Spring 2013

Assessing Change in a Personality Profile

Jonathan S. Gore
Eastern Kentucky University, jonathan.gore@eku.edu

Susan M. Cross
Iowa State University

Daniel W. Russell
Iowa State University

Recommended Citation

Gore, J. S., Cross, S. E., & Russell, D. W. (2013). Assessing Change in a Personality Profile. The American Journal of Psychology, 126(1), 81-94. DOI: 10.5406/amerjpsyc.126.1.0081

Assessing Change in a Personality Profile

JONATHAN S. GORE
Eastern Kentucky University

SUSAN E. CROSS and DANIEL W. RUSSELL
Iowa State University

We tested the validity of 6 methods (mean difference, variance difference, bivariate, profile agreement, pattern similarity, and intraclass) to assess change in a personality profile. During their first 2 months of college, 372 students completed reactive and spontaneous measures of their personality. Eight weeks later, 300 returned to complete a second set of the same measures and noted change in their spontaneous personality list. Sixty participants returned during their second semester to complete a third set of assessments. The bivariate and intraclass change coefficients showed consistent convergent, discriminant, and concurrent validity across time points. Recommendations and caveats for using these coefficients are discussed.

Personality change is one of the most important phenomena in psychology, yet the study of it is difficult because of its rarity and a lack of consensus as to how it should be measured. The rarity of personality change is based partially on genetic and biological factors, but it may also be the result of experiencing a stable social environment. In general, people pay attention to messages in the environment that speak to "the kind of person I am," and in stable environments people easily become schematic for a trait or ability because their environment changes infrequently or to only a small degree (Brinthaupt & Erwin, 1992; Markus, 1977). Conversely, when an environment changes frequently or abruptly, such as when people relocate, people are likely to experience personality change because they are likely to receive different self-relevant feedback than what they received in their original environment (Hormuth, 1990). A recent meta-analysis confirmed that these changes can indeed occur at any stage in the life span (Roberts, Walton, & Viechtbauer, 2006), although others argue that changes tend to be modest after the age of 30 (Costa & McCrae, 2006).

There is a methodological concern in studying personality changes. Personality changes have been examined extensively at the trait level, but little consensus exists as to how to assess changes across various traits in an overall profile. Currently, there

American Journal of Psychology
Spring 2013, Vol. 126, No. 1 pp. 81–94

is growing support for the use of the intraclass correlation coefficient as a summary score for profile similarity (e.g., McCrae, 2008; Samuel & Widiger, 2006; Terracciano & McCrae, 2006; Trull, Widiger, Lynam, & Costa, 2003; van Tuijl, Branje, Dubas, Vermulst, & Van Aken, 2005), but to date no one has tested this coefficient's ability to indicate change compared to other coefficients. The purpose of the following study is to test the validity of six methods for measuring and analyzing profile changes among first-year college students.

Instances That Promote Personality Change and Consequences of Change

The genetic and biological bases for many personality traits make them stable over time, but changes in the social environment can produce changes in a person's personality at any point in the life span (Roberts et al., 2006). One of the most observable changes during a person's life occurs during young adulthood (Roberts & Mroczek, 2008). The changes during young adulthood may result in part from the high likelihood of them experiencing a significant increase in social investments such as attending college, starting their career, or starting a family (Roberts & Wood, 2006). The environmental factors that foster change are rarely given their due credit for influencing personality traits, although in some cases they have been found to be just as influential as genetic factors (Johnson, McGue, & Krueger, 2005). In new environments, self-relevant information is difficult to distinguish from other kinds of information, and much of the time information that may not be self-relevant is encoded as such because people are unfamiliar with the meaning of environmental cues (Wicklund, 1982). For example, students in their first year of college may consider experiences in their first college classes as more indicative of their conscientiousness level than they would consider a class later in their college experience. This is because they would be less aware of some of the external factors that can be involved in their ability to plan and organize tasks (e.g., the clarity of a syllabus, the teacher's leniency in meeting deadlines). Thus, students in their first semester of college are more likely to experience changes in their personality, because of the change in their social environment, than when they are upperclassmen and the social environment is more familiar.

We would not expect an abrupt change in their personality but rather some modest changes in their profile as a result of environmental changes. Overall, personality profiles remain largely stable across the life span, with more rigidity with age (Ferguson, 2010), but the combination of cognitive malleability and changes in social environments during childhood and up to early adulthood makes changes in a personality profile more likely to occur than in later stages of adulthood. Therefore, modest changes in personality profiles during a transitional point in young adulthood are likely to be recognized by a valid assessment of change.

Measures of Profile Change

Measuring changes in an overall profile is not an easy task. Several inconsistencies exist in the operationalization and analysis of personality change, and many times the researchers are more interested in profile stability than in change (e.g., Furr, 2010; McCrae, 1993, 2008). Several approaches have been used to summarize the degree of similarity between two profiles (Cronbach & Gleser, 1953), including similarities in the average score across traits (the profile's elevation), similarities in the distribution of scores in the profile (the profile's scatter), and similarities in the pattern of scores in the profile (the profile's shape). Although recent investigations have compared these methods in their ability to indicate profile similarity, no one has attempted to examine these methods when analyzing profile changes. The following section describes several options for assessing change in a person's profile, with particular emphasis on two categories of assessments: reactive and spontaneous self-report measures (Brinthaupt & Erwin, 1992), as well as the techniques that can be used to indicate change in the profile. We also present some simulation data that makes direct comparisons between the indicators of change.

Reactive Measures of Personality and Change

Reactive self-report measures require self-report ratings on one or more dimensions. Examples of this type of assessment include the Piers–Harris Children's Inventory (Coopersmith, 1967) and the Self-Description Questionnaire (Marsh, 1988). To assess changes in a person's profile, one would need participants to provide ratings of themselves at separate points in time,

which would essentially be a specialized version of a single-perceiver, multiple-target (1PMT) design (see Kenny & Winquist, 2001). Effective measures of change in a personality profile should provide a single, numeric indicator (i.e., a single change score) across a variety of personality traits. The following section describes methods for obtaining a change score in a profile using reactive self-report data.

