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Self-Regulatory Strategies in Daily Life: Selection, Optimization, and Compensation and Everyday Memory Problems

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Abstract

The effective use of self-regulatory strategies, such as selection, optimization, and compensation (SOC) requires resources. However, it is theorized that SOC use is most advantageous for those experiencing losses and diminishing resources. The present study explored this seeming paradox within the context of limitations or constraints due to aging, low cognitive resources, and daily stress in relation to everyday memory problems. We examined whether SOC usage varied by age and level of constraints, and if the relationship between resources and memory problems was mitigated by SOC usage. A daily diary paradigm was used to explore day-to-day fluctuations in these relationships. Participants (n=145, ages 22 to 94) completed a baseline interview and a daily diary for seven consecutive days. Multilevel models examined between- and within-person relationships between daily SOC use, daily stressors, cognitive resources, and everyday memory problems. Middle-aged adults had the highest SOC usage, although older adults also showed high SOC use if they had high cognitive resources. More SOC strategies were used on high stress compared to low stress days. Moreover, the relationship between daily stress and memory problems was buffered by daily SOC use, such that on high-stress days, those who used more SOC strategies reported fewer memory problems than participants who used fewer SOC strategies. The paradox of resources and SOC use can be qualified by the type of resource-limitation. Deficits in global resources were not tied to SOC usage or benefits. Conversely, under daily constraints tied to stress, the use of SOC increased and led to fewer memory problems.

Keywords

lifespan development; midlife; SOC; memory problems; daily stressors; resources; daily variability

Lifespan theories characterize development as a series of gains and losses that impact everyday functioning (Baltes, Lindenberger, & Staudinger, 2006). As such, the use of self-

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regulatory strategies, such as selection, optimization, and compensation (SOC), to promote gains and counteract or adjust to losses varies across the lifespan as well. However, it is unclear under what conditions SOC usage contributes to better everyday functioning. The challenges of stress and resource limitations can affect everyday memory problems (Hahn & Lachman, 2014; Rickenbach, Agrigoroaei, & Lachman, 2015) – one of the most frequent complaints across the lifespan (Lachman, 2004; Slavin et al., 2010). Therefore, the goal of the present study was to examine whether SOC usage varies in relation to situational constraints, and to what extent SOC is beneficial for daily memory. Specifically, we were interested in the relationship of age, daily stress, and cognitive resources to daily SOC use, and whether these factors influence daily memory problems.

Selection, Optimization, and Compensation

The SOC model was first introduced by Paul and Margaret Baltes (Baltes, 1997; Baltes & Baltes, 1990) as a psychological model of successful aging applicable to a variety of functional domains (e.g., cognition, emotion, motivation) (Freund, 2008). This model builds on the belief that across the lifespan, people face certain opportunities (e.g., education) and limitations (e.g., illness) that can be successfully navigated by an orchestration of three components: selection, optimization, and compensation. This orchestration can be defined in an action-theoretical framework that describes strategies of goal selection and pursuit (Freund & Baltes, 1998).

According to the SOC model (Freund & Baltes, 2002), “the biological, social, and psychological opportunities and constraints throughout the life span specify a broad range of alternative possible goals or domains of functioning” (p. 643). *Selection* involves goal setting and a commitment to a specific set of goals. Selection can be elective or loss-based. Elective selection (ES) involves the choice of desired goals, and loss-based selection (LBS) focuses on new goals or modified goals in response to limitations or constraints. *Optimization* involves the use of adaptive resources for goal attainment. *Compensation* refers to the use of alternative strategies to accomplish goals to counteract or make up for losses that interfere with goal attainment (Freund & Baltes, 2002). While each component has a specific role, it is hypothesized that these strategies are best utilized in a coordinated manner to take advantage of their full impact (Freund & Baltes, 1998 and 2002; Jopp & Smith, 2006).

A multitude of studies have demonstrated that self-regulation is essential for successful development (Heckhausen, Wrosch, & Schulz, 2010). Self-regulatory strategies can help to ameliorate losses across the lifespan (Freund & Baltes, 2002). Several theories of developmental regulation exist, however a recent integrative review has suggested they have three processes in common. These include goal engagement, goal disengagement, and metaregulation. Goal engagement involves actively pursuing a goal and trying to accomplish it. Goal engagement relates to all subdomains of SOC, wherein one specifies and commits to certain goals (elective-selection), chooses to focus on the most important goals (loss-based selection), uses persistence and resource allocation to achieve certain goals (optimization), and uses alternative means or external help to achieve a goal (compensation). Conversely, goal disengagement involves separating oneself from a goal and letting go of it. This

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concept relates mainly to aspects of loss-based selection, where one must reconstruct and adapt their standards and goals. Lastly, metaregulation guides adaptive goal selection, where individuals take into account contextual situations for goal engagement and disengagement to bolster successful development (Haase, Heckhausen, Wrosch, 2013). SOC theory does not directly articulate aspects of metaregulation, which is a process for matching goals with opportunities to facilitate optimal development.

The SOC model suggests that goal engagement and disengagement become progressively more adaptive with age, even though resources may become more limited (Jopp & Smith, 2006; Wrosch, Heckhausen, & Lachman, 2000). We suggest there is an apparent paradox regarding SOC use and its benefits. It has been proposed that the use of SOC strategies requires intact resources, and therefore any constraints to such resources will make it difficult to effectively adopt SOC (Baltes & Carstensen, 1996, Freund & Baltes, 2002). However, it is also the case that resource-oriented goal selection and optimal resource use are expected to mitigate the negative effects of diminished resources making SOC strategies particularly important for success when resources are limited (Jopp & Smith, 2006). In other words, using SOC requires resources, but using SOC may be most advantageous to those with fewer resources who are able to effectively use SOC. The current study aimed to further investigate this paradox by exploring if resource limiting constraints are associated with less SOC use and whether SOC use mitigates the impact of these constraints on memory problems.

