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Authors
Lee, Soomi
Koffer, Rachel E
Sprague, Briana N
et al.

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Original Research Report

Activity Diversity and Its Associations With Psychological Well-Being Across Adulthood

Soomi Lee,[1] Rachel E. Koffer,[2] Briana N. Sprague,[2] Susan T. Charles,[3] Nilam Ram,[2,4] and David M. Almeida[2]

[1]Department of Biobehavioral Health and [2]Department of Human Development and Family Studies, Pennsylvania State University, University Park. [3]Department of Psychology and Social Behavior, University of California, Irvine. [4]German Institute for Economic Research (DIW), Berlin, Germany.

Correspondence should be addressed to Soomi Lee, PhD, Postdoctoral Scholar, Department of Biobehavioral Health, Pennsylvania State University, 221 Biobehavioral Health Building, University Park, PA 16802-650. E-mail: smlee@psu.edu

Abstract

Objectives: This study examined age-related cross-sectional and longitudinal associations between activity diversity and four dimensions of well-being: psychological well-being, depression, positive affect, and negative affect.
Method: Activity diversity was defined as the breadth and evenness of participation in seven daily activities including paid work, time with children, doing chores, leisure, physical activities, formal volunteering, and giving informal help to others. Participants from the National Survey of Daily Experiences ($N = 793$, $M_{age} = 46.71$, $SD_{ag} = 12.48$) provided data during two 8-day measurement bursts approximately 10 years apart.
Results: Older adults (age = 60–74 years) who engaged in more diverse activities reported higher psychological well-being than older adults who engaged in less diverse activities; an association not significant among middle-aged adults (age = 35–59 years), and in the opposite direction for younger individuals (age = 24–34 years). Longitudinally, increased activity diversity over 10 years was marginally associated with increases in positive affect. Compared with younger individuals who increased activity diversity, older adults who increased activity diversity reported smaller decreases in psychological well-being, greater increases in positive affect, and greater decreases in negative affect.
Discussion: Our findings suggest that activity diversity may play an important role in older adults' concurrent well-being and also in their long-term longitudinal improvements of well-being.

Keywords: Activity diversity—Age-related differences—Depression—Negative affect—Positive affect—Psychological well-being

Across a prototypical week, individuals may participate in a wide range of activities (e.g., paid work, exercise, volunteer work, leisure, and time with children) or in a narrow range of activities (e.g., work and leisure). Similarly, the relative frequency of time spent in such activities may differ. Among two individuals with the same number of activities, one individual may frequently work for pay but infrequently exercise, volunteer, and spend time with children, whereas the other may exhibit evenly distributed participation across the activities. Such individual differences

in the breadth and evenness of participation in a set of daily activities (i.e., activity diversity) may be associated with well-being. This study examined cross-sectional and longitudinal associations between activity diversity and the psychological aspect of well-being (i.e., hedonic and eudaimonic dimensions) and how they differed by age across adulthood.

Research on engagement in diverse activities began with Barker and Barker (1961), who described the behavioral setting of older adults in terms of the number, types, and

properties of different behaviors in their living contexts. Since the 2000s, researchers have examined diversity of activities (Baker, Cahalin, Gerst, & Burr, 2005) and relationships (e.g., social network diversity; Cohen, Brissette, Skoner, & Doyle, 2000), finding that greater diversity is related to higher psychological and physiological well-being. Diversity in such studies is conceptualized as a simple count of activities, but the relative participation across multiple activities may also provide useful information about activity engagement.

The social integration perspective (Durkheim, [1897] 1951; Pillemer, 2010; Rosow, 1967) posits that diverse social roles and activities in one's life promote extensive knowledge, social networks, and a sense of purpose, all of which are important for well-being. The term "integration" may reflect greater breadth (i.e., less social exclusion) and greater evenness (i.e., less polarization) among multiple domains and thus may correspond to our concept of activity diversity. Higher activity diversity should be positively associated with well-being, as it reflects social integration. Engaging in one type of activity (e.g., volunteering) may also relate to social integration (Musick & Wilson, 2003), but engaging in diverse activities may provide more opportunities for social integration and thus benefit well-being. However, the benefits of social integration through activity diversity may differ by age due to age-related differences in managing social engagement.

Social integration and activity diversity may be particularly important for older adults. Strengthening or expanding social integration may be helpful in countering role losses typically experienced in later adulthood (Musick & Wilson, 2003). In addition, the Strength and Vulnerability Integration model (SAVI; Charles, 2010) posits that older adults have accumulated self-knowledge and enhanced use of strategies to regulate everyday emotional experiences. This suggests that older adults' higher activity diversity may relate to higher well-being as their activities may be well-adjusted to their own needs (Charles, 2010). In contrast, a younger adult's activity diversity may not reflect as much self-knowledge and thus may not best promote levels of well-being. Few studies compared the effects of activity engagement across different ages, but research on late adulthood found the benefit of new activities (increased breadth) in enhancing older adults' psychological well-being (Rebok et al., 2011; Wahrendorf & Siegrist, 2010) and physical and cognitive outcomes (Thomas, 2014). Moreover, some studies on increased engagement in volunteering found greater self-esteem and well-being benefits for older adults than for younger adults (Musick & Wilson, 2003; Omoto, Snyder, & Martino, 2000). These studies suggest that the benefits of activity diversity will be stronger for older adults than for younger adults.

