Effects of Self-Efficacy and Distractors on Complex Cognitive Task Performance

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Abstract

This study explored the interaction between self-efficacy and distractor conditions in a cognitively demanding decoding task, addressing gaps in understanding how internal beliefs influence task performance under external challenges. Using a 3x3 mixed factorial design, the study examined whether high self-efficacy mitigates the impact of absent, non-focal, and focal distractors on task performance. Participants completed decoding tasks under these conditions, while self-efficacy was assessed as a between-subjects factor. Results revealed a significant main effect of the distractor condition, with task performance higher in the non-focal condition than in the control. However, the anticipated decline in the focal condition did not occur. No significant main effect of self-efficacy or interaction between self-efficacy and distractor conditions was found, indicating self-efficacy did not buffer against distractor impacts. These findings suggest further exploration of individual differences and distraction types in cognitive performance.

Keywords: self-efficacy, distractors, complex mental tasks, focus

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Tomorrow, you take the exam you've been dreading and struggled to retain any material for. The next four hours are all you have to study before bedtime. Unfortunately, your roommate has also chosen tonight to finally learn how to play the drums, and his clear inability to keep a simple beat threatens to derail your focus. In moments like these, will you believe in your ability to stay focused? Will your roommate's eighteenth attempt to play that Def Leppard song be his last? Or will the distractions be too much to overcome? While this scenario is a bit hyperbolic, at its foundation lay the reality that many people struggle with—how to stay focused and undistracted with today's short digital attention spans.

The challenge of maintaining focus amidst distractions is not just a personal struggle but also a significant area of study in understanding human attention and performance. While previous research has explored the effects of distractions on cognitive performance or any singular variation of these topics (Lavie, 2005; Rosenberg et al., 2013; Singer et al., 1991; Rae & Perfect, 2014; Merz et al., 2019), the interaction between self-efficacy and distraction remains underexplored. Understanding individual confidence in task performance and how it can influence one's ability to manage distractions could fill this critical gap in cognitive psychology and applied settings. In exploring how individuals navigate distractions and if internal factors, like self-efficacy, can mitigate those distractions, then this research holds potential for practical applications across various domains.

Categories like education, learning, and the workplace seem most fitting when considering applicability. Specifically, classroom design could implement layouts and teaching methods that account for different levels of distractibility and self-efficacy, leading to a more inclusive learning environment (Paas et al., 2010). Training programs that incorporate self-efficacy-boosting techniques could help employees manage distractions, stay focused, and improve overall productivity (Wu, 2016). In terms of health, they could integrate self-efficacy training into Cognitive Behavioral Therapy (CBT) programs to help clients better manage distracting thoughts and improve focus. Finally, in the sports category of performance coaching and sports training, findings could be applied to improve methods for teaching complex skills where maintaining focus and managing cognitive load are crucial.

In skill acquisition, insights could help optimize environments for learning new skills by managing cognitive load and enhancing confidence. Insights could be used to train first responders to maintain focus in high-stress environments. For productivity tools, the findings could lead to the development of personal apps or tools that help users manage distractions and stay focused on tasks (Sweller & Chandler, 1991). Some of these possibilities might seem like a stretch, but logically, none of them are impossible.

Task Performance

Task performance is the execution and completion of a specific task, often assessed by evaluating the quality, speed, and accuracy of the outcomes. It encompasses the behaviors and actions directly related to achieving a task's objectives (Riggs & Knight, 1994). Task performance provides a measurable foundation for assessing how participants handle complex tasks under varied conditions for this study. As the dependent variable, it offers insight into individual effectiveness in navigating cognitive tasks while dealing with external challenges. Fluctuations in performance are anticipated to drive these changing conditions.

Rae and Perfect (2014) suggest that accuracy is a proportion of the correct responses against the total number of responses. It distinctly measures participants' focus and precision in task performance. By evaluating accuracy, insight is gained into how effectively individuals complete tasks. However, this alone will not be enough to determine task performance; Speed will also need to be measured. Response time, or the pace at which individuals complete cognitive tasks, is a key factor in determining cognitive performance (Salthouse, 1996). It should reveal variations in task performance, with anticipated changes in speed depending on the complexity of conditions. This study expects response times to reflect participants' ability to maintain focus and responsiveness, offering insight into how different factors might impact processing speed during the task.