MEAN DIFFERENCES

One option for assessing changes would be to examine changes in the profile's elevation, which would involve the calculation of a mean difference score. When the amount of total change is important, the absolute value of that change should be calculated, and the average amount of change should then be calculated across those difference scores. For example, if Bob rated himself as "intelligent" (with a rating of 3) and "caring" (with a rating of 3) at Time 1, then rated himself as more intelligent (with a rating of 4) and less caring (with a rating of 2) at Time 2, the average amount of change he would have experienced is 1 (the absolute value of 3 – 4 = 1, and the absolute value of 3 – 2 = 1; average change = [1 + 1]/2 = 1). Unfortunately, this strategy has its weaknesses. The operationalization of change through mean differences is notoriously unreliable because of measurement error in the scores at Time 1 and Time 2 and the correlation between the two assessments (Malloy, 1992). Nevertheless, it provides a single assessment of change and it incorporates increases as well as decreases in ratings over time, both of which are necessary for an effective indicator of change.

> Mean difference = |Time 1 mean score on measure X – Time 2 mean score on measure X|.

VARIANCE DIFFERENCES

Another option for assessing changes in a profile is to examine changes in the scatter of the profile, which entails the calculation of the absolute value of the differences in the profiles' variances. Although this technique is rarely used to examine profile similarity, it is an important element of the profile because a valid indicator of profile change must be able to account for changes in a profile's distribution of scores (Cronbach & Gleser, 1953).

> Variance difference = |Time 1 variance on measure X – Time 2 variance on measure X|.

BIVARIATE CORRELATIONS

A third option for assessing changes in a profile is to examine changes in the profile's shape, which would involve obtaining the Pearson's correlation coefficient between ratings of the two profiles. To assess change across multiple traits, correlation coefficients (which measure consistency) must be subtracted from 1.00 so that the resulting coefficient reflects the amount of change (or inconsistency) of ratings between time points. Thus, we operationalize overall change as 1.00 minus the Pearson's correlation coefficient:

> Bivariate change = 1.00 – r.

PATTERN SIMILARITY

A fourth option for assessing change in a profile is to examine the degree to which the person receives similar scores across traits. Cattell (1949) proposed the coefficient of pattern similarity (r_p) for this type of assessment, which has been found to be superior to other similarity measures (Carroll & Field, 1974). The formula for this coefficient is

$$r_p = \frac{2k - \Sigma d^2}{2k + \Sigma d^2}$$

where Σd^2 is the sum of squared differences between standardized profile elements and k is the number of profile elements. Similar to the bivariate indicator, we operationalize pattern change as 1.00 minus the coefficient of pattern similarity:

> Pattern change = 1.00 – r_p.

PROFILE AGREEMENT

The problem with the coefficient of pattern similarity is that although it accounts for relative elevation between traits, it does not take into account absolute elevation among traits (McCrae, 1993). McCrae introduced the coefficient of profile agreement (r_{pa}) as a measure that takes into account both the differences between ratings on profile elements and the extremeness of the traits. The formula for this coefficient starts with an index of profile agreement (I_{pa}) calculation,

$$I_{pa} = \frac{k + 2\Sigma M^2 - \Sigma d^2}{\sqrt{10\,k}},$$

which is then used to calculate the coefficient of profile agreement,

$$r_{pa} = \frac{I_{pa}}{\sqrt{(k-2) + I_{pa}^2}},$$

where $\sum d^2$ is the sum of squared differences between standardized profile elements, k is the number of profile elements, and M^2 is the square of the mean of the two ratings for each profile element. Again, we operationalize profile change as 1.00 minus the coefficient of profile agreement:

$$\text{Profile change} = 1.00 - r_{pa}.$$

The coefficients of profile similarity and profile agreement were both introduced as a way to correct for the bivariate coefficient's insensitivity to profile elevation. Unfortunately, they do not account for all elements of the profile, as is done in an intraclass correlation coefficient.

INTRACLASS CORRELATIONS

Intraclass correlation coefficients typically summarize trait-by-trait consistency across several raters (see Bernieri, Zuckerman, Koestner, & Rosenthal, 1994). In contrast to the bivariate approach, the absolute agreement as reflected by a double-entry intraclass correlation coefficient (ICC) can examine whether the ratings are exactly the same from one time point to the next, which allows the examination of similarity in terms of the organization and patterning of traits (Furr, 2010; Luo & Klohnen, 2005), and has been considered the most effective assessment of profile agreement (McCrae, 2008). To date, however, no one has examined its ability to summarize the amount of change in a profile.

The ICC factors all three elements of a profile (elevation, scatter, and shape) into a single statistic, which offers an overall summary of change but can also hinder its meaning (Furr, 2010). As a result, it may be a useful tool for indicating profile change, or it may provide only a vague description of the actual changes occurring in the profile. As was the case with the other techniques, ICCs are typically used to examine consistency rather than change, so we would also operationalize overall change as 1.00 minus the correlation coefficient:

$$\text{Intraclass change} = 1.00 - r_{\text{ICC}}.$$

AN ILLUSTRATION COMPARING REACTIVE MEASURES

According to the results of recent simulation and empirical studies, the intraclass correlation method of indicating profile similarity is preferable to the other five methods because it accounts for changes in mean scores, in addition to the amount of agreement, between two time points. We wanted to make a side-by-side comparison of these techniques in terms of indicating changes in a profile. In Table 1, this is illustrated using data from three hypothetical cases with differing profiles between Time 1 and Time 2. For Person 1, the ratings given at Time 1 and Time 2 are identical, so all six techniques are able to identify this case as having perfect agreement. Therefore, these measures recognize no change between time points, but it is only in this case that all six indicators agree with one another.

For Person 2, the ratings at Time 1 and Time 2 are all higher by 1.00. In other words, the elevation has changed, but neither the scatter nor the shape has changed. This change in ratings is recognized by the intraclass correlation and the mean difference indicators, but none of the remaining four indicators are able to differentiate Person 2 from Person 1 in terms of the amount of change observed. Therefore, the mean difference and intraclass indicators are sensitive to elevation changes despite consistency in the scatter and shape.

