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Selectivity of Attrition in Longitudinal Studies of Cognitive Functioning

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Objectives. Identify characteristics distinguishing people who do and do not continue to participate in a longitudinal study and determine whether the longitudinal changes for people who continue are representative of the changes that would have occurred had longitudinal data been available from all of the initial participants.

Method. Moderately large samples of returning (N = 2,082) and nonreturning (N = 1,698) participants across a wide age range (i.e., 18–97 years of age) performed a battery of cognitive tests and completed personality and mood questionnaires. Differences between the groups were examined with multiple regression analyses with age, returner status, and their interaction as predictors.

Results. Compared with participants who did not return, returning participants at the initial occasion had higher levels of each cognitive ability and of certain personality characteristics (e.g., agreeableness and openness), but many of the differences were only apparent among adults older than 50 years of age. Importantly, there was no evidence that the longitudinal change for nonreturning participants would have been different from that among the participants who did return.

Discussion. The phenomenon of selective attrition is more complex than often assumed, and it may not necessarily limit the generalizability of longitudinal comparisons.

Key Words: Attrition—Cognitive change—Longitudinal.

SELECTIVE attrition is widely recognized as a potential problem in longitudinal studies because if the people who continue to participate differ in relevant characteristics from the people who drop out, the longitudinal sample may no longer be representative of the initial sample (Baltes, Schaie, & Nardi, 1971; Kennison & Zelinski, 2005; Lindenberger, Singer, & Baltes, 2002; Riegel, Riegel, & Meyer, 1968; Schaie, Labouvie, & Barrett, 1973). Because they are sometimes confused, it is useful to distinguish four related, but conceptually separate, terms when discussing attrition: sample selectivity, magnitude of attrition, selectivity of attrition, and possible bias in the estimates of longitudinal change. Sample selectivity refers to the degree to which the research sample at the initial occasion is representative of a broader population. Magnitude of attrition refers to the proportion of participants in the initial sample who do not return for subsequent occasions, and selectivity of attrition refers to the difference between the returning and the nonreturning participants in a relevant characteristic. Finally, bias in the estimates of change refers to the possibility that the estimates of longitudinal change might have been different had the nonreturning participants continued to participate. Note that there is no necessary relation between representativeness of the initial sample and either the number or selectivity of the people who return for subsequent occasions, and regardless of the proportion who return, the attrition may not be selective, or the change estimates biased, if the people who continue to participate do not differ from those who discontinue participation either in their initial level of functioning, or in the longitudinal change they would have exhibited. Nevertheless, the phenomenon of selective attrition cannot be fully understood without considering each of these characteristics.

The current project addressed five questions relevant to different aspects of selective attrition. First, which types of cognition differ between participants who do and do not return for subsequent longitudinal occasions? A number of studies have reported that individuals who return to participate in longitudinal assessments have higher levels of cognitive functioning at the initial occasion than the individuals who do not return (Baltes et al., 1971; Cooney, Schaie, & Willis, 1988; Euser, Schram, Hofman, Westendorp, & Breteler, 2008; Kennison & Zelinski, 2005; Lo & Jagust, 2012; Riegel et al., 1968). However, the reports have been inconsistent about which particular cognitive abilities differ between returning and nonreturning participants. For example, Cooney and colleagues (1988), Riegel and colleagues (1968), and Siegler and Botwinick (1979) reported larger selective attrition effects on measures of crystallized abilities than on measures of fluid abilities, but Riegel and colleagues (1968) and Schaie and colleagues (1973) found differences on all of their cognitive measures.

Second, are there noncognitive characteristics that distinguish people who do and do not return for a subsequent occasion? As with the first question, the literature on this issue is inconsistent. To illustrate, Riegel and colleagues (1968) reported that returning participants had lower levels of rigidity than nonreturning participants,

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but Schaie and colleagues (1973) found the reverse pattern, and different personality and mood characteristics were found to distinguish returning and nonreturning participants in studies by Cooney and colleagues (1988), Kennison and Zelinski (2005), and Lindenberger and colleagues (2002). A recent review of attrition in longitudinal studies of older adults also revealed little consistency in the predictors of attrition (Chatfield, Brayne, & Matthews, 2005).