Resources, Constraints, and Selection, Optimization, and Compensation

The motivational dynamics associated with SOC are thought to take on unique profiles in young, middle-aged, and older adults (Freund & Baltes, 1998). Middle-aged adults tend to show higher endorsement of SOC strategies than younger and older adults. To explain this trend, it is suggested that young adults use SOC less than middle-aged adults because they have not yet cultivated expertise in using SOC strategies and have fewer demands and responsibilities that do not require the use of SOC. As adults move towards middle-age, they acquire and refine their SOC-related behaviors (Freund & Baltes, 2002). Moreover, middle age is a time of increased demands and responsibilities, therefore the use of SOC may be advantageous for managing daily life (Lachman, Teshale, & Agrigoroaei, 2014). Conversely, as older adults approach the end of their lifespan they become more likely to face a limitation in resources, making SOC use difficult (Baltes & Carstensen, 1996, Freund & Baltes, 2002). For example, one study by Li and colleagues examined how the use of SOC would predict task priority in younger and older adults, where both age groups were asked to memorize something while walking on a narrow track (Li, Lindenberger, Freund, & Baltes, 2001). While both processes tend to be affected by age (declines in memory and balance), the older adults prioritized walking over their memorization task, demonstrating that in old age, individuals attend to declining abilities by prioritizing what is most important (i.e., not falling).

SOC strategies may serve as a protective buffer to declines associated with aging and limited resources. Several studies have shown this buffering effect. Lang, Rieckmann, and Baltes (2002) found that, compared to resource-poor older adults, those who were rich in

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resources exhibited more SOC use and better everyday functioning. Similarly, Chou and Chi (2002) found that SOC use in older adults buffered the relationship between financial strain and life satisfaction; older adults that had heightened financial strain but endorsed SOC strategies more reported greater life satisfaction than older adults that had similar levels of financial strain but reported lower levels of SOC strategies.

Selection, Optimization, and Compensation and Memory

Poor memory has been shown to substantially impact everyday functioning. Deficits in memory are associated with lower life satisfaction and well-being, as well as increased depression and anxiety (Balash, Mordechovich, Shabtai, Merims, & Giladi, 2010; Mol, van Boxtel, Willems, Verhey, & Jolles, 2009). While objective tests are beneficial for measuring and understanding memory in a controlled setting, such tests may illuminate little concerning real-world memory tasks (e.g., remembering to take one's medication or forgetting an appointment) that can be crucial for overall health and well-being (Hertzog & Hultsch, 2000). Therefore, given the daily paradigm of the current study we included a focus on memory problems.

Memory problems are self-reported complaints in remembering desired information in everyday life (e.g., Hertzog & Pearman, 2014; Holsiger, Deveau, Boustani, & William, 2007; Mascherek, Zimprich, Rupprecht, & Lang, 2011). The use of self-regulatory strategies such as SOC may, in part, buffer the impact of resource-related memory problems. Specifically, selection may improve memory by helping individuals to set goals and prioritize activities, and optimization and compensation may help people to cope and improve outcomes for those relevant activities. It also may lead to adoption of effective strategies for remembering important information in the context of daily life (Hahn & Lachman, 2014; Scheibner & Leathem, 2012). While past literature has examined the use of SOC strategies on other performance domains such as job performance and problem solving demands (e.g., Schmitt, Zacher, & Frese, 2012; Yeung & Fung, 2009), to the best of our knowledge, only two studies have examined the relationship between SOC and memory. Scheibner and Leathem (2012) found that optimization and compensation strategies were significantly correlated to forgetfulness, which was measured with a long-term retrospective report of memory problems. Hahn and Lachman (2014) expanded this work by examining naturally occurring everyday memory problems and found that SOC buffered the relationship between memory decline, everyday memory problems, and sense of control. As is evident, research on the relationship between SOC and memory is both promising and scarce, and thus requires further investigation.

It is worthwhile to note that the use of self-reported memory problems has both advantages and disadvantages. One issue concerning subjective assessments of memory problems is that the very nature of self-reporting memory requires awareness or perceptions of memory problems (Rickenbach, Agrigoroaei, & Lachman, 2015). Therefore, those who have worse memory may be less aware of memory deficits, and thus less likely to report memory problems (Hertzog & Pearman, 2014). On the contrary, some research has found evidence that self-reported memory problems are correlated with a transition from normal aging to Mild Cognitive Impairment (MCI) and dementia and with objective memory performance

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(Glodzik-Sobanska et al., 2007; Hülür, Hertzog, Pearman, Ram, & Gerstorf, 2014; Jessen & Wiese, 2007). Nevertheless, subjective memory assessments are useful for capturing daily memory experiences outside of the lab (Rickenbach et al., 2015).

Daily Variability

Frequently, data are gathered during one occasion of measurement, despite evidence that short-term variability contains valuable information (Ghisletta, Nesselroade, Featherman, & Rowe, 2002). While such cross-sectional research contributes to our understanding of performance based on stable between-persons differences, generalizing these findings to variables that vary on a day-to-day basis may be misleading (Lord, Diefendorff, Schmidt, & Hall, 2010). Thus, an additional focus on short term fluctuations within individuals can shed light on individual differences in change processes (e.g., Almeida, 2005).

Selection, Optimization, and Compensation

The majority of SOC studies have investigated trait-like individual differences (Freund & Baltes, 2002). Lord et al. (2010) suggest that such self-regulatory strategies should be also be investigated in terms of within-person processes over time. To our knowledge, only two studies, both within the domain of work, have explored SOC through a daily perspective (Schmitt, Zacher, & Frese, 2012; Yeung & Fung, 2009). Such daily studies represent a dynamic method that can investigate short-term fluctuations, and allow for measurements that are less biased to retrospective recall and more accurate for participants' actual experiences (Bolger, Davis, & Rafaeli, 2003).

Everyday Memory Problems

Previous research has also suggested that memory problems can fluctuate on a day-to-day basis. Recent literature has examined the degree to which certain variables can predict intraindividual variability in cognitive functioning, such as control beliefs and physical activity (e.g., Neupert & Allaire, 2012; Whitbourne, Neupert, & Lachman, 2008). One limitation that could obscure the relationship between memory problems and memory may be the between-person variability in the standards used for assessing memory complaints. That is, individual differences in criteria for rating the experience of memory problems could restrict the extent to which memory and memory problems correlate (Herrmann & Neisser, 1987). Herrmann and Neisser (1987) therefore suggested that examining within-person changes in memory problems could be a more valid assessment, where individuals are serving as their own baseline for assessing change.