For Person 3, all of the ratings at Time 2 are either higher or lower than the ratings at Time 1 by 1.00. This change is recognized by the bivariate, pattern, and intraclass change indicators, but the mean and variance difference scores and the profile change indicator are unable to differentiate Person 3 from Person 2. In conclusion, we have shown that the ICC is sensitive to the three elements of profile change, and it is therefore able to note differences across the three cases. This, again, could be an advantage of the ICC method, or it could suggest that it attempts to summarize too much at once.

Our examination differs from previous investigations of profiles in important ways. First, most research on personality profiles examines similarities between profiles, and comparisons between the profiles have been based only on agreement (e.g., McCrae, 2008). The six techniques outlined earlier were all created to assess the degree of overlap between one profile and another. None of them were created with the intention of examining profile changes. However, we argue that they can easily translate into indicators of change with minor alterations to the calculations. Although these are simple alterations to the calculations, it provides potential for the examination of a new set of psychological phenomena.

TABLE 1. Simulation Comparing the 6 Techniques of Measuring Profile Change

	Person 1		Person 2		Person 3	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Trait 1	1	1	1	2	1	2
Trait 2	2	2	2	3	2	1
Trait 3	3	3	3	4	3	4
Trait 4	4	4	4	5	4	3
Trait 5	5	5	5	6	5	6
Trait 6	6	6	6	7	6	5
	Mean difference	0.00		1.00		1.00
	Variance difference	0.00		0.00		0.00
	Bivariate (r)	0.00		0.00		0.17
	Pattern (r_p)	0.00		0.00		0.25
	Profile (r_{pa})	0.00		0.00		0.00
	Intraclass	0.00		0.15		0.16

Second, most research on personality profiles examines similarities between rather than within individuals. For example, profile similarity between two individuals has been examined as an important factor in their relationship quality (Luo & Klohnen, 2005). There is less attention paid to the profile changes that may occur within an individual during a period of transition. Therefore, our analysis is also unique in that it examines the profile of one person over time rather than profiles between people at a single time point.

Spontaneous Measures of Personality and Change

As mentioned earlier, self-report measures of personality can take on two forms: reactive or spontaneous (Brinthaupt & Erwin, 1992). Spontaneous self-report measures involve participants answering an open-ended question about oneself (e.g., writing a paragraph on "Who I Am"). Examples of this assessment include the Who Are You? Method (Bugental & Zelen, 1950) and the Twenty Statements Test (TST; Kuhn & McPartland, 1954). Although reactive self-report measures are more popular and make analysis easier, spontaneous self-report measures are also acceptable ways of measuring the self-concept (Brinthaupt & Erwin, 1992), particularly if the researcher is able to reduce the amount of coding involved.

To measure change in a spontaneous measure, participants examine their original list of attributes at a later time point and either delete characteristics that are no longer relevant to the self or add characteristics to their list that have since become self-descriptive. The deletions to the list suggest that the person perceives an inability to express his or her original self-aspects in the new environment, because those self-aspects are discouraged or are not recognized in the new environment. In contrast, additions to the list suggest that the person perceives an ability to maintain his or her original profile, but the overall meaning of their profile changes because new information has been added. Assessing the amount of overall change to the profile involves summing the amount of deletions and additions to the person's list. This provides an indicator of perceived self-concept change with a high degree of face validity.

The problem with using this approach alone is that the researcher is unable to determine the degree to which any aspect is self-descriptive. The spontaneous measure provides a list of characteristics, but there is no way to judge the relative importance of the characteristics to each other. Indeed, there may be fluctuations in the descriptiveness of traits even if traits listed in a profile remain constant. In sum-

mary, spontaneous measures are valid assessments of personality, but they are insensitive to changes in the degree to which traits are descriptive. Therefore, spontaneous measures of change may not be preferable in determining the amount of change in a profile. However, the construct validity of these measures may serve a useful purpose in validating a reactive measure of change. Therefore, we used spontaneous measures to test the convergent and discriminant validity of the six indicators of change.

Overview and Hypotheses

Several types of indicators of profile similarity have been proposed over the years, and there has been growing support for the use of the ICC (McCrae, 2008) despite some of its limitations (Furr, 2010). Past researchers have also examined profile stability and change over time (Klimstra, Hale, Raaijmakers, Branje, & Meeus, 2009; Ozer & Gjerde, 1989), but to date no one has compared all these indicators in their ability to demonstrate change in a personality profile. The purpose of our study is to compare the six indicators mentioned earlier by testing three types of validity.

CONVERGENT VALIDITY

The convergent validity was tested by correlating the change scores obtained with these approaches with a measure of spontaneous personality change (i.e., the number of personality traits added and subtracted from an earlier assessment of the self-concept). We expected that valid indicators of reactive personality change would correlate positively with the spontaneous personality change scores. The convergent validity was tested twice across three time points (Time 1-Time 2 and Time 2-Time 3).

DISCRIMINANT VALIDITY

The discriminant validity was tested by correlating the change scores obtained from the three approaches with a measure of spontaneous change across other domains of the self-concept (e.g., the number of deletions and additions to their list involving close relationships, group memberships, activities). A valid measure of change in a specific domain (e.g., personality) should not correlate with change across all other domains (e.g., relationships, health). Therefore, we expected that valid measures of reactive personality change would show no association with a spontaneous change score for other domains. The discriminant validity was also tested twice across three time points (Time 1-Time 2 and Time 2-Time 3).

CONCURRENT VALIDITY

Finally, the amount of change during the initial exposure to a new environment should be larger than the amount of change noted after the person has been exposed to the new environment for an extended period of time. Consequently, a valid measure of change should yield higher values when it is assessed during the first few months of exposure to the new environment (the period between Time 1 and Time 2) than when it is assessed after the person has been in the environment for an extended period of time (the period between Time 2 and Time 3). Thus, the concurrent validity was tested by obtaining the difference between the average amount of change during the first semester of college and the second semester of college. We expected to find higher levels of change during the first semester than during the second semester.