Third, does the magnitude of selective attrition vary according to the reasons for attrition? Most reasons for attrition can be categorized as one of the four Ms, that is, mortality, morbidity, mobility, and motivation. Because the literature on terminal decline indicates that scores on a variety of cognitive measures are lower several years prior to death (see Backman & MacDonald [2006] for a review), mortality-based attrition might be expected to be moderately large. Indeed, Cooney and colleagues (1988) found larger selective attrition for biological reasons (i.e., morbidity and mortality) than for psychological or sociological reasons (i.e., not interested and mobility). However, the question has not yet been definitively resolved because Van Beijsterveldt and colleagues (2002) found few differences at the initial occasion between participants who did not return because they were not interested and participants who did not return because they were deceased.

Fourth, are there different patterns of selective attrition at different ages? Different patterns might be expected at different ages if the reasons for attrition vary with age, and if degree of selectivity varies according to reason. Only a few studies have included adults across a wide age range to examine the phenomenon at different ages, but each reported smaller differences between returners and nonreturners among young adults than among older adults (Baltes et al., 1971; Riegel et al., 1968; Schaie et al., 1973).

And finally, does the presence of selective attrition necessarily lead to distorted estimates of longitudinal change? That is, regardless whether differences between returning and nonreturning participants are found in the initial assessment, selective attrition may or may not be associated with differences in the direction or magnitude of longitudinal change. Obviously change cannot be directly examined in people with only a single measurement occasion, but at least two methods can be used to estimate change in people who do not return for subsequent occasions: (a) change can be examined in the returning participants at the levels of a relevant variable in nonreturning participants at the first occasion and (b) multiple imputation can be used to estimate scores at the second occasion for nonreturning participants. The first method is based on the assumption that the critical difference between returners and nonreturners is captured by a relevant variable at the first occasion, and the second method essentially treats the second occasion scores for nonreturning participants as missing data and estimates these values with multiple imputation (cf. Van Beijsterveldt et al., 2002).

With the exception of the question about age differences in selective attrition, in which the results do not appear to be widely known, the preceding questions either do not currently have an answer or the relevant results have been inconsistent. At least some of the inconsistency may be attributable to relatively small samples of adults and limited assessment of cognitive abilities in the prior studies, and the current study was designed to overcome these limitations. The data were obtained from the Virginia Cognitive Aging Project (VCAP), which is an ongoing longitudinal study involving adults between 18 and older than 90 years of age (Salthouse, 2007, 2010b; Salthouse, Pink, & Tucker-Drob, 2008).

Method

Participants

Recruitment of new participants in VCAP has been continuous since 2001, and returning participants have been retested at variable intervals since 2004. However, new participants from 2011 to 2012 were not included in the current analyses because they have not yet had an opportunity to be invited to return for a second occasion. Of the participants whose first occasion was prior to 2011, 2,082 of them returned for one or more additional occasions, and 1,698 participated on only one occasion. The interval between the first and the second occasion ranged from 1 to 10 years, with an average of 2.9 years. However, because there was no relation between interval length and age, length of the interval between occasions was ignored in the current analyses.

Characteristics of the participants by age decade, with 18- and 19-year olds included in the decade of the 20s, are summarized in Table 1. It can be seen that increased age was associated with more years of education, but with slightly poorer self-ratings of health. Except for adults in their 90s, the average estimated IQ levels (see subsequently) were above 100, and the correlation between age and estimated IQ was very close to zero.

Cognitive Tests

A total of 16 cognitive tests, representing five cognitive abilities, were administered in the same order to all participants. Vocabulary was assessed by a provide-the-definition test, a picture naming test, and multiple-choice synonym and antonym tests. Reasoning was assessed by a matrix reasoning test, a letter sets test, and a series completion test. Spatial visualization ability was assessed by a spatial relations test, a paper folding test, and a form boards test. Episodic memory was assessed by word recall, paired associates, and story (logical) memory tests. Perceptual speed ability was assessed by a digit symbol substitution test, pattern comparison test, and letter comparison test. Details of the tests, including reliabilities and results of factor analyses supporting the hypothesized

Table 1. Sample Characteristics (With Standard Deviations in Parentheses)

