

Tracking Changes in Social Relations Throughout Late Life

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Objectives. This research aimed to chart age-related changes in 11 dimensions of social relations during later life. We also examined interpersonal differences in intra-individual changes.

Methods. We used hierarchical linear modeling with data from a nationwide survey of 1,103 elders who were interviewed up to four times over a 10-year period.

Results. Age-related changes in social relations varied across the different dimensions, and significant interpersonal differences existed in these trajectories. Emotional support was relatively stable with advancing age, whereas other types of received support (i.e., tangible and informational) increased with age and levels of provided support declined. Furthermore, the findings revealed declines in contact with friends, support satisfaction, and anticipated support. These changes were not uniform throughout the sample, as indicated by significant random effects with respect to the intercepts and slopes in virtually each model. Gender and socioeconomic status accounted for some of this variation.

Discussion. These findings highlight the dynamic nature of social relationships in late life. In addition, the findings both provide evidence of older adults managing their social ties to meet the challenges of aging and suggest the importance of the interplay between giving and receiving support.

AN abundance of research findings reveal that the quality and quantity of older adults' social ties are closely linked with a variety of health outcomes, including mortality (Eng, Rimm, Fitzmaurice, & Kawachi, 2002), functional disability (Mendes de Leon et al., 1999), cognitive impairment (Seeman, Lusignolo, Albert, & Berkman, 2001), psychological distress (Matt & Dean, 1993), and disease risk and recovery (for a review, see Seeman, 2000). Indeed, maintaining social connections and having access to social support are key markers of successful aging (Rowe & Kahn, 1998).

Despite compelling evidence that social support is associated with health, however, there is still a great deal researchers do not know about the social support process. Most research on social support and social networks has utilized cross-sectional data. Moreover, analyses of longitudinal data over an extended period of time are rare. As a result, experts know relatively little about how social support changes as people age. When researchers have examined change, most of their studies have focused on aggregate-level, rather than individual-level, change (e.g., Field & Minkler, 1988). Studying within-person change is important because, as research by Krause (1999) revealed, there may be substantial individual variations in levels of support over time.

Describing patterns of change as well as variations in these patterns, however, is only a first step. Researchers also must explain, or account for, interpersonal differences in intra-individual change. Consistent with findings from cross-sectional studies (e.g., Turner & Marino, 1994), the current study focused on social structural differences in individual change. More specifically, we assessed whether gender (Antonucci & Akiyama, 1987), socioeconomic status (Krause & Borawski-Clark, 1995), and race (Peek & O'Neill, 2001) explain change in support over time within individuals.

Aging and Social Relationships

In order to lay the theoretical foundation for this research, we first outline key perspectives regarding the nature of age-related change in social relationship resources. Early work in this area relied upon disengagement theory to explain the hypothesized decline in social interaction among aging adults (Cummings & Henry, 1961). Other scholars, however, argued that aging should not be viewed simply as a period of disengagement, but rather as a time when older adults should be striving to maintain their social activities and social roles (Neugarten, Havighurst, & Tobin, 1968). Still others emphasized older adults' needs for continuity over time in their patterns of social relationships (Atchley, 1989).

More recently, socioemotional selectivity theory has provided a compelling explanation for how social relationships change with advancing age (Carstensen, 1992). This theory suggests that aging adults deliberately allow for reductions of certain types of social ties while striving to maintain others. The social ties that are disbanded are most likely to be of a nonintimate and peripheral nature, whereas those that are maintained are likely to be the most intimate ties in one's network (see also Tornstam, 1997). The reasoning behind this selective reduction in social ties is that as individuals get older and begin to perceive that time is limited, short-term rather than long-term goals become increasingly important. Proponents of this theory consider emotional well-being to be one of the most salient short-term goals for older adults, and maintaining intimate social ties appears to offer the best opportunities for satisfying this particular goal (M. M. Baltes & Carstensen, 1999). Thus, socioemotional selectivity theory suggests that age-related changes in social relationships are not uniform with respect to all dimensions of support: Elders may replace losses

in social contact and support from peripheral ties with gains in contact and emotional support from the more intimate network members that remain. This pattern of replacement of social ties over the life course is consistent with Kahn and Antonucci's (1981) social convoy model as well as P. B. Baltes's (1997) theory of successful aging known as selection, optimization, and compensation.

Empirical Evidence of Age-Related Changes in Social Relationships

Empirical support for the social transitions described by socioemotional selectivity theory is growing, but it suffers from methodological limitations. Most notably, several studies examining social relationship changes in late life have been based on cross-sectional data. For example, studies by Morgan (1988) and Lang and Carstensen (1994) found that currently older respondents reported smaller social networks than did presently younger respondents. Additional cross-sectional studies found stability in levels of support across different age groups (Antonucci & Akiyama, 1987), whereas others found age differences in sources of support, with older adults reporting most of their support as coming from family members and younger adults reporting more support from friends (Levitt, Weber, & Guacci, 1993).