Cognitive load is the measure of mental energy being exerted in working memory at any given time and is influenced by the complexity of the information or tasks and how they are presented (Paas et al., 2010). This idea is part of a bigger theory that should help us measure the cognitive data being mentally manipulated. Cognitive load theory (CLT) proposes that learning can be hindered when working memory is burdened with unnecessary cognitive tasks. It seeks to alleviate this burden by organizing information to enhance cognitive efficiency (Sweller & Chandler, 1991). Ultimately, it provides a framework for understanding how mental demands impact task performance, specifically how increased cognitive load can hinder accuracy and response time. A possible complement to high cognitive load may come from asserting confidence.

Self-Efficacy

Self-efficacy (SE) is a person's belief in their ability to control motivation, behavior, and social environment. It influences thoughts, feelings, and actions, determining the likelihood of initiating a behavior, the effort put forth, and persistence when facing challenges (Bandura, 1977). Self-efficacy theory (SET) outlines four primary sources that shape SE beliefs: personal achievements, where past successes build confidence in similar tasks; vicarious experiences, where observing others' successes boosts belief in one's capabilities; verbal encouragement, where supportive feedback enhances confidence; and physiological states, where bodily responses like stress or calmness affect self-belief (Bandura, 1977). Confidence is at the core of SE, but it is distinct.

Confidence reflects the strength of one's belief in one's capability to perform specific actions to achieve desired results. This self-belief directly influences the ability to engage with and persist in complex tasks, particularly under conditions that challenge focus or accuracy (Bandura, 1977). Higher confidence, linked to SE, may enable individuals to maintain improved task performance by reducing the cognitive load associated with uncertainty or self-doubt. By examining confidence, it can be assessed whether belief in one's abilities is a buffer against a decline in performance.

Motivation refers to cognitive processes that activate and sustain behavior based on future outcomes. It is affected by cognitive representations of potential rewards or consequences, personal standards, and goals (Bandura, 1977). When participants are motivated, they are more likely to engage fully, overcome distractions, and maintain focus, even under demanding conditions. Which naturally lends to persistence due to SE. A lack of participant persistence could suggest that the research design is too difficult and needs to be rethought.

Distractors and Attention

Distractors are stimuli or events in the surroundings that divert attention from a primary task. These can be visual, auditory, or cognitive in nature and often compete with the target task for attentional resources (Rosenberg et al., 2013). Distractors disrupt task performance and can increase cognitive load, making allocating resources efficiently to the primary task harder.

Understanding the types and effects of distractors is crucial for designing strategies to manage their impact.

Attention is the cognitive process of selectively concentrating on specific information while ignoring other perceivable stimuli. Its operation varies under different levels of cognitive load, balanced between filtering out irrelevant information and focusing on task-relevant stimuli (Lavie, 2005). Effective attentional control can help sustain accuracy and optimize response times, particularly when performance is challenged. By considering attention—albeit indirectly—the study explores how shifts in attentional focus (potentially bolstered by SE) may influence participants' ability to complete complex tasks, which aligns with our expectations for resilience in task performance. Attention helps prioritize relevant information, enabling the mental processes to retain and manipulate task-critical details (Eysenck et al., 2007).

Working memory (WM)—also known as short-term memory—is a cognitive system with a clear deficit in capacity whose main functions are to temporarily hold and process information. It is crucial for reasoning, learning, comprehension, and other complex cognitive activities (Ricker & Cowan, 2014). This system is much more than short-term memory; it's part of a bigger model with various properties. The working memory model (WMM) provides a framework for understanding how cognitive processes handle temporary storage and manipulation of information during complex tasks. Central to this theory is the idea that working memory has limited capacity, typically constrained to holding around 4±1 items, and is susceptible to interference and decay (Ricker & Cowan, 2014). Their numbers give a rough estimate and a threshold for how many memory tasks could be employed by this study without too much loss**.** Currently, there are two major camps for forgetting regarding working memory; it is either driven by time or heightened interference (Ricker & Cowan, 2014). With the right amount of both elements, perhaps attention and focus could also be tested this way.

Current Study

The present study aims to explore the interaction between SE and distractor levels in a mentally demanding decoding task. It should fill a gap in the literature by investigating whether high SE can help mitigate the negative impact of distractions. The study also introduces novelty. By exploring whether higher SE enhances resistance to distractors with varying spatial relevance, the research should provide insights into how beliefs in one's capabilities interact with external interference to affect cognitive performance under different distraction conditions.

The study uses a mixed design that combines within-subjects and between-subjects approaches. Each participant will experience three distractor conditions (absent, non-focal, and focal) in a within-subjects design to observe how task performance changes under varying levels of distraction. SE, measured as a quasi-independent variable, will be treated as a between-subjects factor to explore whether high versus low SE influences performance across distraction conditions. Task performance, assessed by accuracy and response time, is the dependent variable. This design enables the study to weigh the main effects of distraction types with SE and their potential interactions.