Stress

There is evidence that stress fluctuates both over the short and long term (e.g., Almeida, 2005; Neupert, Almeida, Mroczek, & Spiro, 2006). Not only will long-term cumulative stress likely expose someone to more daily stressors, but it also may increase his or her reactivity to daily stressors (Almeida, 2005) and subsequently impact everyday functioning, including memory. Research suggests both negative between- and within-person relationships between stress and cognition (Lupien, Maheu, Tu, Fiocco, & Schramek, 2007; Neupert et al., 2006; Sliwinski, Smyth, Hofer, and Stawski, 2006). A focus on biological

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mechanisms suggests that this negative relationship is driven by glucocorticoids produced by stress. Glucocortical levels have been shown to impact cognitive functioning across the lifespan (Lupien, McEwen, Gunnar, & Heim, 2009). Specifically, in adulthood, research has found that the effect of acute stressors is dependent on the level of glucocorticoid change; smaller increases in glucorticoid levels result in enhanced hippocampal function, whereas larger increases are related with decreased hippocampal function (Lupien et al., 2009). Another hypothesis, known as the *attention-depletion hypothesis*, explains this negative stress-cognition relationship by suggesting that the experience of stress competes for attentional resources and thus impairs attention-dependent cognitive processes (Kahneman, 1973; Klein & Boals, 2001a, 2001b; Sliwinski et al., 2006). Some work has shown that stress-management may help to buffer the negative relationship between stress and cognition. For example, an intervention study (Klein & Boals, 2001a) demonstrated that college students who underwent an expressive writing intervention improved their working memory significantly more than a control group. However, little is known about whether self-regulatory processes, such as SOC, may mitigate the negative cognitive effects of stressors in middle-aged and older adults.

Current Study

SOC use, stress, and memory problems are dynamic processes that can vary from day to day. Therefore, the present study used a daily diary approach to capture these within-person relationships. The current study design can help to illuminate nuances regarding the intraindividual variability of these factors that may have otherwise been overlooked by the traditional between-persons approach. The main aim of this study was to explore the seeming paradox of resource-intensive SOC use and its predicted benefits for those with limited resources. The first research question was whether daily SOC use varied by age, stress, and cognitive resources. Secondly, we examined whether those with limited resources or greater stress were more or less likely to show benefits for daily memory when using SOC.

SOC Usage

Past research has shown that middle-aged adults use more general SOC strategies than younger and older adults, but this has yet to be established when assessed with a daily perspective. We predicted a similar pattern in our sample, wherein middle-aged adults would report using more daily SOC strategies than younger and older adults. We also examined whether constraints of daily stress and limited resources were related to SOC usage. Because we were interested in SOC use within the context of everyday memory, we used an objective measure of episodic memory as our indicator of cognitive resources. We predicted that those low in cognitive resources would use fewer daily SOC strategies. Additionally, there is evidence to suggest that the experience of stress competes for attentional resources (Sliwinski et al., 2006). Therefore, stress may act as a constraint and deplete resources that influence one’s ability to use SOC. We predicted that those who report more daily stressors will report less SOC use. We also explored if cognitive resources and stress moderated the relationship between age and SOC usage.

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Benefits of SOC

We predicted that more SOC usage would be associated with fewer memory problems. Because SOC is theorized to be most effective for individuals who have the most demands on their resources (Freund & Baltes, 2002; Young, Baltes, & Pratt, 2007), we predicted that SOC use would moderate the relationship between cognitive resources and everyday memory problems. Specifically, fewer cognitive resources should be associated with more reported memory problems, but less so for those who report using more SOC strategies. Additionally, we predicted that SOC would moderate the negative relationship between daily stressors and memory problems. Specifically, on days when people report more daily stressors, they will report more memory problems, but less so for those who report using more SOC strategies. We also examined whether these buffering effects would vary by age.

Method

Participants

Participants (n=145), ranging from 22 to 95 years of age, were recruited mainly from Boston area communities and also other regions across the United States using a design stratified by age, sex, and education. Participants were recruited using signs in public locations and local newspaper advertisements for the Daily Experiences and Memory Study, which involved assessments over a 7-day period. Of the 239 participants who initially responded to advertisements and expressed interest in the study, 145 were enrolled. The remaining 94 were not enrolled due to ineligibility (n=37), lack of interest (n=11), or lost contact (n=46). Response rates were high across the seven days, with an average response rate of 97.2%. Responses were lowest on day 5 (95.9%) and highest on day 2 (98.6%). Descriptive statistics for the final sample are presented in Table 1.

Measures

Selection, Optimization, and Compensation—Daily SOC strategies were assessed with a modified version of Freund and Baltes' SOC Questionnaire (2002; r_{tt} = .74–.82) that asked how often the participant used SOC strategies on that day. Typically, SOC is assessed as a trait-like individual differences variable. To evaluate SOC on a daily basis, we adapted the questions to focus on experiences of the current day. Each SOC component was assessed with one item: "*I committed myself to one or two important goals*", "*When I couldn't do something as well as I used to, I thought about my priorities and what exactly is important to me*", "*I made every effort to achieve a given goal*", and "*When things didn't go as well as they used to, I kept trying other ways until I could achieve the same result I used to*." Participants indicated on a six-point scale how representative these strategies were of their experience that day. While each component of SOC has a specific function, an integral characteristic of the SOC model is the assumption that the strategies work together in an orchestrated manner. Thus, all items were averaged to form a composite SOC score. The individual items are significantly correlated (see Table 2), supporting the use of a composite score (Freund & Baltes, 1998, 2002). Possible scores ranged from one to six (indicating that all of the SOC behaviors were selected and all highly represented the participants' daily experience, i.e., high SOC strategy use). Cronbach's alpha was 0.72.

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For comparison purposes, we also administered the 12-item general SOC questionnaire (also adapted from Freund & Baltes, 2002). Possible scores ranged from 0 to 12 (highest possible amount of trait SOC use). Cronbach's alpha was 0.63. The daily and general SOC measures were significantly correlated, $r = 0.23$, $p > .001$.

Cognitive Resources—Cognitive resources were assessed using the episodic memory subtest from the Brief Test of Cognition by Telephone (BTACT; Lachman, Agrigoroaei, Tun, & Weaver, 2013). This is an immediate free recall test of a 15-word list drawn from the Rey Auditory-Verbal Learning Test (RAVLT; Rey, 1964).

Daily Stressors—Daily stressors were measured with the daily inventory of stressful events (DISE; Almeida, Wethington, & Kessler, 2002). Each day over a 7-day period, participants filled out a five-item survey indicating whether or not they experienced certain stressors that day (i.e., "In the past 24 hours did you have an argument or disagreement with anyone?"). If the participant indicated no experience of the stressor that day, the item was coded as a "0", and the experience of as stressor was coded as a "1." The items were summed to form a composite daily stressor score. Possible scores ranged from 0 to 5 daily stressors.