To construct our measure of activity diversity, we adapted Shannon's (1948) entropy, a widely used diversity index. This method has been recently used to quantify stressor diversity (Koffer, Ram, Conroy, Pincus, & Almeida, 2016), emotion diversity (Quoidbach, Gruber, & Norton,

2014), and social diversity (Ram, Conroy, Pincus, Hyde, & Molloy, 2012), but has not yet been used to quantify the diversity of activity engagement. An activity diversity index can assess the relative participation across multiple activities in two aspects (i.e., breadth and evenness) that cannot be assessed by traditional measures of activity engagement. To illustrate, Figure 1 displays two individuals with differing activity diversity. The individual on the left engages in five activities (less breadth), compared with the individual on the right who engages in seven activities (more breadth). The individual on the left also engages in two out of seven activities the majority of the time, and in three others only rarely (less evenness), whereas the individual on the right engages in all seven activities with fairly even frequency (more evenness). In this example, the individual on the right has higher activity diversity than the individual on the left.

Daily diary data provide for a precise estimation of day-to-day activity diversity. Previous study designs typically measure total engagement across more macro timespans, not day-to-day diversity (e.g., Baker et al., 2005; Cohen et al., 2000). However, knowing an individual exercised 5 hours per week does not inform whether the amount of exercising is evenly distributed across a week or a once a week occurrence. Recall bias also occurs when asking respondents, particularly older adults, whether and how they participate in a set of activities across years, months, or even unspecified time scales (Lee & Almeida, 2016). Our study design that assessed activity engagement during two sets of eight consecutive days 10 years apart enabled us to estimate activity diversity with more precision and also to examine the benefit of activity diversity in well-being across times.

Present Study

Based on social integration (Durkheim, [1897] 1951; Pillemer, 2010; Rosow, 1967) and SAVI (Charles, 2010), this study examined age-related cross-sectional and longitudinal associations between activity diversity and the psychological aspect of well-being. Cross-sectionally, we hypothesized that higher activity diversity would be more
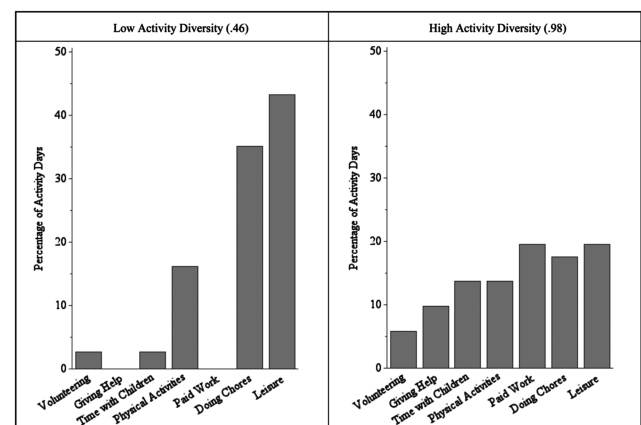

Figure 1. Examples of low and high activity diversity.

strongly associated with well-being for older adults (e.g., 60s+) than for younger adults (e.g., 30s–). Our focus of comparison was between older adults versus younger adults, but we also explored the associations for middle-aged adults. We were unable to predict an association for middle-aged adults given that this age group spans many years and has great heterogeneity in social role transitions (Lachman, 2004), but we believe such exploration is useful for future theory development.

Moving beyond cross-sectional models—the focus of most prior research (Wahrendorf & Siegrist, 2010)—we also examined how longitudinal changes in activity diversity were related to changes in well-being across 10 years. We took a within-person approach, determining whether a person's change in activity diversity predicts change in well-being relative to his or her baseline, which also can show the benefits of activity diversity after ruling out stable unmeasured third variable explanations. We hypothesized that older adults who increased activity diversity across 10 years (e.g., 60s → 70s) would exhibit greater increases in their well-being compared with younger individuals who increased activity diversity across 10 years (e.g., 30s → 40s), and again explored comparisons with middle-aged adults.

To more comprehensively measure the psychological aspect of well-being, this study considers both eudaimonic and hedonic dimensions. Hedonic well-being pertains to what makes life pleasant and unpleasant and is typically assessed by subjective well-being measures, including life satisfaction, the presence of positive mood, and the absence of negative mood (Ryan & Deci, 2001). In contrast, depression is often considered a separate dimension indicating mental health problems (Charles, Piazza, Mogle, Sliwinski, & Almeida, 2013). Eudaimonic well-being includes roles and activities that afford personal growth and social integration and is considered an indication of human actualization and flourishing (Ryff & Keyes, 1995). The mechanisms associated with changes in the positive and negative aspects of hedonic and eudaimonic well-being differ, so examining associations between any construct and well-being benefit from a nuanced approach including multiple well-being measures (Diener, Suh, Lucas, & Smith, 1999). Our approach utilized four measures of well-being (i.e., psychological well-being, depression, positive affect, and negative affect) to explore whether activity diversity is more or less important for these specific dimensions of well-being. Higher well-being was operationalized by higher levels of psychological well-being and positive affect and lower levels of depression and negative affect.

Method

Data for the current study were drawn from the National Survey of Daily Experiences (NSDE), the daily diary component of the Midlife in the United States Survey (MIDUS). Comprehensive details of the design and sample can be found in Almeida, McGonagle, and King (2009), with details relevant to the current analysis provided in the following sections.

