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Does Meaning Matter? Associations Between Engagement in Meaningful Activities, Leisure Activity, and Cognition in Adults

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Abstract

Multiple theories from the psychological and occupational therapy sciences suggest that there may be reciprocity between activity selection and the meanings we draw from them. As such, meaningfulness may be an important contextual mechanism through which activity engagement positively influences cognition, but no research has examined these links in healthy middle-aged and older adults. This study examined the predictive ordering of the associations between activity engagement, meaningfulness, and cognition. Eighty-one individuals aged 41-94 years old completed questionnaires on activity participation, engagement in meaningful activities, and a range of cognitive tests. Structural equation modeling controlling for age and education was used to test multiple mediation pathways linking activity and meaningfulness to cognition. There was a significant positive direct effect of meaningfulness on activity, where individuals who had higher ratings of meaningfulness also engaged more frequently in activity. However, neither activity nor meaningfulness significantly mediated the pathway to cognition, and direct effects between activity engagement with cognition and meaningfulness with cognition were unexpectedly not significant. Correlational results showed the strongest connection occurred between social activity and meaningfulness, highlighting domain specific effects, and suggesting that social health, a key part of successful aging, is linked to the perceived value of an activity. It remains possible that the links between activity, meaningfulness, and cognition may exist longitudinally or at the daily level.

Keywords
Cognitive functioning; activity engagement; meaningfulness; midlife

1. Introduction

Studies examining the extent to which modifiable lifestyle factors may slow age-related cognitive declines suggest that greater frequency of participation in cognitively stimulating physical and social activities may be associated with favorable cognitive outcomes [1]. However, little research has considered the psychological context in which activity occurs, specifically the meaning an individual assigns to a leisure experience [2-4]. The potential influence of psychological factors on activity-cognition associations may help to better explain this relationship and the mechanisms underlying it [5-7]. The present study aimed to identify the structure between activity engagement, meaningfulness, and cognition to determine the predictive ordering of these associations.

Activities that support an individual's sense of identity are connected to health-related outcomes, possibly through goal motivation [8]. When leisure activities are personally meaningful, they contribute to psychological well-being and sustained occupational engagement [9]. Progress towards personally relevant work and leisure goals fosters a sense of purpose, formulates life structure, and promotes personal agency [10].

Further, the meaningfulness of activity may amplify the positive effects associated with activity engagement [11]: when actions express an individual's values (e.g., the importance of time with family) or allow for the expression and affirmation for one's attributes (e.g., as a caring individual), they offer resources that can potentially promote healthy cognitive development. Although the effects of activity meaningfulness have been well-documented in occupational therapy, occupational sciences, and rehabilitation research [9], little research has examined this construct in relation to activity and cognitive ability in healthy aging adults.

Evidence from cognitive rehabilitation suggested that meaningfulness may be an important contextual mechanism through which activity engagement positively influences cognition [3, 4]. In occupational therapy, occupational sciences, and rehabilitation literature, meaningful activity has been used as a therapeutic tool to promote psychological well-being [2, 12]. Regier and colleagues [13] demonstrated that in cognitively healthy persons, engagement in favorite activity over the past year was associated with better memory performance. While promising, the directionality of effects between activity engagement and psychological meaning are unknown.

Multiple theories suggest that there may be reciprocity between activity selection and the meanings we draw from them. According to theories of meaning, our actions shape our meanings, and these meanings, in turn, influence what activities we engage in [14, 15]. According to research on leisure activity [16] and theories of meaning in occupation [8], the meaning assigned to certain types of activities may predict activity selection [14, 17, 18]. Relatedly, the selection, optimization, and compensation model of human development [19] states individuals maximize functioning through their selection and optimization of activities (e.g., selecting activities completed with high competency versus those that have become challenging).

Similarly, other psychological predictors (e.g., cognitive costs, intrinsic motivation) have been shown to play a role in predicting engagement [20]. The selective engagement theory [21] states that selecting demanding activities is related to the associated cost (i.e., subjective experience), leading to selective participation in more rewarding activities due to changes in motivation. Finally, according to the environmental complexity hypothesis, if the cognitive effort from a complex environment is rewarded, individuals will become more motivated to apply mental resources across similar situations and contexts, improving cognitive performance [22]. From this perspective, meaningfulness might stimulate cognitive ability by promoting selective activity engagement and motivation [14, 17-19].

The present study focused on identifying the structural arrangement between three latent variables: activity, meaningfulness, and cognition. Two mediation models were tested using structural equation modeling (SEM) to determine the directional effects of frequency of activity engagement and meaningfulness of activity on cognition. The expectation was that all three variables would be related to one another. However, the direction of associations between predictor variables activity and meaningfulness was unknown. According to theories of leisure and recreation, there seems to be a reciprocal relationship between activity selection and the meaning ascribed to specific experiences [23]. Thus, two directional questions were posed to determine which variables served as the predictor and mediator in the relationship to cognition.

Our first research question was: Does meaningfulness mediate the relationship between activity engagement and cognitive performance? We predicted that higher activity engagement would positively predict cognitive performance (direct model). In the second model (indirect effect), we predicted that adding meaningfulness as the mediator would reduce the direct effect between activity and cognition (i.e., the association between activity and cognition was mediated by meaningfulness).