Everyday Memory Problems—Everyday memory problems were assessed with 10 items used in previous diary studies (Hahn & Lachman, 2014; Whitbourne et al., 2008) and drawn from a 35-item measure of everyday memory problems (Sunderland, Harris, & Baddley, 1983). Participants were asked if they had experienced certain memory problems that day (i.e., "had trouble remembering someone's name", or "forgot what you were about to say"). Items were coded where "0" represented the absence of a memory problem, and "1" represented a reported memory problem. The 10 items were summed to give a composite score of memory problems on each of the seven days. Possible daily scores ranged from 0 to 10 memory problems.

Covariates—The following variables were used as covariates because of their previously recognized relationship with SOC use and memory problems: age, gender, education. Additionally, a number of studies have demonstrated an association between neuroticism and stress (for review see Suls & Martin, 2005), as well as self-reported memory problems (e.g., Neupert, Mroczek, & Spiro, 2008). Age was measured continuously. Participants indicated their gender as either male (coded as "1") or female (coded as "2"). Education was measured continuously by numbers of years of education that the participant reported. Neuroticism was measured with the Midlife Development Inventory (MIDI; Lachman & Weaver, 1997) that assessed. The MIDI is a 31-item measure that assesses six personality traits (Neuroticism, Extraversion, Openness to Experience, Conscientiousness, Agreeableness (Communion), and Agency. Only Neuroticism was included as a covariate. Participants were asked to rate how well each item described them on a likert scale ranging from one (a lot) to four (not at all). The neuroticism composite score was compiled by averaging across four items (moody, worrying, nervous, and calm (reverse-coded) so that a higher score was indicative of greater neuroticism. Time (day 1, day 2, etc.) was also

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included as a covariate to account for the drop off in reports of memory problems that often occurs in diary data collection (Bolger et al., 2003; Hahn, Cichy, Small, & Almeida, 2013).

Design and Procedures

On Day 1 of the study, participants were contacted via telephone and screened for eligibility with a short mental status questionnaire (Pfeiffer, 1975). Participants were deemed eligible if they had no more than two errors. The eligible participants were then given the BTACT and mailed a package with several background questionnaires and seven daily diaries. Participants filled out the background questionnaire and mailed it back to the research lab in a stamped and addressed envelope. The next day, the participants began the first of seven consecutive daily protocols. Each night, they filled out the daily SOC, stressor, and memory problems questionnaires as well as other questionnaires not included in the current analysis. A researcher called the participant each night to check in and remind the participant to fill out the questionnaires. Participants had the opportunity to earn a total of $100 ($10 for every daily questionnaire that is mailed back on time and an additional $30 for returning all study materials on time).

Statistical Analyses—Multilevel modeling (MLM) was used to examine within-person variability in the relationship between the Level 1 and Level 2 predictor and outcome variables using SAS PROCEDURE MIXED in Version 9.4. Daily SOC strategies, daily stressors, and everyday memory problems were measured at level one, and person-level data (e.g., cognitive resources, age, and other covariates) were measured at level two. Multilevel modeling (MLM) offers numerous advantages for diary data. This includes the ability to estimate variability within- and between-persons, as well as the opportunity to examine data from a sample of participants who varying in number of measurement points (Raudenbush & Bryk, 2002). Diary studies can be time-intensive for participants; therefore this ability to measure a varying amount of data from participants can enhance the power and feasibility of using diary data.

SOC use: First, we examined the relationship between age and daily SOC use (Model 1), and how this relationship was moderated by daily stressors and cognitive resources (Model 2). For Model 3 we examined both the between-persons (BP) person-mean and within-persons (WP) main effects of stress. Originally, Models 2 and 3 also examined age-squared interactions with cognitive resources and daily stressors, respectively. These age-squared interactions were not significant and were therefore removed from the models for parsimony.

$$\begin{aligned}\text{DAILY SOC}_{\text{ij}} = {} & \gamma_{00} + \gamma_{01}\,(\text{DAY}) + \gamma_{02}\,(\text{AGE}) + \gamma_{03}\,(\text{GENDER}) + \\ & \gamma_{04}\,(\text{EDUCATION}) + \gamma_{05}\,(\text{AGE} * \text{AGE}) + u_{0j} + u_1 j + r_{ij}\end{aligned} \tag{1}$$

$$\begin{aligned}\text{DAILY SOC}_{ij} = {} & \gamma_{00} + \gamma_{01}\,(\text{DAY}) + \gamma_{02}\,(\text{AGE}) + \gamma_{03}\,(\text{GENDER}) + \\ & \gamma_{04}\,(\text{EDUCATION}) + \gamma_{05}\,(\text{COGNITIVE RESOURCES}) + \gamma_{10}\,(\text{AGE} * \text{COGNITIVE RESOURCES}) + u_{0j} + u_1 j + r_{ij}\end{aligned} \tag{2}$$

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$$\begin{aligned}\text{DAILY SOC}_{ij} = \gamma_{00} + \gamma_{01}\,(\text{DAY}) + \gamma_{02}\,(\text{AGE}) + \gamma_{03}\,(\text{GENDER}) + \\ \gamma_{04}\,(\text{EDUCATION}) + \gamma_{05}\,(\text{WP STRESS}) + \gamma_{06}\,(\text{BP STRESS}) + \gamma_{10} \\ (\text{AGE} * \text{WP STRESS}) + u_{0j} + u_1 j + r_{ij}\end{aligned} \quad (3)$$

Benefits of SOC: Secondly, we examined whether SOC usage, daily stressors, and cognitive resources were associated with memory problems. Specifically, in separate models, we investigated whether fewer cognitive resources and more daily stressors were related to more everyday memory problems, and whether this relationship was attenuated for people who used more SOC strategies. For Model 5 we examined both the between-persons (BP) person mean and within-person (WP) main effects of daily stressors. BP effects examine whether, for example, individuals with a greater number of daily stressors, on average, report a greater number of memory problems, on average. WP effects examine whether individuals report a greater number of memory problems on days when they report a greater number of daily stressors than they usually do. For the following models, we also explored three-way interactions between age, SOC use, and daily stressors or cognitive resources. None of the three way interactions were significant and age was not related to memory problems; thus, we dropped the three way interactions from the models and focused on the two way interactions.