Group	*N*	Attrition	Age	Females	Education	Health	Est. IQ
20s	688	.67	23.0 (3.1)	.57	14.7 (2.1)	2.0 (0.9)	108.7 (11.8)
30s	351	.51	34.3 (2.8)	.72	15.8 (2.8)	2.1 (0.8)	107.4 (14.6)
40s	601	.40	45.0 (2.9)	.73	15.3 (2.6)	2.1 (0.9)	107.2 (15.5)
50s	848	.37	54.4 (2.8)	.70	15.9 (2.6)	2.2 (0.9)	110.2 (14.6)
60s	597	.34	64.2 (2.9)	.66	16.4 (2.8)	2.1 (0.9)	111.2 (13.3)
70s	463	.38	74.2 (2.8)	.58	15.8 (2.8)	2.4 (0.9)	109.4 (13.3)
80s	209	.54	83.1 (2.6)	.41	16.2 (3.2)	2.6 (0.8)	105.9 (13.9)
90s	23	.61	92.2 (1.9)	.30	16.2 (3.2)	2.5 (0.9)	96.3 (11.9)
Age correlation				−.02	.18*	.15*	.01

Notes. Attrition refers to the proportion of participants at T1 who did not return at T2, females refers to the proportion of female participants, education is reported in years completed, and health is on a scale from 1 (*for excellent*) to 5 (*for poor*). Est. IQ refers to the estimated full-scale IQ (see text for details). *$p < .01$.

ability structure, are reported in other publications (Salthouse, 2007, 2010a, 2010b; Salthouse et al., 2008).

Cognitive functioning was examined with composite scores formed by averaging *z* scores (based on the means and standard deviations from the first assessment in the complete sample) for the three or four measures representing each cognitive ability. A principal components analysis was conducted on all 16 measures, and because the first principal component (PC1) was associated with 43.7% of the variance, it was also used as a general measure of cognitive functioning in some analyses.

Noncognitive Measures

The participants completed a set of questionnaires at home, and thus the relations of these measures to attrition were also examined. The questionnaires included the International Personality Item Pool Big Five personality inventory (Goldberg, 1999), the Center for Epidemiological Studies-Depression symptoms inventory (Radloff, 1977), the Spielberger Trait Anxiety Scale (Spielberger, Gorsush, Lushene, Vagg, & Jacobs, 1983), the Need for Cognition Scale (Cacioppo, Petty, Feinstein, & Jarvis, 1996), and the Life Satisfaction Scale (Diener, Emmons, Larsen, & Griffin, 1985). Internal consistency reliabilities for these scales in a subset of the current sample ranged from .78 to .94 (Soubelet & Salthouse, 2011).

Assessment of Representativeness

In a recent study (Salthouse, in press), both the VCAP test battery and the Wechsler Adult Intelligence Scale-IV (WAIS-IV) test battery were administered to 90 adults between 20 and 80 years of age, which allowed estimates of WAIS full-scale IQ scores to be derived in the VCAP participants. This information about IQ referenced to the nationally representative normative sample is valuable to express representativeness of the initial sample (i.e., sample selectivity), as well as to characterize the selectivity of the returning sample (i.e., selective attrition) in a familiar metric.

Because IQ scores in the Wechsler battery are age adjusted, the estimation procedure consisted of partialling age from the VCAP raw scores to create residual scores, determining the best prediction of WAIS-IV IQ from the 16 residual scores, and then using the resulting regression equation to estimate IQ in the VCAP participants. The most parsimonious regression equation with good prediction of IQ (i.e., $R^2 = .86$) was 109.32 + 2.47 (series completion residual) + 1.54 (antonym vocabulary residual) + 1.78 (paper folding residual). The estimated IQ had a correlation of .80 with the PC1, but the two measures differed in terms of their correlations with age as the IQ measure had a correlation of .01, whereas the PC1 measure had a correlation of −.43.

Both the range of IQs, from 60 to 141, and the standard deviation of 13.9, were similar to the values in the nationally representative sample used to create the norms for the Wechsler IQ scores, and therefore the current sample can be inferred to have nearly the same degree of variability as that found in the U.S. population.

Results

Attrition

The third column in Table 1 contains the proportions of the total sample of participants who did not return for a second longitudinal occasion. It can be seen that 60% or more of the participants between 40 and 80 years of age returned for a subsequent occasion, with somewhat smaller percentages at younger and older ages.

