



The role of interest in optimizing performance and self-regulation[☆]



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HIGHLIGHTS

- Task performance was optimized when affect- and value-related interest were high.
- Depletion was also minimized when affect- and value-related interest were high.
- Interest supports effective and efficient engagement without depleting resources.
- Results underscore the importance of interest as a motivational variable.

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ABSTRACT

The present research tested the hypothesis that interest functions, in part, to optimize performance while also optimizing self-regulatory resources, and that this occurs when both affect- and value-related interest are high. Study 1 provided evidence that both affect- and value-related interest support task performance such that undergraduates ($N = 153$) in the high task importance condition, who also reported high affect-related interest, demonstrated relatively superior performance on a word-forming problem set. Study 2 ($N = 88$) provided further evidence that affect- and value-related interest were associated with superior anagram performance. A subsequent task demonstrated that self-regulatory resources were optimized for participants with both high affect- and value-related interest. The present studies provide evidence that high levels of performance can be achieved while maintaining optimal self-regulatory resources, depending on affect-related interest and the task's personal significance. Implications for goal pursuit and self-regulation are discussed.

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Introduction

What allows people to sustain effective engagement in their goals without wearing out? Some people can work on solving the Rubik's Cube for hours or spend a sleepless night deriving mathematical equations and feel energized by the experience, whereas others would be mentally exhausted in moments. It stands to reason that the more effort people exert, the more taxed they should feel. Indeed, research has consistently documented this effect (see Muraven, 2012; Muraven & Baumeister, 2000 for reviews), particularly with regard to the self-control required to inhibit the desire to give up on difficult goals (Burkley, 2008; Muraven, Shmueli, & Burkley, 2006; Muraven, Tice, & Baumeister, 1998). That said, it is fairly common for people to feel invigorated by challenging goals (Csikszentmihalyi, 1990). In fact, it has been

suggested that interesting tasks can feel effortless (Lipstein & Renninger, 2007; Renninger & Hidi, 2002) and that interest may contribute as a mental resource (Hidi, 1990). Clearly, the latter experience of goal pursuit is more adaptive, such that it fosters deep, sustained engagement. Accordingly, the purpose of the present research was to examine the role of interest in optimizing performance while also optimizing the self-regulatory resources required for effective engagement.

Much of the extant theory and research on interest has focused on its definition (e.g., Renninger, 1992; Sansone & Harackiewicz, 1996; Schiefele, 1991, 2009; Silvia, 2008), development (e.g., Harackiewicz, Durik, & Barron, 2005; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008; Hidi & Renninger, 2006; Hulleman & Harackiewicz, 2009; Linnenbrink-Garcia, Patall, & Messersmith, 2013), maintenance (e.g., Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997), as well as its antecedents and consequences (e.g., Ainley, Hidi, & Berndorff, 2002; Ainley, Hillman, & Hidi, 2002; Durik & Harackiewicz, 2007; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Harackiewicz, Barron, Tauer, & Elliot, 2002; Harackiewicz & Larson, 1986; Harackiewicz et al., 2008; Linnenbrink-Garcia et al., 2013; Plass et al., 2013; Renninger, Hidi, & Krapp, 1992; Schiefele, 1991, 2001; Senko & Harackiewicz, 2005). Relatively little work, however, has focused on its function (cf. Fredrickson, 1998; Izard, 1977; Izard & Ackerman,

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2000; Thoman, Smith, & Silvia, 2011). Why does interest exist, and how does it help us accomplish challenging goals? Research has demonstrated its association with various beneficial outcomes, including heightened attention (e.g., Ainley, Hidi, & Berndorff, 2002; Ellsworth & Smith, 1988; McDaniel, Waddill, Finstad, & Bourg, 2000; Renninger & Wozniak, 1985; Smith & Ellsworth, 1985), the adoption of adaptive goals (e.g., Harackiewicz et al., 2000, 2008; Senko & Harackiewicz, 2002), and learning (Harackiewicz et al., 2002; Hulleman & Harackiewicz, 2009), but less is understood about the purpose of interest and its functions independent of other constructs, such as intrinsic motivation. To this end, the present research was designed to examine one possible function of interest: that it simultaneously optimizes performance and the use of self-regulatory resources.

Theoretical background

The current work draws from contemporary research and theory on interest (Hidi & Renninger, 2006; Renninger et al., 1992; Schiefele, 1991, 2009) and self-regulation (Muraven, 2012; Muraven & Baumeister, 2000). To provide the theoretical basis on which the current studies are designed, we begin by describing our theoretical perspective on interest and then turn to a discussion of research related to the expenditure of self-regulatory resources. Finally, we discuss how these two areas of research can be merged.

Interest

Contemporary researchers studying interest have primarily differentiated between two main forms of interest: individual and situational. *Individual interest*, also referred to as personal interest, resides within the individual and is relatively stable. It involves both a deep personal connection to the domain, activity, or content and an eagerness to re-engage in the object of interest over time (Hidi & Renninger, 2006; Renninger, 1992, 2009; Schiefele, 1991, 2001, 2009). For example, an individual may have an interest in chemistry that he or she pursues or attends to reliably over time. *Situational interest*, on the other hand, emerges from, and is supported by, environmental qualities (Hidi & Baird, 1986; Hidi & Renninger, 2006; Krapp, 2002; Schiefele, 2009). For instance, a student's interest in chemistry may be piqued when his or her instructor performs exciting classroom demonstrations. While individual interest can also be supported and actualized within a particular context, it is not dependent on the context in the way that situational interest is. In the present work, we focus on individual interest and thus describe this form of interest in greater detail.