Participants and Procedure

An initial sample of 7,108 participants completed a telephone survey of demographic characteristics and well-being in MIDUS (1995–1996). Of these, 1,843 individuals were invited to participate in NSDE Burst 0 (1996–1997), an 8-day daily diary. 1,483 respondents (81% participation) provided data on their daily experiences, including daily time use. Ten years later, 793 (53% retention) again provided data in another 8-day daily diary, NSDE Burst 1 (2006–2007). Reasons for attrition included refusal (53%), loss of contact (30%), deceased (13%), and no longer eligible (4%). Longitudinal participants were more likely to be White, highly educated, and married than attriters (but did not differ in age, gender, physical health status, and total hours spent in activities) and thus represent a positively selected population (see Charles et al., 2016, for more detail).

The 793 (44% men) individuals who participated in both NSDE Bursts 0 and 1 ranged in age from 24 to 74 years at baseline ($M = 46.71$, $SD = 12.48$). The majority were White (94%), married or living with a romantic partner (77%), and had, on average, three or more years of college ($M = 7.24$ on a 12-level scale, $SD = 2.44$), two children ($SD = 1.55$), and "very good" physical health ($M = 3.80$ on a 5-point scale, $SD = 0.87$).

Measures

Activity diversity

During each end-of-day interview, individuals reported daily activities, answering, "Since this time yesterday, how much time did you spend _____," with the hours and minutes they spent in seven activities: paid work, with children, doing chores, on leisure, in physical activities, on formal volunteering, and giving informal help to people who do not live with respondents (e.g., friends, neighbor, parent, other relatives, etc.). In order to gauge whether individuals had (=1) or had not (=0) participated in an activity on a given day, times were converted to a set of time-varying binary variables. These seven binary, daily activity engagement indicators were then used to measure activity diversity, calculated as Shannon's (1948) entropy:

$$\text{Activity diversity}_{bi} = -\left(\frac{1}{\ln(m)}\right)\sum_{j=1}^{m} p_{ij}\ln p_{ij}$$

where $m = 7$ is the number of activity types, and p_{ij} is the proportion of individual i's total activities that were in each activity type, $j = 1$ to m. Resulting activity diversity scores can range from 0 (*no diversity*—all daily activity in a single category) to 1 (*complete diversity*—daily activity spread evenly across all seven categories). Burst 0 activity diversity

scores ranged from 0.35 to 0.98 ($M = 0.78$, $SD = 0.09$). For longitudinal analyses, 10-year changes in activity diversity were calculated as the difference between Burst 1 and Burst 0 scores, such that positive scores indicated increases in activity diversity over the 10 years ($M = –0.02$, $SD = 0.11$).

Psychological well-being

At each burst, individuals' level of psychological well-being was measured using the Psychological Well-Being scale (Ryff & Keyes, 1995), an 18-item questionnaire that covers six dimensions of eudaimonic well-being (autonomy, environmental mastery, personal growth, purpose in life, positive relations with others, and self-acceptance). Respondents completed items such as, "When I look at the story of my life, I am pleased with how things have turned out so far," and, "I have confidence in my own opinions, even if they are different from the way most other people think," using a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. Relevant items were summed to obtain subscale scores that were then averaged to obtain a total psychological well-being score (Cronbach's $\alpha_{burst0} = .75$, $\alpha_{burst1} = .80$), where higher scores indicate greater psychological well-being ($M = 16.93$, $SD = 2.30$).

Depression

Depression was measured at each burst using 7 items of depressive affect and 6 items of anhedonia (Wang, Berglund, & Kessler, 2000). Specifically, depressive affect was assessed as responses to "(During two weeks in past 12 months), *when you felt sad, blue, or depressed*, did you (1) lose interest in most things, (2) feel tired or low energy, (3) lose appetite, (4) have more trouble falling asleep, (5) have a lot more trouble concentrating, (6) feel down on yourself or worthless, and (7) think a lot about death?"; and anhedonia was assessed as responses to (2) to (7) above, "*when you lost interest in most things,* did you" Responses on each item were coded as 0 (*no*) or 1 (*yes*). An overall depression index was calculated as the mean of the depressive affect and anhedonia items. Scores ranged from 0 to 7 ($M = 0.63$, $SD = 1.75$), with higher scores indicating higher depression.

Positive and negative affect

Global positive and negative affect was measured at each burst using the Positive and Negative Affect Scales (Watson, Clark, & Tellegen, 1988). Participants were asked, "(During the past 30 days), how much of the time did you feel _____" (1 = *none of the time* to 5 = *all of the time*). Positive affect was calculated as the mean of responses to 6 items: cheerful, in good spirits, extremely happy, calm and peaceful, satisfied, and full of life. Scores ranged from 1 to 5 ($M = 3.46$, $SD = 0.67$), with higher scores indicating more positive affect ($\alpha_{burst0} = .90$, $\alpha_{burst1} = .90$). Negative affect was calculated as the mean of 6 items: so sad nothing could cheer you up, nervous, restless or fidgety, hopeless, that everything was an effort, and worthless. Scores ranged from 1

to 4.83 ($M = 1.50$, $SD = 0.58$), with higher scores indicating more negative affect ($\alpha_{burst0} = .87$, $\alpha_{burst1} = .84$).

Age

To capture life-course differences in roles and activity, age was recoded as a 3-level categorical variable, following aging studies that emphasize physical and mental health differences between age groups (e.g., Xu, Liang, Bennett, Botoseneanu, & Allore, 2015). The categorical split was based on mean age at baseline ± 1 *SD*: younger = 24 to 34 years ($n = 163$), middle-aged = 35 to 59 years ($n = 484$), and older = 60 to 74 years ($n = 146$). A diagnostic check supported the usefulness of categorical age groups due to nonlinearity in the associations between age and activity diversity (Supplementary Figure 1).