Although findings from cross-sectional studies are informative, evaluating age differences in social relationships across, rather than within, individuals makes it impossible to distinguish between true age effects and those that are due to cohort or period differences across the sample. Therefore, some investigators have used longitudinal data in an attempt to more accurately represent the experiences of individuals as they progress through adulthood. Most of these studies corroborated findings from cross-sectional studies with respect to an overall decline in network size or social contact among older adults (e.g., Barnes, Mendes de Leon, Bienias, & Evans, 2004; Krause, 1999). Nevertheless, others found considerable stability in social contact with advancing age (Martire, Schulz, Mittelmark, & Newsom, 1999). Again, it appears that different patterns of change are evident across different aspects of social relationships. For example, as suggested by socioemotional selectivity theory, Field and Minkler's (1988) findings showed that the bulk of reductions in social contact were associated with social ties that were beyond the family (see also van Tilburg, 1998). Additional studies suggested that at least some types of support from social network members increase with age (e.g., Cornman, Lynch, Goldman, Weinstein, & Lin, 2004), whereas others found levels of social support to be stable over time (Bergeman, Neiderhiser, Pedersen, & Plomin, 2001), even in the face of declining social roles (Bosse, Aldwin, Levenson, Spiro, & Mroczek, 1993).

Although these findings appear to provide some support for the basic tenants of socioemotional selectivity theory, it is uncertain if they represent the experiences of the general population of older adults as these individuals age over extended periods of time. The current study aimed to address this issue by estimating change in a full complement of social support and social network measures over an extended period of time, using data from a nationally representative sample of older adults. Specifically, we hypothesized that only those aspects of social relationships that helped older adults to meet their relatively immediate needs, such as emotional and tangible

support, would increase with advancing age. In contrast, we hypothesized decreasing levels of social relationship dimensions that were unhelpful in meeting immediate needs, such as provided support or negative interaction, or that involved peripheral rather than intimate ties.

Heterogeneity in Age-Related Trajectories of Social Relationships

The general age-related changes in social relationships described by socioemotional selectivity theory apply to the population as a whole; however, the notion of aged heterogeneity (Dannefer & Sell, 1988) predicts substantial variation around these general trends. Indeed, compelling empirical support for such heterogeneity in age-related social relationship changes currently exists (Krause, 1999; Stoller & Pugliesi, 1991; Taylor & Lynch, 2004). Presently, however, there is a clear need to explain this heterogeneity by identifying factors that are associated with variability in these individual trajectories. Consistent with the notion of a social stratification of social relationship resources, and given the strong cross-sectional evidence for gender, socioeconomic, and race differences in social relationships resources, it makes sense to begin trying to account for variation in social relationship trajectories by focusing on these same social status indicators. Accordingly, in light of evidence that women have relatively strong interpersonal orientations compared to men (Turner & Marino, 1994), we hypothesized less age-related decrement in social relationship resources among aging women than among men. In addition, because most research seems to suggest that social networks in lower socioeconomic groups do not function as well as those in upper socioeconomic groups (Krause & Borawski-Clark, 1995), we hypothesized greater decrement in the social relationship trajectories of older adults of low socioeconomic status compared with their counterparts of high socioeconomic status. Finally, although some controversy exists in the literature (Kaniasty & Norris, 2000), the bulk of current evidence seems to indicate that social networks are more well developed among minority elders. Thus, we hypothesized advantages in the social relationship trajectories of older minorities compared to Whites.

METHODS

Sample

Data for this study came from the first four waves of a nationwide longitudinal survey of adults aged 65 years or older at baseline (Krause, 1994). Researchers conducted the baseline survey in 1992/1993, at which time they defined the study population as all household residents aged 65 or older who were not institutionalized, who spoke English, and who were retired (i.e., not working for pay). The survey excluded residents of Alaska and Hawaii, as well as elderly people who did not have a Social Security number and those who were 100 years or older at baseline. A total of 1,103 respondents completed interviews at baseline. Researchers collected additional waves of data from 605 study participants in 1996/1997, 530 participants in 1998/1999, and 269 respondents in 2002/2003.

To minimize the loss of respondents due to missing items or attrition, we used multiple imputation (Rubin, 1987).

Specifically, we imputed missing data on social support for any nonrespondent at a given wave by using data collected at baseline as well as repeated measures of social support up to the time when that individual became a nonrespondent. We imputed six complete data sets with the NORM software developed by Schafer (1997), and we ran analyses on each of these six data sets. For all analyses, we averaged each estimate across the six imputations to generate a single point estimate. We then calculated standard errors using a formula that combined the average of the squared errors of the estimates and the variance of the parameter estimates across the six samples (Rubin, 1987). Having employed these multiple imputation procedures, we obtained sample sizes at each wave as follows: 1,103 at Wave 1; 1,103 at Wave 2; 930 at Wave 3; and 854 at Wave 4.

The data analytic procedures described in the section Data Analysis (hierarchical linear modeling) allowed us to base estimates on all 1,103 original respondents. Of these, 39% were men, and 92% were White. The average age at baseline was 74.49 years ($SD = 6.74$). Also at baseline, these respondents reported having completed an average of 11.39 years ($SD = 3.58$) of schooling.