EXPERIMENT

METHOD

Participants

Participants were 398 undergraduate students from a Midwestern university (105 men, 290 women, 3 unspecified), who were recruited to participate in this study in their first 2 months of college. Of these students, 26 were transferred from other universities and were excluded from analysis, which resulted in a total of 372 participants at Time 1 (96 men, 273 women, 3 unspecified).

Two samples were collected over the course of two consecutive school years (ns = 143 for the first year and 255 for the second year). The results of a multivariate analysis of variance demonstrated no significant differences between the two samples nor any significant sex difference on any of the variables (ps > .10). The only other difference between the samples was that one was collected over the course of three sessions (twice during their first semester and once during their second semester), and the other sample was collected during their first semester only. For our analyses, we combined the two samples' data for the first semester. For the first two sessions, participants received extra credit toward their grade in an introductory psychology class. For the second

session, 300 participants returned (117 during the first year and 183 during the second year) for a total return rate of 81% (78 men, 220 women, 2 unspecified).

Only students from the first year of data collection were asked to return for the third session. For this session, participants received either credit for an introductory psychology class in which they were currently enrolled or an entry into a four-winner drawing for $50 if they were not enrolled in an introductory psychology course. Only 60 participants returned for the third session (9 men, 50 women, 1 unspecified), for a return rate of 52% of participants from the first year who attended the Time 2 session. One participant was excluded from analysis due to being an outlier on the T2T3 Spontaneous Personality Change measure (z score > 3.33; see Fidell & Tabachnick, 2003, for cutoff criteria). For the sake of clarity, we report the results from the Time 2-Time 3 data separately from the Time 1-Time 2 data. Participants with incomplete data were excluded from analysis.

Materials

REACTIVE PERSONALITY MEASURE

To assess participants' personalities using a reactive measure, we asked them to complete a 25-item version of the Big 5 personality measure (John, 1989). Participants rated single words or phrases (e.g., *affectionate, competitive*) based on how self-descriptive they were on a 5-point scale (1 = *not at all descriptive of me,* 5 = *extremely descriptive of me*). This measure was administered at all three time points. We examined changes across items rather than across factors to allow a more sensitive measure of change across time.

REACTIVE PERSONALITY CHANGE

To assess personality change, we transposed participants' ratings in the dataset so that each item was treated as a separate case, and the time points served as the variables. Six change indicators were computed for participants' ratings between Time 1 and Time 2, between Time 2 and Time 3, and between Time 1 and Time 3. These indicators were the mean difference in ratings between time points, the variance difference between time points, the bivariate correlation between time points, the coefficient of pattern similarity, the coefficient of profile agreement, and the double-entry ICC between time points. For the last four coefficients, the resulting coefficients indicated the consistency of participants' responses between the two time points. Consequently, the coefficients were subtracted from 1.00 in order to indicate the degree of inconsistency in participants' responses compared with the previous time point. These calculations were computed separately for each participant, and the scores were subsequently named bivariate change, pattern change, profile change, and intraclass change.

SPONTANEOUS PERSONALITY MEASURE AND CHANGE

To assess participants' profiles using a spontaneous measure, we administered the TST (Kuhn & McPartland, 1954), which involved completing the statement "I am . . ." 20 times. Next, participants categorized each of their statements into one of the following: personality characteristic, physical characteristic, activity or skill, relationship with a friend, relationship with a family member, group membership, attitudes/beliefs/values, or other. Finally, participants listed up to five objects they own that they believe are symbolic of who they are and five places that they believe are symbolic of who they are. To assess spontaneous change, participants at Time 2 received their Time 1 Twenty Statements list and the objects and places lists. They crossed out the items they believed were no longer relevant to their life in college or were difficult to express in their current environment. They also were asked to add any new statements that were not included in their list at Time 1 but characterized what they thought about themselves. These added characteristics were then categorized based on the domains listed earlier. At Time 3, participants received their Time 1 Twenty Statements list again with the items they had crossed out and added at Time 2. This way, the participants were made aware of the items they had indicated previously as irrelevant or difficult to express. The number of crossed-out and added items from their lists at each time point was tallied to calculate their spontaneous total change score (T1T2 scores ranged from 0 to 26, $M = 4.80$, $SD = 4.15$; T2T3 scores ranged from 0 to 15, $M = 4.24$, $SD = 3.70$). The number of additions and deletions involving the personality traits only were then obtained to assess their spontaneous personality change score (T1T2 scores ranged from 0 to 11, $M = 2.27$, $SD = 2.38$; T2T3 scores ranged from 0 to 3, $M = 0.88$, $SD = 1.20$), and the difference between the spontaneous total change and spontaneous personality change scores was obtained for the spontaneous other change score (T1T2 scores ranged from 0 to 23, $M = 3.00$, $SD = 3.61$; T2T3 scores ranged from 0 to 13, $M = 3.24$, $SD = 3.30$).

Procedure

Participants signed up for this study in the months of September and October of their first year in college. Upon arrival at the laboratory, participants were

seated and asked to provide consent. They then completed the Twenty Statements list and the preselected self-domain measures. Upon completion, participants received a reminder card indicating when they were to return (8 weeks later) and were dismissed.

They were contacted by e-mail 2 days before to remind them of the second session, which took place 8 weeks after the initial session. Upon arrival, participants received their original Twenty Statements list and objects and places lists and were asked to cross off any items on the list they believed were either irrelevant or difficult to express in their current environment. They were then asked to add any statements to the list that currently described them but were not on the original list. Participants were then asked to categorize any of the statements they added into one of the eight domains. The remainder of the session proceeded in the same manner as the Time 1 session. Upon completion, participants were either reminded of the third session and dismissed (for the first-year sample) or debriefed (for the second-year sample).