Covariates

Individual and family characteristics known to be related to well-being were included as covariates (Pinquart & Sörensen, 2000), measured at Burst 0, and in some cases also at Burst 1. These included respondents' gender (0 = *woman*, 1 = *man*), race (0 = *non-White*, 1 = *White*), marital status (0 = *single*, 1 = *married or living with a romantic partner*), number of children (biological and adopted), highest level of education (1 = *no school/some grade school* to 12 = *PhD or other professional degree*), two personality traits that may be related to activity diversity and well-being (i.e., extraversion and neuroticism; each scale was constructed by calculating the mean across each set of items on a scale of 1 = *not at all* to 4 = *a lot*), self-reported health status (1 = *poor* to 5 = *excellent*), and, to isolate the unique effects of activity diversity, individual's total activity time ($M = 14.73$ hours per day, $SD = 4.92$, range = 3.35 to 49.13).

Data Analysis

The nested data structure, with 1,586 observations across two bursts nested within 793 individuals, was accommodated by using multilevel models (Bryk & Raudenbush, 1992). Models were fit individually to the four well-being outcomes (psychological well-being, depression, positive affect, and negative affect), and specified as follows:

$$\text{Well-being}_{bi} = \beta_{0i} + \beta_1(\text{Older}_i) + \beta_2(\text{Middle}_i) + \beta_{3\,to\,11}(\text{Covariates}_{bi}) + \beta_{12}(\text{Burst}_{bi})$$
$$+ \beta_{13}(\text{Activity diversity}_{bi})$$
$$+ \beta_{14}(\text{Older}_i)(\text{Diversity}_{bi}) + \beta_{15}(\text{Middle}_i)(\text{Diversity}_{bi}) + u_{0i} + e_{bi}$$

Most cogent for hypothesis H1, β_{14} represents differences between older and younger adults in the associations between activity diversity and the well-being outcomes. Where significant, the age-group interaction was probed to describe differences at low (–1 *SD*) and high (+1 *SD*) diversity. Cases with incomplete data for covariates (mostly for race and physical health) and well-being outcomes (between 1% and 6% missing) were not systematically different from other cases and thus were treated as missing

at random (Bryk & Raudenbush, 1992). Models were fit using SAS Proc Mixed with all continuous variables centered at the sample means.

The associations between longitudinal changes in activity diversity and the four well-being outcomes were tested using residualized gain models (Fitzmaurice, Laird, & Ware, 2004; fit using SAS Proc GLM) specified as:

$$\text{Wellbeing}_{b=1,i}$$
$$= \beta_0 + \beta_1 \left(\text{Wellbeing}_{b=0,i} \right) + \beta_2 \left(\text{Older}_i \right) + \beta_3 \left(\text{Middle}_i \right)$$
$$+ \beta_{4 \text{ to } 12} \left(\text{Covariates}_{bi} \right) + \beta_{13} \left(\text{Activity diversity}_{b=0,i} \right)$$
$$+ \beta_{14} \left(\text{Changes in diversity}_i \right) + e_i$$

where, for hypothesis H2, β_{14} indicates the association between changes in activity diversity (change scores calculated by subtracting Burst 0 score from Burst 1 score) on residual gains of well-being, after adjusting for prior well-being (β_1) and activity diversity (β_{13}).

Lastly, age-group differences in the longitudinal associations were probed using an ANCOVA-type set-up in a regression model. The sample was divided into six groups (1 = *older who decreased activity diversity*, 2 = *older who increased*, 3 = *middle-aged who decreased*, 4 = *middle-aged who increased*, 5 = *younger who decreased*, 6 = *younger who increased* = reference group), whereby these dummy variables isolate how specific combinations of age and activity diversity change were associated with later well-being. Of specific interest for hypothesis H3 in the model,

$$\text{Wellbeing}_{b=1,i}$$
$$= \beta_0 + \beta_1 \left(\text{Wellbeing}_{b=0,i} \right) + \beta_{2 \text{ to } 10} \left(\text{Covariates}_{bi} \right)$$
$$+ \beta_{11} \left(\text{Activity diversity}_{b=0,i} \right)$$
$$+ \beta_{12} \left(\text{Older who decreased diversity}_i \right)$$
$$+ \beta_{13} \left(\text{Older who increased diversity}_i \right) \ldots\ldots$$
$$+ \beta_{16} \left(\text{Younger who decreased diversity}_i \right) + e_i$$

was β_{13}, which indicates the difference in well-being residualized gains between older adults who increased activity diversity and younger individuals who increased activity diversity.

Results

Age-Related Differences in Cross-Sectional Associations Between Activity Diversity and Well-Being

Results from multilevel models examining associations between activity diversity and each of the well-being dimensions are shown in Table 1. Across well-being outcomes, the covariates were generally related to well-being in expected ways (e.g., better health associated with better well-being;

Table 1. Results of Multilevel Models Examining Cross-Sectional Associations Between Activity Diversity and Well-Being

