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In The Zone: Flow State and Cognition in Older Adults

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Abstract

The current study investigated the nature of the flow state among older adults. Flow is a pleasurable experiential state that occurs during full-capacity engagement in which an individual is performing at a level that is matched with the demands of the task. Each participant completed a scale assessing dimensions of flow in a particular activity selected by the participant. More cognitively demanding activities elicited higher levels of flow for those with higher fluid ability, but lower levels of flow for those with lower fluid ability. This pattern was reversed for activities that were low in demand. Our data highlight the potential importance of considering motivational states such as flow in understanding cognitive optimization in adulthood.

Keywords

Flow; Cognitive Aging; Motivation; Activity Engagement; Optimal Experience; Activity Flow State Scale

Since Csikszentmihalyi (1975) first introduced the flow state as a general theory of the phenomenology of motivation, it has interested researchers from fields as diverse as education (Vollmeyer & Rheinberg, 2006), sports psychology (Jackson & Marsh, 1996), human factors (Choi, Kim & Kim, 2007), and neuroscience (Dietrich, 2004). Flow, which is defined as the experiential state that occurs as one approaches optimal engagement with a task, emerged from interest in describing the experience of optimal performance (Nakamura & Csikszentmihalyi, 2009). While the flow construct has been explored in various fields, neither the nature of flow in older adults nor its role in cognitive aging has been examined. This is surprising given the role of flow in subjective well-being (Myers & Diener, 1995) and the increased interest in the relationship between well-being and healthy aging (Ryff, Singer, & Love, 2004). While young participants have reported greater levels of flow when engaged in intellectually challenging activities than when participating in passive and easy activities (Csikszentmihalyi, 1990), the nature of such experiences has yet to be empirically

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assessed in an older sample. Furthermore, our review of the literature reveals little investigation of the mechanisms by which we derive pleasure from intellectual activities as we grow older. To the extent that an intellectually engaging lifestyle may contribute to cognitive vitality (Hertzog, Kramer, Wilson, & Lindenberger, 2008; Crowe, Andel, Pedersen, Johansson, & Gatz, 2003; Wilson, Scherr et al., 2007; Parisi, Stine-Morrow, Noh & Morrow, 2009; Schooler & Mulatu, 2001; Schooler, Mulatu, & Oates, 1999), a full account of such enrichment effects will ultimately depend on understanding motivational states (such as flow) that may serve a self-regulatory function in engendering such choices in engagement. In the current study, we made a preliminary step toward addressing such issues by examining the nature of the flow state in older adults.

Csikszentmihalyi (1990) defined flow in terms of nine dimensions which include challenge-skill balance, the merging of actions with awareness, having clear task goals, unambiguous feedback, full concentration on the task at hand, a sense of control, a loss of self-consciousness, a perception of the transformation of time, and an autotelic (or intrinsically rewarding) experience (see Csikszentmihalyi, 1990 for a comprehensive review of these dimensions). Flow is described as an exceptionally positive state and has been posited as the phenomenological experience that motivates people to perform difficult activities at a high level and to persevere in these activities across long periods of time (Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005). This state occurs when a person is completely absorbed in a task or situation and is characterized by entering a “channel” where task demands and skills are equivalent so that one is not below this channel in a state of boredom or above this channel where the challenges of the task overcome one’s skill set (Nakamura & Csikszentmihalyi, 2009). This suggests that the flow experience will be more likely if there is a match between the capacities afforded by ability and the demands of the activity, what we call the Match Hypothesis. In other words, activities that are more cognitively demanding should elicit higher levels of flow for those with higher fluid ability, and lower levels of flow for those with lower fluid ability, as they would presumably be operating above their skill level, outside of the flow channel.