Our second research question was: Does activity mediate the relationship between meaningfulness and cognitive performance? We hypothesized that greater meaningfulness was associated with higher levels of cognitive performance (direct model). In the second model, we hypothesized that adding the activity mediator would reduce the direct effect between meaningfulness and cognition (i.e., the association between meaningfulness and cognition was mediated by activity).

2. Materials and Methods

Data was collected between 2016-2018 and taken from the Recording Everyday Activities and Cognition using Tablets (REACT) study conducted in Fort Collins, Colorado. Only study procedures relevant to the present focus are described.

2.1 Participants

Participants were recruited from existing databases of participants from prior studies, and advertisements in university listservs, newsletters, and community locations. To meet inclusion criteria, participants had to be English-speaking adults aged 40 years or older, not have a clinical diagnosis of dementia, or suffer from any significant visual or hearing impairment. Participants were also required to wake regularly between the hours of 4-10 a.m. (i.e., to adhere to tablet prompts in momentary component of study).

Ninety adults completed the first testing session, but only 81 individuals completed the second testing session that involved cognitive testing. Reasons for discontinuing the study included time constraints, occupational interferences, and personal reasons. There were 59 females and 22 males, and the mean age was 61.10 years (*SD* = 12.24; 41-94 years). Nearly all participants, were Caucasian (92.6%), 54.3% were married, and 71.6% lived with others. Average educational attainment was 17.35 years (*SD* = 2.79). Most participants (64.2%) were working, and the rest either completely or partially retired. Approximately 75% reported household incomes higher than $50,000, and 95.1% rated their health as good or better.

Participants were entered in a drawing for 10 tablets (~$150 value), and 20 $50 gift cards. Each participant who completed the study received one entry, and if they achieved at least 90% compliance in the momentary daily portion of the study, they received an additional entry.

2.2 Ethics Statement

The data were collected with approval by the Institutional Review Boards at Colorado State University, Protocol ID 15-5950H, approved August, 2015.

2.3 Procedure

Data for the present analysis were collected over two testing sessions. All testing sessions occurred on campus and were conducted by a trained lab member. The first session was conducted in a small group setting and took approximately two hours to complete. Following informed consent, participants completed a series of questionnaires and surveys that collected basic demographic and health information, a general activity questionnaire, and other questionnaires about personality and meaningful activity. Two to three days later the participant returned to the lab for the second testing session where a series of cognitive tests were administered. This session took approximately an hour to complete.

2.4 Measures

2.4.1 Activity Participation

The abbreviated version of the Victoria Longitudinal Study Activity Questionnaire (VLS-AQ) [24] was used to assess participation in 57 activities. Participants were instructed to indicate how often they engaged in each activity over the past two years on a 9-point scale: 0 = never, 1 = less than once a year, 2 = about once a year, 3 = 2 or 3 times a year, 4 = about once a month, 5 = 2 or 3 times a month, 6 = about once a week, 7 = 2 or 3 times a week, and 8 = daily. Jopp and Hertzog [24] found an 11-factor structure: Physical, Crafts, Games, TV, Social Private, Social Public, Religious, Travel, Experiential, Developmental, and Technology. The specific activity questions are provided in Supplementary Files (Table S1). For older adults, Jopp and Hertzog [24] reported Cronbach's alpha for the eleven activity categories ranging from 0.15 (Travel) to 0.78 (Craft) in one sample and 0.38 (Experiential) to 0.81 (Craft) in another sample.

2.4.2 Meaningful Activity Engagement

The Engagement in Meaningful Activities Survey (EMAS) [25, 26] is a 12-item survey that has established validity. Each item began with the phrase, "The activities I do…" and included: help me take care of myself (e.g., keep clean, budget my money); reflect the kind of person I am; express my creativity; help me achieve something which gives me a sense of accomplishment; contribute to my feeling competent; are valued by other people; help other people; give me pleasure; give me a feeling of control; help me express my values; give me a sense of satisfaction; and have just the right amount of challenge. Response options included: 1 = rarely, 2 = sometimes, 3 = usually, and 4 = always. Previous research [25, 27] has found two factors: Social-Experiential Component (SEC) reflecting pleasure, satisfaction, control, just-right challenge, and expression of personal values; and the Personal Competence Component (PCC) relating to personal experience with competence or achieving accomplishment, expression of the self, and personal creativity. Eakman et al. [28] reported a person reliability index of 0.85, indicating good measurement reliability.

2.4.3 Cognitive Functioning

<u>Coding Symbol Digit Task [29].</u> This paper task showed a key where numbers 1-9 had a corresponding unique symbol. Participants were given 90 seconds to fill in as many numbered boxes as possible with the correct corresponding symbol. The outcome measure was the total number of correctly written symbols and served as a measure of processing speed.

<u>Letter Sets [30].</u> For this paper task, participants were shown 15 problems. Each problem included five different sets of 4-letters. Participants were instructed that one letter set did not follow the same pattern or rule as the other four letter sets and to draw an X through the one letter set that was unlike the others. Participants were allowed seven minutes to complete this test. The outcome score was the total number of correct responses and provided an index of reasoning ability.