The proportions of nonreturning participants in the moved, not interested, demented, and deceased categories are reported in Table 2. The proportions do not sum to 1.0 because some participants were not reachable or had expressed a willingness to participate but had not yet been scheduled because of availability. Mortality was assessed from social security death records, and mobility was primarily determined from the return of first class letters indicating a change of address outside of the local metropolitan area. The not interested category was probably comprised a mixture of individuals who did not return because of low

Table 2. Proportions of Participants Who Did Not Return by Reason and Age Decade

Group	*N*	Moved	Not interested	Dementia	Died
20s	461	.66	.05	.00	.00
30s	179	.57	.06	.00	.00
40s	241	.42	.09	.00	.01
50s	313	.41	.11	.00	.01
60s	203	.30	.24	.00	.03
70s	175	.34	.26	.01	.06
80s	112	.28	.18	.04	.11
90s	14	.07	.14	.00	.36

motivation or poor health (i.e., morbidity). The numbers in the dementia category are undoubtedly underestimates because they are based on reports from a spouse or other relative and were not based on formal evaluations of all nonreturners. Inspection of the entries in Table 2 reveals that mobility was greatest at the youngest ages. The proportions in the other categories were generally small but were higher at older ages.

Selectivity of Attrition

Figure 1 portrays the estimated IQs for participants who did and did not continue to participate as a function of age decade. It should be noted that the estimated IQs in both returning and nonreturning groups were above 100 at all ages, which indicate that the initial sample was selected relative to the general population. Also evident in Figure 1 is that returners had higher scores than nonreturners for participants older than 50 years of age, but that the reverse was true for participants younger than 40 years of age.

Characteristics associated with attrition were examined with regression analyses in which age, returner status (0 for not return, 1 for return), and their interaction (after centering the age variable to minimize collinearity) were predictors of the cognitive composite scores, and of the mood and personality variables (in *z* score units), at the first measurement occasion (T1). Unstandardized regression coefficients for these analyses are reported in Table 3.

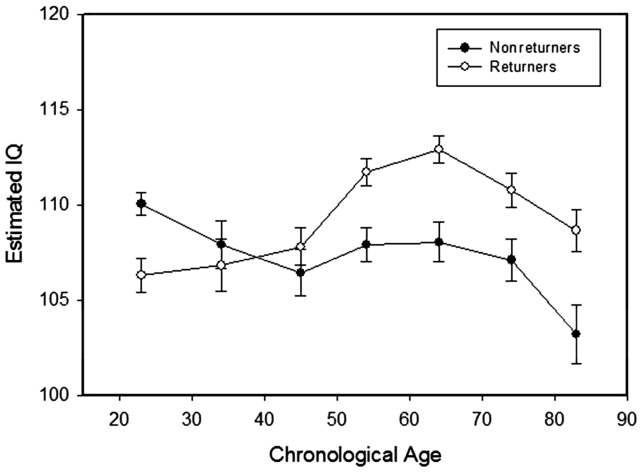

Figure 1. Estimated IQ at the first occasion for adults who did and who did not return for a second occasion as a function of age decade. Error bars are standard errors.

The entries in the first two rows indicate that there were no differences between male and female participants with respect to returner status, and that the people who returned had better self-rated health (i.e., ratings closer to 1) than those who did not return. The significant interaction for education indicates that among young adults, individuals with higher levels of education were less likely to continue to participate than those with lower levels of education, but that no differences were evident among older adults.

Rows 4–9 in Table 3 contain information about the cognitive ability measures. All cognitive measures are in *z* score units, and thus the age coefficient reflects the difference in number of standard deviations associated with 1 year of age, and the coefficient for returner status reflects the standard deviation difference between returners and nonreturners. As expected, the age relations on the cognitive abilities were all significant, in a positive direction for vocabulary and in a negative direction for other abilities. The positive effect of returner status indicates that the T1 scores for each cognitive ability were higher for the returning participants than for the nonreturning participants.

Consistent with the pattern in Figure 1, all of the age-by-returner status interactions were in the direction of higher values for returning participants at older ages, but lower values for returners at younger ages. Analyses conducted at each decade generally revealed that the interactions were attributable to significantly higher values for nonreturning

Table 3. Unstandardized Regression Coefficients Predicting Characteristics at T1 From Age, Returner Status, and Their Interaction