The Match Hypothesis has yet to be examined in older adults, in part because a generalized flow measure does not exist. However, a nine-factor measure of flow tailored to athletic performance has been validated. Jackson and Marsh (1996) used confirmatory factor analysis to establish construct validity of their Flow State Scale (FSS), demonstrating good fit to both a nine-factor model and a single global factor model of flow. Evidence for predictive validity included correlations between flow and other constructs theorized to relate to flow (i.e. perceived ability, anxiety, and motivation; Jackson, Kimiecik, Ford & Marsh, 1998). To our knowledge, flow has not been quantitatively assessed with this model for non-sports activities. Furthermore, the primary population for which the FSS measurement model has been explored has been elite athletes, most of whom have been relatively young. Thus, there is limited evidence that this measurement model of flow generalizes across tasks and populations.

We had two goals in the current study. First, we tested the validity of an adapted flow scale, the Activity Flow State Scale, for use in assessing the flow state across different activities and within a population of older adults. Second, we tested the Match Hypothesis by examining the relationship between cognitive ability and the flow experience in activities of low and high demand. We hypothesized that more cognitively demanding activities would elicit higher levels of flow for those with higher fluid ability, but lower levels of flow for those with lower fluid ability, and that the pattern would be reversed in low demanding activities.

Method

Participants

Participants included 197 community dwelling older adults from the Champaign-Urbana area1. Participants ranged in age from 60 to 94 years (*M* = 72.1, *SD* = 7.7 years), and had an average of 15.5 years of education (*SD* = 2.7).

Measures

Multiple instruments were used to assess fluid cognitive abilities. Processing speed (α=.80) was measured with letter comparison and pattern comparison tests (Salthouse & Babcock, 1991) and the identical pictures test (Ekstrom, French, & Harmon, 1976). Working memory was measured with the letter number sequencing test (Wechsler, 1997). Visual spatial processing (α =.71) was measured with the card rotation and hidden patterns tasks (Ekstrom et al., 1976). Divergent thinking (α =.69) was measured with the different uses and opposites tests (Ekstrom et al., 1976). Inductive reasoning (α =.90), was measured with the letter sets, number sets, letter series, and word series tests (Ekstrom et al., 1976) and the everyday problem solving test (Marsiske & Willis, 1995). The composite for these tests of fluid ability showed high reliability (α =.91).

The Activity Flow State Scale (AFSS) contained 34 items representing each of the nine dimensions of flow. The majority of items were adapted from Jackson's FSS (Jackson & Marsh, 1996). Where items did not translate well from the domain of physical activities to general activities, they were removed or replaced with items adapted from other flow measures (Vollmeyer & Rheinberg, 2006). Participants rated items on a Likert scale ranging from (1) Strongly Disagree to (5) Strongly Agree. Instructions for our flow measure were as follows: Below you will read a number of statements that describe how people sometimes experience certain activities or events in their daily lives. Think about one activity that you performed or experience that you had during the last week, particularly one that you enjoyed and/or found satisfying. Try to remember how you experienced that activity as you read each statement below. Provide a rating for each statement to indicate how well it describes your experience by circling the appropriate number.

In the AFSS, participants were free to report on any kind of activity that they had participated in recently. In order to determine activity demand, we categorized participants' open-ended reports of their selected activity into groups representing activities of either high cognitive demand (HCD) or low cognitive demand (LCD). Estimates between independent raters that were blind to participants' flow ratings and cognitive abilities showed good inter-rater reliability (κ =.86).

HCD activities included: working (14.3%), participating in art and music (12.5%), educational activities including taking classes and teaching (6.7%), reading and literacy activities (4.2%), completing puzzles and challenging games such as crosswords, cards, and Sudoku (3.6%), and searching for information in library settings or on computers (2.4%). LCD activities included: attending parties and social events (34.8%), physical exercise (10.2%), watching television (2.8%), cooking (2.4%) and vacation and resting (2.1%). Groups reporting HCD (N = 69) and LCD (N = 109) activities did not differ in age (M_{HC} = 72.1, 60–92 years; M_{LC} = 72.2, 60–94 years; $t < 1$), education (M_{HC}= 15.8, 7–20 years; M_{LC}=15.4, 12–21 years; $t < 1$), or fluid cognitive ability (M_{HC}= .07, *SE* = .07; M_{LC}= .04, *SE*

[1]Data are reported from the Senior Odyssey project, an ongoing community-based experiment investigating the effects of intellectual engagement on cognition. These data are based on pretest measures, before participants were randomly assigned to an experimental or control group.