<u>Opposites Test [30].</u> Participants were asked to think of words that were the opposite or nearly the opposite in meaning to four target words. Participants were given five minutes to complete this test by providing up to six opposite words for each target word. The total number of correct opposite words served as the outcome measure and provided a measure of verbal fluency.

<u>Letter-Number Sequencing [29].</u> In this task, the participant was read a series of letters and numbers and asked to repeat back the numbers in ascending order, followed by the letters in alphabetical order. The task started with two letter-number combinations and progressed up to eight letter-number sequences. Each test item included three trials. Credit was given if all numbers and letters were recalled in the correct sequence, even if the letters were recalled first. The longest sequence of correctly identifying each letter-number trial was the outcome measure, indexing working memory.

Trail Making Test (TMT) [31]. Parts A and B of the paper-version TMT were administered. For Part A, circles numbered 1-25 were randomly distributed across a page. Participants were to draw lines connecting the circles in chronological order until they reached circle 25. For Part B, the form had numbers and letters, and participants were to draw lines connecting the circles in alternating chronological and alphabetical order (1-A-2-B) until they reached the end. The time to complete each part was recorded. Part A measured visual-processing speed and Part B measured executive functioning. The TMT difference time score was used as the outcome (time Part B – time Part A).

Visual Puzzles [29]. This task required participants to view a completed puzzle and select three of six puzzle pieces that, when combined and mentally rotated, reconstructed the puzzle. Pieces were not allowed to overlap, and three pieces had to be chosen. For each puzzle, participants were given 20 seconds to respond. There were 22 recorded puzzles. The total number of correctly identified puzzles was recorded, indicating nonverbal reasoning and analysis and synthesis of visual stimuli.

Explicit Memory Test. Using a laptop, a PowerPoint presentation displayed a list of 12 common words one at a time, followed by an arithmetic question. Next, the administrator asked the participant to recall the words presented in any order. This process was repeated two more times with two different 12-word lists. The outcome measure was the total number of correctly recalled words across all three trials and measured working memory.

2.5 Statistical Analyses

Statistical analyses were performed using SPSS Statistics version 26. Skewness and kurtosis were examined to ensure each variable was normally distributed. Little's Missing Completely at Random Test [32] for both activity ($\chi^2(200) = 224.19$, $p = 0.12$) and meaningfulness questionnaires ($\chi^2(8) = 11.76$, $p = 0.16$) indicated the data was missing at random. Less than 5% of the data was missing from the VLS-AQ and EMAS, and expectation maximization procedures were used to input missing data. There was no missing data for the cognitive tasks.

A series of factor analyses were then performed for each of the main variables: activity, meaningfulness, and cognition. This was necessary to confirm prior factor solutions for the VLS-AQ [24], and the EMAS [33]. Confirmation of these prior factor solutions was first conducted. If needed, exploratory analyses were conducted following the pattern of exploratory factor analysis (EFA) followed by confirmatory factor analysis (CFA) evaluating model fit. These analyses use a reflective measurement model based on the assumption that the individual items measured the underlying constructs of engagement and meaningfulness. The same process of EFA and CFA was performed for cognition to classify tasks with similar functional properties. Once the ideal factor structure underlying each latent variable was confirmed, mediation analysis proceeded. Although mediation analyses cannot speak to causal pathways in a cross-sectional sample, the analyses provide a starting point to examining the associations between these constructs.

Two primary SEM models were tested. Model 1a evaluated the direct effect of activity on cognition and Model 1b tested the indirect effect of activity on cognition mediated by meaningfulness. Model 2a evaluated the direct effect of meaningfulness on cognition and Model 2b tested the indirect effect of meaningfulness on cognition as mediated by activity. Model fit was evaluated using several indicators: chi-square (χ^2) statistic, where lower values typically indicate better fit; root-mean-square error approximation (RMSEA), where values <0.05 indicate good model fit; incremental fit index (IFI) and Tucker-Lewis index (TLI), where higher values indicate better fit (e.g., IFI > 0.90, TLI > 0.80); and comparative fit index (CFI), where values ≥0.9 indicate good model fit [34]. The significance of the indirect effect was tested using bootstrapping procedures. Unstandardized indirect effects were computed for each of the 1,000 bootstrapped samples, and the confidence interval was computed by determining the indirect effects at the 5th and 95th percentiles. In all models, age and education were included as covariates.

2.6 Power Analysis

A calculator for SEM was used to estimate power [35]. Both direct models with two latent variables with N = 81 had >99% power to detect large effects and 76% power to detect medium effects. The indirect models with three latent variables were estimated to have >99% power to detect large effects, and 60% power to detect medium effects. Both models were estimated to have limited power to detect small effects (10-13%). Given that there was no research thus far directly examining relationships between activity meaningfulness and activity participation, it was unclear what effect sizes to expect. Due to limited power for detecting small-to-medium effects, non-parametric bootstrapping (1000 samples) was also used. This approach is a robust alternative method that provides more reliable estimates.