As at Time 2, participants from the first-year sample were reminded by e-mail of the third session 2 days before they were to return (between mid-January and late February). This session proceeded in the same way as the Time 2 session except all of the changes participants made to their lists at Time 2 (the deletions and additions) were included in the list given to them at Time 3. Upon completion, participants were fully debriefed.

RESULTS

Time 1-Time 2 Analyses

To test the validity of the change indicators between Time 1 and Time 2, a series of bivariate correlation analyses were conducted with the Time 1-Time 2 mean difference, variance difference, bivariate change, coefficient of pattern change, coefficient of profile change, and intraclass change scores and the Time 2 spontaneous personality change and Time 2 spontaneous other change scores (Table 2). The results indicated that all indicators except profile change were positively associated with spontaneous personality change ($ps < .05$), indicating that most of them had convergent validity. All of the indicators were unassociated with spontaneous other change ($ps > .10$), indicating that they all had discriminant validity. Taken together, the results for Time 1-Time 2 supported the convergent and discriminant validity of all indicators except for profile change.

Time 2-Time 3 Analyses

To test the validity of the change indicators between Time 2 and Time 3, a series of bivariate correlation analyses were conducted with the Time 2-Time 3 mean difference, variance difference, bivariate change, coefficient of pattern change, coefficient of profile change, and intraclass change scores,

TABLE 2. Correlations Between Time 1 and Time 2 Variables With Descriptive Statistics ($n = 338$)

Variable	1	2	3	4	5	6	7	8
T1T2 mean difference	—	.34**	.51**	.76**	.57**	.55**	.14*	.08
T1T2 variance difference		—	.09	.20**	.10	.15*	.13*	−.03
T1T2 bivariate change			—	.67**	.65**	.78**	.11*	.08
T1T2 coefficient of pattern change				—	.73**	.71**	.18**	.07
T1T2 coefficient of profile change					—	.67**	.03	.09
T1T2 intraclass change						—	.12*	.10
Time 2 spontaneous personality change							—	−.19**
Time 2 spontaneous other change								—
M	0.56	0.27	0.36	0.52	0.54	0.39	2.27	3.00
SD	0.20	0.23	0.20	0.22	0.17	0.19	2.38	3.61

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

Time 3 spontaneous personality change, and Time 3 spontaneous other change scores (Table 3). The results indicated that all of the indicators except variance difference were positively associated with spontaneous personality change ($p < .05$), indicating that most of them had convergent validity. All of the indicators except profile change were unassociated with spontaneous other change ($p > .10$), indicating that most had discriminant validity. The results of Time 2-Time 3 supported the convergent and discriminant validity of all indicators except for variance difference.

To test the concurrent validity of the indicators, six paired-samples t tests were conducted for participants with complete data from Time 1 to Time 3 ($n = 60$). Specifically, we examined differences between the T1T2 and T2T3 scores for each indicator. The results indicated that the T1T2 change scores were higher than the T2T3 change scores for the mean difference, bivariate, and intraclass indicators but not for the other three (Table 4), demonstrating that the mean difference and correlational methods for assessing change were able to identify the larger amount of change during the initial months of exposure to a new environment than during later stages of exposure. Taken together, the results for the Time 2-Time 3 interval provided support for the mean difference, bivariate, and intraclass correlation techniques.

Additional Analyses

We also used the Heise (1969) formula to assess true reliability across personality traits (i.e., reliability due to stability and not due to measurement error), then subtracted these values from 1.00 to assess true change. We could do this only with the first sample and with four of the six change indicators (i.e., bivariate, intraclass, pattern, and profile change) because the Heise formula requires at least three time points with correlational data. In a series of bivariate correlation analyses, we found that the intraclass and bivariate scores correlated positively with T1T3 spontaneous personality change, although they were marginally significant ($r = .25, p = .06$ for intraclass, $r = .21, p = .10$ for bivariate). There was not a significant association between these change indicators and spontaneous other change ($r = .12$, *ns* for intraclass, $r = .06$, *ns* for bivariate). The pattern and profile change scores using the Heise formula were not associated with spontaneous personality change ($rs = -.02$ and $-.11$, *ns*). Pattern change was positively associated with spontaneous other change ($r = .40, p < .01$), indicating a failure to demonstrate discriminant validity. Therefore, both the intraclass and bivariate change indicators showed convergent

TABLE 3. Correlations Between Time 2 and Time 3 Variables With Descriptive Statistics ($n = 59$)

Variable	1	2	3	4	5	6	7	8
T2T3 mean difference	—	.38**	.57**	.96**	.48**	.58**	.44**	–.10
T2T3 variance difference		—	–.03	.27**	–.06	.03	.07	–.15
T2T3 bivariate change			—	.53**	.52**	.98**	.23*	.11
T2T3 coefficient of pattern change				—	.46**	.55**	.49**	–.11
T2T3 coefficient of profile change					—	.59**	.30*	–.18
T2T3 intraclass change						—	.23*	.13
Time 3 spontaneous personality change							—	.21
Time 3 spontaneous other change								—
M	0.50	0.25	0.32	0.55	0.55	0.35	0.70	3.38
SD	0.21	0.21	0.16	0.21	0.23	0.17	0.89	3.30

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

TABLE 4. Paired Samples *t* Test Results Between Time 1-Time 2 and Time 2-Time 3 Indicators of Change ($n = 59$)

	Time 1-Time 2		Time 2-Time 3		
	M	*SD*	*M*	*SD*	*t*
Mean difference	0.56	0.20	0.47	0.18	2.84**
Variance difference	0.32	0.30	0.25	0.21	1.52
Bivariate change	0.36	0.20	0.32	0.17	1.97*
Pattern change	0.58	0.21	0.55	0.21	1.21
Profile change	0.54	0.21	0.55	0.23	–0.06
Intraclass change	0.39	0.19	0.35	0.17	1.99*

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

and discriminant validity using the Heise corrective technique, but the pattern and profile change indicators did not.

