Cognitive Interventions and Aging

An Engagement Model of Cognitive Optimization Through Adulthood

Elizabeth A. L. Stine-Morrow, Jeanine M. Parisi, Daniel G. Morrow, Jennifer Greene, and Denise C. Park

University of Illinois at Urbana–Champaign.

The engagement hypothesis suggests that social and intellectual engagement may buffer age-related declines in intellectual functioning. At the same time, some have argued that social structures that afford opportunities for intellectual engagement throughout the life span have lagged behind the demographic shift toward an expanding older population. Against this backdrop, we developed the Senior Odyssey, an existing team-based program of creative problem solving. We tested the engagement hypothesis in a field experiment. Relative to controls, Senior Odyssey participants showed improved speed of processing, marginally improved divergent thinking, and higher levels of mindfulness and need for cognition after the program. This pilot translational project suggests that the Senior Odyssey program may serve as one effective model of engagement with good scaling-up potential.
demands to make decisions in ill-defined circumstances, is related to increases in intellectual functioning across a 20-year period (controlling for initial levels of performance; Schooler et al., 1999). Similarly, data from the Maastricht Longitudinal Study revealed that 3 years after baseline, at which no participants (aged 50–80) showed cognitive impairment, 1.5% of those with mentally demanding jobs developed cognitive impairment, whereas 4% of those with relatively light job demands developed some cognitive impairment (Bosma et al., 2003). Intelligence test scores of married partners become more similar over time (Schaie, 1994), presumably because partners provide an intellectual context for one another. There appears to be a relationship between participation in cultural events and survival (e.g., Bygren, Konlaan, & Johansson, 1996; Konlaan, Theohald, & Bygren, 2002). Finally, education and frequent engagement in cognitive activities are related to cognitive function (Wilson et al., 1999) and appear to buffer against the manifestation of Alzheimer’s disease (Bennett et al., 2003; Wilson, Barnes, & Bennett, 2003; Wilson & Bennett, 2003; Wilson et al., 2000; Verghese et al., 2003). All of these data are consistent with the idea that cognitive engagement has broad-based effects and enhances cognitive function, resilience in the face of mild levels of brain disease, and perhaps even longevity.

At the same time, such evidence for experience-stimulated vitality is ambiguous, as it is correlational in nature, with all of the foibles associated with correlations. An equally plausible explanation is that educational and occupational attainment, cognitive engagement, and cognitive functioning all derive from some inherent vitality of the individual (which, in fact, may show limited plasticity). In other words, it is possible that achievement, intellect, leisure activities, and vulnerability to dementia (and their trajectories over time) are biobehavioral markers for the senescence process, and, as with other biobehavioral markers, are normally distributed in the population.

The solution then would appear to be the use of experimental designs that could demonstrate a causal relationship between the experience and the outcome. Training studies, in which older adults have shown an increase in cognitive performance in response to targeted experience (e.g., Ball et al., 2002; Schaei & Willis, 1986; Willis & Nesselroade, 1990), do demonstrate the existence of cognitive plasticity in later adulthood. The effectiveness of booster training in maintaining gains (Ball et al., 2002) also speaks to the importance of continued practice. However, the effects of training tend to be highly circumscribed (a theme echoed in the expertise literature; e.g., Clancy & Hoyer, 1994; Morrow, Leiner, Fitzsimmons, & Altieri, 1994), not showing transfer to related abilities or to everyday cognitive performance, and not especially effective for those with declines in those abilities. Collectively, then, the data supporting the aphorism that individuals should “use it or lose it” are weak (Salthouse, 2006).

There may be principled reasons for such shaky evidence that make it hard to definitively demonstrate broad-based effects of engagement on cognitive function in a human population. First, the nature of intellectual engagement is that it is a habit of mind that presumably shapes behavior and neural networks over the long term. Our ability as researchers to track and measure level of engagement, or to engage participants in stimulating activities, over the long term is limited. Second, the nature of engagement is highly individualized so that—depending on ability, interests, and experience—the same activity may produce wide variability in actual engagement (Park, Stine-Morrow, & Meade, 2006).