Although there are subtle variations in the conceptualization of individual interest, two central components that are shared across leading perspectives include affect and value (e.g., Eccles, 1983; Hidi & Renninger, 2006; Krapp, 2005; Renninger & Hidi, 2011; Schiefele, 2001, 2009). The affect component pertains to the feelings related to involvement with particular content or activities and is characterized by states such as enjoyment, fascination, and excitement. The value component pertains to the importance ascribed to the content, activity, or domain. For example, content that is personally relevant or meaningful. These components also overlap with aspects of the modern expectancy-value model (Eccles, 1983; Schiefele, 2009; Wigfield & Cambira, 2010; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). Specifically, the affective component is similar to intrinsic value by focusing on enjoyment or subjective interest; whereas the value component overlaps both with utility value, in terms of whether the activity helps the individual meet future goals, and attainment value, in terms of the centrality of the domain to the self. Notably, when one focuses on actualized interest within the context of a particular task, as we do in the present work, the overlap with task value is even greater as both can be focused on the positive feelings and value associated with a particular task or activity in that moment.

Importantly although the terms 'interest' and 'motivation' are often used interchangeably, these constructs are not synonymous (Schiefele, 2009). Interest refers to a preference for and tendency to engage in particular activities or domains (Hidi & Renninger, 2006). It is content and experientially driven. Motivation, on the other hand, is a broader process referring to the desire to bring about a particular end state in a particular situation, which includes initiating and sustaining goal-related behavior (Schunk, Pintrich, & Meece, 2008). It can be shaped by interest, but also by other processes, such as motives and goals. Thus, knowing that one enjoys a particular type of task or activity, or that a particular domain or task holds personal value may lead one to initiate and sustain on-task behavior. Accordingly, in the current work, we control for chronic achievement motivation in order to analyze the unique contribution of interest.

Finally, it is important to note that interest is associated with enhanced engagement and achievement (Schiefele, 2001). However, the specific mechanisms through which interest supports engagement and achievement requires further investigation. Moreover, additional research examining the interplay between the various facets of interest (affect and value) in supporting engagement and achievement would provide further insight into how the various aspects of interest work together to support engagement. For example, Durik and Harackiewicz (2007) found that enhancing the perceived utility of the task for those individuals high, but not low, in affect-related interest was associated with higher levels of task engagement; although interest alone, regardless of utility value, supported task performance.

Self-regulatory resources

In the pursuit of challenging goals, people must often persist even when they would otherwise prefer to withdraw effort. The inhibition of this overriding desire to disengage can require self-control (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Muraven, & Tice, 2000; Muraven et al., 1998), which can have deleterious consequences to the pursuit of goals (see Muraven, 2012 for a review). Research suggests that people have a finite pool of self-regulatory resources, and that exertions of self-control deplete those resources (see Muraven, 2012; Muraven & Baumeister, 2000 for reviews). Thus, the resources necessary for sustaining goal engagement or the initiation of other goals may be in short supply, ultimately lessening the effectiveness of those pursuits. These resources can be restored by various methods including rest (Tyler & Burns, 2008) or experiencing positive affect (Tice, Baumeister, Shmueli, & Muraven, 2007).

For example, Baumeister, Bratslavsky, Muraven, and Tice (1998) investigated the effect of overcoming temptation on self-regulatory resources. Participants took part in what they were told was a "taste perception" study, and were presented with radishes and chocolate chip cookies and other chocolate foods. In one condition, they were instructed to eat the radishes, but not the chocolate treats. In the other condition, they were instructed to do the opposite. There was also a control condition in which participants did not take part in the "taste perception" part of the study. In a seemingly unrelated task, participants were then instructed to work on a set of problems – problems that were selected by the researchers to be impossibly difficult – and told them that they could stop at any time. The researchers found that those in the radish condition not only gave up on the task sooner than the chocolate and control conditions, but also made less attempts to solve each puzzle before giving up. Those in the radish condition had to resist a far more desirable alternative, which depleted their self-regulatory resources, ultimately decreasing their persistence and perseverance on the challenging problems that followed. In a similar study, Muraven et al. (1998) found that participants who were asked to refrain from expressing emotion while watching a humorous video subsequently held a spring-loaded handgrip closed for less time than participants who were not asked to regulate their emotions. Therefore, the depletion experienced in the pursuit of one goal can come at the cost

of a subsequent, unrelated pursuit. This phenomenon of regulatory depletion has been clearly documented in a variety of related studies (see Muraven, 2012 for a review). In the present research, we examined how interest may function to circumvent this regulatory depletion; that is, how engagement may be experienced in a way that optimizes the use of self-regulatory resources without resulting in decrements in performance on present and subsequent tasks.

Interest and resource management

Although the role of interest in optimizing self-regulatory resources remains largely unexamined, there is some evidence to support the prediction. Hidi (1990) had originally suggested that interest might elicit attention automatically, thereby alleviating the need for resources to direct and sustain attention. McDaniel et al. (2000; Study 1) tested this notion by examining the effect of text-based interest (a form of situational interest) on attentional resources. Participants read several stories on a computer screen that were determined to be interesting and uninteresting in pretesting. While reading the narratives, tones were played at random and participants were instructed to press the spacebar as soon as they detected them. The researchers found that reaction times were faster for interesting stories, particularly in the second half of the experimental session, suggesting that interesting texts required less attentional resources than uninteresting texts.

A series of studies by Thoman et al. (2011) also provides preliminary evidence. In three separate studies, they first depleted participants' self-regulatory resources (e.g., using the Stroop task), then had participants engage in tasks that either elicited situational interest, positive affect, or nothing (control), and then measured persistence on a subsequent task. They found that persistence on the final task was the longest when preceded by an interesting task, demonstrating that participants' resources had either been replenished or used relatively minimally. Therefore, their findings provide initial evidence that interest is, at least in part, involved in the optimization of self-regulatory resources.