= .07; $t < 1$). The global flow factor also maintained high reliability in both groups (α_{HC}= .89; α_{LC}= .91).

In order to establish external validity for our coding scheme, we examined participants' self-perceptions of cognitive demand in a number of activities that were collected in a separate instrument. In this activity measure, participants were asked to rate the perceived levels of cognitive demand on a number of different everyday activities (see Salthouse, Berish, & Miles, 2002) All activity groupings listed above as HCD or LCD were included in this measure. HCD activities were rated by participants as significantly more demanding than LCD activities (M_{HCD}= 3.73, *SE* = .07; M_{LCD}= 2.86, *SE* = .06), t (176) = 12.65, $p < .001$, d = 1.00. Thus, even though any of these activities can likely vary in intellectual demand (e.g., "cooking" might constitute heating up leftovers or organizing a dinner party for 12), the participants who completed our AFSS shared our independent raters' perceptions that activities could be generally characterized in terms of cognitive demand.

Procedure

Participants completed the AFSS and the activity assessment as part of a larger set of measures that were mailed to their home. Participants were later administered the battery of cognitive measures in an individual laboratory session lasting approximately two hours. The time between completing the packet and completing the lab session was approximately one week.

Results

We used confirmatory factor analysis (CFA) to test factorial validity. The following fit indices were used to evaluate the adequacy of the model: the comparative fit index (CFI), non-normed fit index (NNFI), and root mean square error approximation (RMSEA). Items that did not load on the latent factors were removed. When flow was modeled as a single latent factor, parcels were used as indicators and constructed by the item-to construct technique (Little et al., 2002).

First, we formally tested a nine-factor model to validate the Activity Flow State Scale for assessing flow in activities and among older adults. Overall, the nine-factor model showed good fit to the data (χ^2=479.39, *df* = 266, NNFI/TFI= .90, CFI = .92, RMSEA = .06, *90% CI* =. 05, .07). These findings suggest that our measure adequately captures the nine components of flow in various activities. Table 1 provides the items in this scale and item factor loadings from this model. Table 2 provides scale reliability estimates and intercorrelations among the nine factors. The findings are in line with the nine proposed dimensions of flow (Csikszentmihalyi, 1990) and suggest that the multidimensional measurement model of flow (Jackson & Marsh, 1996) generalizes across general activities and to a previously unexamined population of older adults.

Because the Match Hypothesis includes no explicit predictions about what dimensions of flow would be related with specific or broad-based cognitive abilities, we aimed to operationalize flow as a single global construct (a global flow factor [F_g]; Jackson et al., 1998) and to examine relationships between F_g and cognition. Previous research has suggested that flow can be meaningfully examined at both a specific level of analysis (9 facets) or through a higher order global construct (Jackson et al., 1998; Jackson & Marsh, 1996; Jackson & Eklund, 2002). To do this, we formally tested the fit of the F_g model, which included all indicators loading on a single first-order latent factor. This model showed good fit to the data (χ^2=12.74, *df* = 4, NNFI/TFI= .98, CFI = .98, RMSEA = .09, *90% CI* = .06, .12). Thus, we found evidence that the flow construct is multidimensional but can also be meaningfully assessed as a unitary construct (Jackson et al., 1998).

The Match Hypothesis posits that the experience of flow will vary as a function of the alignment between the person's cognitive ability and the cognitive demands of the task. Cognitive ability was modeled hierarchically with a latent factor representing general fluid ability (G_f) with lower order latent factors for processing speed, inductive reasoning, visual-spatial processing, divergent thinking, and working memory. This model of cognitive ability showed good fit to the data (χ^2 = 111.80, *df* = 62, NNFI/TFI= .93, CFI = .97, RMSEA = .06, *90% CI* = .05, .08), suggesting that the measures of cognition among our older adults represented a general fluid ability factor (Carroll, 1993; Cattell, 1987).