Nonetheless, recent evidence in neuroscience provides relatively strong support for the premise that experience sculpts the adult brain. Research with animal models shows that the introduction of novel and complex environments engenders synaptogenesis in the visual cortex of adult rats, a change that appears to be relatively enduring (e.g., Briones, Klintsova, & Greenough, 2004). Also, a growing literature in cognitive neuroscience appears to show selective effects of experience on human brain structure and function that are harder to explain in terms of environmental selection effects. For example, Maguire and colleagues (2003) showed that relative to non-driver controls, London cab drivers showed a greater volume of gray matter in the posterior hippocampus; however, within a non-expert population there was no relationship between hippocampal volume and navigational expertise, suggesting that it was the intensive 2-year training and continued use that caused hippocampal development in the cab drivers (rather than individual differences in navigational ability causing engagement in navigational tasks). In an experimental design, Draganski and colleagues (2004) demonstrated that adults trained to juggle showed expansion of gray matter bilaterally in the mediotemporal area and in the left posterior parietal lobe, structural change in areas thought to control visual storage and processing; interestingly, after a 3-month period with no practice, this area decreased (although it was still above baseline levels).

Finally, literacy shows strong effects on both cognitive function and brain structure (Morais & Kolinsky, 2000). An interesting piece of research that supports the idea that it is experience that shapes the brain (rather than the reverse) is the Portuguese fishing village study (Petersson, Reis, & Ingvar, 2001; Reis & Castro-Caldas, 1997; Reis, Petersson, Castro-Caldas, & Ingvar, 2001). In this study, the investigators exploited an unusual cultural practice that can arguably separate the effects of literacy from socioeconomic factors associated with literacy. It was the custom in this village for the eldest daughter to stay at home to help tend for younger siblings and do housework whereas the younger siblings, without as much responsibility, were free to attend school. In a series of studies, the investigators compared illiterate eldest daughters with their literate sisters, enabling an examination of the effects of literacy while controlling for at least some aspects of home experience. In addition to interesting cognitive differences in processing phonology and two-dimensional representations, literates showed increased intrahemispheric specialization (measured with evoked potentials) and had a larger corpus colossum in the posterior parietal region (see Reis et al., 2001), suggesting that the literate brain was one with relatively greater (coordinated) hemispheric specialization. In the context of models of cognitive aging that suggest more diffuse recruitment of resources across the hemispheres (e.g., Cabeza, 2002), it is interesting to speculate that to the extent that this is the case, it may be as much due to intellectual disengagement as to aging per se.

Thus, we believe that there is good reason to be optimistic that engagement can promote successful cognitive aging.
What Are the Principles of Cognitive Optimization?
Collectively, the data from the training studies are important in demonstrating plasticity in fluid ability and effects that may be cumulative, and therefore optimized through regular and consistent experiences with target tasks. Ironically, in rigorously exploring the nature of plasticity, the narrowness and specificity of the training may be the very element that minimizes transfer, given that training is most likely to produce transfer when learners are encouraged to practice a variety of examples in different situations or to perform complex tasks under variable conditions. Challenges (“desirable difficulties”; Schmidt & Bjork, 1992), such as changing priorities to task components of complex tasks, reducing feedback, or increasing the requirements for participant-generated responses, can hinder initial acquisition but can have long-term benefits for retention and transfer (Richland, Bjork, Finley, & Linn, 2005; Swezy & Llaneras, 1997). The engagement literature may show broader effects on cognition than does the training literature, in part because an engaged lifestyle capitalizes on such variability and creates an ecology of desired difficulty, in which individuals practice component skills in varying and relevant contexts so as to provide continuous opportunity for tractable challenges. One would expect that repeated success with accomplishing goals would be favorable for the development of self-efficacy (Welch & West, 1995), which one in turn would expect to promote further practice.

Furthermore, individuals integrate engagement in substantively complex work or leisure activities into the fabric of life, so that rather than being relegated to defined segments of time, practice occurs “in between the cracks” (e.g., working out the kinks of a new frittata recipe in the shower, or reflecting on a museum experience during the drive on the way home). Note that within an engagement framework, the lack of long-term effects of training without continued engagement (Salthouse, 2006) is irrelevant to the test of the “use or lose it” hypothesis, because one assumes that, like Draganski’s jugglers, individuals lose capacity without regular and consistent engagement.

Another factor may be the extent to which engagement is most likely bound up with affective and social goals. There is evidence that, with age, adult cognition becomes more tightly linked to socioemotional systems, so that goals that serve social or emotional motives drive engagement and differentially enhance cognitive outcomes in later adulthood (Adams, Smith, Pasupathi, & Vitolo, 2002; Carstensen, 1995; Isaacowitz, Charles, & Carstensen, 2000; Stine-Morrow, Miller, & Hertzog, 2006).