	Age	Returner (0,1)	Age × Returner Interaction
Sex (0 = M)	.000	.032	−.002
Health (1 = *excellent*, 5 = *poor*)	.009*	−.085*	−.004
Education	.019*	.052	.015*
Vocabulary	.007*	.143*	.007*
Reasoning	−.026*	.133*	.008*
Spatial visualization	−.026*	.042	.008*
Memory	−.024*	.141*	.008*
Speed	−.033*	.113*	.005*
First principal component	−.029*	.165*	.010*
Emotional stability	.008*	−.073	.003
Extraversion	−.003	−.051	.006*
Openness	−.006*	.105*	.004
Agreeableness	.001	.109*	.005
Conscientiousness	.008*	.065	.002
CES-D (depressive symptoms)	−.008*	−.059	−.003
Trait anxiety	−.012*	−.005	−.003
Need for cognition	−.007*	.032	.008*
Life satisfaction	.004*	.019	.004

Notes. CES-D = Center for Epidemiological Studies-Depression. All dependent variables except sex, health, and education are in *z* score units. *$p < .01$.

participants in their 20s, but significantly higher values for returning participants among participants aged 50 and older. The opposite pattern at younger ages was likely attributable to the higher mobility at this age (cf. Table 2). Indeed, comparison of the estimated IQs for the individuals who had or had not moved revealed a significant difference only at the youngest decade, in which the movers had an estimated IQ of 111 compared with 107 for nonmovers.

The remaining rows in Table 3 contain information about the noncognitive variables. The analyses with the personality and mood characteristics indicated that returners had higher levels of openness and agreeableness than the nonreturners, and among older participants, the returning participants were higher in extraversion and in Need for Cognition than nonreturning participants. No differences were evident between those who did and did not return in the measures of anxiety, depressive symptoms, or emotional stability (i.e., reverse of neuroticism).

Estimating Change in Nonreturning Participants

Two methods were used to determine whether the people who did not continue to participate might have had a different pattern of longitudinal change than people who did continue. One method involved a two-step process in which the relation of change to overall cognitive ability was first determined in the returning participants, and then that relation was used to estimate the cognitive change corresponding to the initial ability levels of the returning and nonreturning participants. Parameters of the regression equations predicting the T2 – T1 differences in the composite cognitive scores from age, a measure of overall cognitive ability, and their interaction, are reported in Table 4. In order to facilitate comparisons across ability measures, the relations in Table 4 are expressed as standardized coefficients. It can be seen that the patterns were very similar when general cognitive ability was assessed with the estimated IQ measure and with the PC1 measure.

Table 4. Standardized (Beta) Coefficients Predicting T2 – T1 Longitudinal Difference in Five Cognitive Abilities From Age, Initial Ability, and Their Interaction

	Age	Est. IQ	Age × Est. IQ
Ability = Est. IQ			
Vocabulary	−.157*	−.105*	−.047
Reasoning	−.105*	−.124*	−.007
Spatial visualization	−.178*	−.040	−.056
Memory	−.232*	.042	−.042
Speed	−.161*	−.018	−.055
	Age	PC1	Age × PC1
Ability = PC1			
Vocabulary	−.196*	−.094*	−.026
Reasoning	−.163*	−.124*	.000
Spatial visualization	−.187*	−.029	−.031
Memory	−.234*	−.031	−.024
Speed	−.192*	−.065	−.036

Notes. PC1 = first principal component.
*$p < .01$.

Increased age was associated with more negative longitudinal change in each cognitive ability, which is consistent with other reports based on subsets of these data (Salthouse, 2010a, 2010b). There were also significant ability effects on the change in the vocabulary and reasoning composite scores, in the direction of more negative change at higher ability levels. However, the lack of interactions of general cognitive ability with age suggests that the ability-change relations were similar at each age for all five cognitive composite scores.

The parameters from the regression equations were next used to determine the change from T1 to T2 at the estimated IQ levels of the returning and nonreturning participants. These values are portrayed as a function of age decade in the five panels of Figure 2. It can be seen that the functions for the estimated change at the T1 ability levels corresponding to the returning and nonreturning participants were almost identical. Although not illustrated, a very similar pattern was evident when ability was assessed with the PC1 measure instead of estimated IQ.

The second method used to estimate longitudinal change for nonreturning participants was based on imputation of the T2 score. That is, multiple imputation was used to estimate the T2 composite scores for nonreturners on the basis of data from all participants for age, composite cognitive scores at T1 and at T2 (only for returners), and values of openness, agreeableness, extraversion, and Need for Cognition at T1. Five separate imputations were generated, and then pooled estimates of the T2 composite scores were created for each ability. These pooled T2 estimates were used to determine T2 – T1 composite score differences for the nonreturners, which are plotted together with the observed differences for returners in the five panels of Figure 3. Inspection of the figure reveals that the imputed changes were very similar to the observed changes in each ability and at each age decade.