$$\begin{aligned}\text{MEMORY PROBLEMS}_{ij} = \gamma_{00} + \gamma_{01}\,(\text{DAY}) + \gamma_{02}\,(\text{AGE}) + \gamma_{03}\,(\text{GENDER}) \\ + \gamma_{04}\,(\text{EDUCATION}) + \gamma_{05}\,(\text{NEUROTICISM}) + \gamma_{06}\,(\text{BP SOC}) + \gamma_{10} \\ (\text{COGNITIVE RESOURCES}) + \gamma_{11}\ (\text{COGNITIVE RESOURCES} * \text{BP SOC}) + u_{0j} + u_1 j + r_{ij}\end{aligned} \quad (4)$$

$$\begin{aligned}\text{MEMORY PROBLEMS}_{ij} = \gamma_{00} + \gamma_{01}\,(\text{DAY}) + \gamma_{02}\,(\text{AGE}) + \gamma_{03}\,(\text{GENDER}) \\ + \gamma_{04}\,(\text{EDUCATION}) + \gamma_{05}\,(\text{NEUROTICISM}) + \gamma_{06}\,(\text{BP STRESSORS}) + \\ \gamma_{07}\,(\text{BP SOC}) + \gamma_{10}\ (\text{WP STRESS}) + \gamma_{11}\,(\text{WP STRESS} * \text{BPSOC}) + u_{0j} + u_1 j + r_{ij}\end{aligned} \quad (5)$$

Results

Table 1 displays intercorrelations, as well as sample descriptives for all study variables.

SOC Use

First, we examined SOC usage as a function of age and daily stressors, and age and cognitive resources. Table 2 displays the results of the main analyses examining predictors of daily SOC, adjusted for covariates. Confirming age patterns found in past work with general SOC usage, we found a significant Age^2 effect indicating that daily SOC usage was highest among middle-aged adults, $\gamma = -0.00$, $p = .028$, 95% [−0.00, −0.00]. The curvilinear pattern is displayed in Figure 1.

Cognitive resources did not predict SOC use. However, there was a significant interaction between age and cognitive resources, $\gamma = 0.00$, $p = .044$, 95% [0.00, 0.01] (Figure 2). To further investigate this interaction, we conducted a slope analysis using a web-based tool (Preacher, Curran, & Bauer, 2006). Results revealed a significant positive slope when cognitive resources were high (1 SD above the mean), $\gamma = 0.02$, *SE = 0.01*, $p = .024$, and no

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significant slope when cognitive resources were low (1 SD below the mean), $p = .623$. Neither between- or within-persons daily stressors were related to daily SOC use, nor was there an interaction with age and stressor on daily SOC use.

Benefits of SOC

We next tested models to examine whether daily stressors and cognitive resources predicted memory problems and if daily SOC moderated these relationships. Table 3 displays the results of adjusted models examining predictors of memory problems. Age was not significantly related to memory problems in any of the models, consistent with past research (Hahn & Lachman, 2014; Slavin et al., 2010).

Although cognitive resources were correlated with memory problems (r = −0.29, p < .001, 95% [−.32, −.20]), when covariates were added they did not predict memory problems There was no significant relationship between daily SOC use and memory problems, nor was there a significant interaction between SOC and cognitive resources.

Between-person daily stress was positively related to memory problems, $\gamma = 0.58$, $p < .001$, 95% [0.27, 0.88], indicating that those who experience more daily stressors also experience more memory problems. Additionally, there was a significant positive relationship between within-person stress and memory problems, $\gamma = 0.83$, $p < .001$, 95% [0.41, 1.26] indicating that high stress days were associated with more memory problems. Further, daily SOC moderated this relationship, $\gamma = -0.14$, $p = .005$, 95% [−0.24, −0.04] (Figure 3). To further investigate this relationship, Preacher and colleagues' (2006) slope analysis web tool was used. Results revealed that for those who use fewer SOC strategies, high stress days were associated with significantly more memory problems than low stress days, $\gamma = 0.36$, $SE = 0.07$, $p < .001$. In contrast, no significant difference in memory problems between high and low stress days was found for those high in SOC strategies, $p = .14$.

Discussion

This study focused on daily self-regulatory processes in relation to everyday memory problems. We investigated to what extent constraints and limitations associated with age, cognitive resources, and stress drive the use of SOC strategies and whether SOC usage can mitigate the effects. We raised an apparent paradox that stems from SOC theory in that SOC use requires resources, yet it is also expected to be most beneficial for those who have suffered losses in resources. The results of the study shed light on this seeming contradiction and suggest that limitations involving more global resources (i.e., cognitive resources) obstruct SOC use, but the presence of more daily constraints (i.e., daily stressors) promotes SOC use. Additionally, SOC did not moderate the relationship between the more general cognitive resources and memory problems, but it did help to buffer the relationship between daily stressors and memory problems. It is also worth noting that cognitive resources were not related to the general, traitlike measure of SOC.

SOC Use

First we examined under which contextual constraints (aging, daily stress, and low cognitive resources) daily SOC use is more likely to be used. As predicted, we found that middle-aged

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adults, compared to younger and older adults, reported using the greatest amount of daily SOC strategies, in line with past work with trait-like SOC (Freund & Baltes, 2002). We expected that cognitive resources and daily stressors would moderate this relationship between age and daily SOC usage. Older adults who had good memory utilized SOC strategies more than other age groups, and more than older adults who had poor memory. This further demonstrates the integral role that both expertise and resources play in the relationship between age and SOC use. Older adults are thought to have the most expertise in using SOC, but often struggle to use it because they lack the resources that allow them to effectively use such self-regulatory strategies (Freund & Baltes, 2002). Our results revealed that, when older adults maintained high cognitive resources, they were able to use more SOC compared to other age groups who lack their expertise. When cognitive resources were low, however, such a linear relationship between age and SOC use did not persist. This is in line with previous work on goal-directed everyday problem solving. Allaire and Marsiske (1999) demonstrated that older adults with limited cognitive resources showed worse problem solving. Additionally, reduced cognitive resources may lead to difficulty tolerating negative emotions, which are related to daily stressors (Hess & Queen, 2014).

Contrary to the predicted negative relationship, results showed no significant relationship between daily SOC use and daily stressors. Additionally, there was a no interaction between daily stressors and age.

Benefits of SOC

After establishing which contextual variations (age, daily stress, and cognitive resources) are associated with the most SOC use, we examined if daily SOC strategies would be beneficial for everyday memory. Specifically, we tested whether SOC use moderated the relationship between cognitive resources and/or daily stressors and memory problems. Despite a significant negative bivariate correlation between cognitive resources and memory problems, when controlling for all covariates, neither age nor cognitive resources were associated with memory problems, Past work has found that objective memory performance on tests is not necessarily correlated with memory problems and that adults of all ages complain of memory problems (Jungwirth et al., 2004; Rickenbach et al., 2015; Lachman, 2004; Slavin et al., 2010; Van Bergen et al., 2009).