	Psychological well-being		Depression		Positive affect		Negative affect	
	Estimate	(*SE*)	Estimate	(*SE*)	Estimate	(*SE*)	Estimate	(*SE*)
Fixed effects								
Intercept, β_0	15.87***	(0.30)	1.08***	(0.24)	3.25***	(0.09)	1.83***	(0.07)
Older (vs. younger[a]), β_1	0.35	(0.22)	−0.29	(0.18)	0.16*	(0.06)	−0.13*	(0.05)
Middle-aged (vs. younger), β_2	0.13	(0.16)	−0.19	(0.13)	0.08†	(0.05)	−0.04	(0.04)
Men (vs. Women), β_3	0.05	(0.12)	−0.23*	(0.10)	0.06†	(0.04)	−0.05†	(0.03)
White (vs. Non-white), β_4	0.62*	(0.26)	0.09	(0.21)	0.10	(0.08)	−0.22***	(0.06)
Education, β_5	0.06*	(0.03)	−0.02	(0.02)	−0.01	(0.01)	−0.00	(0.01)
Personality—Extraversion, β_6	1.29***	(0.11)	−0.05*	(0.09)	0.28***	(0.03)	−0.08**	(0.03)
Personality—Neuroticism, β_7	−1.27***	(0.10)	0.43***	(0.08)	−0.35***	(0.03)	0.35***	(0.02)
Physical health status, β_8	0.27***	(0.05)	−0.17***	(0.05)	0.12***	(0.02)	−0.09***	(0.01)
Married/partnered (vs. Not), β_9	0.40**	(0.13)	−0.33**	(0.11)	0.03	(0.04)	−0.08*	(0.03)
Number of children, β_{10}	0.02	(0.04)	0.02	(0.03)	−0.01	(0.01)	0.00	(0.01)
Time spent in 7 activities (hours), β_{11}	0.02*	(0.01)	0.03*	(0.01)	−0.00	(0.00)	0.00	(0.00)
Burst 1 (vs. Burst 0), β_{12}	−0.17*	(0.08)	−0.07	(0.08)	−0.01	(0.02)	−0.02	(0.02)
Activity diversity, β_{13}	−2.96**	(1.25)	0.11	(1.10)	0.44	(0.38)	0.01	(0.31)
Activity diversity × Older, β_{14}	5.89***	(1.56)	−0.86	(1.38)	−0.32	(0.48)	−0.32	(0.39)
Activity diversity × Middle-aged, β_{15}	3.47*	(1.37)	−0.46	(1.21)	−0.41	(0.42)	−0.11	(0.34)
Random effects								
Intercept, σ_{u0}^2	1.53***	(0.15)	0.62***	(0.10)	0.13***	(0.01)	0.07***	(0.01)
Residual, σ_e^2	2.14***	(0.11)	2.18***	(0.11)	0.20***	(0.01)	0.14***	(0.01)

Notes: N = 793; 1586 observations across two bursts; 1484, 1554, 1481, and 1479 observations were used in model for psychological well-being, depression, positive affect, and negative affect, respectively.

[a]Younger individuals were the reference group.

†*p* < .10. **p* < .05. ***p* < .01. ****p* < .001.

see also unadjusted descriptive statistics and correlations in Supplementary Table 1). After adjusting for the covariates, there was no significant main effect of activity diversity on the four dimensions of well-being (results without including interaction with age are not shown). However, age moderated the relation between activity diversity and psychological well-being (β_{14}, β_{15}). The interaction displayed in Figure 2 shows the age-related pattern. Older adults with higher activity diversity reported higher levels of psychological well-being than younger adults with higher activity diversity (β_{14} = 5.89, SE = 1.56, $p < .001$). The post hoc test revealed that the mean psychological well-being was greater for older adults with higher activity diversity (+1 SD = 0.89), compared with older adults with lower activity diversity (−1 SD = 0.67). In contrast, younger individuals with higher activity diversity reported lower psychological well-being than younger individuals with lower activity diversity. Middle-aged adults' psychological well-being did not differ by activity diversity, although middle-aged adults with higher activity diversity reported greater psychological well-being than younger adults with higher activity diversity (β_{15} = 3.47, SE = 1.37, $p < .05$). Note that these associations of activity diversity with psychological well-being were independent of total time spent in the activities.

We also tested the associations with subcomponents of psychological well-being. Among the six subcomponents, the same patterns of results were found with environmental mastery (β_{14} = 7.03, SE = 2.44, $p < .01$), personal growth (β_{14} = 8.72, SE = 2.35, $p < .001$), and purpose in life (β_{14} = 9.07, SE = 2.63, $p < .001$), but not with autonomy, positive relations with others, and self-acceptance (results are available upon request). In sum, our cross-sectional hypothesis that activity diversity and well-being will be positively associated for older adults and negatively associated for younger adults was supported for one of the outcomes, psychological well-being.

Age-Related Differences in Longitudinal Associations Between Activity Diversity and Well-Being

Table 2 shows results from testing whether and how changes in activity diversity predict changes in well-being. There was no significant association between changes in activity diversity and residual gains in psychological well-being, depression, and negative affect. However, change in activity diversity was associated with residualized gains in positive affect at a trend level (β_{14} = 0.40, SE = 0.22, p = .06). Individuals who increased activity diversity over the 10 years also had increased positive affect, even after controlling for baseline levels of activity diversity as well as positive affect.