A limitation of the above studies, however, is that it is difficult to understand which aspects of the interest experience are driving the effects. The present research was designed to provide a more nuanced examination of the relation between interest and self-regulatory resources by examining how two well-documented components of individual interest (affect and value) contribute to goal engagement and the expenditure of self-regulatory resources. As noted by Eccles and Wigfield (2002), it is important to consider affect and value separately because individual interests vary with regard to their appeal; some are principally based on feelings, whereas others are based more on personal significance. Although engagement can be depleting (Burkley, 2008; Muraven et al., 1998, 2006), high levels of interest-related affect and value may alleviate the resource demands that would otherwise contribute to self-regulatory depletion, whereas affect or value alone may not be sufficient.

Also central to our investigation, we examined task performance in order to understand its relation to both interest and self-regulatory resources. In particular, we tested the hypothesis that pursuing a highly interesting (i.e., high levels of affect- and value-related interest) task increases performance, but not at the cost of the resources necessary for effective engagement. Without both components of interest present, one may not have the enthusiasm needed to actively engage in the goal or the personal value to anchor and guide their pursuit. We also chose to focus on task performance as the primary outcome rather than other indicators of engagement, such as persistence, because our intention was to examine the role of interest in efficient goal pursuit, which other outcomes could not similarly afford. Finally, we intended to demonstrate that our predicted effects were not driven by chronic achievement motivation or positive affect. Our intention was to demonstrate that the effect of interest is distinct from these two related constructs and that interest plays a unique and critical role in the management of self-regulatory resources.

The present research

Across two studies, we examined the notion that interest functions, in part, to optimize performance, while also optimizing self-regulatory resources. Specifically, we examined the interaction of affect- and value-related interest in order to examine their combinatory contributions at various levels. A drawback of examining unitary constructs with multiple components, such as individual interest, is that an overall score can be misleading. In the present case, although very high or low scores would clearly suggest high or low interest, moderate scores are less clear. A moderate score may suggest high affect-related interest and low value-related interest, or high value-related interest and low affect-related interest. It could also suggest moderate scores on both components. By examining their interaction, we are able to test our hypotheses more precisely by isolating the combinatory levels of affect and value. Specifically, that the best performance and the most optimal use of self-regulatory resources will result when both components of interest are high as suggested by the unitary construct. This method of analysis is also important because people vary with respect to how they affectively experience goals and the personal significance they ascribe to them (Eccles & Wigfield, 2002).

Study 1 was designed to first test the hypothesis that simultaneously high levels of affect- and value-related interest would result in the relatively best performance and employed an experimental manipulation of value-related interest and self-reports of affect-related interest. Study 2 was designed to replicate and extend the results of the first study by additionally assessing post-task self-regulatory resources. Participants provided self-reports of affect- and value-related interest.

Study 1

Method

Participants

One hundred fifty-three undergraduates (95 females) from the psychology subject pool at a selective private university in the southeastern United States participated in the study in exchange for credit toward their course requirement. Six participants did not properly follow instructions on the experimental task and were consequently omitted from all analyses. The final sample included 147 participants (91 female) with a mean age of 19.39 ($SD = 1.17$). No statistically significant gender differences were observed on any of the variables assessed and will not be discussed further.

Procedure

Upon arrival, participants were seated at one of three computer stations, facing different walls of the laboratory. The entire experimental session was computer-administrated. After providing informed consent, participants began working on the main experimental task, Word Prospector, which was adapted from Burson, Larrick, and Klayman (2006). For this task, participants were required to create as many 4-, 5-, and 6-letter words from a 10-letter word presented to them. For example, given the word TYPEWRITER, possible correct responses include "type," "write," and "pewter." Participants first read the task instructions and reviewed a worked example. Before completing any problems, but after reading the instructions, their affect-related interest in the task was assessed, and then they were presented with the experimental manipulation. Those in the neutral importance condition (control) read the following statement: "The problems you will be working on have not been shown to be diagnostic of intellectual ability (Watson & Rogers, 2001);" those in the high importance condition read: "The problems you will be working on have shown to be diagnostic of intellectual ability (Watson & Rogers, 2001)." Given that participants were students at a highly competitive and selective university where intelligence is highly valued and internalized, highlighting its potential diagnosticity was expected to make the task personally significant and

increase its attainment value, both core attributes of value-related interest. Importantly, however, participants were never told that their intellectual ability would actually be assessed. Thus, it was not expected that the manipulation would invoke worries about evaluation.

Subsequently, five problems (PETROGLYPH, GORGANZOLA, GARGANTUAN, CUMMERBUND, TROGLODYTE) were presented sequentially to participants, and they entered all of their responses in a textbox. Participants were permitted to work on each item for as long as they wished and could advance to the next item at any time. After completing the final item, participants responded to assessments of perceived task importance (manipulation check), chronic achievement motivation, achievement goals, and demographics, and were then debriefed. Achievement goals were assessed in order to ensure that the manipulation invoked interest-related value without invoking performance goal orientations (or ego involvement).

Measures

A series of surveys and assessments served as the independent variable, manipulation check, covariates, and dependent variables.

Affect-related interest. Affect-related interest for the Word Prospector task was assessed using five items adapted from the Individual Interest Scale (Linnenbrink-Garcia et al., 2010). Participants responded to questions such as “I really enjoy working on problems like this,” and “Problems like this are exciting to me,” on a 6-point Likert scale anchored at 1 (*strongly disagree*) to 6 (*strongly agree*) ($\alpha = .97$).

Task importance. The importance of the Word Prospector task was assessed by asking, “To what extent do you think solving problems like this is a valuable skill?” Participants responded on a 7-point scale anchored at 1 (*Not valuable*) and 7 (*Very valuable*). This measure served as the manipulation check for the importance manipulation.