Measures

The survey contained measures of 11 dimensions of social networks and support in each of the four waves. Table 1 presents the individual items that contributed to each scale, along with their response options. We selected these measures to represent each of the social relationship dimensions identified by Barrera (1986): (a) social embeddedness, which is assessed with measures of the frequency of contact with family and friends; (b) enacted support, which is measured with items that estimate the amount of emotional, tangible, and informational support received from others in the year prior to the interview; and (c) perceived support, which is measured by indicators of satisfaction with support exchanges, anticipated support (i.e., the belief that assistance would be forthcoming in the future should the need arise), and negative interaction. The survey also included measures of the amount of emotional, tangible, and informational support that respondents provided to others in the year prior to the survey. The origins of each of these scales, as well as their internal consistency reliability estimates, have been described previously (Krause, 1999). As revealed in that study, all of the reliability estimates are acceptable. Table 2 presents the means and standard deviations for each scale at each wave.

Other measures used in the current study included age (years since birth), gender (1 = male; 0 = female), education (years of completed schooling), and race (1 = White; 0 = non-White).

Data Analysis

The data analytic strategy employed to make full use of these longitudinal data involved estimating individual social relations trajectories, or growth curves, using hierarchical linear modeling (Raudenbush & Bryk, 2002). The analysis of individual growth curves is considered hierarchical in that the four occasions of measurement of social relations are nested within individuals. This enabled us to examine how social relations changed with increasing age within individuals, rather than just across age groups as is proposed with cross-sectional data.

We carried out the statistical procedures for examining individual growth curves in two stages. In the descriptive stage,

we modeled social support as a function of age (centered on the sample mean) over the course of the four waves of data collection for each individual as follows (Level 1):

$$SS_{ij} = \pi_{0i} + \pi_{1i}Age_{ij} + \varepsilon_{ij}, \quad (1)$$

where SS_{ij} is any of the 11 social support/relations measures for individual i at age j ; π_{0i} is the intercept, which, because the variable Age is centered on the sample mean, is located at the mean age level across all observations (78.69); π_{1i} is the rate of change (slope) in social support for individual i with increasing age; and ε_{ij} represents random error for individual i at age j .

In order to control for potential cohort effects, we included two dummy variables representing birth cohort in the Level 2 models as follows:

$$\pi_{0i} = \beta_{00} + \beta_{01}Born1908-1917_i + \beta_{02}Born1918-1927_i + u_{0i} \quad (2)$$

$$\pi_{1i} = \beta_{10} + \beta_{11}Born1908-1917_i + \beta_{12}Born1918-1927_i + u_{1i} \quad (3)$$

In these models, the cohort born prior to 1908 served as the reference group for the birth cohort variables. Each of the birth cohort variables was centered on its mean value (see Hox, 2002, p. 56). Thus, the fixed effects β_{00} and β_{10} represent the average level of social support and the average growth rate for social support with increasing age for the sample taken as a whole, after controlling for the effects of birth cohort. The random effects u_{0i} and u_{1i} represent the degree to which respondents' social support at the intercept and growth trajectories deviates from the mean. We used these to determine whether social support levels and rates of change were uniform throughout the sample, or alternatively, whether the data included between-subjects variance with regard to trajectories of social support. We should note that in addition to the linear model presented in Equations 1 through 3, we tested a nonlinear model by adding a quadratic term ($\pi_{2i}Age_{ij}^2$) to Equation 1 and decomposing the parameter π_{2i} into fixed and random effects exactly as we had done in Equations 2 and 3.

In the second stage of analysis, we entered the explanatory variables (gender, education, and race) into the Level 2 models (Equations 2 and 3) in order to explain individual differences in the intercept and slope parameters. We can represent these explanatory models by combining the Level 1 and 2 models as follows:

$$SS_{ij} = \beta_{00} + \beta_{10}Age_{ij} + \beta_{01}Born1908-1917_i + \beta_{02}Born1918-1927_i + \beta_{03}Gender_i + \beta_{04}Education_i + \beta_{05}Race_i + (\beta_{11}Born1908-1917_i \times Age_{ij}) + (\beta_{12}Born1918-1927_i \times Age_{ij}) + (\beta_{13}Gender_i \times Age_{ij}) + (\beta_{14}Education_i \times Age_{ij}) + (\beta_{15}Race_i \times Age_{ij}) + u_{0i} + u_{1i}Age_{ij} + e_{ij} \quad (4).$$

In this equation, the main effects for gender, education, and race represent the association between these variables and the level of social support at the mean age of the sample. The multiplicative terms represent the effects of these social structural variables on the linear slope representing the relationship