Next, to test age-related differences in the longitudinal associations, we classified individuals based on the direction of changes in activity diversity over 10 years. Among the 146 older adults, 105 (72%) decreased activity diversity and 41 increased. Among the 484 middle-aged adults, 301 (62%) decreased activity diversity and 183 increased. Among the 163 younger adults, 63 (39%) decreased activity diversity and 100 increased. Results of group contrasts are shown in Figure 3. All six groups' psychological well-being decreased over the 10 years, but older adults who increased activity diversity exhibited smaller decreases in psychological well-being than did younger individuals who increased activity diversity (Panel 1). These oldest adults also exhibited the smallest decreases in psychological well-being. Also, there seemed a difference in depression (Panel 2). Older adults who increased activity diversity exhibited greater decreases in depression than younger individuals who increased activity diversity at a trend level (p = .07). Older adults who increased activity diversity was the only group who exhibited a decrease in depression over the 10 years. Moreover, older adults who increased activity diversity reported greater increases in positive affect (Panel 3) and greater decreases in negative affect (Panel 4) than their younger counterparts. Younger individuals exhibited decreases in positive affect and increases in negative affect as a function of increases in activity diversity. In sum, our longitudinal hypothesis that older adults who increased activity diversity will exhibit greater increases in well-being compared with younger individuals who increased activity diversity was supported for psychological well-being, positive affect, and negative affect.
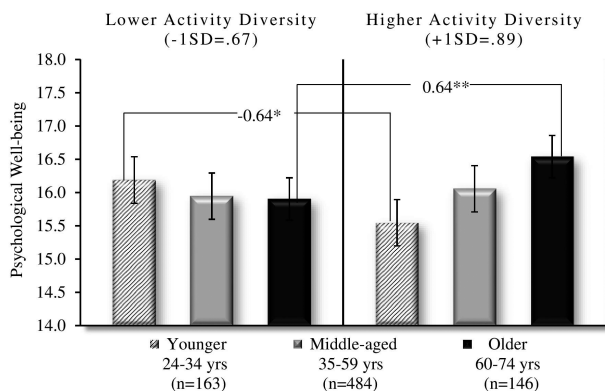
Discussion

Activity diversity, the breadth and evenness of activity engagement that comprise daily life, may indicate the extent of social integration (Durkheim, [1897] 1951; Pillemer,

Figure 2. Age-related difference in the cross-sectional association between activity diversity and psychological well-being. The adjusted means for middle-aged and older adults were also compared with the mean for younger individuals; among those with higher activity diversity, the mean psychological well-being was significantly higher for middle-aged adults (B = 0.51, SE = 0.20, $p < .05$) and older adults (B = 0.99, SE = 0.28, $p < .001$) compared with younger individuals; among those with lower activity diversity, the mean psychological well-being was not significantly lower for middle-aged and older adults compared with younger individuals. *$p < .05$. **$p < .01$.

Table 2. Results of General Linear Models Examining Longitudinal Associations Between Activity Diversity and Well-Being

	Psychological well-being at Burst 1		Depression at Burst 1		Positive affect at Burst 1		Negative affect at Bburst 1	
	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)	Estimate	(SE)
Intercept, β_0	15.80***	(0.37)	1.15***	(0.30)	3.26***	(0.11)	1.61***	(0.09)
Outcome at Burst 0, β_1	0.50***	(0.04)	0.22***	(0.03)	0.47***	(0.04)	0.36***	(0.04)
Older (vs. younger[a]), β_2	0.50†	(0.26)	–0.52*	(0.21)	0.25**	(0.08)	–0.21***	(0.06)
Middle-aged (vs. younger), β_3	0.58**	(0.19)	–0.46**	(0.15)	0.20***	(0.06)	–0.08†	(0.04)
Gender, Men (vs. Women), β_4	0.01	(0.14)	–0.18	(0.12)	0.03	(0.04)	–0.03	(0.03)
Race, White (vs. Non-white), β_5	0.42	(0.33)	0.11	(0.26)	0.04	(0.1)	–0.03	(0.08)
Education, β_6	0.01	(0.03)	–0.01	(0.03)	–0.01	(0.01)	–0.01	(0.01)
Personality—Extraversion, β_7	0.48***	(0.14)	0.09	(0.11)	0.09*	(0.04)	–0.02	(0.03)
Personality—Neuroticism, β_8	–0.35**	(0.13)	0.21*	(0.10)	–0.01	(0.04)	0.07*	(0.03)
Physical health status[b], β_9	0.43***	(0.08)	–0.22***	(0.07)	0.15***	(0.02)	–0.10***	(0.02)
Married/partnered (vs. Not)[b], β_{10}	0.09	(0.17)	–0.30*	(0.14)	–0.04	(0.05)	–0.01	(0.04)
Number of children[b], β_{11}	0.05	(0.04)	0.03	(0.04)	0.00	(0.01)	0.01	(0.01)
Total time spent in 7 activities (hours)[b], β_{12}	0.01	(0.02)	0.02	(0.01)	0.00	(0.01)	0.00	(0)
Activity diversity at Burst 0, β_{13}	0.33	(0.86)	–1.19	(0.73)	0.19	(0.25)	–0.26	(0.2)
Changes in activity diversity[c], β_{14}	0.75	(0.73)	–0.47	(0.61)	0.40†	(0.22)	–0.22	(0.17)
Fit statistics								
F test	37.83***		7.71***		28.37***		24.48***	
R^2	0.43		0.12		0.37		0.33	

Notes: N = 793; 709, 779, 706, and 704 observations were used in model for psychological well-being, depression, positive affect, and negative affect, respectively.
[a]Younger individuals were the reference group.
[b]Burst 1 assessment was used.
[c]Change scores were calculated subtracting Burst 0 score from Burst 1 score.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

2010; Rosow, 1967), and thus may relate to well-being in adulthood. Extending the SAVI model (Charles, 2010), we expected that the benefit of activity diversity in the psychological aspect of well-being would be more apparent for older adults than for younger adults. In support of our hypotheses, both cross-sectional and longitudinal analyses revealed that activity diversity was positively related to well-being more strongly among older, relative to younger adults. Our findings demonstrate that activity diversity is important for older adults' concurrent and long-term well-being beyond the net amount of time spent in the activities.