In line with past work suggesting a deleterious relationship between stress and memory (i.e., Rickenbach, Almeida, Seeman, &Lachman, 2014; Lupien et al., 2009; Neupert et al., 2006; Sliwinski et al., 2006), we found that daily stressors were related to more memory problems, both between- and within-persons. Moreover, daily SOC use moderated this relationship; for those who used fewer SOC strategies, high-stress days were associated with more memory problems than low-stress days; and the relationship between stressors and memory problems dissipated when greater amounts of SOC were used. This suggests that using self-regulatory SOC strategies may help to mitigate the relationship between daily stressors and memory problems. This relationship found between SOC and stress is consistent with Lazarus & Folkman's (1984; Folkman, Lazarus, Pimley, & Novacek, 1987) model of stress and coping. Specifically, an experience of stress may lead to an appraisal that activates coping mechanisms, such as the use of SOC strategies. Individual differences in coping are

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influenced by one's goals (Coats, Hoppmann, & Scott, 2014; Folkman & Moskowitz, 2004; Hoppmann & Blanchard-Fields, 2010). While our SOC questionnaire was not specific about the nature of the goals, it is likely that compensatory strategies in the face of stress and coping might surface in the context of obstructed goal pursuit. Additionally, our findings support past work that suggests a positive role of SOC use for memory problems in the context of aging-related declines (Hahn & Lachman, 2014; Schiebner & Leathem, 2012) and other domains (Schmitt et al., 2012).

Limitations and Future Directions

One of the main limitations of this study is that that many of our measures were based on self-report. For example, it is not possible to determine whether participants actually or effectively used SOC strategies. We suggest that future research manipulate SOC use with an experimental paradigm or intervention to address causality and directionality within this relationship. It is important to note that memory problems were also self-reported, therefore requiring intact metamemory abilities. In other words, to report memory problems one has to recognize or remember having had the memory problems. The daily nature of our study could allow for less bias in retrospective recall. Consistent with past work suggesting that self-ratings of memory abilities were related to memory performance (Rickenbach et al., 2015), our results indicated that cognitive resources were negatively correlated with memory problems, suggesting that those lower in memory abilities actually reported more daily memory problems. For the purposes of this study and the focus on memory problems, episodic memory was chosen as the most relevant measure of cognitive resources. Of course, episodic memory is not the only possible measurement of cognitive resources; other possible measures could include educational attainment or executive functioning. Future studies should explore other possible factors as measures of cognitive resources.

Because daily stressors can impact outcomes other than memory, such as increased negative affect (Stawski, Sliwinski, Almeida, & Smyth, 2008), future research should continue to explore how the use of SOC strategies may buffer such relationships (e.g., daily stressors and negative affect). The design of the current study does not allow for addressing directionality or causality of the associations identified. Future research could address this through the use of experience sampling and/or lagged analysis to achieve a closer look at the timing and sequencing of the key variables involved.

Conclusion

This study furthers the understanding of SOC as a self-regulatory strategy for managing daily life tasks as a means to minimizing memory problems and reducing the impact of constraints. When assessing SOC use as a daily self-regulatory strategy, we found that age differences in SOC were moderated by cognitive resources. Specifically, when cognitive resources were high, SOC usage increased with age, but when cognitive resources were low, there was little relationship between age and SOC use. It is possible that more global factors (i.e., cognitive resources) may impede SOC usage, but that daily constraints (i.e., daily stressors) might promote SOC use. This kind of distinction between global and daily limitations can be seen in the moderating effects of SOC use on memory problems, wherein

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SOC did not help to buffer the relationship between cognitive resources and memory problems, but did help the relationship between daily stressors and memory problems.

In conclusion, it appears that the paradoxical relationship between resources and SOC use can be qualified by the nature of resource-limitations. That is, those with deficits in global resources do not seem to use as many SOC strategies, nor benefit from using them if and when they do. Conversely, those with more day-to-day constraints do seem to use more SOC strategies and in turn benefit from using them. Future research should aim to explore a broader range of outcomes, as well as other resource-related factors to further our understanding of effective self-regulation in the context of aging-related losses.

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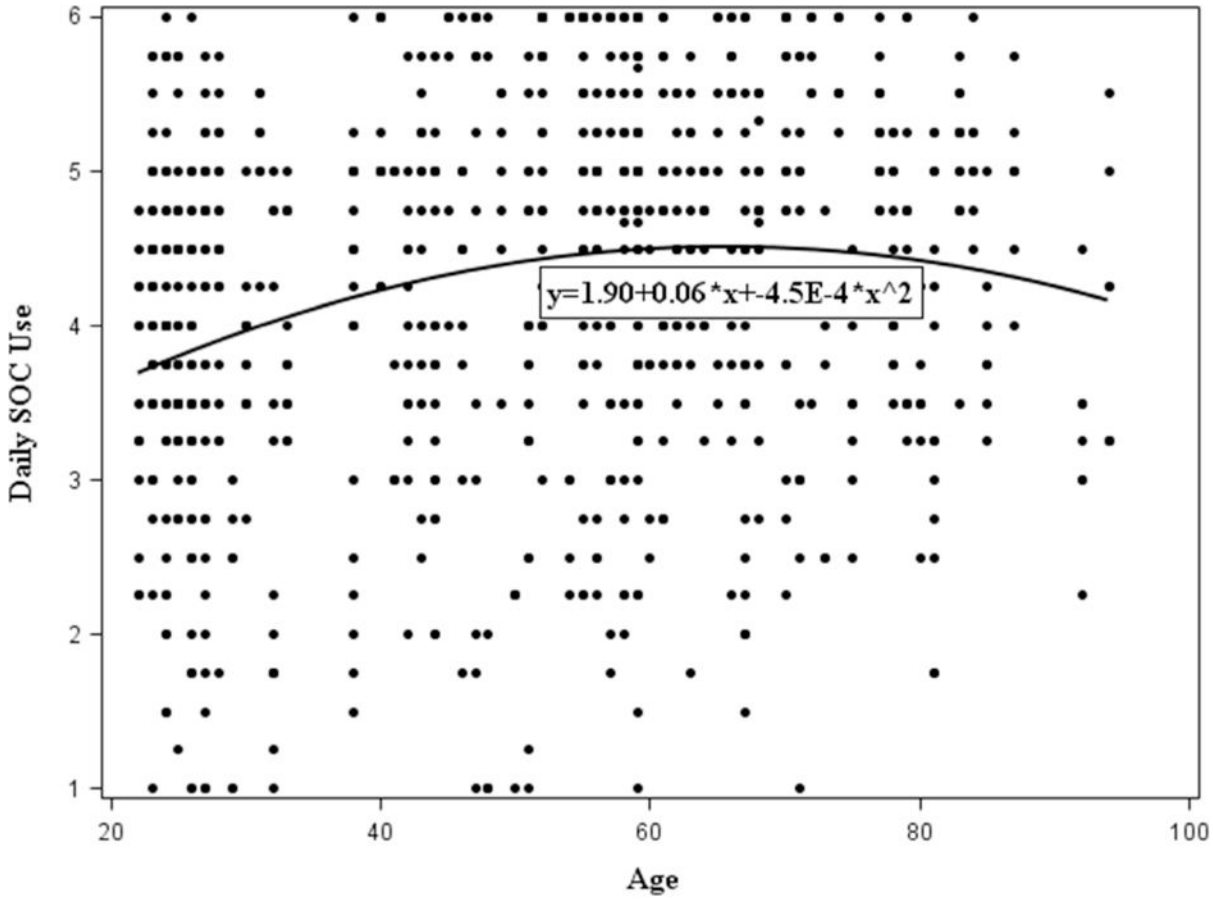