Table 1. Study Measures

A. Social Embeddedness ^a	
A.1. Contact with family	
A.1.1.	In the past two weeks, how often have you gone out to visit family?
A.1.2.	In the past two weeks, how often have you had family visit you?
A.1.3.	In the past two weeks, how often have you had contact by phone or letter with family?
A.2. Contact with friends	
A.2.1.	In the past two weeks, how often have you gone out to visit friends?
A.2.2.	In the past two weeks, how often have you had friends visit you?
A.2.3.	In the past two weeks, how often have you had contact by phone or letter with friends?
B. Enacted Support ^b	
B.1. Emotional support received from others	
B.1.1.	How often has someone been right there with you in a stressful situation?
B.1.2.	How often has someone comforted you by showing you physical affection?
B.1.3.	How often has someone listened to you talk about your private feelings?
B.1.4.	How often has someone expressed interest and concern in your well-being?
B.2. Tangible support received from others	
B.2.1.	How often has someone provided you with some transportation?
B.2.2.	How often has someone pitched in to help do something that needed to get done, like household chores or yard work?
B.2.3.	How often has someone helped you with shopping?
B.3. Informational support received from others	
B.3.1.	How often has someone suggested some action that should be taken in order to deal with a problem?
B.3.2.	How often has someone given you information that made a difficult situation easier to understand?
B.3.3.	How often has someone told you what they did in a stressful situation that was similar to one you were experiencing?
C. Provided Support ^b	
C.1. Emotional support provided to others	
C.1.1.	How often have you been right there with someone who was experiencing a stressful situation?
C.1.2.	How often have you comforted someone by showing them physical affection?
C.1.3.	How often have you listened to someone talk about their private feelings?
C.1.4.	How often have you expressed interest and concern in someone's well-being?
C.2. Tangible support provided to others	
C.2.1.	How often have you provided someone with some transportation?
C.2.2.	How often have you pitched in to help someone do something that needed to get done, like household chores or yard work?
C.2.3.	How often have you helped them with their shopping?
C.3. Informational support provided to others	
C.3.1.	How often have you suggested some action that someone should take in order to deal with a problem they were having?
C.3.2.	How often have you given someone information that made a difficult situation clearer and easier to understand?
C.3.3.	How often have you told someone what you did in a stressful situation that was similar to one they were experiencing?
D. Perceived support	
D.1. Satisfaction with support exchanges ^c	
D.1.1.	Are you satisfied with the amount of emotional support that you received from others, or do you wish that others had given you this kind of help more often or less often?
D.1.2.	Thinking back over the past year, would you say you feel satisfied with [the tangible support you have received], or do you wish it was given to you more often or less often?
D.1.3.	Thinking back over the past year, would you say you feel satisfied with [the informational support you have received], or do you wish it was given to you more often or less often?
D.1.4.	Thinking over the past year, are you satisfied with the amount of help you've given others, or do you wish you had helped others more often or less often?
D.2. Anticipated support ^d	
D.2.1.	If you were sick in bed, how much could you count on the people around you to help out?
D.2.2.	If you needed to talk about your problems and private feelings, how much would the people around you be willing to listen?
D.2.3.	If you needed to know where to go to get help with a problem you were having, how much would the people around you be willing to help out?
D.3. Negative interaction ^b	
D.3.1.	How often have you felt that others made too many demands on you?
D.3.2.	How often have you felt that others were critical of you and things you did?
D.3.3.	How often have you felt that those around you tried to pry into your personal affairs?
D.3.4.	How often have you felt that others took advantage of you?

Notes: ^aItems scored as follows: not at all (1), once or twice (2), 3 to 6 times (3), more than 6 times (4).

^bItems scored as follows: never (1), once in a while (2), fairly often (3), very often (4).

^cItems scored as follows: not satisfied (0), satisfied (1).

^dItems scored as follows: not at all (1), a little (2), some (3), a great deal (4).

Table 2. Means and Standard Deviations for Each Dimension of Social Support and Social Networks

Social Support Dimension	Wave 1 (<i>N</i> = 1,103)	Wave 2 (<i>N</i> = 1,103)	Wave 3 (<i>N</i> = 930)	Wave 4 (<i>N</i> = 854)
Contact with family (3–12)	7.39 (2.21)	7.36 (2.21)	7.39 (2.21)	7.44 (2.15)
Contact with friends (3–12)	7.17 (2.32)	6.93 (2.22)	7.05 (2.30)	7.00 (2.22)
Emotional support (4–16)	10.65 (3.66)	10.78 (3.43)	10.71 (3.51)	10.83 (3.41)
Tangible support (3–12)	5.63 (2.64)	6.00 (2.59)	6.42 (2.60)	6.86 (3.13)
Informational support (3–12)	4.83 (2.06)	5.35 (2.11)	5.20 (2.04)	5.77 (2.09)
Emotional support provided (4–16)	10.36 (3.35)	10.07 (3.19)	10.06 (3.18)	9.65 (3.06)
Tangible support provided (3–12)	5.65 (2.34)	5.15 (2.07)	5.11 (2.04)	4.68 (1.84)
Informational support provided (3–12)	5.26 (2.14)	5.35 (2.08)	5.29 (2.04)	5.17 (1.89)
Satisfaction with support exchanges (0–4)	3.33 (0.99)	3.11 (1.05)	3.20 (0.98)	2.27 (1.27)
Anticipated support (3–12)	10.10 (2.22)	9.97 (2.12)	9.97 (2.15)	9.94 (1.98)
Negative interaction (4–16)	5.72 (2.30)	5.72 (2.01)	5.71 (2.02)	5.78 (1.84)

between age and social support. The inferences drawn from these models utilize the robust standard errors produced by hierarchical linear modeling because they are somewhat tolerant of violations to the assumption of normally distributed response variables (Hox, 2002).

RESULTS

Descriptive Models

The parameter estimates and robust standard errors for each of the descriptive models appear in Tables 3 through 6. We present estimates for only the linear slopes. We tested quadratic slope estimates, but we do not present them here because none were statistically significant. The linear age slope fixed effects from these models showed that, after controlling for the effects of birth cohort, levels of received tangible and informational support increased with age (see Table 4), whereas contact with friends (Table 3), provided support (Table 5), and perceived support (Table 6) each decreased. At the same time, received emotional support (Table 4), contact with kin (Table 3), and negative interaction (Table 6) appeared to be relatively stable. Especially noteworthy increases were evident with respect to tangible support received (slope = .919, $p < .001$) and informational support received (slope = .349, $p < .001$),

whereas fairly substantial decreases were evident with respect to contact with friends (slope = $-.199$, $p < .01$), emotional support provided (slope = $-.555$, $p < .001$), tangible support provided (slope = $-.692$, $p < .001$), and satisfaction with support exchanges (slope = $-.504$, $p < .001$).