Finally, some have argued that a creative element is important (Levy & Langer, 1999). Lindauer (1998) has presented data that suggests artists are more likely to be long lived relative to the general population. Controlling for income and the extensiveness of social networks, Bygren and colleagues (1996) found that participation in cultural activities (e.g., museums, plays, concerts) was predictive of survival 8 years later. Levy and Langer (1999) argued that such correlations between participation in creative activities and longevity may reside in a causal connection: Creative people necessarily vary their environment, which increases mindfulness, a disposition toward actively drawing novel distinctions in interpreting experience (in contrast to mindless reliance on previously learned categories). Levy and Langer argued that it is a mindful disposition that contributes to cognitive effectiveness and longevity (Langer, 1997, 2000). Similarly, Park, Stine-Morrow, and Meade (2006) argued that the foundation of engagement effects on cognition is productive engagement, in which knowledge schemas must accommodate to new experience. Essentially, cognitive growth in later life requires that giddy euphoria of learning something genuinely new, of the Gestalt switch of surprise in developing new categories of thought through which to interpret experience.

Based on these ideas, we designed the Senior Odyssey program as a cognitive intervention with several key features: (a) regular and frequent exposure to ill-defined problems (Schooler & Mulatu, 2001; Schooler et al., 1999); (b) a collaborative context, because with age, cognition may be more tightly related to socioemotional goals (e.g., Isaacowitz et al., 2000); (c) competition, because it provides an inherent reward structure for the development of effective solutions for ill-defined problems (cf. Schooler et al., 1999); and (d) an emphasis on creativity, under the assumption that creative activities are inherently engaging, absorbing, rewarding, and engender a mindful approach to experience (cf. Csikszentmihalyi, 1996; Levy & Langer, 1999; Sternberg & Lubart, 1996). We designed the program to be a community-based program that takes advantage of existing social structures so as to create potential for age integration. We intended the study of the Senior Odyssey, as translational research, to fill the gap between correlational studies of engagement and environmental complexity and experimental studies of training by experimentally examining the broad-based effects of engagement.

Odyssey of the Mind as a Model of Cognitive Engagement
We modeled the Senior Odyssey in part on the Odyssey of the Mind program (OOTM; www.odysseyofthemind.org), which was developed as an enrichment activity for children and young adults (age-graded divisions ranging from primary grades through university level). This is a well-established program with more than 1 million participants from 12,000 schools and universities in 18 countries (Longworth & Davies, 1996). The overarching goal of the program is to promote creative problem solving through a collaborative and competitive context. The existing OOTM program offers many features that are the hallmarks of a substantively complex environment: repeated opportunities for engagement with ill-defined problems with multiple solutions.

OOTM teams form in the fall and work together through the winter to prepare for local and regional tournaments in the spring, with successful teams progressing to an international tournament in early summer. There are two components for the spring tournaments. Teams prepare a solution to a selected long-term problem and also practice working as a group to solve novel spontaneous problems. OOTM organizers develop a new set of long-term problems each year, and teams work together through the season on design, implementation, and effective presentation. Organizers draw long-term problems from four broad areas: literature, science and technology, civil engineering, and history. For example, teams build a structure of balsa wood within certain parameters designed so as to maximize the weight it will bear (civil engineering); create and
present an original performance that reinterprets a certain classical work (literature); create and present a musical performance that presents alternative interpretations for some historical event (history); design a transport that will achieve a certain goal within certain limits (science and technology). Thus, a goal is presented that may be effectively achieved in an infinite number of ways by people of widely varying abilities. Indeed, both third graders and college students can solve most OOTM problems. These different groups bring different skills to bear, and the quality of the solutions will vary by division, but the important point is that all age groups can solve the problem in some way. The flip side is that there is no perfect solution, so that any solution is, by its nature, subject to revision. Teams present solutions in the context of a short performance and earn points not only for the innovation in the solution but also for “style.” In the implementation, teams must develop a plan and apportion and coordinate work (divergent thinking, prospective memory); build sets, costumes, and structures (spatial processing); write a short script (language processing); and learn a performance (memory). Thus, working toward the presentation of a solution to a long-term problem engages many basic cognitive skills in a creative and collaborative context.