Achievement goals. An adapted version of the Achievement Goal Questionnaire (Cury, Elliot, Da Fonseca, & Moller, 2006) was used to assess achievement goals. The assessment included the performance-approach ($\alpha = .90$; e.g., “I wanted to do well compared to others”) and performance-avoidance ($\alpha = .89$; e.g., “I wanted to avoid performing poorly compared to others”) scales, as those scales were the only ones relevant to ego involvement. Participants responded to all items on a 7-point scale anchored at 1 (*strongly disagree*) and 7 (*strongly agree*).

Chronic achievement motivation. The Jackson Personality Research Form (PRF, Jackson, 1974) was used to assess participants' motive to achieve, which was included as a covariate to control for chronic achievement motivation ($\alpha = .70$). Participants responded “true” or “false” to 16 statements, indicating the extent to which it reflected their self-perceptions. Sample items include “People should be more involved with their work,” and “I often set goals that are difficult to reach.”

Demographics. Participants reported age, year in college, grade point average (GPA), number of credits taken in current semester, gender, and ethnicity.

Task persistence. The total time (in seconds) participants spent working on all five experimental Word Prospector items was calculated ($M = 672.43$, $SD = 305.10$) and used as a covariate. Controlling for persistence afforded an analysis of participants' efficiency, such that their performance could not be explained simply by the amount of time they spent on the task.

Task performance. The number of correctly spelled English words generated for the five Word Prospector items was used to measure the dependent variable of task performance ($M = 25.10$, $SD = 12.50$).

Results

Manipulation check

To ensure that the importance manipulation had the desired effect, responses to the task importance item were compared between conditions. Results demonstrated that those in the no importance condition rated the Word Prospector task to be less valuable ($M = 3.76$, $SD = 1.39$) than those in the importance condition ($M = 4.29$, $SD = 1.23$), $t(145) = -2.45$, $p = .02$, $d = .40$. Therefore, the manipulation was successful in creating conditions that were perceived as relatively less and more important.

That said, it is possible that the importance condition may have raised concerns about normative performance and thus influenced participants' performance goal orientations. To test whether the experimental manipulation affected participants' ego involvement during the experimental trials, t-tests were conducted to assess differences in performance goal orientations between the experimental conditions. As expected, no statistically significant differences were observed for performance-approach ($t(145) = -.38$, $p = .70$) and performance-avoidance goals ($t(145) = -.58$, $p = .56$). Furthermore, participants' performance-approach ($r(147) = .12$, $p = .15$) and performance-avoidance ($r(147) = .10$, $p = .24$) goal orientations were not related to their performance on the task, suggesting that the adoption of performance goals was not influenced by their perceived competence on the task. Therefore, there is no evidence that the experimental manipulation invoked ego involvement.

Performance

To test our prediction that a task perceived to be personally significant and highly affectively interesting leads to relatively superior task performance, two multiple regression analyses were conducted, the first without covariates and a second with covariates. In the first model, performance scores were regressed onto affect-related interest, importance condition (coded as -1 for neutral importance and 1 for important), and their interaction. The analysis yielded a main effect for affect-related interest ($\beta = .47$, $t(143) = 6.24$, $p < .001$) suggesting that higher levels of affect related interest were related to better task performance. The predicted interaction was also found ($\beta = .17$, $t(143) = 2.30$, $p = .02$).

In the second model, covariates were included. Performance scores were regressed onto affect-related interest, importance condition, and their interaction, controlling for total time spent on the task (persistence),² chronic achievement motivation, and GPA (an indicator of baseline ability), as well as each covariates' interaction with the importance variable. Including interactions of each covariate with the manipulated independent variable allows the interaction of the two independent variables to be estimated without bias (Yzerbyt, Muller, & Judd, 2004). The analysis yielded main effects for affect-related interest ($\beta = .39$, $t(137) = 5.86$, $p < .001$), persistence ($\beta = .45$, $t(137) = 6.76$, $p < .001$), and GPA ($\beta = .15$, $t(137) = 2.17$, $p = .03$), suggesting that increases in these variables were related to better performance. A main effect was also found for chronic achievement motivation ($\beta = -.15$, $t(137) = 2.25$, $p = .03$), such that lower levels were associated with better performance. The analysis also yielded the predicted affect-related interest by importance interaction ($\beta = .15$, $t(137) = 2.21$, $p = .03$), which showed the same magnitude and pattern observed in the model without covariates (see Fig. 1). Simple slope analyses revealed that participants performed better in the importance (as compared to neutral importance) condition when affect-related interest

² An analysis of persistence was also conducted. Regressing persistence times onto affect-related interest, importance condition, and their interaction resulted in a null effect for the interaction ($\beta = .11$, $t(143) = 1.35$, $p = .18$). The only significant effect was for affect-related interest ($\beta = .22$, $t(143) = 2.63$, $p = .01$), which suggested that higher affect-related interest scores were associated with longer persistence. That said, the model was marginally significant ($F(143) = 2.51$, $p = .06$), so individual effects should be interpreted with caution.