It is also important to assess the random effects estimated in these models. Tables 3 through 6 show that in each of the 11 unconditional models, the random effect associated with the intercept was highly significant. This was an indication of individual differences with respect to the level of each type of social support. Additionally, the random effects associated with the linear slopes in 10 of the 11 models were significant, suggesting the existence of interpersonal variability underlying the normative age-related changes in social support.

Analysis of Attrition

Before turning to the analyses testing the extent to which gender, education, and race explained individual differences in the intercept and slope parameters, it is necessary to call attention to the fact that those individuals with complete data across all four waves of this study were likely to differ from those who had dropped out or died during the study period. Although the fixed effects presented in Tables 3 through 6 were based on data from all 1,103 original participants, because these

Table 3. Parameter Estimates and Robust Standard Errors for Linear Growth-Curve Models of Social Embeddedness

Effects	Contact With Kin		Contact With Friends	
	Descriptive Model	Explanatory Model	Descriptive Model	Explanatory Model
Fixed effects				
Intercept	7.457 (.07)***	7.453 (.07)***	7.102 (.08)***	7.091 (.08)***
Age slope	-.045 (.09)	-.051 (.09)	-.199 (.08)**	-.204 (.08)**
Gender (1 = male)		-.258 (.09)**		-.284 (.12)*
Education		.005 (.02)		.065 (.02)***
Race (1 = White)		.231 (.21)		.153 (.17)
Gender \times Slope		.140 (.11)		.021 (.09)
Education \times Slope		.003 (.01)		-.009 (.01)
Race \times Slope		-.184 (.18)		-.134 (.18)
Random effects				
Variances				
Intercept	0.868***	0.853***	0.800***	0.731***
Slope	.137**	.133**	.148**	.150**
Akaike's information criterion	17,399	17,406	17,687	17,666

Notes: Each model controlled for the effects of birth cohort. Standard errors are in parentheses.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 4. Parameter Estimates and Robust Standard Errors for Linear Growth-Curve Models of Enacted Social Support

Effects	Emotional Support Received		Tangible Support Received		Informational Support Received	
	Descriptive Model	Explanatory Model	Descriptive Model	Explanatory Model	Descriptive Model	Explanatory Model
Fixed effects						
Intercept	10.777 (.13)***	10.773 (.13)***	6.135 (.11)***	6.138 (.11)***	5.219 (.09)***	5.219 (.09)***
Age slope	.193 (.15)	.187 (.15)	.919 (.09)***	.890 (.09)***	.349 (.06)***	.347 (.06)***
Gender (1 = male)		-.602 (.14)***		-.775 (.01)***		-.224 (.09)*
Education		.007 (.02)		-.078 (.01)***		.013 (.01)
Race (1 = White)		-.109 (.31)		-.236 (.19)		-.324 (.20)
Gender × Slope		.436 (.15)**		.231 (.11)*		.137 (.08)
Education × Slope		.002 (.02)		.024 (.02)		-.001 (.01)
Race × Slope		-.150 (.25)		.094 (.20)		.243 (.21)
Random effects						
Variances						
Intercept	1.665***	1.560***	0.936***	0.727***	0.444***	0.415***
Slope	.235**	.247**	.087**	.086**	.068	.073
Akaike's information criterion	21,245	21,232	18,638	18,549	17,149	17,153

Notes: Each model controlled for the effects of birth cohort. Standard errors are in parentheses. * $p < .05$; ** $p < .01$; *** $p < .001$.

effects were weighted composites of each individual trajectory, those with complete data were given more weight than those with incomplete data. Thus, it was possible that these fixed effects masked systematic differences in individual growth curves between participants with complete data and those who had dropped out.

In order to investigate this possibility, we formed a new variable that distinguished between respondents with complete data after the imputation ($n = 854$) and those with incomplete data ($n = 249$). Following the work of Mroczek and Spiro (2005), we then added this variable as a predictor in the Level 2 models in order to see if the distinction between remaining in the study and dropping out was associated with interpersonal variation in the intercept or slope parameters of any of the social support trajectories. The results of these analyses showed that the trajectories of participants who had remained in the study did not differ widely from those of the participants who had dropped out. However, there were two exceptions to this

trend. As shown in Table 7, elders who had remained in the study had a significantly larger intercept for emotional support provided than those who had dropped out. In addition, satisfaction with support exchanges declined more precipitously for respondents who had remained in the study compared to those who had dropped out.