In contrast to the reflective side of creativity engendered by long-term problems, spontaneous problems encourage the generation of (as the name implies) spontaneous online ideas (“thinking on your feet”). They may be verbal (e.g., “Name something that destroys something else,” with more points awarded for creative responses like “Poor reviews destroy a Broadway play” than common responses like “Bombs destroy cities”), hands-on (e.g., given a mailing label, a piece of paper, and a rubber band, protect a light bulb so that it can be tossed without breaking), or a combination of the two. These activities encourage speeded processing in a collaborative context in that participants typically have to consider and build upon what others in the group have done (working memory).

Thus, inherent in this program is not only the exercise of basic cognitive processes, but also decision-making, creativity, evaluation of ideas, and competition, arguably a substantively complex environment that offers rewards for participation and effective solutions. As an established program, OOTM occurs within a well-structured social system so that roles and expectations are well defined and transmitted across generations of participants.

Little empirical work has evaluated the effects of OOTM participation as an educational intervention. Carman (1992) showed that seventh-grade OOTM participants had better scores on a test of mathematical problem solving at the end of the season relative to age-matched controls drawn from the same (ability-grouped) math classes; OOTM participants also rated themselves as more proficient in this arena. Researchers have used the Odyssey model before with elders. In the Mental Aerobics program (Paggi & Hayeslip, 1999), seniors met weekly to engage in exercises of spontaneous problems (including verbal and spatial puzzles), story telling, and rebuses, as well as take-home problems (e.g., elaborating on metaphors), which suggests that such a program is feasible with elders.

We developed the Senior Odyssey program in stages. Evaluating the process and outcomes of each step, using both quantitative and qualitative assessments, has enabled us to build incrementally. We used long-term problems developed by the OOTM program. In developing problem sets for the spontaneous portion of the program, we concentrated on developing activities that (based on task analysis) exercise targeted abilities known to be vulnerable to aging (i.e., working memory, inductive reasoning, visuospatial processing, divergent thinking, and speed of processing), with an effort to keep the pace of sessions as fast as possible relative to the capabilities of each group. Incremental development has allowed us to create training procedures for coaches and to develop ties with the community and the OOTM state organization.

In Fall 2003, three small groups of seniors (N = 16, M = 68 years old, age range = 52–81 years) participated in a single 2-hr session of the spontaneous component. All participants provided ratings of various aspects of the program, and we conducted interviews with 7 volunteers to obtain feedback on the nature of the problems and activities and overall satisfaction with the program. The program was generally well received, and the input helped us to adjust problem difficulty. In Spring 2004, four groups (N = 20, aged 61–87 years; two groups in local retirement complexes, one in an adult day care setting, one on campus with community-dwelling adults; Mini-Mental State Examination score > 22 for all) participated in a 4-week program (again, the spontaneous portion only) with a short cognitive battery administered before and after the program. An additional 5 people started the program but did not complete it (80% retention). There was no control group for this pilot to evaluate whether practice or Hawthorne factors contributed to change over the 4 weeks, but we found significant differences from pre- to post-test sessions for one measure of visuospatial processing (paper folding, t(12) = 2.6, p = .024) and two measures of divergent thinking (substitute uses, t(18) = 3.0, p = .007, and alternate uses fluency score, t(17) = 2.43, p = .026). These small-scale studies suggested that the program over time was feasible, that retention could be very good, and that there was a reasonable expectation for measurable growth in cognitive scores.

With this groundwork laid, we developed and implemented a community-scale program, synchronized with the international program, during the 2004–2005 academic year. We obtained a membership in OOTM, giving us access to complete descriptions of the long-term problems and other materials. We developed a 20-week program with both spontaneous and long-term components, as well as a spring tournament in a local community center. To accommodate a larger number of participants, we recruited and trained a small staff of undergraduate coaches. We used an experimental design, with random assignment to a participant group or a wait-list control, and we expanded our psychosocial battery in order to more comprehensively measure both cognition and dispositional factors related to cognitive engagement. In the remainder of this article, we present preliminary findings from the first wave of this field experiment.

Methods

Participants

Initially, we recruited 85 adults (aged 55–93) from the community and local retirement villages. Following the pretest, we
randomly assigned participants to either an experimental or control group, with the restriction that partners be assigned together (we did this so that those with partners were distributed proportionately over the experimental and control groups). Because of the effort put into developing relationships with the retirement communities, we assigned these participants to the experimental group (n = 21). In this way, we assigned 61 participants to the experimental group and 24 to the control group.