Discussion

The current study was conducted to investigate five questions related to selective attrition. The first question was what aspects of cognitive functioning differ between individuals who do and do not return for a subsequent occasion in a longitudinal study. The results in Table 3 indicate that returning participants had higher levels of all five cognitive abilities and of the PC1 representing variance that all cognitive variables had in common. Although some earlier studies reported larger differences for measures of crystallized intelligence or vocabulary, their representation of other abilities was limited and the sample sizes were small compared with the present study.

The second question was whether there were noncognitive differences between returning and nonreturning

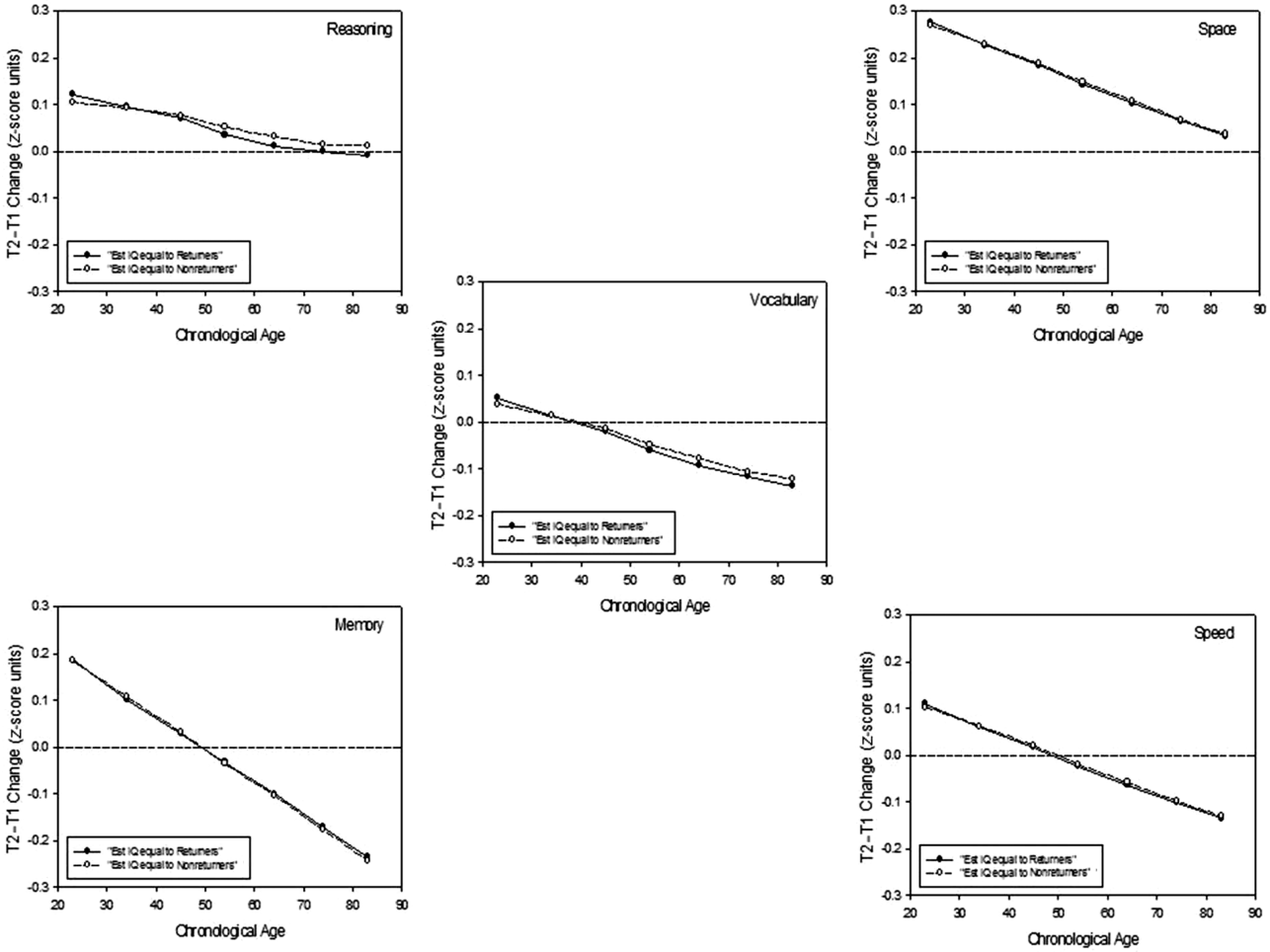

Figure 2. Change (T2 – T1 difference in composite scores) in returning participants at estimated IQ levels at T1 corresponding to those for returning and nonreturning participants as a function of age decade.