Explanatory Models

We further examined interpersonal differences with respect to both the intercepts and slopes of the age-related trajectories of social support by testing the extent to which these differences were associated with gender, education, and race. The explanatory models in Tables 3 through 6 show these results. The main effects of the explanatory models predicting social embeddedness (see Table 3) showed that, at the mean age of the sample, elderly men had less contact with both family ($B = -.258, p < .01$) and friends ($B = -.284, p < .05$) than did elderly women. In addition, these results showed that highly

Table 5. Parameter Estimates and Robust Standard Errors for Linear Growth-Curve Models of Provided Social Support

Effects	Emotional Support Provided		Tangible Support Provided		Informational Support Provided	
	Descriptive Model	Explanatory Model	Descriptive Model	Explanatory Model	Descriptive Model	Explanatory Model
Fixed effects						
Intercept	10.022 (.12)***	10.010 (.11)***	5.091 (.09)***	5.085 (.09)***	5.237 (.07)***	5.232 (.07)***
Age slope	-.555 (.14)***	-.560 (.14)***	-.692 (.08)***	-.685 (.07)***	-.141 (.06)*	-.141 (.06)*
Gender (1 = male)		-.810 (.15)***		.207 (.09)*		-.196 (.08)*
Education		.093 (.02)***		.065 (.01)***		.047 (.01)***
Race (1 = White)		.015 (.35)		.153 (.15)		-.279 (.23)
Gender × Slope		.427 (.14)**		-.119 (.07)		.057 (.08)
Education × Slope		-.024 (.02)		-.018 (.01)		-.017 (.01)
Race × Slope		.000 (.26)		-.095 (.15)		.202 (.18)
Random effects						
Variances						
Intercept	1.873***	1.662***	0.841***	0.784***	0.623***	0.589***
Slope	.214**	.185**	.130***	.133***	.082*	.071*
Akaike's information criterion	20,381	20,317	16,774	16,750	16,880	16,878

Notes: Each model controlled for the effects of birth cohort. Standard errors are in parentheses. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 6. Parameter Estimates and Robust Standard Errors for Linear Growth-Curve Models of Perceived Social Support and Negative Interaction

Effects	Satisfaction With Support Exchanges		Anticipated Support		Negative Interaction	
	Descriptive Model	Explanatory Model	Descriptive Model	Explanatory Model	Descriptive Model	Explanatory Model
Fixed effects						
Intercept	3.018 (.04)***	3.018 (.04)***	9.980 (.08)***	9.973 (.08)***	5.613 (.07)***	5.614 (.07)***
Age slope	-.504 (.04)***	-.499 (.04)***	-.155 (.08)*	-.157 (.08)*	-.016 (.06)	-.014 (.06)
Gender (1 = male)		.121 (.05)*		-.085 (.09)		-.123 (.09)
Education		.010 (.01)		.026 (.01)		-.004 (.01)
Race (1 = White)		.050 (.08)		.096 (.17)		-.225 (.15)
Gender × Slope		-.058 (.05)		-.033 (.09)		.197 (.08)*
Education × Slope		-.008 (.01)		-.024 (.01)*		-.011 (.01)
Race × Slope		-.038 (.07)		-.027 (.16)		.264 (.16)
Random effects						
Variances						
Intercept	0.104***	0.101***	0.738***	0.725***	0.701***	0.697***
Slope	.013**	.011**	.072*	.068*	.151***	.136***
Akaike's information criterion	12,102	12,115	17,215	17,227	16,907	16,916

Notes: Each model controlled for the effects of birth cohort. Standard errors are in parentheses.

* $p < .05$; ** $p < .01$; *** $p < .001$.

educated older adults had more contact with friends than did less well-educated adults ($B = .065$, $p < .001$). The multiplicative terms in these models showed the extent to which gender, education, and race were associated with the age-related linear slopes of social embeddedness. None of the multiplicative terms in these models were significant. This suggests that interpersonal differences with respect to rates of age-related change in social embeddedness are not associated with gender, education, or race.

Table 4 presents the results of the explanatory models predicting enacted support. These results showed that, at the average age of the sample, men received less of emotional support ($B = -.602$, $p < .001$), tangible support ($B = -.775$, $p < .001$), and informational support ($B = -.224$, $p < .05$) than did women. In addition, these results showed that, at the average age of the sample, older adults with higher levels of education received less tangible support than did those with less education

($B = -.078$, $p < .001$). Two of the multiplicative terms in these models were significant. In particular, these coefficients indicated greater age-related increases in both emotional support received and tangible support received among men compared to women. Taken together, these findings suggest that deficits in received social support experienced by elderly men tend to attenuate with increasing age, at least with respect to emotional and tangible support (see Figure 1).

Table 5 presents the results of the same explanatory models used to predict provided support. These models again showed male deficits, in this case with respect to provided emotional ($B = -.810$, $p < .001$) and informational support ($B = -.196$, $p < .05$). In contrast, men at the average age of the sample appeared to provide more tangible support than did women ($B = .207$, $p < .05$). Education was also consistently associated with provided support, with more highly educated older adults reporting more of each type of provided support. Only one multiplicative term was significant across these three models. This significant coefficient for the Gender × Slope term ($B = .427$, $p < .01$; column 3 of Table 5) suggests that, compared to elderly women, elderly men were less likely to experience the age-related decline in provided emotional support that we had observed in the descriptive model (column 2).

Table 6 presents the findings of models predicting perceived support and negative interaction. These results showed that elderly men, at the average age of the sample, had higher levels of satisfaction with support exchanges than did elderly women ($B = .121$, $p < .05$). Results from the explanatory model predicting anticipated support showed a significant multiplicative term indicating that the general age-related decline in anticipated support exchanges observed in the sample as a whole was more severe among more highly educated older adults ($B = -.024$, $p < .05$). Additionally, a significant multiplicative term in the model predicting negative interaction indicated that the age-related increase in negative interaction was greater among men than among women ($B = .197$, $p < .05$).