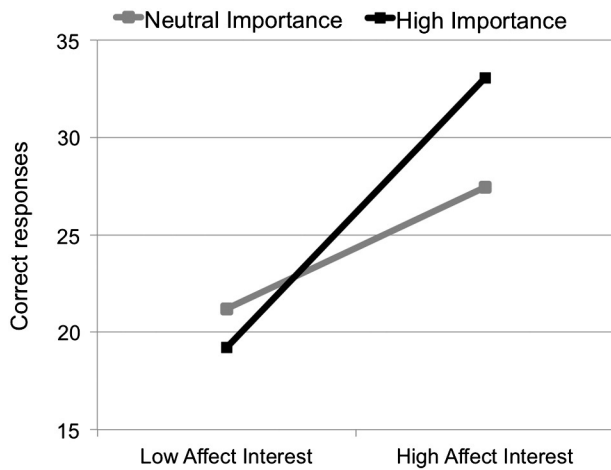


Fig. 1. Performance on the main experimental task in Study 1 as predicted by the interaction of affect-related interest and manipulated task importance. Low affect-related interest is represented at 1 *SD* below the mean, whereas high affect-related interest is represented at 1 *SD* above the mean. The analysis controlled for total time spent on the task, chronic achievement motivation, and GPA, as well as each covariate's interaction with the condition variable.

was high (+1 *SD*; $p = .02$). When affect-related interest was low (−1 *SD*), however, there was no difference in performance between the two conditions ($p = .39$). The region of significance for affect-related interest was outside of the $-5.20-0.43$ (*SD*) range. This pattern of results suggests that those in the importance condition evinced relatively higher performance when they were also highly affectively interested in the task as compared to those in the neutral importance condition.

Discussion

The results for Study 1 are in keeping with our first prediction, such that performance was relatively optimized for those high in affect-related interest when the task was framed as personally significant. Interestingly, when the analysis controlled for time spent on the experimental task, results suggested that the effect was not driven by persistence. In other words, participants who were high in affect-related interest and perceived the task to be high in value-related interest did not perform well because they were motivated to work on it longer. Instead, they evinced superior performance independent of their persistence, suggesting that the high affect-related interest and task importance may also result in relatively more efficient engagement. The analysis also demonstrated that neither chronic achievement motivation nor baseline ability drove the effects. The purpose of Study 2 was to extend this finding by examining the possibility that, in addition to producing relatively superior performance, the combination of high affect- and value-related interest also optimizes the use of self-regulatory resources.

Study 2

The second study was designed to extend the first in several important ways. First, value-related interest was measured rather than manipulated. It was assessed via a self-report that queried students directly about the personal significance of doing well on the task. This was done, in part, to ensure that our manipulation in Study 1 was consistent with self-reported value-related interest. Second, the task was changed to a set of anagrams in order to examine whether the previous results would extend to a different task. Third, positive affect was assessed so that it could be used as a covariate in the analyses. Prior research has demonstrated the replenishing effects of positive affect (Thoman et al., 2011; Tice et al., 2007); however, our intention was to demonstrate that our predicted effects for interest were unique and

independent of positive affect. Finally, and most central to the present study, self-regulatory resources were assessed after the main experimental task. As in Study 1, it was predicted that performance would be optimized when affect- and value-related interest were both high. It was also predicted that self-regulatory resources would be optimized under the same conditions.

Furthermore, perceived competence was assessed and used as a covariate in place of GPA as an indicator of baseline ability. Six participants did not provide their GPA, making it a significant source of missing data. By employing perceived competence, we were able to retain these six participants in the performance analysis.

Method

Participants

Eighty-eight undergraduates from the psychology subject pool of a selective private university in the southeastern United States participated in return for credit toward their course requirement. One participant arrived for the study early and learned of the experimenters' deception. Consequently, this participant was eliminated from all analyses. The remaining 87 participants (51 female) had a mean age of 19.06 ($SD = 1.09$).

Procedure

Each participant completed the session individually. To begin, participants completed a computer-administrated measure of positive and negative affect and were told to inform the experimenter when they were done. When the experimenter was retrieved, she explained that the study materials had been misplaced and instructed participants to work on a set of 25 anagrams for an unrelated pilot study. Before working on the items, but after reading the instructions and seeing a worked example, they reported their affect- and value-related interest for the task, as well as their task-relevant perceived competence. The anagram set was, in fact, the dependent measure (task performance) for the study. It was necessary to use this deception in order to ensure that participants' engagement in the anagrams was driven by their affect- and value-related interest rather than its perceived challenge or diagnosticity of ability. Thus, participants were led to believe that the anagrams were not part of the experiment. For this task, participants were instructed to unscramble each letter string into a real English word using all of the letters provided (e.g., TOOPH can be unscrambled to form the word "photo"). The experimenter further explained that she would return when she located the experimental materials. She then exited the lab and waited in an adjacent room with a one-way mirror that looked into the room where the participant was working. The participant then worked on the anagrams while the experimenter covertly observed from the adjacent room. This observation was done simply to ensure that participants worked on the task in case they thought it was optional. The experimenter returned after 5 min, claiming that she had found the necessary materials and collected the anagram sheet. All participants worked on the anagram set for the full 5 min. Then, participants squeezed a handgrip for as long as they were able as a measure of self-regulatory depletion while the experimenter timed them with a stopwatch. Subsequently, the participant was instructed to return to the computer and complete an assessment of chronic achievement motivation and general demographics. Afterward, they were debriefed and excused.

Measures

Affect-related interest and chronic achievement motivation were assessed in the same manner as described in Study 1; however, the items for affect-related interest were modified slightly to refer specifically to the anagram task (e.g., "I really enjoy working on anagrams," and "Anagrams are really exciting to me"). Reliabilities for the affect-related interest ($\alpha = .95$) and chronic achievement motivation ($\alpha =$

.69) scales were good. Several additional measures were added for Study 2, which are described below.

Affect. Baseline positive affect was assessed using the PANAS (Watson, Clark, & Tellegen, 1988). Participants were presented with ten positively valenced emotion words (e.g., alert, enthusiastic, proud; $\alpha = .85$) and ten negatively valenced emotion words (e.g., irritable, upset, distressed; $\alpha = .88$), and were asked to report the extent to which they were currently experiencing each emotion on a 5-point scale, anchored at 1 (*very slightly or not at all*) to 5 (*extremely*). Only the positive affect scale was utilized as a covariate.