DISCUSSION

When personality change occurs, it is often when people are exposed to new social environments, and these changes typically have important cognitive and emotional consequences. Unfortunately, the lack of consensus in assessing changes within personality profiles hinders research in this area. The purpose of this study was to identify the most valid assessment for the sake of developing more research on the antecedents and consequences of profile change. The results of our study showed that both the intraclass and bivariate correlation coefficient techniques demonstrated convergent and discriminant validity with spontaneous measures of change, and they demonstrated concurrent validity by showing decreasing values over time as the students became accustomed to their new environment. The bivariate and intraclass correlation indicators appear to be the most valid for assessing change in a profile. Although there is no single statistic that summarizes a profile's shape, much less one that summarizes change in a profile's shape, the lack of an association between most of the other indicators of change with the spontaneous change measure suggests that the changes in the shape of the profile produce the most important psychological changes.

Despite the relative equality of the intraclass method and the bivariate method, there are instances when the bivariate method may be more desirable. When major changes occur in the profile, such as a negative correlation of traits between Times 1 and 2, the ICC no longer remains viable (see also Furr, 2010, for a discussion of this limitation), whereas the bivariate coefficient remains relatively unaffected by these data. As noted before, however, major shifts in a personality profile are extremely rare (Ferguson, 2010), and the modest changes that the ICC recognizes are much more common. In addition, the bivariate correlation coefficient does not account for all three profile elements, which arguably makes it easier to interpret (Furr, 2010) and may be a simpler way to examine change in a profile.

A lingering concern about some of the indicators of change is that, by subtracting the stability value from 1.00, we are obtaining scores that contain some degree of actual change and some degree of measurement error. Although we could have obtained these results due to poor reliability between measures, we argue that we have captured mostly actual change with the correlation indicators for three reasons. First, short-term disparities in scores generally indicate poor reliability, but only when there is no reason to expect the sample to change. For example, if we had shown changes in scores over the course of 1 week, it would be unlikely that those scores would indicate actual change in the person. In contrast, we examined change over the course of 2 months during a significant life transition, the first year of college. Life transitions such as these are particularly likely to involve changes in personality and other self-aspects (Filipp & Klauer, 1986; Kling, Ryff, & Essex, 1997).

Therefore, it is unlikely that the results are due to poor test–retest reliability.

Second, we reanalyzed the data by rescoring the bivariate and intraclass coefficients using Heise's (1969) formulas for correcting coefficients to reduce measurement error, and we obtained similar results. Therefore, we suggest that the residual variance we examined using the intraclass and bivariate coefficients represented actual changes in the individuals more than it represented measurement error.

Implications

These studies contribute to the current literature on personality change in that we have identified a valid and simple way for summarizing the amount of overall change across several traits rather than examining increases or decreases in a single trait. In cases where the researcher wants to examine change in a single trait, we recommend using the latest growth curve modeling techniques. In other cases, when the researcher wants to examine specific changes in the profile (e.g., changes in elevation or scatter), we recommend a differentiated analysis of those elements (as suggested by Furr, 2010). In cases where the researcher is interested only in overall change and several independent constructs are involved in the profile, we recommend summarizing the degree of profile change by subtracting either the bivariate or the double-entry intraclass correlation coefficient from 1.00. This versatile summary technique can be used across any reactive self-report data, regardless of the variety of self-domains the researcher includes.

This research is also distinct from the recent work on personality change, which tends to examine the rate of change of specific traits, particularly among the Big Five traits and among traits that demonstrate social maturity (see Roberts & Mroczek, 2008, for a review). We recognize that analyzing the rate of change within a given trait is important for determining specific outcomes, such as the links between increased social maturity and health (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007) and between increased neuroticism and mortality (Mroczek & Spiro, 2007). However, we believe that the assessment of overall change to an entire profile is necessary to uncover some of the more universal consequences of change, as well as some of the most influential environmental factors that can change one's whole self-concept.

Similar to other research on aspects of the self-concept, we examined change across personality traits (Block, 1961; Donahue, Robins, Roverts, & John, 1993; McReynolds, Altrocchi, & House, 2000; Sheldon, Ryan, Rawsthorne, & Ilardi, 1997). Unfortunately, our studies excluded other important self-domains, including the relational and collective selves (Sedikides & Brewer, 2001). We also excluded the lesser-known ecological self, which refers to objects and locations that are self-descriptive (Neisser, 1993), and we did not include possible selves (Markus & Nurius, 1986) in our analysis. In short, our studies have examined only a small portion of the self-concept. Future applications of this research may consider investigating change in these other domains and whether change in these domains have similar consequences as changes in personality.

Examining additional consequences of change, such as motivation and skill acquisition, would add insight into the influence this process has on psychological functioning. It would be particularly important to address the positive consequences of change across all self-domains. Thus, future research should consider expanding the operationalization of the self-concept and investigating the strongest antecedents and consequences of change. Other applications of this work may address some of the methodological limitations of the current study.

Limitations and Future Directions

This study leaves unanswered a number of questions that should be addressed in future research. In addition to some of the caveats mentioned earlier, there are some circumstances when ICCs are ineffective at recognizing change. Most notably, cases in which a person's ratings of all traits are equal (e.g., providing a rating of 3 out of 5 for all items) would result in a coefficient of 0.00 regardless of what the ratings are at other time points (this would also create problems for several of the other indicators). This may hinder the ability of the ICC to recognize change in all cases. However, it should be noted that we recommend using the ICCs only when the traits or aspects are independent constructs, and it is unlikely that any valid case would have the same ratings across all aspects. If these cases occurred, they may indicate an

acquiescence bias or response set, and they should consequently be excluded from analysis. Thus, the weaknesses of the ICCs to recognize change may typically involve cases with invalid data.

Furr (2010) also outlined several reasons why the ICC method for assessing profile similarity, and subsequently profile change, should be used with caution. As noted earlier, if a person has a personality profile at one time point that is similar in shape to his or her profile at a second time point but dissimilar in elevation or scatter, this may produce a negative ICC. We argue that this circumstance is probably rare for within-person changes. In addition, changes in a profile's elevation or scatter, despite having a consistent shape, may be important information that a valid change indicator should note. For example, if the ratings of traits increase and the variability decreases, this may indicate that the person is becoming more certain of his or her personality characteristics, even though the relative importance of those traits to each other is the same.