Finally, we should highlight one additional result from these explanatory models. In particular, it is important to note that in

Table 7. Parameter Estimates and Robust Standard Errors for Linear Growth-Curve Models Showing Significant Effects of Attrition

Effects	Emotional Support Provided	Satisfaction With Support Exchanges
Fixed effects		
Intercept	9.620 (.02)***	3.050 (.00)***
Age slope	-.388 (.01)***	-.138 (.00)***
Complete data group	.507 (.03)***	-.055 (.00)
Complete data group × Slope	-.132 (.02)	-.133 (.00)***
Random effects		
Variances		
Intercept	1.913***	0.099***
Slope	.074***	.003***
Akaike's information criterion	20,373	12,235

Notes: No significant attrition effects were found for 9 of the 11 dimensions of social support and social networks. Only the models with significant attrition effects appear here. Standard errors are in parentheses.

*** $p < .001$.

most of the explanatory models, the random effects associated with both the intercept and slope remained significant. This means that additional interpersonal variation in these parameters—beyond that which can be explained by gender, education, and race—remained unaccounted for in these models.

DISCUSSION

The results of this study contribute to the literature in three main areas. First, the results reveal the population norms of long-term, age-related change in a host of social support and social network variables during late life. Although researchers have examined late-life changes in social relations with nationally representative data (Krause, 1999), the normative trajectories derived in the current study are particularly informative because they are based upon a much longer period of follow-up than was previously examined. These results show, for example, that with increasing age, older adults tend to report substantially less contact with friends but relatively stable levels of contact with family. This decline in contact with friends, but not family, is consistent with a socioemotional selectivity perspective (Carstensen, 1992), suggesting that as people grow older, they invest increasingly scarce resources in maintaining relationships with more intimate social ties.

Other normative trajectories found in the current study highlight the importance of the interplay between giving and receiving support. Our findings show that older adults provide less emotional, tangible, and informational support as they age. At the same time, they report receiving progressively more tangible and informational support. This combination of increased receiving and decreased giving is consistent with Antonucci's (1985) notion of the support bank. According to this perspective, young and middle-aged adults provide more support than they receive. This imbalance, however, allows them to "bank" credits to be used in later life when, as older adults, they may need more from their social network members than they provide. Thus, equity in social exchanges is achieved when viewed over the entire life course.

One normative trajectory that is somewhat difficult to interpret is that of emotional support received. Whereas levels of tangible and informational support received increase with age, levels of emotional support received are fairly stable. This continuity in levels of emotional support received may initially appear to be at odds with socioemotional selectivity theory (Carstensen, 1992). However, further consideration suggests otherwise. In particular, the observation of stability in levels of emotional support in the face of declining rates of contact with friends, but unwavering levels of contact with family, suggests that individuals may be adapting to old age by relinquishing some of the emotional support provided by friends while garnering more emotional support from a smaller set of family ties.

The second contribution of our study involves the level of interpersonal heterogeneity found in age-related trajectories of social relations. For 10 of the 11 dimensions of social relations examined in the current study, individuals varied significantly with respect to both levels (i.e., intercepts) as well as rates of change (i.e., slopes). These findings are consistent with the aged heterogeneity hypothesis (Dannefer & Sell, 1988). Viewed more generally, these results show that even though

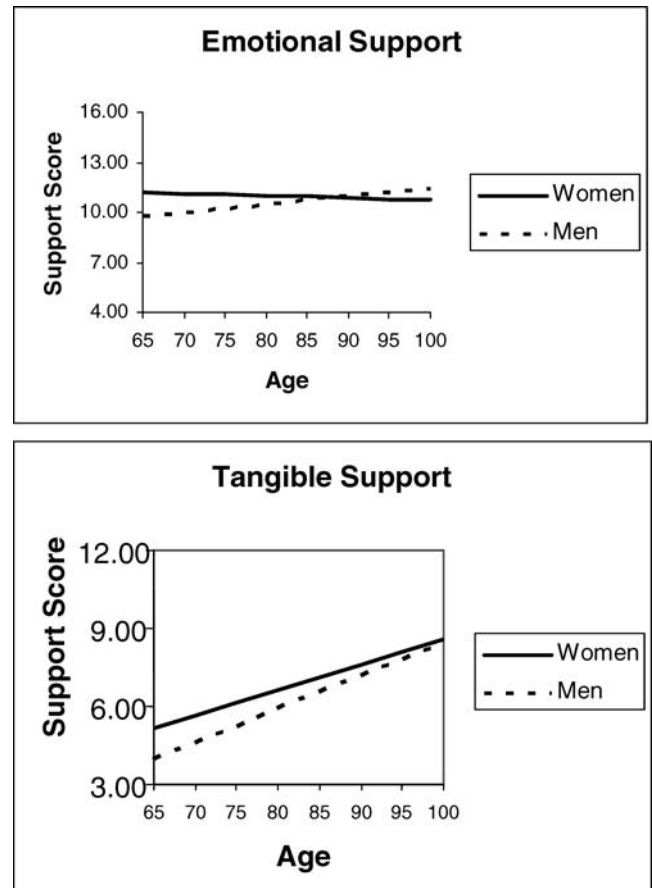


Figure 1. Age \times Gender interactions for emotional and tangible support received.

normative trajectories of social support and social networks are informative, they may conceal a number of distinct subtrajectories exhibited by different individuals. For example, support may increase for some, decrease for others, and remain the same for yet other subgroups of older adults. Because we examined 11 different dimensions of support in this study, it was not possible to identify individual subtrajectories of change in each dimension. Nevertheless, we laid the groundwork for doing so by establishing the existence of substantial individual variation in the way in which support changes in late life.