To test the Match Hypothesis, we used hierarchical regression to examine the joint effects of activity demand and cognitive ability on intensity of the flow state. Using the F_g composite as the criterion variable, we first entered the main effects of G_f and the dummy-coded activity demand (0 for LCD; 1 for HCD). We then entered the cross-product term of G_f and activity demand in Step 2. While neither the main effect of G_f nor of activity demand was predictive of the flow state (β= −.12, t (160) = −1.28, p > .05; β = −.04, t (160) = .08, p > .05, respectively), the interaction term was significant (β= .30, t (160) = 3.45, p < .01). Consistent with the Match Hypothesis, this interaction suggests that the magnitude of the relationship between fluid ability and flow state varied as a function of the demand of the activity.

We examined conditional effects of the interaction to determine if fluid ability was positively related to flow for cognitively demanding activities and negatively related to flow for non-cognitively demanding activities (i.e., testing if both slopes are significantly different from zero, rather than significantly different from each other). Using the simple slopes technique (Aiken & West, 1991; Preacher, Curran, & Bauer, 2006), we decomposed the interaction term into a simple regression of flow onto fluid abilities for both non-cognitively demanding activities and cognitively demanding activities. Results indicate that both slopes were significant, with fluid ability positively related to flow for cognitively demanding activities (*B* = .25, *SE* = .11; t (93) = 2.26, p < .05), and fluid ability negatively related to flow for non-cognitively demanding activities (*B* = −.19, *SE* = .06; t (64) = −3.00, p < .01). Figure 1 illustrates this interaction, presenting the best-fit lines between flow and cognition for both cognitive and non-cognitive activities. The three-way interaction between age, fluid ability and activity demand was negligible (β = .04; t (160) = .05, p >.10). Collectively, these findings, along with the lack of correlation between age and flow (see Table 3 in online appendix), suggest that the ability to experience a flow state is not compromised with age.

Discussion

Our findings support the Match Hypothesis: participants with higher fluid abilities experienced higher levels of flow in cognitive activities, while those with lower fluid abilities experienced lower levels of flow. However, participants with lower fluid abilities experienced higher levels of flow in non-cognitive activities, while those with higher fluid abilities experienced lower levels of flow. These data are consistent with the resource-based selection view, in which resource scarcity arises when the "total demands required by multiple tasks exceed total available resources" (Riediger et al., 2006; p. 301) as well as the challenge-skill balance conception of flow. Among older adults, those who are generally resource-rich have the capacity to be more absorbed by activities of higher cognitive demand as opposed to resource-poor individuals who are more absorbed with activities of lower cognitive demand. To the extent that the flow state engenders persistence in an activity, this suggests that experiential states may contribute to the degree to which we gain from that activity, an account that is echoed in the educational literature with younger adults (cf. Engeser, Rheinberg, Vollmeyer, & Bischoff, 2005; Vollmeyer & Rheinberg, 2006).

With a population different from previous studies (including elders and non-experts) and across a broad range of self-selected activities, we showed similar model fit indices and factor loadings to previous measurement models of flow for both a 9-factor model (facets of flow) and a 1-factor (global flow) model (Jackson & Eklund, 2002; Jackson et al., 1998). Though our central test of the Match Hypothesis required only the global flow factor, we present evidence that the multidimensional model shows good fit as well, consistent with the previous validation of the scale and in line with flow theory. These different levels of analysis may prove important in future research. For example, it is often the case that lower order facets of personality traits predict outcomes above and beyond the broad trait (Paunonen & Ashton, 2001). Thus, while flow as a global construct is related to cognition during activity engagement, the facets of flow may be differentially associated with other outcome measures in older adulthood.

The finding that older adults have the capacity to experience flow when cognitive capacity and intellectual demands are in synch is potentially important for theories of cognitive optimization and translation into health recommendations and programs of life-long education. To the extent that educational experiences early in the life span engender more favorable trajectories of cognition in later life (e.g., Stern, 2009), flow offers a potential explanatory mechanism for such self-perpetuating effects: early development of cognitive capacities enables the experience of pleasure in the face of cognitive challenge, which fosters self-regulation of an intellectually stimulating lifestyle, which in turn, nurtures cognition through adulthood.