Activity Diversity, Psychological Well-Being, and Age

Cross-sectional findings revealed that higher activity diversity was associated with higher psychological well-being for older adults than for younger adults. Higher activity diversity may benefit older adults because their activities are geared toward more emotionally rewarding experiences, consistent with SAVI (Charles, 2010). This greater breadth and evenness in activities (i.e., higher activity diversity) may deepen their social integration (Baker et al., 2005). Consistent with this view, supplementary analyses with the subdomains of psychological well-being showed that higher

activity diversity was associated with higher environmental mastery, personal growth, and purpose in life, which represent eudaimonic aspects of well-being (Ryff & Keyes, 1995). Conversely, younger adults' higher activity diversity was associated with lower psychological well-being. This unexpected finding may be due to age-related differences in the role context of activity diversity. Unlike older adults', younger adults' activity diversity may reflect the strain of many obligatory roles and activities (Goode, 1960; Moen, Kelly, & Huang, 2008). A descriptive examination of the extent of engagement in seven daily activities across age groups is consistent with this interpretation (Figure 4). Older adults with higher activity diversity spent their time quite evenly across several voluntary activities (e.g., leisure, giving informal help to others, and formal volunteering) in addition to paid work. Younger individuals with higher activity diversity scores spent the most amount of time with their children followed by time in paid work at both measurement bursts; this may reflect higher demands associated with higher activity diversity among younger individuals.

Changes in Activity Diversity Across 10 Years

Longitudinal analyses also allowed us to examine how 10-year changes in activity diversity correspond to

10-year changes in well-being. There was no significant main effect of changes in activity diversity on changes in well-being, although increases in activity diversity were marginally linked to increases in positive affect ($p = .06$). This association (albeit at a trend level) suggests that increases in activity diversity during 10 years of aging may contribute to improving positive affect at

Figure 3. Comparisons between older adults and younger individuals who increased activity diversity in the residualized gains of well-being. $^{†}p < .10$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

the within-person level. Increased activity diversity may reflect extending social networks, experiences, and psychological resources, as the social integration theory suggests (Durkheim, [1897] 1951; Pillemer, 2010; Rosow, 1967). Such increases in optional (and presumably enjoyable) activities may have been most important for increasing positive affect, but not as relevant to other dimensions of well-being. Future studies will need to investigate individuals' motivations for current activities, and reasons why activity diversity increases, decreases, or remains stable over time.

Older adults who increased activity diversity over 10 years also had smaller decreases in psychological well-being, greater decreases in depression (albeit marginally), greater increases in positive affect, and greater decreases in negative affect, compared with younger adults who increased activity diversity over 10 years. Previous studies reported that older adults who engaged in new activities experienced less age-related decline across psychological, physical, and cognitive domains than older adults who did not (Thomas, 2014; Wahrendorf & Siegrist, 2010). Limited research comparing different age groups also found stronger benefits of volunteering for older adults than younger adults (Musick & Wilson, 2003; Omoto et al., 2000). The current findings add to the literature on activity engagement in later adulthood: Older adults who increased engagement in diverse activities enhanced their well-being over the 10 years more so than their younger counterparts. Although older adults tend to decrease engagement in social activities over time (Baltes & Baltes, 1990), there is evidence that a group of older adults increases activity diversity. This may represent a special group of older adults who have not experienced age-related physical or cognitive decline that necessitate selecting among their activities as the model of selective
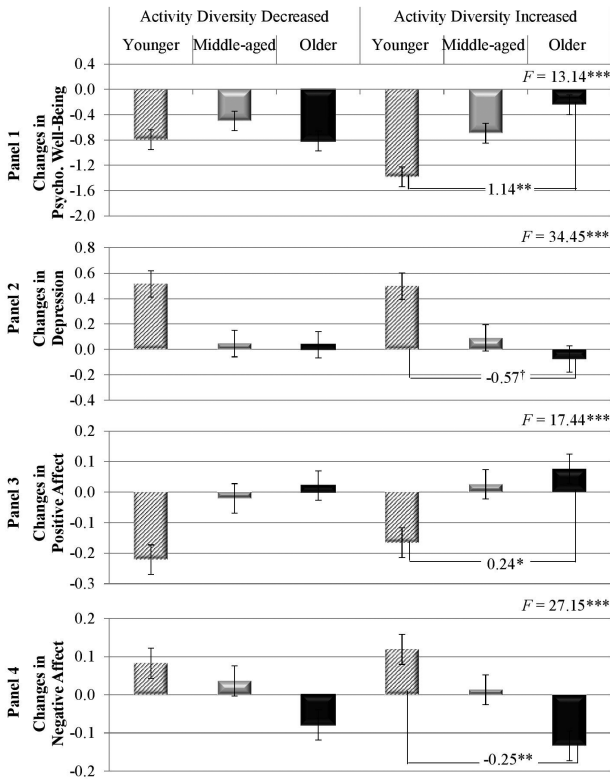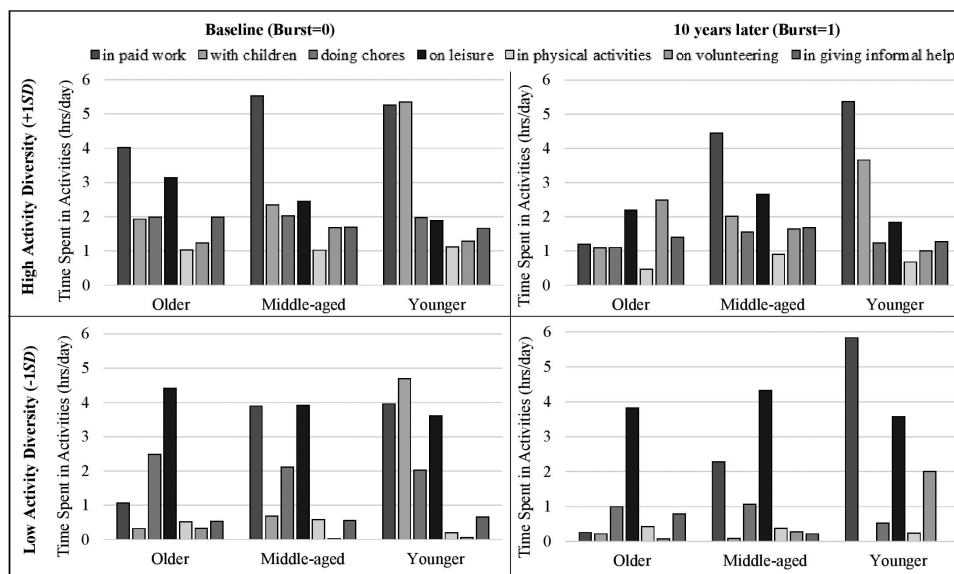