3. Results

Results were obtained through several different analyses but only mediation model findings are presented here (see Tables S1-S9 for factor analyses). In brief, the best-fitting model for the VLS-AQ had five factors ($\chi^2(220)$ = 284.80, p = 0.002, RMSEA = 0.061, IFI = 0.86, TLI = 0.82, CFI = 0.85), the EMAS had three factors ($\chi^2(51)$ = 66.33, p = 0.073, RMSEA = 0.061, IFI = 0.95, TLI = 0.93, CFI = 0.95), and the cognitive measures fit two factors ($\chi^2(13)$ = 7.50, p = 0.875, RMSEA = 0.00, IFI = 1.06, TLI = 1.11, CFI = 1.00). Descriptive statistics for these variables can be seen in Table 1.

Table 1 Descriptive Statistics for the VLS-AQ, EMAS, and Cognitive Measures Factors.

	M (SD)	Skewness	Kurtosis	Cronbach's alpha
VLS-AQ 1: Physical	4.92 (2.12)	-0.72	-0.24	0.70
VLS-AQ 2: Games	4.66 (1.46)	-0.52	-0.35	0.73
VLS-AQ 3: Home	2.88 (1.16)	0.99	1.39	0.77
VLS-AQ 4: Social	4.06 (1.20)	0.44	-0.28	0.70
VLS-AQ 5: Developmental	1.30 (1.39)	1.29	1.08	0.59
EMAS 1: Self-Expression & Caring	2.89 (0.45)	-0.12	0.21	0.68
EMAS 2: Personal Experiential	3.02 (0.45)	0.07	0.26	0.78
EMAS 3: Social Value & Competence	2.88 (0.45)	-0.68	1.47	0.72
Cognition 1: Fluid-Memory	150.00 (23.03)	0.01	-0.74	0.65
Cognition 2: Reasoning-Executive Functioning	200 (29.56)	-0.56	0.87	0.72

Notes: VLS-AQ = Victoria Longitudinal Study Activity Questionnaire. EMAS = Engagement in Meaningful Activities Survey. Cognitive test scores were converted to *t*-scores prior to composite factor calculation.

3.1 Mediation Model 1–Activity

In Model 1a, activity was regressed onto cognition (see Table 2). Model 1a provided poor fit, $\chi^2(23) = 33.19$, $p = 0.08$, RMSEA = 0.09, IFI = 0.89, TLI = 0.80, CFI = 0.87. The direct effect hypothesis was not supported: β = 0.29, $p = 0.77$, demonstrating the link between activity and cognition was not significant.

Table 2 Standardized Regression Coefficients (β) for Direct Effect (Model 1a) & Indirect Effect (Model 1b).

Model 1 Pathways Coefficients	Direct Effect (Model 1a)		Indirect Effect (Model 1b)	
	β	*p*	β	*p*
Activity → Cognition	0.29	0.77	-0.21	0.75
Age → Activity	0.61	0.01*	0.54	0.01*
Age → Cognition	-0.91	0.15	-0.68	0.00**
Education → Activity	0.68	0.01*	0.72	0.00**
Education → Cognition	-0.06	0.93	0.28	0.54
Activity → Meaningfulness			2.67	0.58
Meaningfulness → Cognition			0.17	0.75
Age → Meaningfulness			-1.03	0.69
Education → Meaningfulness			-1.84	0.59

Notes: * denotes significance at the $p < 0.05$ level, ** denotes significance at the $p < 0.01$ level.

The indirect effect Model 1b was tested with meaningfulness added as the mediating variable (see Figure 1). Table 2 reports the standardized regression coefficients (β) for each pathway in this model. The indirect effect Model 1b provided good fit, $\chi^2(46) = 56.40$, $p = 0.14$, RMSEA = 0.05, IFI = 0.94, TLI = 0.90, CFI = 0.93. In comparison to the direct effect Model 1a, the fit indices for the indirect effect were significantly better (i.e., higher IFI, TLI, CFI) and acceptable for a “good fitting” model. However, the regression coefficients linking activity to meaningfulness and meaningfulness to cognition were not significant. These results indicated that activity did not predict meaningfulness, and neither activity nor meaningfulness predicted cognition. Further, the association between activity and cognition was not mediated by meaningfulness. The bootstrapped unstandardized indirect effect of activity on cognition as mediated by meaningfulness was not significant (-0.10, SE = 0.64, 95% CI = -2.39, 0.53, $p = 0.51$).