The participants in the experimental (n = 50; 82%) and control (n = 21; 88%) groups retained through posttest did not significantly differ in age (ME = 73.6 years, range 60–93; MC = 70.2 years, range 58–85), t(69) = 1.54, p = .13; educational level (ME = 16.1, SE = 0.4; MC = 15.4, SE = 0.7), t(69) = 0.34, p > .20; or extended range vocabulary (Ekstrom, French, & Harman, 1976; ME = 15.5, SE = 0.7; MC = 13.1, SE = 1.1), t(67) = 1.83, p = .07. They also did not differ on the Hultsch, Hertzog, Small, and Dixon (1999) Activity Scale, t(64) = 0.65, p > .20. Of the 50 experimental participants retained through posttest, 40 completed the full 20-week program, including tournament participation. Of the 50 experimental participants, the average number of weeks of program participation (out of 20 team meetings) was 17.3 (the average number of weeks of program participation (out of tournament participation. Of the 50 experimental participants, post-test, 40 completed the full 20-week program, including experimental group, even if they did not complete the program).

We also included three measures of dispositions plausibly reflective of habitual cognitive engagement. Mindfulness (Bodner & Langer, 2001) is a tendency to be alert to novel distinctions in present experience. Need for cognition (Cacioppo & Petty, 1982; Cacioppo, Petty, Feinstein, & Jarvis, 1996) is a tendency to seek information and to reflect on experience to make sense of events. A composite measure of memory self-efficacy, derived from the Change and Capacity scales of the Metamemory in Adulthood questionnaire (Dixon, Hultsch, & Hertzog, 1988), assessed beliefs that effective memory performance can derive from appropriate allocation of effort. Finally, we included the Hultsch and colleagues (1999) measure of activity.

Following pretest, participants who had been assigned to the experimental group were distributed into Senior Odyssey teams. We formed nine teams based on individual choice of the long-term problem at pretest as well as the need to accommodate scheduling constraints. Although there were 20 weekly meetings scheduled for each group, there were breaks in the schedule (e.g., holidays, weather); generally teams interacted in the context of formal and informal meetings from October through March. We developed a common set of spontaneous problems for each formal meeting that (based on a task analysis) cycled through problems exercising one or more of the targeted abilities (i.e., speed, working memory, reasoning, visuospatial processing, divergent thinking) through particular problem types (e.g., alternative uses, rebuses, odd-one-out) and through problems varying in difficulty. The 20 team meetings were led by the coach using a common set of PowerPoint presentations that displayed these problems. Coaches worked to keep sessions as fast paced as possible and to use different strategies of eliciting solutions (e.g., free response, turn taking, competition among teams or triads). Meetings early in the season were primarily devoted to spontaneous problems, but as the tournament approached, the emphasis shifted to developing and implementing solutions for the long-term problem.

RESULTS AND DISCUSSION

We created composite measures of the four cognitive constructs for which we had multiple measures by averaging z scores of the relevant measures. The lower right portion of Table 1 presents the correlations between these indices of cognitive function and our indices of a predisposition toward engagement, both collected at pretest. First, we note that in our sample we replicated the basic phenomenon in the engagement literature: Older adults who reported at pretest more frequent engagement in a breadth of activities also showed generally higher cognitive scores. Additionally, psychosocial measures of predispositions that afford habitual intellectual activity, mindfulness, need for cognition, and self-efficacy were generally related to the effectiveness of cognitive performance (though for mindfulness this relationship was only reliable with divergent thinking).

The central question here was whether the experience in the Senior Odyssey program could evoke growth and/or prevent decline in these abilities (and dispositions). We calculated difference scores (posttest – pretest) for the four composites of cognitive ability (speed, inductive reasoning, visuospatial processing, divergent thinking), working memory, and the four dispositional measures. Presented in the left side of Table 1 are the mean difference scores for the experimental and control groups and t values that tested group differences in the difference scores. Only processing speed showed differential positive change in the experimental group relative to the control group; differential change in divergent thinking reached a marginal level of significance. Patterns of change in working memory, inductive reasoning, and visuospatial processing were also in the predicted direction but did not reach significance. Furthermore, individuals in the experimental group showed differential positive change in both mindfulness and need for cognition. There was a trend for activity level to decrease in the experimental group. Because this measure assessed breadth of
activities, this may reflect the fact that participants may have had to sacrifice some of their other activities during the Odyssey season in order to meet the demands of the program.