participants. Results relevant to this question are also presented in Table 3. Compared with individuals who did not return, those who returned had better self-rated health and were higher in openness and agreeableness. Furthermore, among older adults, the returners were higher in extraversion and on the Need for Cognition Scale. No differences between participants who did and did not return were apparent in measures of negative affect (i.e., depressive symptoms, trait anxiety, or emotional stability).

The third question was whether selectivity varied according to the reasons for attrition. Very small proportions of participants in the sample had died or were identified as demented, and therefore only nonreturning participants in the not interested and moved categories were compared. The only significant difference was at young ages, in which people who had moved had higher initial levels of cognitive ability than those who discontinued participation because they were not interested.

The fourth question addressed in the study was whether there were age differences in the selectivity of the attrition. The answer to this question was unequivocally positive, as pronounced age differences were apparent in Figure 1, and several interactions of age and returner status in Table 3 were significant. In each case, older returning participants had higher initial levels than the nonreturning participants, but, probably because of the greater mobility among high functioning young adults, the reverse was true at younger ages. As mentioned in the Introduction section, several earlier studies have also reported little or no selective attrition among young adults (Baltes et al., 1971; Riegel et al., 1968; Schaie et al., 1973). Those results, together with the results of the current study, indicate that selective attrition is not always in the direction of survival of the fittest because this does not appear to be the case at younger ages where the direction of selectivity may even be reversed.

The fifth question investigated in the study was whether selectivity is also apparent in the direction or magnitude of longitudinal changes. Two methods were used to investigate this question. The first method was based on the assumption that the primary factor affecting longitudinal