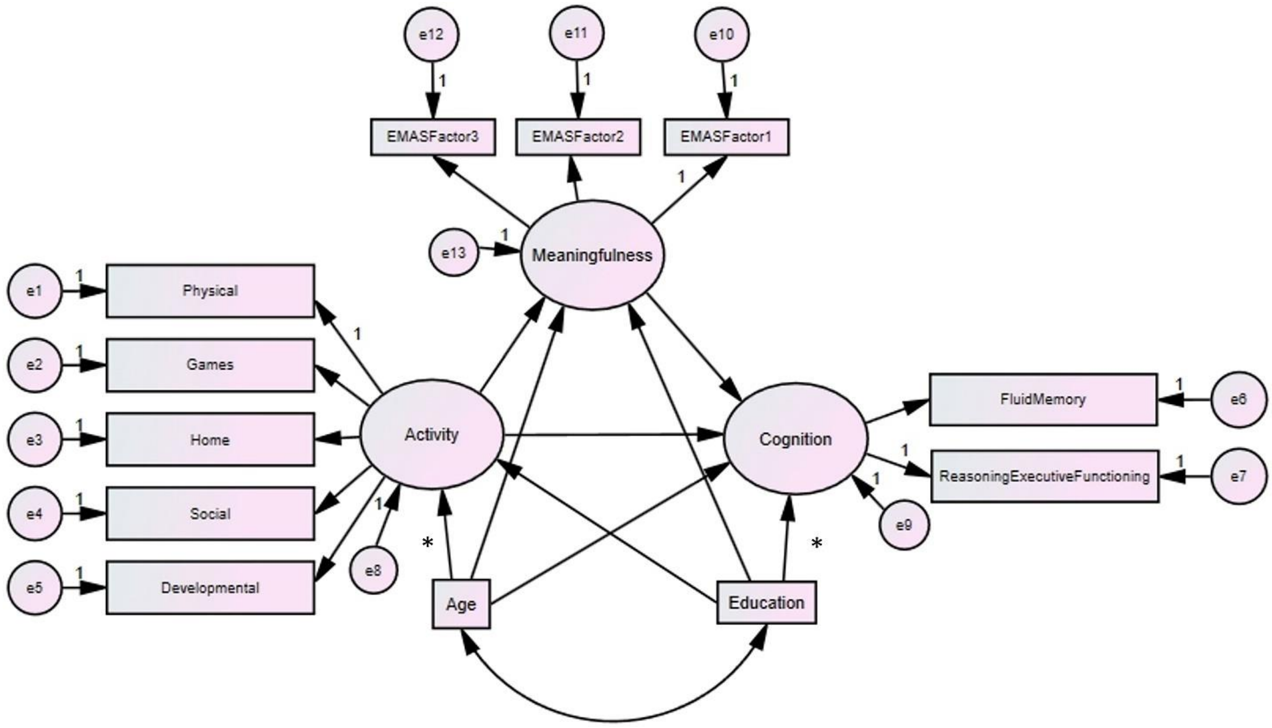

Figure 1 SEM Diagram for Model 1 Testing the Indirect Effect of Activity on Cognition via Meaningfulness.

The standardized regression coefficient (β) for the direct effect of activity on meaningfulness was quite large (β = 2.67) as was the effect of age and education on meaningfulness (β = -1.84). Standardized values outside the range of -1 to 1 can sometimes be valid [36], indicating a high correlation between predictor variables. It can also indicate that unreasonable model constraints have been imposed, however no error messages were incurred nor was the maximum iteration reached; therefore, these values were deemed acceptable. Rather, the range for standardized coefficients was likely exceeded due to the small correlations between the EMAS factors and the social activity factor. However, because the multicollinearity was considered quite small (>0.4) by research standards [37], it did not pose a significant threat to this analysis. The correlation matrix for all observed variables is reported in Table 3.

Table 3 Correlation Matrix of Observed Variables in SEM Models.

	AF1	AF2	AF3	AF4	AF5	EMAS1	EMAS2	EMAS3	Cog1	Cog2
AF1	1	0.02	-0.12	0.13	0.12	0.15	0.13	0.23*	0.14	0.03
AF2	0.02	1	0.05	0.08	-0.01	-0.12	0.11	0.08	-0.08	0.19
AF3	-0.12	0.05	1	0.10	0.01	0.17	0.08	0.17	-0.23*	0.03
AF4	0.13	0.08	0.10	1	0.14	0.28*	0.35**	0.27*	-0.21	-0.24*
AF5	0.12	-0.01	0.01	0.14	1	0.13	0.17	0.24*	0.17	-0.01
EMAS1	0.15	-0.12	0.17	0.28*	0.13	1	0.51**	0.47**	-0.17	-0.22*
EMAS2	0.13	0.11	0.08	0.35**	0.17	0.51**	1	0.56**	-0.15	-0.27*
EMAS3	0.23*	0.08	0.17	0.27*	0.24*	0.47**	0.56**	1	0.04	-0.13
Cog1	0.14	-0.08	-0.23*	-0.21	0.17	-0.17	-0.15	0.04	1	0.44**
Cog2	0.03	0.19	0.03	-0.24*	-0.01	-0.22*	-0.27*	-0.13	0.44**	1

Notes: AF1 = Activity Factor 1: Physical; AF2 = Activity Factor 2: Games; AF3 = Activity Factor 3: Home; AF4 = Activity Factor 4: Social; AF5 = Activity Factor 5: Developmental. EMAS1 = EMAS Factor 1: Self-Expression & Caring; EMAS2 = EMAS Factor 2: Personal Experiential; EMAS3 = EMAS Factor 3: Social Value & Competence. Cog1 = Fluid Memory; Cog2 = Reasoning Executive Functioning. * Denotes significance at the $p < 0.05$ level, ** denotes significance at the $p < 0.01$ level.