Perceived competence. Perceived competence was assessed with a single item asking “How good do you think you are at solving anagrams?” on a 5-point scale anchored at 1 (*not at all good*) and 5 (*very good*).

Value-related interest. Participants responded to the question, “How important do you think it is to perform well on anagram tasks like this?” on a 5-point scale anchored at 1 (*not at all*) and 5 (*very much*). The mean was 2.80 ($SD = .83$). This question was created to capture attainment value, but also personal significance given its relevance to our high-achieving university sample.

Anagram task performance. The sum of correct responses was used as an indicator of task performance. Participants were asked to provide only one possible response for each item, thus the possible range of performance was from 0 to 25 ($M = 8.78$, $SD = 4.31$).

Self-regulatory depletion. Participants squeezed a spring-loaded hand-grip – the type used for exercise – for as long as they were able, which was timed by the experimenter with a stopwatch. A wad of paper was placed between the handles at the start time so that the experimenter would know to stop timing when the paper dropped. This method has been used successfully as a measure of self-regulatory depletion in numerous studies (e.g., Hong & Lee, 2008; Muraven et al., 1998; Tice et al., 2007). Longer grip times are associated with less depletion, as it takes self-regulatory resources to override the impulse to release one's grip.

Results

Several multiple regression analyses were conducted. The first set examined the interactive influence of affect- and value-related interest on task performance, and the second set examined its influence on self-regulatory depletion. For each set, results are presented for models without and with covariates. The independent variables, affect- and value-related interest, had a small, positive correlation ($r(87) = .29$, $p < .01$).

Performance

Task performance was calculated by summing the total number of correct responses on the anagram scores for each participant ($M = 9.36$, $SD = 4.95$). To assess the prediction that high affect- and value-related interest would result in relatively optimal performance, the anagram scores were regressed onto affect-related interest, value-related interest, and their interaction. The model was marginally significant ($F(83) = 2.37$, $p = .076$), so individual effects should be interpreted with caution; however, the interaction was statistically significant ($\beta = .22$, $t(83) = 2.05$, $p = .04$).

In a second analysis, chronic achievement motivation, perceived competence, and positive affect were added as covariates in the regression analysis. The model was significant ($F(80) = 2.88$, $p = .01$) and the analysis yielded a main effect for perceived competence ($\beta = .38$, $t(80) = 3.01$, $p = .003$), such that the better participants expected to perform on the anagram task, the higher their scores were. The analysis also resulted in the predicted interaction between affect- and value-

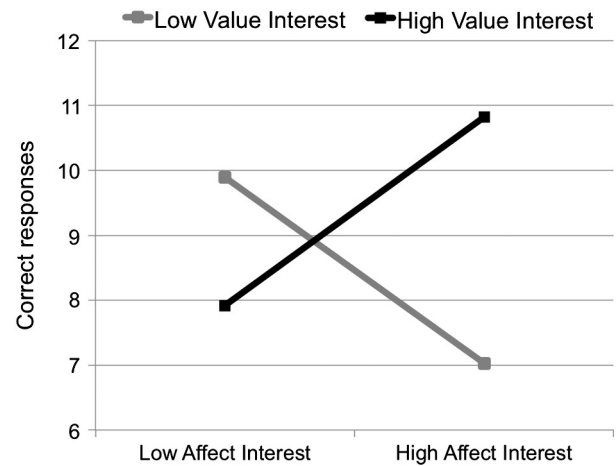


Fig. 2. Performance on the main experimental task in Study 2 as predicted by the interaction of affect- and value-related interest. Low affect- and value-related interest are represented at 1 SD below their means, whereas high affect- and value-related interest are represented at 1 SD above their means. The analysis controlled for chronic achievement motivation, perceived competence, and positive affect.

related interest ($\beta = .27$, $t(80) = 2.54$, $p = .01$; see Fig. 2). Simple slope analyses revealed that participants who perceived the task to be highly valuable (+1 SD) performed better when affect-related interest was high (+1 SD) than when they perceived it to be of little importance (−1 SD; $p = .02$). There was no difference in performance, however, for those high vs. low in value-related interest when affect-related interest was low (−1 SD; $p = .25$). The region of significance was outside of the −2.49–0.55 (SD) range.

Self-regulatory resources

Self-regulatory resources were operationalized as participants' grip times. There were inaccuracies in recording grip times for five participants (the wad of paper was accidentally held in place by the participants' fingers, rather than being clamped in place by the grip handles), and they were consequently omitted from the analyses. The data were transformed by taking the natural log in order to normalize the positively skewed distribution.

To test our second prediction regarding self-regulatory resources, two multiple regression models were tested: one without covariates and one with covariates. In the first model, transformed grip times ($M = 3.89$, $SD = .88$) were regressed onto affect-related interest, value-related interest, and their interaction, which yielded a nonsignificant model ($F(77) = .28$, $p = .84$). This null result was expected, chiefly because gender was predicted to account for a large portion of the variance of grip times—a variable included in the following model with covariates.