Of greater concern is the influence that the variability of scores can have on the ICC. Specifically, if the two profiles vary greatly in terms of scatter, the magnitude of the ICC is likely to be exaggerated (see simulation data in Furr, 2010), which means that the ICC change indicator would note less change. For the sake of our interest in noting change, this issue would be particularly troublesome. However, our empirical data did not display this trade-off between the variance difference scores (scatter dissimilarity) and intraclass change scores. If this occurred, then we would not have seen greater intraclass change scores between Time 1 and Time 2 compared with Time 2 and Time 3, because the scatter dissimilarity for the Time 1-Time 2 interval was higher than (although not significantly different from) the scatter dissimilarity for the Time 2-Time 3 interval. If scatter dissimilarity were affecting the ICC scores in our sample, then we probably would have seen evidence for a trade-off at the Time 1-Time 2 interval. In short, we still recommend the intraclass correlation approach despite some of its shortcomings.

Although the double-entry intraclass approach may be used to measure profile change, there are other ways to improve on this approach. First, researchers examining profile similarity have generated a value for "no similarity" because the distribution is not centered at zero. This is done by obtaining the value of similarity from random dyads in their sample (Furr, 2010; Kenny, Kashy, & Cook, 2006; Robins, Fraley, Roberts, & Trzesniewski, 2001). Similarly, this could be done in future applications of this work by generating a value for "no change" from random dyads of profiles from Time 1 and Time 2. Researchers may also consider examining each profile element (i.e., elevation, scatter, and shape) separately to further identify the important differences in how the elements change and the consequences of such change. Although this study is an important first step in identifying the shape of the profile as the most important element for noting change, additional longitudinal research is needed to investigate this element further.

Another option would be to examine personality change from a cognitive activation approach. The self-concept functions in the same way as other cognitive structures. People come to understand the self in the same way they understand the definition of objects and people, using cognitive schemas, but the self-schema is typically more elaborate than other schemas. The more established a dimension is in memory, the quicker a person will be to recognize the dimension as self-relevant (Markus, 1977). Because the self-concept is a cognitive structure, contemporary methods for assessing the strength of cognitive associations (i.e., reaction time measures) should be used in a research program analyzing overall change. A reaction time component to this measure could serve as an indicator of the certainty or salience of that characteristic (Spencer-Rodgers, Boucher, Mori, Wang, & Peng, 2009). In future applications, it may be most beneficial to ask participants to generate their own list of self-descriptive characteristics; rate those characteristics one at a time on a computer, measuring the rating they provide and the response latency; and then ask them to rate the same characteristics at a later time. Changes in their ratings and their response latencies would then be assessed using the intraclass correlation approach. By using this strategy, researchers would have the advantages of spontaneous, reactive, and reaction time assessments of the self-concept in a single instrument.

Conclusions

The lack of consensus among researchers for assessing changes to a personality profile required the development of a valid technique. The results from this study suggest that the most valid technique for

assessing profile change involves obtaining the ICC across ratings on a reactive measure. By obtaining this overall change score, researchers can now investigate the antecedents and consequences of change to higher-order cognitive structures and therefore answer some of the deeper questions regarding the structure of personality and human adaptability.

NOTE

Address correspondence about this article to Jonathan S. Gore, 127 Cammack Building, 521 Lancaster Avenue, Richmond, KY 40475 (e-mail: jonathan.gore@eku.edu).

REFERENCES

Bernieri, F. J., Zuckerman, M., Koestner, R., & Rosenthal, R. (1994). Measuring person perception accuracy: Another look at self-other agreement. *Personality and Social Psychology Bulletin, 20,* 367–378.

Block, J. (1961). Ego identity, role variability, and adjustment. *Journal of Consulting Psychology, 25,* 392–397.

Brinthaupt, T. M., & Erwin, L. J. (1992). Reporting about the self: Issues and implications. In T. M. Brinthaupt & R. P. Lipka (Eds.), *The self: Definitional and methodological issues. SUNY series, studying the self* (pp. 137–171). Albany: State University of New York Press.

Bugental, J. F. T., & Zelen, S. L. (1950). Investigations into the "self-concept." The W-A-Y technique. *Journal of Personality, 18,* 483–498.

Carroll, R. M., & Field, J. (1974). A comparison of the classification accuracy of profile similarity measures. *Multivariate Behavioral Research, 9,* 373–380.

Cattell, R. B. (1949). r_p and other coefficients of pattern similarity. *Psychometrica, 14,* 279–298.

Coopersmith, S. (1967). *The antecedents of self-esteem.* San Francisco, CA: Freeman.

Costa, P. T., & McCrae, R. R. (2006). Age changes in personality and their origins: Comments on Roberts, Walton, and Viechtbauer (2006). *Psychological Bulletin, 132,* 26–28.

Cronbach, L. J., & Gleser, G. C. (1953). Assessing similarity between profiles. *Psychological Bulletin, 50,* 456–473.

Donahue, E. M., Robins, R. W., Roverts, B. W., & John, O. (1993). The divided self: Concurrent and longitudinal effects of psychological adjustment and social roles on self-concept differentiation. *Journal of Personality and Social Psychology, 64,* 834–846.

Ferguson, C. J. (2010). A meta-analysis of normal and disordered personality across the life span. *Journal of Personality and Social Psychology, 98,* 659–667.

Fidell, L. S., & Tabachnick, B. G. (2003). Preparatory data analysis. In J. A. Schinka & W. F. Velicer (Eds.), *Handbook of psychology: Research methods in psychology* (Vol. 2, pp. 115–141). New York, NY: Wiley.

Filipp, S. H., & Klauer, T. (1986). Conceptions of self over the life span: Reflections on the dialectics of change. In M. E. Baltes & P. B. Baltes (Eds.), *The psychology of control and aging* (pp. 167–206). Hillsdale, NJ: Erlbaum.