3.2 Mediation Model 2–Meaningfulness

In Model 2, the roles of the latent predictor variables were reversed where meaningfulness served as the independent variable predicting cognition. Model 2a provided good model fit, $\chi^2(10) = 10.09$, $p = 0.43$, RMSEA = 0.01, IFI = 0.99, TLI = 0.99, CFI = 0.99. However, the direct effect of meaningfulness on cognition was not significant, demonstrating that greater meaningfulness was not associated with higher cognition (see Table 4 for model parameters).

Table 4 Standardized Regression Coefficients (β) for Direct Effect (Model 2a) & Indirect Effect (Model 2b).

Model 2 Pathways Coefficients	Direct Effect (Model 2a)		Indirect Effect (Model 2b)	
	β	*p*	β	*p*
Meaningfulness → Cognition	-0.02	0.89	0.17	0.75
Age → Meaningfulness	0.41	0.01**	0.40	0.00**
Age → Cognition	-0.72	0.01**	-0.68	0.00**
Education → Meaningfulness	0.07	0.58	0.06	0.61
Education → Cognition	0.14	0.23	0.28	0.54
Meaningfulness → Activity			0.82	0.04*
Activity → Cognition			-0.21	0.75
Age → Activity			0.21	0.31
Education → Activity			0.67	0.03*

Notes: * denotes significance at the $p < 0.05$ level, ** denotes significance at the $p < 0.01$ level.

Next, activity was added to the model as the mediator variable. Figure 2 displays the simplified path diagram for the indirect effect Model 2b. Model 2b provided adequate model fit, $\chi^2(46) = 56.35$, $p = 0.14$, RMSEA = 0.05, IFI = 0.94, TLI = 0.90, CFI = 0.93. Meaningfulness significantly predicted activity; as meaningfulness scores increased by 1 unit, the frequency of activity engagement increased by 0.82. However, higher activity levels did not predict cognition, nor was the relationship between meaningfulness and cognition mediated by activity engagement frequency. The bootstrapped unstandardized indirect effect of meaningfulness on cognition as mediated by activity was not significant (0.20, SE = 0.84, 95% CI = -0.47, 4.57, $p = 0.40$).

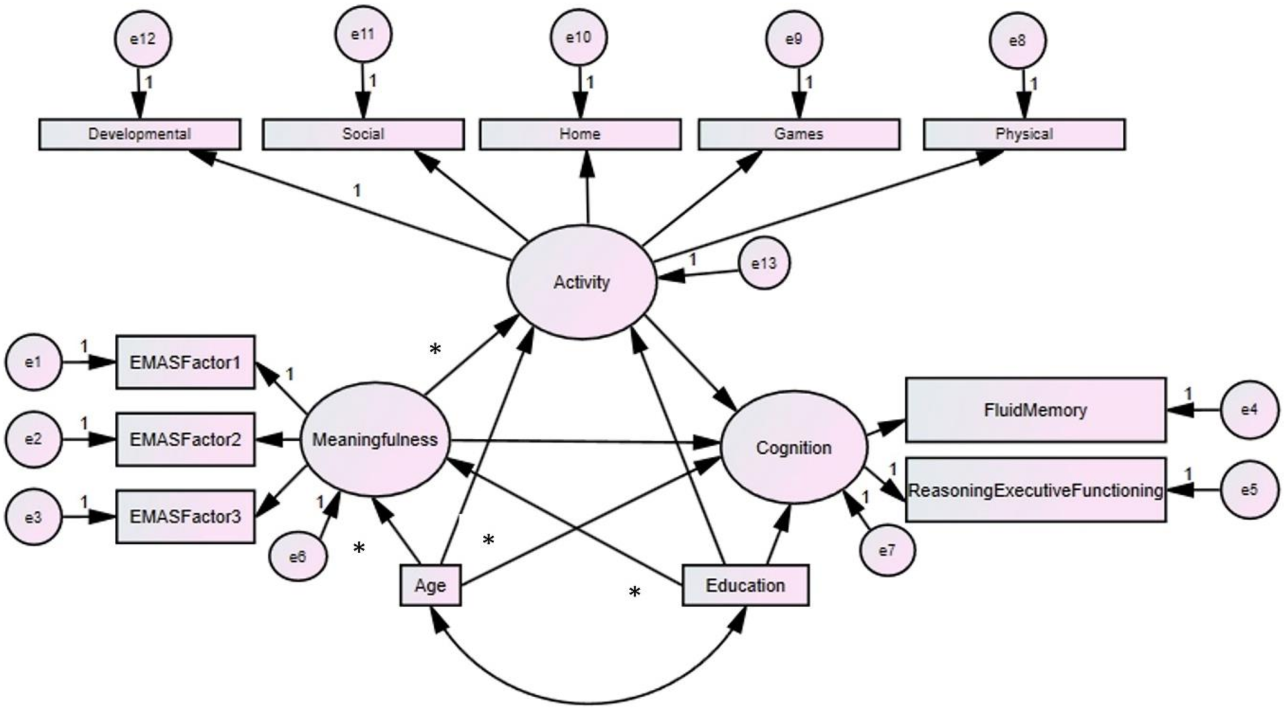

Figure 2 SEM Diagram of Mediation Model 2 Testing the Indirect Effect of Meaningfulness on Cognition via Activity.