In the next analysis, transformed grip times were regressed onto affect-related interest, value-related interest, and their interaction, controlling for chronic achievement motivation, positive affect, anagram performance, and gender. The model was significant ($F(73) = 7.72$, $p < .001$) and yielded main effects for affect-related interest ($\beta = .26$, $t(73) = 2.49$, $p = .02$) and chronic achievement motivation ($\beta = .26$, $t(73) = 2.62$, $p = .01$), suggesting that higher levels of each variable were associated with greater levels of self-regulatory resources. Another significant main effect for gender ($\beta = .61$, $t(73) = 6.37$, $p < .001$) suggested that males evinced longer grip times than females. Finally, the analysis yielded the predicted interaction between affect- and value-related interest ($\beta = .22$, $t(73) = 2.28$, $p = .03$; see Fig. 3). Simple slope analyses revealed that when affect-related interest was high (+1 SD), those who perceived the task as highly valuable (+1 SD) had marginally significantly longer grip times than when they perceived it to be of little value (−1 SD; $p = .08$). There was no difference in performance, however, for those high vs. low in value-related interest when

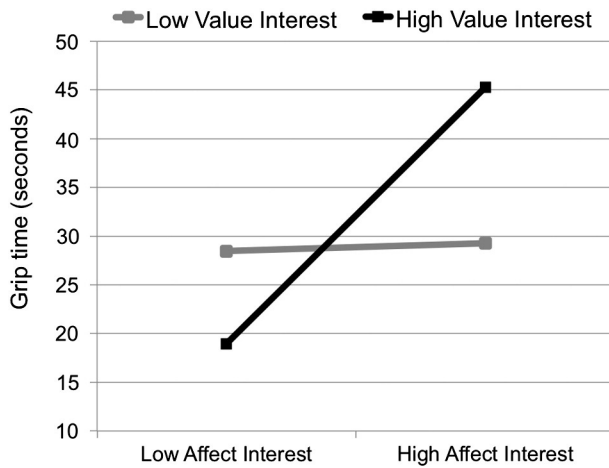


Fig. 3. Grip time as a function of the interaction between affect-related interest ($-/+1$ SD) and value-related interest ($-/+1$ SD), controlling for chronic achievement motivation, positive affect, anagram performance, and gender. Transformed grip times were reverted to their original values for ease of interpretation.

affect-related interest was low (-1 SD; $p = .15$). The region of significance was outside of the -2.41 – 1.37 (SD) range.

Discussion

As expected, high levels of affect- and value-related interest were associated with the optimization of both performance and self-regulatory resources. For anagram performance, higher levels of affect-related interest were associated with better performance when the task was also high in value-related interest. Because the time spent on the task was held constant at 5 min, the finding was not due to highly interested participants persisting longer on the task. As in Study 1, it suggests that participants high on both measures were more efficient while working on the task. The effect was observed even when controlling for participants' chronic achievement motivation, perceived competence, anagram performance, and positive affect. Furthermore, the deception used in the study – that the anagram task was for an unrelated pilot study – was designed to minimize participants' perception of the anagram task as an evaluative challenge, as to not augment their motivation, allowing their interest in the anagram task to guide their engagement.

The pattern of the interaction was slightly different than it was in Study 1, which is likely due to the fact that value-related interest was measured rather than manipulated. In Study 1, the task was framed to be either important or neutral. In Study 2, participants reported their value-related interest on a full spectrum, from not at all important to very important. Therefore, we were able to examine the interaction when participants found the task unimportant, and the interaction pattern likely reflects this difference. When value-related interest was high, the same pattern was observed as in Study 1. In Study 2, however, a downward trend was observed for affect-related interest when value-related interest was low (as opposed to neutral).

As in Study 1, high levels of affect-related interest were associated with relatively poorer performance when the task was viewed as less valuable. This may have occurred because interest is associated with intellectual exploration and curiosity, which may lead to engagement that is more exploratory in nature. When engaging in tasks with low value-related interest but are affectively interesting, people may be more inclined to focus on improving strategies and refining skills rather than obtaining a high score. This replication is also noteworthy because it suggests that our method of manipulating task importance in Study 1 had a similar effect as measuring value-related interest in the present study.

In line with our predictions, the presence of both high affect- and value-related interest was also associated with relatively more self-regulatory resources available for the subsequent handgrip task as compared to when value-related interest was low. The analysis controlled for chronic achievement motivation, suggesting that it was unlikely the effect occurred simply because people who were motivated by the challenge of one task (e.g., anagrams) were also motivated by the challenge of another (e.g., squeezing a handgrip for as long as possible). The analysis also controlled for positive affect, suggesting that self-regulatory resources were not being optimized due to positive affect. Furthermore, the interaction was not driven by participants' anagram performance, an indicator of effort. Indeed, it may be that interesting tasks are not experienced as effortful (Lipstein & Renninger, 2007; Renninger & Hidi, 2002). Moreover, the two interactions between affect- and value-related interest demonstrated that performance can be optimized, while also optimizing self-regulatory resources. That is, participants high in both facets of interest had the highest relative levels of task performance on the anagrams and held the handgrip the longest, suggesting that their performance on the anagram task also optimized their use of self-regulatory resources leaving additional resources available for the handgrip task.

General discussion

The present research was designed to examine one possible function of individual interest; that it allows people to perform at optimal levels while also maintaining self-regulatory resources vital to effective engagement. These two qualities have largely been considered inversely related, such that high levels of effort (that which requires self-control) deplete the self-regulatory resources needed for optimal goal pursuit (Muraven, 2012; Muraven & Baumeister, 2000). Across two studies, however, our results demonstrated that the most optimal performance and use of self-regulatory resources were associated specifically with high levels of affect- and value-related interest.

Our results underscore the importance of interest as a motivational variable that not only guides goal-related behaviors, but also aids in their management. Many goals require high levels of effort, focus, and persistence, all of which can draw upon self-regulatory resources (Muraven, 2012). People must regulate their behaviors, however, to ensure they have the resources needed to bring about their desired outcomes (Muraven et al., 2006; Shah & Kruglanski, 2008). For example, there are self-regulatory costs associated with initiating (Brandstätter, Lengfelder, & Gollwitzer, 2001) and sustaining (Burkley, 2008; Muraven et al., 1998, 2006) goal engagement, as well as avoiding tempting alternative goals (Baumeister et al., 1998). Our results, however, suggest that these costs may be offset or buffered against if one has a strong affective interest in the goal being pursued and if it is personally significant.