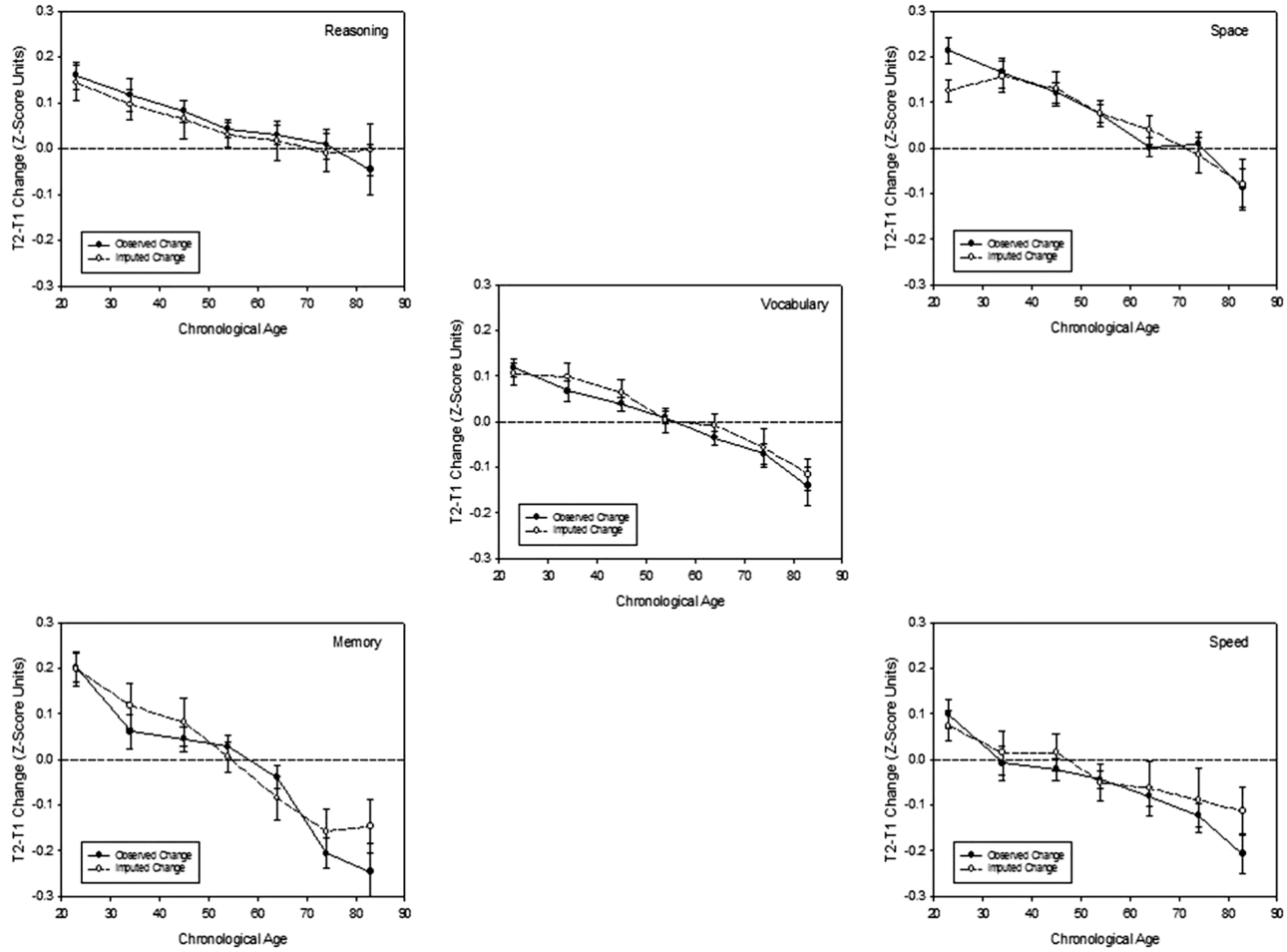

Figure 3. Observed change (T2 – T1 difference in composite scores) for returning participants and imputed change for nonreturning participants as a function of age decade. Error bars are standard errors.

change is initial level of overall cognitive ability, and therefore cognitive change was examined in the sample of returning participants at the mean level of initial ability corresponding to the nonreturning participants. Results of these analyses are portrayed in the five panels of Figure 2. Perhaps because none of the age-by-ability interactions in Table 4 were significant, the age-change relations for returning and nonreturning participants in the five panels of Figure 2 were nearly identical.

The second method used to estimate change among nonreturning participants relied on multiple imputation to derive the best estimate of what the score at T2 would have been had there been no missing data. That is, the cognitive scores at T1 and T2 and the noncognitive variables at T1 that were associated with attrition in Table 3 were used as predictors of the imputed values of the cognitive composite scores at T2. The estimated mean T2 – T1 differences derived from these imputed T2 scores are plotted by age decade in the five panels of Figure 3. Although there is clearly more variability in this figure than in Figure 2, the age-change functions for the observed changes in returning participants and for the estimated changes in nonreturning participants were very similar in each panel. The results in Figures 2 and 3 therefore suggest that although the older individuals who participated in this longitudinal study had higher levels of cognitive abilities on the initial occasion than those who did not, there was little indication that the magnitude of cognitive change would have been different had there been no attrition.

It is important to recognize that the use of data from returning participants to predict the T2 scores (and T2 – T1 changes) of nonreturning participants is based on the missing at random (MAR) assumption that the T2 scores for nonreturning participants are unrelated to returner status after controlling the values of other measured variables. It is therefore possible that the estimates of change in Figures 2 and 3 are inaccurate if the individuals who do not return differ from those who do return in aspects of T2 scores (and T2 – T1 changes) that are not fully captured by the T1 scores (for the estimates in Figure 2) or by the variables found to differ between returning and nonreturning participants (for the estimates in Figure 3). Unfortunately, because no T2

data are available from the nonreturning participants, the validity of this assumption cannot be directly evaluated with the current data.

To summarize, the current results indicate that the phenomenon of selective attrition is complex, as the direction and magnitude of selective attrition vary with the age of the individual and according to the type of variable under consideration. Compared with people who do not continue to participate, people who continue to participate had higher average levels of cognitive abilities and higher values in personality characteristics such as openness and agreeableness. However, even when selective attrition is pronounced, the results of this study suggest that, at least among moderately healthy adults ranging from 18 to older than 80 years of age and assuming that the data from nonreturning participants are MAR, selective attrition does not necessarily lead to biases in the estimates of longitudinal change.

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