4. Discussion

This study investigated the structural associations between activity engagement, meaningfulness, and cognitive ability. Two SEM models were tested: the first evaluated if activity was a primary predictor of cognition and if meaningfulness mediated the relation; and the second evaluated if meaningfulness significantly predicted cognition and if activity mediated the relation. Contrary to our hypotheses, neither model showed significant mediating effects. Further, direct effects between activity engagement with cognition and meaningfulness with cognition were unexpectedly not significant. However, subjective meaning from activity was positively associated with activity engagement. Given that there are several relations within each model, the results are discussed between each pair of variables.

4.1 Activity and Meaningfulness

Our hypotheses of mediation of cognition relied on the expectation of a positive relationship between activity and meaningfulness. Meaningfulness positively predicted activity, where higher levels of meaningfulness was associated with higher levels of activity participation. This is in line with the selective engagement hypothesis [21], which proposed that activities with greater meaning are selected more often and engaged in more frequently than less meaningful activities. This also aligns with occupational therapy research, reporting that more meaningful and frequent activity engagement in older adults explains higher life satisfaction and other favorable psychological health and well-being outcomes [33]. The positive relationship may particularly apply to physical, social, and developmental activities (see Table 3). All three EMAS factors were positively correlated with the social activity factor, suggesting that social health, a key part of successful aging, is linked to the perceived value of an activity. The physical and developmental activity factors were also positively correlated with the social value and competence EMAS factor.

Meaningful activity experiences may also foster intrinsically motivated behavior. Eakman [38] has argued meaningful activities as assessed by the EMAS are commonly imbued with experiences of autonomy, competence, and pro-social relatedness, which serve to motivate engagement and promote well-being through fulfilling psychological needs [39]. Additionally, activity engagement as assessed by the VLS-AQ may be sensitive to the EMAS meanings of pleasure and satisfaction which are known to motivate persistence in goal-directed action [40]. Given these findings, encouraging meaningful activity may represent a promising way to promote engagement, a key component in a successful aging trajectory.

In contrast, the path coefficient of activity predicting meaningfulness was not significant. Therefore, while directionality cannot be determined with these cross-sectional data, this pattern of association aligns with the idea that the meaning attached to engagement may be more closely tied to driving activity participation rather than vice versa. These findings can be explained by theories of leisure and recreation, which state that meaningfulness motivates self-creation and promotes participation in novel experiences [41]. According to Atchley [14], individuals select and develop ideas, relationships, environments, and activities based on personal dispositions about meaning in their lives. Personal meaning influences both individual and social expectations regarding activity engagement and suggests that when an activity is perceived to be more meaningful (i.e., feelings of self-determination and competence), it is more likely to be expressed through behavior [41].

4.2 Meaningfulness and Cognition

In comparison to the direct effect model of activity on cognition (Model 1a), the model fit statistics for the direct effect of meaningfulness on cognition (Model 2a) were much stronger. However, in the individual parameters, meaningfulness did not directly or indirectly influence cognition. This was unexpected given theoretical predictions stemming from the environmental complexity hypothesis [22] which suggests that activities with greater meaning are selected more frequently due to their level of cognitive stimulation. From this perspective, meaningfulness was thought to enhance cognitive ability by promoting activity selection and motivation [14, 17, 18]. Although the results showed that meaningfulness predicted activity selection, these selections were not significantly associated with cognitive performance in the current sample. Explanations for this may lie in disentangling the correlations. For example, the reasoning and executive functioning cognitive factor was negatively correlated with EMAS factors 1 and 2 and the social activity factor.

Although these associations were small, the mediational results suggest that there may be complex associations between different domains of meaningful engagement and cognition.

4.3 Activity Predicting Cognition

In both model variations, the pathways linking activity to cognition were not significant. These findings were unexpected, as associations between activity and cognition are fairly-well established [1, 42, 43]. Although some cross-sectional investigations have shown that increased participation in certain cognitively demanding activities (e.g., reading the newspaper, Sudoku) is related to higher cognitive performance, others found that higher cognitive performance was associated only with a greater frequency of participation in activities that occurred within a group setting (e.g., bowling, religious activity) [42, 43]. However, the absence of a statistically significant overall association between activity and cognition found in the present study is consistent with some prior research [44, 45], and there is evidence that associations are more common between certain activity and cognitive domains rather than overall activity [46].

Another point to consider is the activity questionnaire that was used. Some researchers suggest that different time frames over which activity is assessed provide different engagement depictions by tapping into different underlying meaning and memory processes [47]. Although a well-established scale with a wide range of activity was used, the consideration of activity over the past two years may not fully capture fluctuations in activity participation. When activity is assessed over a shorter time frame (e.g., weekly, daily), reported information may be less subject to cognitive biases and memory distortions [1, 5, 45, 47, 48]. It is unknown whether assessment at the daily level provides a stronger link to cognition, but research points to the benefit of using multiple types of assessments to measure activity in relation to cognition [46]. Further, there are several challenges in measuring activity engagement (see [1, 6, 7]), and it remains possible that the scale used to assess activity engagement contributed to the null results.