Figure 1.
Quadratic relationship between age and daily Selection, Optimization, and Compensation (SOC) use.
Note. n=145.

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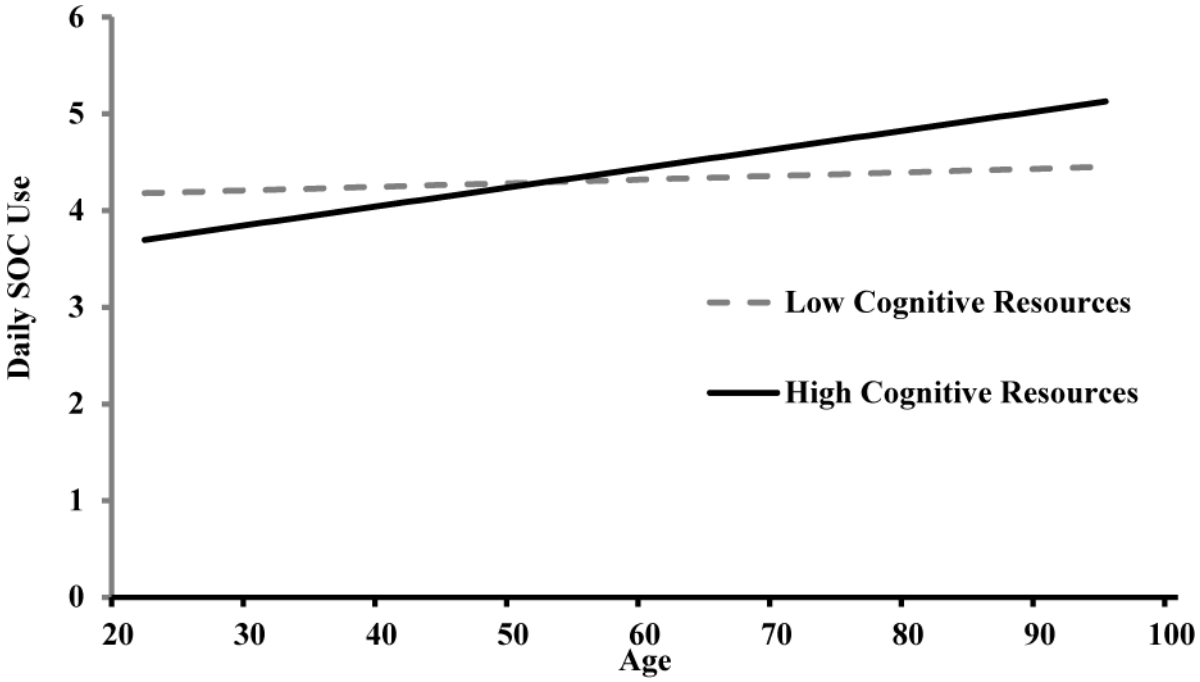

Figure 2.

The relationship between age and daily Selection, Optimization, and Compensation (SOC) use, moderated by cognitive resources.

Note. The line for low cognitive resources depicts participants that had immediate recall scores below 5.34 (1 SD below the mean, n = 30). The line for high cognitive resources depicts participants that had immediate recall scores above 9.94 (1 SD above the mean, n = 25). The remaining 90 participants that fell within 1 SD (2.30) of the mean (7.64) are not depicted on the graph.

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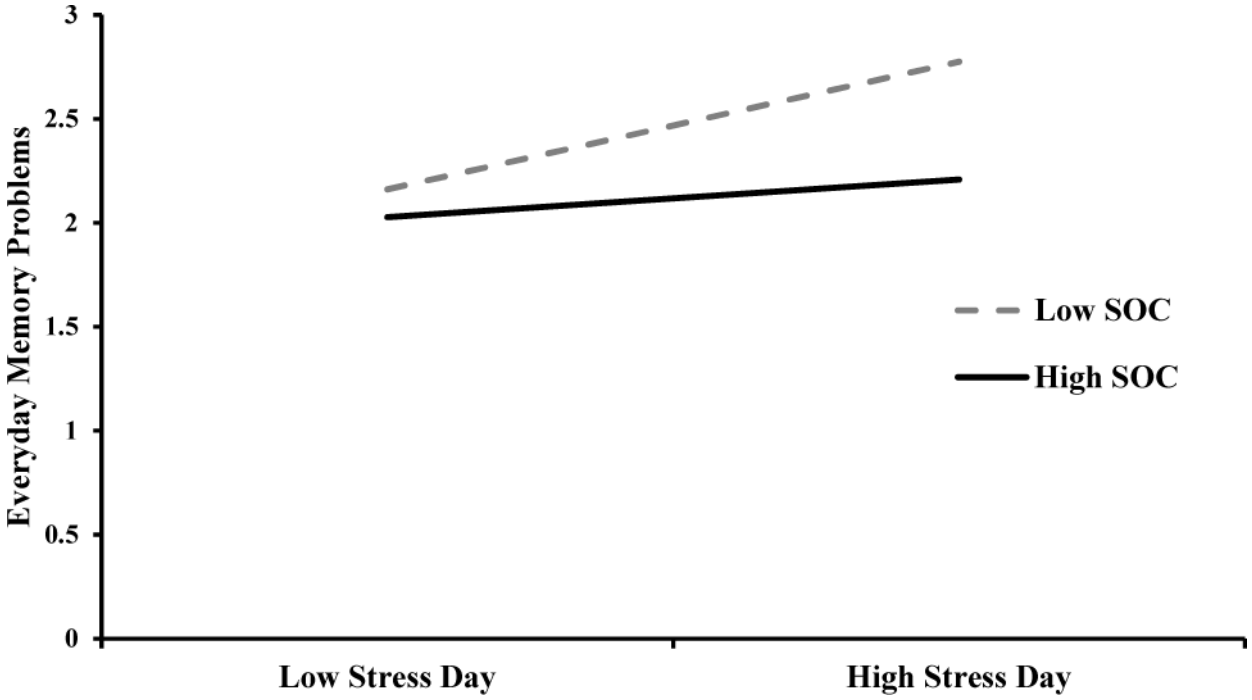