Furr, R. M. (2010). The double-entry intraclass correlation as an index of profile similarity: Meaning, limitations, and alternatives. *Journal of Personality Assessment, 92,* 1–15.

Heise, D. R. (1969). Separating reliability and stability in test-retest correlation. *American Sociological Review, 34,* 93–101.

Hormuth, S. E. (1990). *The ecology of the self: Relocation and self-concept change.* Cambridge, England: Cambridge University Press.

John, O. P. (1989). Towards a taxonomy of personality descriptors. In D. M. Buss & N. Cantor (Eds.), *Personality psychology: Recent trends and emerging directions* (pp. 261–271). New York, NY: Springer.

Johnson, W., McGue, M., & Krueger, R. (2005). Personality stability in late adulthood: A behavioral genetic analysis. *Journal of Personality, 73,* 523–551.

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis.* New York, NY: Guilford.

Kenny, D. A., & Winquist, L. (2001). The measurement of interpersonal sensitivity: Consideration of design, components, and unit of analysis. In J. A. Hall & F. J. Bernieri (Eds.), *Interpersonal sensitivity: Theory and measurement. The LEA series is personality and clinical psychology* (pp. 265–302). Mahwah, NJ: Erlbaum.

Klimstra, T. A., Hale, W., Raaijmakers, Q. W., Branje, S. T., & Meeus, W. J. (2009). Maturation of personality in adolescence. *Journal of Personality and Social Psychology, 96*(4), 898–912.

Kling, K. C., Ryff, C. D., & Essex, M. J. (1997). Adaptive changes in the self-concept during a life transition. *Personality and Social Psychology Bulletin, 23,* 981–990.

Kuhn, M. H., & McPartland, T. S. (1954). An empirical investigation of self-attitudes. *American Sociological Review, 19,* 68–76.

Luo, S., & Klohnen, E. C. (2005). Assortative mating and marital quality in newlyweds: A couple-centered approach. *Journal of Personality and Social Psychology, 88,* 304–326.

Malloy, T. E. (1992). Structural equation modeling of self-initiated change. In Y. Klar, J. D. Fisher, J. M. Chinsky, & A. Nadler (Eds.), *Self change: Social psychological and clinical perspectives* (pp. 63–86). New York, NY: Springer-Verlag.

Markus, H. (1977). Self-schemata and processing information about the self. *Journal of Personality and Social Psychology, 35,* 63–78.

Markus, H., & Nurius, P. (1986). Possible selves. *American Psychologist, 41,* 954–969.

Marsh, H. W. (1988). *Self-Description Questionnaire: A theoretical and empirical basis for the measurement of multi-*

ple dimensions of pre-adolescent self-concept. San Antonio, TX: The Psychological Corporation.

McCrae, R. R. (1993). Agreement of personality profiles across observers. *Multivariate Behavioral Research, 28,* 13–28.

McCrae, R. R. (2008). A note on some measures of profile agreement. *Journal of Personality Assessment, 90,* 105–109.

McReynolds, P., Altrocchi, J., & House, C. (2000). Self-pluralism: Assessment and relations to adjustment, life changes, and age. *Journal of Personality, 68,* 347–381.

Mroczek, D. K., & Spiro, A. III. (2007). Personality change influences mortality in older men. *Psychological Science, 18,* 371–376.

Neisser, U. (1993). *The perceived self: Ecological and interpersonal sources of self-knowledge*. New York, NY: Cambridge University Press.

Ozer, D. J., & Gjerde, P. F. (1989). Patterns of personality consistency and change from childhood to adolescence. *Journal of Personality, 57,* 483–507.

Roberts, B. W., Kuncel, N., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The power of personality: A comparative analysis of the predictive validity of personality traits, SES, and IQ. *Perspectives on Psychological Science, 2,* 313–345.

Roberts, B. W., & Mroczek, D. (2008). Personality trait change in adulthood. *Current Directions in Psychological Science, 17,* 31–35.

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin, 132*(1), 1–25.

Roberts, B. W., & Wood, D. (2006). Personality development in the context of the neo-socioanalytic model of personality. In D. Mroczek & T. Little (Eds.), *Handbook of personality development* (pp. 11–39). Mahwah, NJ: Erlbaum.

Robins, R. W., Fraley, R. C., Roberts, B. W., & Trzesniewski, K. H. (2001). A longitudinal study of personality change in young adulthood. *Journal of Personality, 69,* 617–640.

Samuel, D. B., & Widiger, T. A. (2006). Clinicians' judgments of clinical utility: A comparison of the DSM-IV and five factor models. *Journal of Abnormal Psychology, 115,* 298–308.

Sedikides, C., & Brewer, M. B. (2001). *Individual self, relational self, collective self*. New York, NY: Psychology Press.

Sheldon, K. M., Ryan, R. M., Rawsthorne, L. J., & Ilardi, B. (1997). Trait self and true self: Cross-role variation in the Big Five personality traits and its relations with psychological authenticity and subjective well-being. *Journal of Personality and Social Psychology, 73,* 1380–1393.

Spencer-Rodgers, J., Boucher, H., Mori, S., Wang, L., & Peng, K. (2009). The dialectical self-concept: Contradiction, change, and holism in East Asian cultures. *Personality and Social Psychology Bulletin, 35,* 29–44.

Terracciano, A., & McCrae, R. R. (2006). How to measure stereotypes? Response. *Science, 311,* 777–779.

Trull, T. J., Widiger, T. A., Lynam, D. R., & Costa, P. T. (2003). Borderline personality disorder from the perspective of general personality functioning. *Journal of Abnormal Psychology, 112,* 193–202.

van Tuijl, C., Branje, S. J. T., Dubas, J. S., Vermulst, A. A., & Van Aken, M. A. G. (2005). Parent–offspring similarity in personality and adolescents' problem behavior. *European Journal of Personality, 19,* 51–68.

Wicklund, R. A. (1982). How society uses self-awareness. In J. Suls (Ed.), *Psychological perspectives on the self* (Vol. 1, pp. 209–230). Hillsdale, NJ: Erlbaum.