The present work also offers a more nuanced approach to examining individual interest. Past research has typically not examined the individual contributions of the multiple facets of interest. In the present work, we focused on the facets relating to affect and value. As suggested by Eccles and Wigfield (2002), we demonstrated that people vary with regard to their levels of affect- and value-related interest in particular tasks. These are not the only facets of interest, however. Stored knowledge, for example, is another important quality of individual interest (Hidi & Renninger, 2006). As people begin to develop an interest for particular content, events, or activities, they also begin to store relevant knowledge. This stored knowledge increases across the development of interest as the content area becomes more personally significant. Therefore, the amount of stored knowledge about a topic may also be an important moderator to examine in interest's role in optimizing performance and self-regulatory resources.

The present work also suggests that the characterization of individual interest as a positive emotion may be oversimplified (cf. Turner & Silvia, 2006). Positive emotions tend to have a "broaden and build"

effect (Fredrickson, 1998, 2001), such that they tend to expand momentary thought-action repertoires and contribute to physical and intellectual resources. This may have been the case for participants who were high in affect-related interest, but low in value-related interest (Study 2). Their low performance suggests that they may have been in an exploratory mode, such that they were enjoying the process of solving the anagram problems or trying to figure out new strategies, and that this was more important than performing well. But when value-related interest was also high, participants appear to have narrowed their focus, evidenced by their superior performance—similar to Csikszentmihalyi's (1990) assertion that flow involves full immersion and a loss of awareness beyond the activity itself. This result is interesting because it suggests that, depending on how affectively stimulating and personally significant the task is, interest may result in two very different modes of engagement.

Thus, our results also complement and extend research on flow (Csikszentmihalyi, 1990), a form of interest (Fredrickson, 1998). Csikszentmihalyi (1990) suggests that flow is a cognitive state during which people are single-mindedly immersed in an activity and experience a heightened and energized focus. During this flow state, people evince extremely high levels of concentration while engaged in a challenging activity at the edge of their ability, yet experience their actions as being effortless (Csikszentmihalyi, 1990; Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005). Again, this appears to contradict much of what is understood about the relation between high levels of effort and persistence, and self-regulatory resources. The present research offers a possible mechanism, such that flow may be the result of high levels of affect- and value-related interest, and, in turn, optimizes self-regulatory resources.

But what is happening to these resources? The present work shows a pattern of relative differences in self-regulatory resources as a function of various levels of affect- and value-related interest, but we do not yet have an understanding of how interest influences these resources. Do interest and flow states simply not require self-regulatory resources? This conclusion is plausible considering that these states appear to not require self-control. Or could these states increase resources? Hong and Lee (2008) found that when one's motivational orientation matches the framing of a goal – as in the case of regulatory fit (Higgins, 2008) – self-regulatory resources increase above baseline, suggesting that they are not just replenished, but strengthened. Considering that regulatory fit can also increase interest in activities (Higgins, Cesario, Hagiwara, Spiegel, & Pittman, 2010), it is certainly possible that engaging in goals that are personally interesting may increase resources. It is also possible that interest requires some resources, but in minimal quantities. Or it may require resources, but replenishes them simultaneously. Future research will need to clarify this issue.

Future research should also rule out an alternative explanation for our results. It is possible that those who reported high interest in the anagram task were also highly interested in the handgrip task. This could have been caused by a disposition to be interested in various activities or perhaps an interest in psychology experiments. In such a case, one's interest in the handgrip task could have influenced their performance on it. One way to rule out this possibility is to counterbalance the anagram and handgrip tasks. If all other elements of the procedure employed in Study 2 remained the same, it would be expected that performance on the handgrip task would be observed only after engagement in the anagram task.

Our research also compliments and extends extant research on intrinsic motivation. For example, Self-Determination Theory (SDT; Ryan & Deci, 2000) posits a developmental continuum from externally regulated behavior to more internally regulated behavior (e.g., doing a task because it is aligned with one's own values rather than for money). When reasons for behaviors are more internalized, they are experienced as being more self-determined, yet still distinct from intrinsic motivation (e.g., doing a task for its own sake). Along this continuum, behavior becomes internally regulated (identified) when the reasons

for engagement become personally significant and more aligned with one's own values and needs. In this way, identified regulation is based on value/importance and can be thought of as distinct from intrinsic motivation, which is based on the inherent enjoyment of the task itself. In other words, according to SDT, personal significance and enjoyment are aspects of two separate autonomous forms of regulation: identified and intrinsic motivation, respectively. This suggests that identified regulation (based on personal significance or value) and intrinsic motivation (based on inherent enjoyment of the task) are two distinct forms of regulation that do not necessarily cross (e.g., Burton, Lydon, D'Alessandro, & Koestner, 2006). Our research, however, suggests that people can experience engagement at various levels of value and enjoyment, and that these varying levels interact to result in different outcomes for performance and self-regulatory depletion. Thus, we provide evidence that both identified and intrinsic forms of motivation may be key for enhancing performance while also keeping self-regulatory resources intact.

Conclusion

Many of life's most important goals are long and arduous. Earning a college degree or a coveted promotion at work, for instance, are valuable goals to which many people aspire. They are not accomplished easily, however. They require countless hours of concentration and diligence that can become overwhelmingly taxing. Unfortunately, many people abandon their goals for this reason. The present work, however, suggests that if people experience these goals as both exciting and personally significant, their chance of success increases. The pursuit of personally interesting goals not only improves performance, but also creates an energized experience that allows people to persist when persisting would otherwise be too depleting. Our work also suggests that educators, employers, and parents, among others, should take the task of cultivating both affect- and value-related interest in their students, employees, and children in earnest. Interest is integral to the pursuit of many of life's most personally rewarding goals.

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