The third major contribution of this study arises from our efforts to explore social structural correlates of change in social relations. Previous work in this area (Krause, 1999) focused solely on describing change. The additional waves of data in the current study allowed us to take advantage of more sophisticated multilevel modeling procedures in order to begin accounting for interindividual variation in these patterns of change. These results provide some support for the view of social relations as resources that are subject to unique social stratifications in later life. For example, the current findings show that elderly men generally receive and provide less support than do elderly women, but that men are also more satisfied than are women with their support exchanges. In addition, gender differences in age-related support trajectories emerging from this study help to specify finer nuances of

socioemotional selectivity theory. In particular, the data suggest that levels of emotional support increase with age, but only among older men. This may provide evidence that gender roles change in late life such that men become increasingly concerned with interpersonal issues (Gutman, 1987).

The findings from this study also provide some insight into how socioeconomic stratification may influence social ties in late life. More specifically, the data suggest that older adults with less education experience persistent disadvantages over time with regard to levels of social contact with friends and provided support compared to older people with more schooling. Whereas some researchers have found evidence of a late-life convergence of education-based differences in support (House, Lepkowski, & Kinney, 1994), and others have found evidence of enlarging differences (Schieman, 2001), the current findings suggest that for at least some social relationship factors, stratification across education levels simply endures.

However, the data further reveal that socioeconomic differences in social support are not always straightforward. In particular, the findings suggest that levels of received tangible support are higher, and levels of anticipated support decline less precipitously, among individuals with low levels of education compared to their more educated counterparts. Perhaps the increase in tangible support received is a response to greater material needs among less educated individuals, whereas less decline in anticipated support may be a direct consequence of receiving relatively abundant tangible support.

It was somewhat surprising to find that there were no significant associations between race and either the intercepts or slopes of the social relationship trajectories. Previous research also found a lack of association between race and social support slopes (Barnes et al., 2004); however, we did not anticipate the lack of race differences in levels of social support. This lack of race differences may be partially due to racial differences in education. That is, education may have mediated racial differences in social support (Guralnik, Land, Blazer, Fillenbaum, & Branch, 1993). In addition, because non-Whites represented only 8% of the total sample, inadequate statistical power may be partially responsible for the lack of significant race effects. Finally, this lack of race differences could be due to the fact that we compared Whites to all non-Whites, rather than to a single group such as Blacks. We did this because of the relatively small number of cases in specific minority groups. This may have created problems because research has revealed that some minority group members receive less support than do Whites, whereas other minority group members receive more (e.g., Kaniasty & Norris, 2000).

As readers review these findings, they should keep in mind a number of limitations of this study. First, although the data for this study were collected at four different observation periods over a 10-year period, the current analyses would have benefited from additional waves of data collection. For instance, use of additional waves of data may make it possible to detect patterns of nonlinear change in support over time. Future research should also examine potential social status differences in the curvatures of social relations trajectories.

An additional limitation arises from our use of age, rather than time since baseline, as an indicator of the passage of time in our models. Although the use of age in this way allowed us to examine how social relations changed with increasing age

within individuals, the normative trajectories that were produced from these analyses did not fully distinguish between aging and cohort effects. Although we attempted to control for potential cohort effects with relatively coarse measures of birth cohorts, it is likely that the trajectories presented in this study still reflect some combination of aging and cohort effects. We should note, however, that using time since baseline as the time scale would have had its own problems: It would have failed to distinguish between aging and period effects. That is, we could not have been sure whether any changes observed during a particular time period would have been due to the aging process or due to other influences unique to that particular time period. Given the limitations of both approaches, we based our choice of age as the time indicator on our primary substantive interest in examining changes in social relations with increasing age rather than changes over a certain 10-year period. Incidentally, in a supplemental set of (unpublished) analyses, we estimated each of our normative trajectories using time since baseline as the time scale and found only two major differences: The slopes of contact with friends and informational support provided, which had demonstrated significant change ($p < .05$) in the age-based models, were no longer statistically significant.

Finally, the current analyses do not include any time-varying predictors that might help to explain age-related changes in various measures of social relations. For example, given the positive association between being married and receiving social support (Turner & Marino, 1994), along with the increasing likelihood of becoming widowed in late life, future analyses should include marital status as a time-varying predictor in order to test whether marital transitions mediate the effects of age on social support and interaction.

Despite these limitations, the findings from this study clearly highlight the existence of tremendous diversity in the nature of the social ties that people maintain with others as they grow older. We hope that these findings encourage other investigators to enter the complex, but largely unexplored, study of change in social relationships during late life. Bringing aspects of change to the foreground of research on social support and social networks should lead to an improved ability to represent and understand the dynamic facets of older adults' changing lives.

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