Figure 3.
The interaction between within-person daily stressors and daily Selection, Optimization, and Compensation (SOC) strategy use on everyday memory problems.

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Table 1

Descriptive characteristics and intercorrelations for all study variables (n = 145)

Variable	M (SD) or %	1	2	3	4	5	6	7	8
Level 2 (person-level)									
1. Age	50.53(19.12)	–							
2. Gender (% female)	60.00	.09 [.01, .13]	–						
3. Education (years)	15.16(2.47)	.11 [.05, .17]	−.09 [−.16, −.04]	–					
4. Neuroticism	2.25(0.64)	−.08 [−.23, −.11]	.27 [.20, .31]**	−.30** [−.32, −.21]	–				
5. Cognitive Resources	7.64(2.30)	−.32 [−.27, −.15]**	.05 [.05, .07]	.22 [.13, .25]**	.00 [−.14, −.02]	–			
6. Background Selection, Optimization, and Compensation (SOC)	7.62(2.29)	−.09 [−.14, −.02]	.08 [.01, .13]	.05 [−.01, .11]	−.05 [−.14, −.02]	.02 [−.07, .05]	–		
Level 1 (daily-level)									
1. Day	4.00 (2.00)	–							
2. Daily Selection, Optimization, and Compensation (SOC) Composite	4.24 (1.21)	−.03 [−.06, .06]	–						
3. Daily Elective Selection	4.50(1.55)	−.04 [−.06, .06]	.81 [.86, .89]**	–					
4. Daily Loss-Based Selection	3.91 (1.53)	.03 [−.06, .06]	.75 [.74, .79]**	.44 [.60, .59]**	–				
5. Daily Optimization	4.64 (1.45)	−.09 [−.06, .06]**	.83 [.86, .89]**	.67 [.78, 83]**	.45 [.45, 54]**	–			
6. Daily Compensation	3.88 (1.57)	−.02 [−.06, .06]	.78 [.85, .88]**	.45 [.63, .70]**	.47 [.60, .67]**	.53 [.65, .72]**	–		
7. Daily Stressors	0.98 (1.12)	−.13 [−.06, .06]**	.03 [−.13, −.01]	.01 [−.14, −.02]	.07 [.02, .15]*	.03 [−.14, −.02]	.02 [−.14, −.02]	–	
8. Daily Memory Problems	2.06 (1.90)	−.13 [−.06, .06]**	−.05 [−.20, −.08]	−.08 [−.21, −.02]*	.04 [−.02, .10]	−.05 [−.21, −.09]	−.05 [−.22, − .10]	.24 [.33, .44]**	–

Note

* p < .05,

** p < .01. Values in brackets represent the 95% confidence intervals. Possible scores for neuroticism ranged from 1 to 4. Cognitive resources scores ranged from 2 to 14. Possible scores for background SOC (composite, elective selection, low-based selection, optimization, and compensation) ranged from 0 to 12. Possible scores for daily SOC (composite, elective selection, low-based selection, optimization, and compensation) ranged from 1 to 6. Possible scores for daily stressors ranged from 0 to 5. Possible scores for memory problems ranged from 0 to 10.

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Table 2

Fixed effects estimates for multilevel models predicting daily Selection, Optimization, and Compensation use.

	Cognitive Resources			Within-Persons Daily Stressors		
Parameter	**Est**	***95% CI***	***p***	**Est**	***95% CI***	***p***
Intercept	4.48	2.55, 6.41	<.001	2.96	1.82, 4.11	<.001
Day	−0.01	−0.04, 0.01	.298	−0.01	−0.04, 0.02	.388
Gender	−0.06	−0.36, 0.25	.716	−0.02	−0.33, 0.28	.887
Education	0.05	−0.01, 0.11	.127	0.05	−0.01, 0.11	.115
Age	−0.01	−0.04, 0.01	.288	0.01	0.00, 0.02	.003
Constraint	−0.18	−0.38, 0.02	.076	0.11	−0.07, 0.30	.230
Between-Persons				0.01	−0.19, 0.21	.888
Age*Constraint	0.00	0.00, 0.01	.043	−0.00	−0.01, 0.00	.407

Note. n = 145.

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Table 3

Fixed effects estimates for multilevel models predicting memory problems.

	Cognitive Resources			Within-Persons Daily Stressors		
Parameter	**Est**	***95% CI***	***p***	**Est**	***95% CI***	***p***
Intercept	5.00	0.70, 9.29	.023	2.62	0.35, 4.89	.024
Day	−0.12	−0.16, −0.08	< .001	−0.10	−0.14, −0.06	< .001
Gender	−0.18	−0.69, 0.32	0.470	−0.14	−0.63, 0.35	.581
Education	−0.02	−0.12, 0.08	0.667	−0.06	−0.16, 0.04	.208
Age	−0.00	−0.01, 0.01	0.982	0.01	−0.00, 0.02	.208
Neuroticism	0.42	0.01, 0.83	0.044	0.39	−0.02, 0.79	0.06
Constraint	−0.28	−0.74, 0.19	0.240	0.83	0.41, 1.26	< .001
Between-Persons				0.57	0.27, 0.88	< .001
Daily Selection, Optimization, and Compensation	−0.36	−1.13, 0.41	0.354	−0.19	−0.45, 0.07	.156
Constraint*Daily Selection, Optimization, and Compensation	0.03	−0.08, 0.13	0.598	−0.14	−0.24, −0.04	.005

Note. n = 145.