It would be premature at this point to claim support in these data for the hypothesis that engagement produces broad-based effects on cognition. Speed of processing and, to some extent, divergent thinking may have shown differential change for the experimental group because, amidst the explicit practice of particular processes, the generation of new ideas at a fast pace was a thread that ran through the whole program. Thus, the fact that these abilities showed the clearest effects of the program is actually more consistent with a training model than an engagement model. Nevertheless, we reserve judgment on this issue pending further data collection (which is ongoing).

In order to further examine the plausibility of the notion that engagement-evoked cognitive change may be bound up with broader changes in the way experience is approached we looked for evidence of correlated change between predispositional measures and cognitive constructs in our data. Consistent with Levy and Langer’s (1999) conceptualization of creativity, persons with greater change in divergent thinking also tended to show greater change in mindfulness, \( r = .23, p < .07 \), and need for cognition, \( r = .32, p < .01 \). This was true for the experimental group alone, \( r = .26, p < .09 \), and for \( r = .23, p < .05 \), respectively, but not for the control group, \( r = -.01 \), and \( r = .21 \); the differences in correlations between groups were not reliable.

Finally, we complemented our quantitative assessment of cognitive abilities with a qualitative analysis of participants’ comments about the program during structured interviews; the advantage of such a mixed-methods approach is that it allows elaboration, enhancement, illustration, and clarification of findings from different perspectives (Greene, Caracelli, & Graham, 1989). A report of these findings is beyond the scope of this article, and we refer the interested reader to Parisi, Greene, Morrow, and Stone-Morrow (in press).

Conclusions
In spite of provocative evidence, there is considerable controversy surrounding the engagement hypothesis (e.g., Hertzog, Hultsch, & Dixon, 1999; Hultsch et al., 1999; Salhouse, 2006; Salhouse, Berish, & Miles, 2002). As a cognitive intervention in the context of creativity and collaboration, the Senior Odyssey program represents translational research to test the engagement theory in the context of everyday life. Our findings to date suggest that seniors can integrate this program into their lives and that this participation may have the potential to evoke at least modest gains in cognitive performance and mindfulness. To the extent that high levels of cognitive performance are a result in part of habits of mind (Stone-Morrow, Miller, & Hertzog, 2006), regular participation in creative problem solving may engender the habit of engaging experience in a meaningful and mindful way so as to afford routine practice of basic cognitive processes in varying contexts. By bootstrapping onto a program that is already well established, Senior Odyssey offers potential for an age-integrated program that could be practically implemented (Riley & Riley, 1994) and effectively scaled up so as to be more readily available in community and educational venues (cf. Sternberg et al., 2006).

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CORRESPONDENCE
Address correspondence to Elizabeth A. L. Stone-Morrow, Department of Educational Psychology, University of Illinois at Urbana-Champaign, 226 Education Building, 1310 South Sixth St., Champaign, IL 61820-6990. E-mail: eals@uiuc.edu

Table 1. Change in Cognitive Scores for Psychosocial and Cognitive Measures and Correlations Between Measures of Perceived Cognitive Engagement and Cognitive Components

<table>
<thead>
<tr>
<th>Measure</th>
<th>Δ (SD units)</th>
<th>r(Engagement, Cognition)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>-0.02</td>
<td>-0.40</td>
</tr>
<tr>
<td>Need for cognition</td>
<td>0.11</td>
<td>-0.28</td>
</tr>
<tr>
<td>MIA self-efficacy</td>
<td>-0.06</td>
<td>-0.09</td>
</tr>
<tr>
<td>Perceived activity level</td>
<td>-0.11</td>
<td>0.15</td>
</tr>
<tr>
<td>Processing speed</td>
<td>0.09</td>
<td>-0.70</td>
</tr>
<tr>
<td>Working memory</td>
<td>0.12</td>
<td>-0.06</td>
</tr>
<tr>
<td>Inductive reasoning</td>
<td>0.22</td>
<td>-0.29</td>
</tr>
<tr>
<td>Visualspatial processing</td>
<td>0.33</td>
<td>0.01</td>
</tr>
<tr>
<td>Divergent thinking</td>
<td>0.29</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Notes: MIA = Metamemory in adulthood.
*Positive \( r \) values indicate differences in change in the predicted direction.
\( *p < .10; **p < .05; ***p < .01 \) (two-tailed).
REFERENCES