Certain limitations need to be addressed. Our coding scheme for the cognitive demand of activities was binary and based on open-ended responses. While there are likely some individual differences in the degree to which a particular activity is demanding, we set conservative estimates for what constitutes a highly demanding activity. Using independent ratings of the intellectual demand of activities is not an atypical approach (Arbuckle et al., 1992, Gold et al., 1995, Hultsch et al., 1999); in the current study, this categorization yielded good inter-rater reliability and external validity, and was consistent with perceived demand among participants. Future research is needed to examine a more fine-grained relationship between demands of the task and level of ability. Additionally, while the AFSS allows for participants to report flow on a wide range of activities, the retrospective nature of these reports is certainly a limitation.

Similar to a great deal of the literature on activity engagement and cognition, the current study is cross-sectional and correlational, limiting the ability to make causal claims. Longitudinal and experimental work is needed to chart the determinants of flow and the long-term effects on cognitive health and well-being. This research offers an instrument with good psychometric properties to address such questions. Future work that assesses the flow state as a function of activities as a manipulated variable would be valuable in isolating causal relationships. Nevertheless, our results offer preliminary evidence that older adults can find pleasure with intellectual pursuits within their capacity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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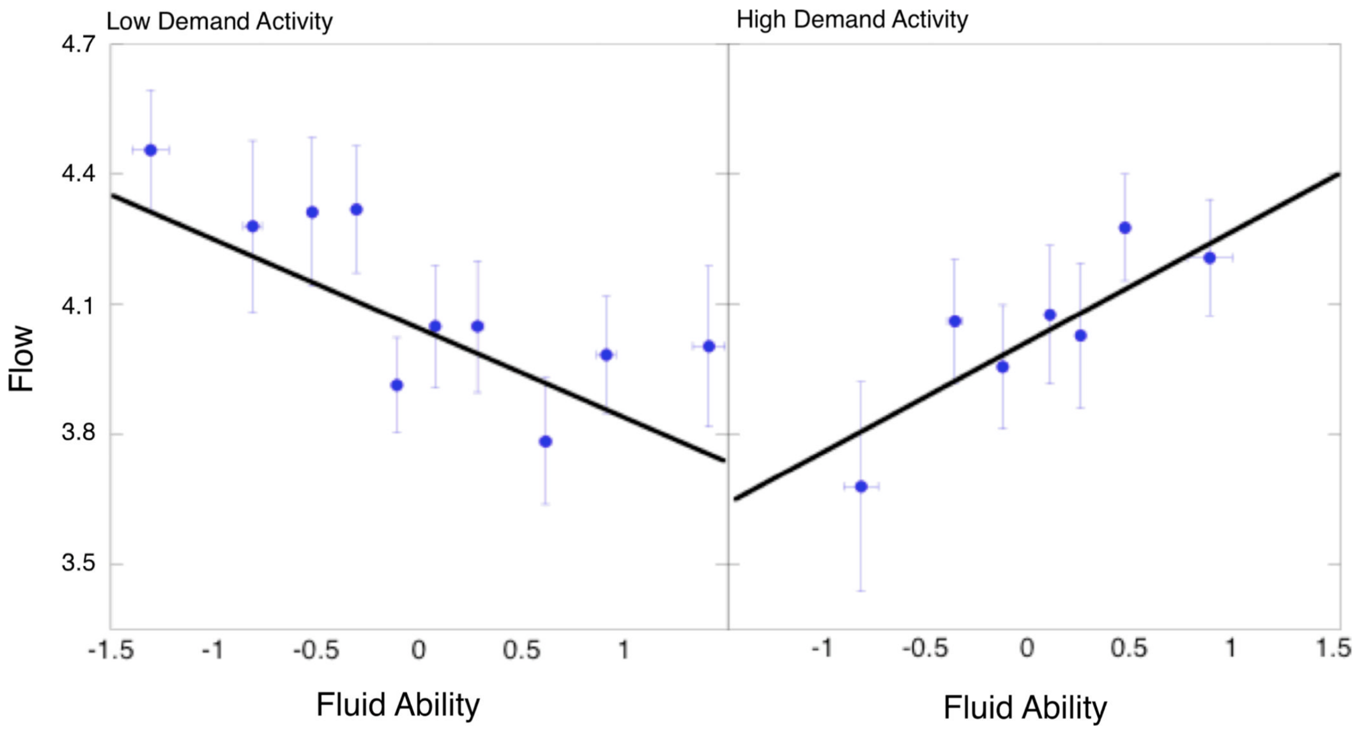