Figure 4. The extent of engagement in seven daily activities by the levels of activity diversity and by age groups.

optimization with compensation describes (Baltes & Baltes, 1990). In contrast, younger adults who increased activity diversity over the 10 years exhibited increases in depression, decreases in positive affect, and increases in negative affect. This may relate to our earlier discussion on the potential differences in the role context of activity diversity between age groups. As they approach early midlife, a time when the number of social roles often increase (e.g., 30s → 40s), younger adults' increases in activity diversity may reflect increases in obligatory roles and activities (Goode, 1960; Moen et al., 2008), which might have contributed to decreases in mental health and hedonic dimensions of well-being. Note that we included covariates to rule out other individual and family characteristics such as personality traits, physical health, and marital status that can explain changes in well-being as prior research reported (Pinquart & Sörensen, 2000). Thus, our results suggest that activity diversity is related to well-being in later life beyond other life-style factors. Future studies can focus on understanding what makes older adults increase activity diversity and the outcomes of their increased activity diversity across a variety of well-being measures.

Limitations and Future Directions

The strengths and implications of this study must be considered with its limitations. Our measure of activity diversity summarized the dispersion of activity across types without drilling into the specific types of activities that may drive such dispersion. It is possible, for example, that people who engage in volunteering have higher activity diversity scores than those who do not, given that volunteering occurred on 8% of the total days and in only 12% of the sample at baseline. Similarly, work is associated with age, as older adults are more likely to be retired. Sensitivity checks wherein we systematically removed activity types (i.e., paid work and chores) one at a time from the activity diversity computation revealed consistent findings (Supplementary Table 2), corroborating the importance of the diversity of overall activity as opposed to specific activities. However, replication of age-related differences in activity diversity and its associations with well-being is still warranted and may depend on the specifics of the measurement paradigm. Future work may need to add more detailed subcategories of activities to test, for example, different types of leisure activities and how diversity across other types of activities relates to changes in their well-being. Further, we took a rather general approach to activity engagement, noting any number of minutes greater than 0 as having engaged in an activity. As future works drill down into the activity types, it will be useful to consider the quantity of time spent in certain activities, perhaps in relation to clinically meaningful cutoffs (e.g., 30 minutes of physical activity).

In addition, the select nature of the sample (high functioning participants assessed at two bursts) may have limited the identification of relations between activity diversity and well-being. Future research should look for ways to include less healthy adults and the oldest-old, to see whether current findings are replicated in a sample with less capability. For example, activity diversity for the oldest-old may not be as beneficial as for older adults (e.g., 60s and 70s), as the oldest-old may select among activities to overcome their physical declines and vulnerabilities (Baltes & Baltes, 1990). Furthermore, only two bursts of data did not allow us to discern causal direction of effects. Changes in activity diversity may lead to changes in well-being, but the reverse may also be true. Future research using randomized experimental designs could examine causal directionality between increases in activity diversity and increases in well-being.

Our current findings may inform future intervention research targeting older adults' well-being. For example, interventions designed to increase activity diversity by introducing novel activities may provide psychological benefits to older adults, as suggested by this study. Given that previous observational studies find that engagement in a variety of activities is important for older adults' cognitive functioning (Krueger et al., 2009) and physical health (Everard, Lach, Fisher, & Baum, 2000), interventions that involve activity diversity may also provide cognitive and health benefits to older adults (e.g., Rebok et al., 2011). Additionally, our work may serve as the basis for future research examining the role of diverse roles and activities in midlife. Although no significant effect of activity diversity was found in our sample of middle-aged adults, there was a linear trend with age in the cross-sectional and longitudinal links between activity diversity and well-being (Figures 2 and 3). Given the wide array of social roles in midlife (Lachman, 2004), future work could examine whether activity diversity is important for middle-aged adults with a specific role configuration, such as adult caregivers or parents who undergo the transition to the empty nest.

Conclusion

This study adds to the aging literature by demonstrating that activity diversity is related to older adults' concurrent well-being and to their long-term improvements in well-being. The strengths of this study include the analytical refinement for assessing activity diversity and a study design that compared different implications of activity diversity for older and younger individuals' well-being both cross-sectionally and longitudinally. Our findings suggest that breadth and evenness of activity engagement are important for healthy aging and open future research geared toward gaining more understanding of the activity diversity construct and how it relates to a variety of individual outcomes.

Supplementary Material

Please visit the article online at http://psychsocgerontology.oxfordjournals.org/ to view supplementary material.

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