4.4 Limitations

Given the exploratory nature of this study, these structural models offer a preliminary framework for these relations and highlight several methodological avenues for future research. The sample was not representative of the middle-aged and older adult population, as they were highly educated, primarily White, and reported earning a higher income than U.S. population studies [49]. The lack of sample diversity might have contributed to the non-significant results through lower interindividual variability in cognition and engagement, and limits the generalizability of the findings. Further, it seems probable that the nature of leisure varies greatly depending upon available environmental resources and cultural influences. Future research should examine the associations between activity, meaningfulness of engagement, and cognition cross-culturally, as cultural values towards activity may impact these structural relations.

Several limiting factors may have contributed to the null effects. The sample size complicated interpretations of the factor analyses, especially regarding the model fit for the VLS-AQ, and it is unclear how these complications may have impacted the mediational analysis. The lack of inclusion of various activities due to factor constraints in the structural model may also explain the lack of an association between activity and cognition. Other research reporting significant effects on cognition has generally used larger samples which allowed for more activity items to fit within factor parameters (e.g., n = 153 [20]; n = 267 [24]). Relatedly, there was limited power to detect small effects, implying that links between activity, cognition, and meaningfulness may in fact exist. For example, confidence intervals around the indirect paths of meaningfulness on cognition as mediated by activity, and activity on cognition as mediated by meaningfulness were both quite large, suggesting the effect might exist but the estimates were imprecise in the dataset. The sample size also reduced the range of analytical opportunities that could be explored post-hoc (e.g., moderated mediation). We also note that conducting EFA and mediation testing on the same dataset may cause model overfitting. While our primary goal was examining structural relationships rather than scale validation, future research should use independent samples to confirm these findings.

Further, testing only baseline structural associations between these constructs may not have fully captured the dynamic and contextual influences of the subjective experiences associated with engagement. According to the environmental complexity hypothesis [22], motivation to selectively engage in more meaningful activity occurs when cognitive skills are applied across various settings and situations. Thus, the inability to predict cognition may lie in the static nature of the cross-sectional study design. Relatedly, the EMAS assessed meaningfulness of activity in general versus as they occurred. The relations between activity, cognition, and meaningfulness may be more apparent over micro timeframes such as throughout and across days. Moreover, parsing meaningfulness towards specific activities may also be a fruitful future direction.

Finally, although the present findings adjusted for age and education, other covariates (e.g., gender, subjective health status) were not controlled because of the added complexity that tended to over-saturate the models. Lifestyle and health factors can influence cognition and future work with larger samples should incorporate these relevant influences.

5. Conclusions

The present results did not support the predictions of mediating influences of activity engagement and meaningfulness on cognition. However, findings showed that meaningfulness served the model best as a predictor of activity engagement, where individuals who had higher ratings of meaningfulness also engaged more frequently in activity. In addition, neither meaningfulness nor activity significantly predicted higher cognitive performance within these models. The correlational results showed the strongest connection occurred between social activity and meaningful engagements, pointing to the link between the subjective value of engagement and social health. The present study offers a conceptual foundation for exploring the links between activity engagement, meaningfulness, and cognition, and future work using alternative metrics and timeframes are needed to provide additional evidence. For example, because the present data were cross-sectional, causal inference about the directionality of any observed associations could not be established and it remains possible that the links between activity, meaningfulness, and cognition may exist longitudinally. Moreover, studies investigating how the activity-cognition relationship functions at the daily level will provide insight into the contextual factors that influence engagement and will help clarify how certain patterns of daily activity and meaningfulness are related to momentary shifts in daily cognitive performance.

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Author Contributions

Cassandra Hatt: Conceptualization, data curation, formal analysis, writing – original draft. Aaron Eakman: Conceptualization, formal analysis, writing – review and editing. Allison Bielak: Conceptualization, data curation, project administration, methodology, writing – review and editing. All authors have read and approved the published version of the manuscript.

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Competing Interests

The authors have declared that no competing interests exist.

Data Availability Statement

Data can be obtained by contacting Dr. Allison Bielak Allison.bielak@colostate.edu.

Additional Materials

The following additional materials are uploaded at the page of this paper.

1. Table S1: 7-Factor EFA factor loadings and communalities for the VLS-AQ.
2. Table S2: 6-Factor EFA factor loadings and communalities for the VLS-AQ.
3. Table S3: 5-Factor EFA factor loadings and communalities for the VLS-AQ.
4. Table S4: Final 5-Factor EFA factor loadings and communalities for the VLS-AQ.
5. Table S5: Correlation matrix of Activity factor composite scores.
6. Table S6: CFA Standardized Regression Weights for the EMAS Factors.
7. Table S7: EFA and item analysis coefficients for the EMAS.
8. Table S8: EFA and Item Analysis for Cognitive Ability Factors.
9. Table S9: CFA Standardized Regression Weights (Factor Loading) Cognitive Ability.

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