-8556.

Van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European Journal of Developmental Psychology, 9*(4), 486-492.

Van De Schoot, R., Schmidt, P., De Beuckelaer, A., Lek, K., & Zondervan-Zwijnenburg, M. (2015). Measurement invariance. *Frontiers in Psychology,* 6: 1064. doi.org/10.3389/fpsyg.2015.01064

Van de Vijver, F. J., & Leung, K. (2000). Methodological issues in psychological research on culture. *Journal of Cross-Cultural Psychology*, *31*(1), 33-51.

Van der Linden, D., Scholte, R. H., Cillessen, A. H., te Nijenhuis, J., & Segers, E. (2010). Classroom ratings of likeability and popularity are related to the Big Five and the general factor of personality. *Journal of Research in Personality*, *44*(5), 669-672.

Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods*, *3*(1), 4-70.

Yamagishi, T., Cook, K. S., & Watabe, M. (1998). Uncertainty, trust, and commitment formation in the United States and Japan. *American Journal of Sociology*, *104*(1), 165-194.

Yamagishi, T., Hashimoto, H., & Schug, J. (2008). Preferences versus strategies as explanations for culture-specific behavior. *Psychological Science*, *19*(6), 579-584.

Yamagishi, T., Hashimoto, H., Li, Y., & Schug, J. (2012). Stadtluft macht frei (City air brings freedom). *Journal of Cross-Cultural Psychology*, *43*(1), 38-45.

Yuki, M., & Schug, J. (2012). Relational mobility: A socioecological approach to personal relationships. In O. Gillath, G. Adams, & A. Kunkel (Eds.), *Decade of Behavior 2000–2010. Relationship Science: Integrating Evolutionary, Neuroscience, and Sociocultural Approaches* (pp. 137-151). American Psychological Association.

Yuki, M., & Schug, J. (2020). Psychological consequences of relational mobility. *Current Opinion in Psychology*, *32*, 129-132.

Yuki, M., Schug, J., Horikawa, H., Takemura, K., Sato, K., Yokota, K., & Kamaya, K. (2007). Development of a scale to measure perceptions of relational mobility in society (Working Paper 75). Sapporo, Japan: Hokkaido University, Center for Experimental Research in Social Sciences.

Zhang, R., & Li, L. M. W. (2014). The acculturation of relational mobility: An investigation of Asian Canadians. *Journal of Cross-Cultural Psychology*, *45*(9), 1390-1410.

Zou, X., Tam, K.P., Morris, M.W., Lee, S.-L., Lau, I.Y.-M., & Chiu, C.-Y. (2009). Culture as common sense: Perceived consensus versus personal beliefs as mechanisms of cultural influence. *Journal of Personality and Social Psychology, 97,* 579–597