Figure 1.
Relationship between fluid ability and flow for activities of low and high cognitive demand. (Note: Data points are binned per approximately every 10 participants; vertical bars represent SE for flow, horizontal bars represent SE for fluid ability).

Table 1

Factor Loadings from Confirmatory Factor Analysis of Flow State Scale

Factor	Item	Standardized Loadings
MAA		
	I performed automatically, without having to think about it.	.74
	Things just seemed to happen automatically	.84
	I did things spontaneously without having to think	.82
CG		
	I had a strong sense of what I wanted to accomplish.	.83
	I knew what I want to achieve.	.70
	My goals were clearly defined.	.81
CO		
	My attention was focused entirely on what I was doing.	.70
	It was no effort to keep my mind on what was happening.	.77
	I had total concentration.	.77
	I had no difficulty concentrating.	.84
UF		
	It was really clear to me how my performance was going.	.93
	I had a good idea while I was performing about how well I was doing.	.89
CS		
	I was challenged, but I believe my skills will allow me to meet that challenge.	.55
	The challenge and my skills were at an equally high level	.86
	I felt just the right amount of challenge.	.75
TT		
	Time seemed to alter (either slows down or speeds up).	.73
	The way time passed seemed to be different from normal.	.86
	I lost my normal awareness of time.	.70
CN		
	I felt as though I had everything under control.	.85
	I felt that I had everything under control.	.92
SC		
	I was not concerned with how others might be evaluating me.	.77
	I was not concerned with how I was presenting myself.	.62
	I was not worried about what others might be thinking of me.	.72
AE		
	I really enjoyed the experience.	.93
	The experience left me feeling great	.92
	The experience was extremely rewarding.	.89

Note. MAA = merging actions and awareness; CG = clear goals; CO = concentration on task at hand; UF =unambiguous feedback; CS = challenge skill balance; TT = transformation of time; CN = sense of control; SC = Loss of self-consciousness; AE = autotelic experience.

Table 2

Reliability Estimates and Intercorrelations Among Flow Factors

Flow Factor	α	r(facet,F_g)	αF_g ID	MAA	CG	CO	UF	CS	CN	SC	AE
1. Merging Actions and Awareness	.83	.56**	.77								
2. Clear Goals	.83	.64**	.75	.06							
3. Concentration on Task at Hand	.81	.72**	.74	.28**	.72**						
4. Unambiguous Feedback	.90	.63**	.74	.13	.70**	.46**					
5. Challenge Skill Balance	.76	.63**	.74	.11	.74**	.54**	.78**				
6. Sense of Control	.78	.70**	.73	.44**	.61**	.56**	.55**	.61**			
7. Loss of Self Consciousness	.86	.50**	.78	.50**	.13	.40**	.20*	.07	.17*		
8. Autotelic Experience	.71	.60**	.76	.32**	.34**	.64**	.16*	.34**	.49**	.30**	
9. Transformation of Time	.89	.52**	.77	.33**	.28**	.31**	.31**	.32**	.23*	.22*	.26**

Note. α = Scale internal consistency; r(facet, F_g) = correlation of facet with global flow; αF_g ID = internal consistency if factor items deleted; MAA = merging actions and awareness; CG = clear goals; CO = concentration on task at hand; UF = unambiguous feedback; CS = challenge skill balance; CN = sense of control; SC = Loss of self-consciousness; AE = autotelic experience; TT = transformation of time.

* $p < .05$,

** $p < .01$