Hypotheses

Hypothesis 1. It predicts that task performance will be highest in the no-distractor condition, lower in the presence of a non-focal distractor, and lowest when a focal distractor is present.

Hypothesis 2. It predicts that participants who self-rate with high self-efficacy will achieve higher task performance scores than those with low self-efficacy.

Hypothesis 3. It predicts that a significant interaction between self-efficacy and distractor conditions would emerge, such that participants with high self-efficacy will maintain relatively high task performance across distractor conditions. In contrast, participants with low self-efficacy will show a decrease in performance when distractors are present.

Method

Participants

The study involved students from a medium-sized, Midwestern university aged 18 to 33, including 60 females and 22 males, totaling 82 participants. 18-year-olds who were full-time students were included and treated as emancipated despite Nebraska's legal adult age being 19. Power from similar studies being referenced, it was calculated that a minimum of 40 participants were needed to ensure adequate sampling and avoid small sample bias.

Recruitment was conducted through the SONA system, where students voluntarily chose to participate after reading the study description. All participants who consented to the study (regardless of whether or not they completed it) received extra credit for courses where their professors allowed it. The study was classified as no-risk, and a researcher guided each participant through the process.

Exclusion Criteria

After collecting the data, three participants who did not complete the tasks were excluded, and another three who did not complete both surveys. No one was excluded for failing the proof-of-life question since participants were observed from start to finish.

Materials

Stimuli

The task was administered via Qualtrics, displaying a randomly selected decoding legend in the top left corner of the page (see Appendices A and B for the HTML, CSS, and JavaScript used to modify the presentation). The main task required participants to translate numbers into corresponding letters using this legend (see Figure 1 for depictions of these descriptions). Below the legend, participants encountered a grid of five columns, each containing a predetermined number that mapped to the legend. Beneath each number was an input box for participants to enter their translation responses. The complete task consisted of five rows, each containing five columns. The numbers were selected to ensure no number was repeated immediately across consecutive columns, maximizing cognitive load.

Distractor Focality

The distractors were incorporated into the legend itself. In the non-focal condition, distracting characters appeared to the right of the legend's target characters, displayed in bold and blinking in unison. In the focal condition, the distractors were placed between the legend's first three and last three characters. These focal distractors had slightly larger font sizes and blinked at different rates to create a higher level of distraction. This design manipulated the distractors' prominence and placement to evaluate their effect on task performance.

Scales

Self-Efficacy Scale. The Personal Efficacy Beliefs Scale was used to measure SE (Riggs & Knight, 1994). The scale's original framing was modified to focus on cognitive tasks and added one item, creating a five-item scale. Previous research demonstrated the scale's internal reliability with Cronbach's alpha values between .76 and .90 (Riggs & Knight, 1994), indicating consistency and good psychometric characteristics. The following is an example question, "I have confidence in my ability to execute cognitive tasks."

Distractibility Scale. To assess perceived distraction caused by the distractors, the NASA Task Load Index was modified for use (Gore, 2022). The modified scale focused on mental demands, temporal demands, performance, effort, and frustration to reflect aspects most relevant to distraction. Participants self-rated statements on a five-point Likert scale. The scale's internal reliability was calculated with Cronbach's alpha values between .80 and .90, confirming its usefulness. "The distractor made it difficult for me to concentrate on the task" is an example question. It also served as our manipulation check.

Task Performance

Participants mentally solved multiple number-to-letter translations repeatedly. Performance was measured by the time to complete all the task sets with a three-second penalty for incorrect responses.

Self-Efficacy. SE was assessed using the Modified Self-Efficacy scale in a survey participants completed before the task, which asked them to self-rate their confidence in executing the task despite the distractors.

Perceived Distraction. After the task, the modified NASA-TLX survey was used as a direct measure to determine how distracting participants found the distractors. It served as a manipulation check. All participants were required to provide feedback to ensure minimal loss of data.

Distractor Conditions. Distractors were presented at different locations. The focal distractor was centrally placed between the task elements in the legend. Non-focal distractors were placed on the right side of the legend. The distractor conditions were randomly presented to each participant to deal with effect order bias.

Procedures

When participants arrived, they were informed that the entire process would take no more than 20 minutes. The researcher read a standardized disclaimer to the participant. The consent form was displayed on the screen, providing a detailed version of this information. Participants indicated their consent by selecting "Yes" at the bottom of the form, which allowed them to proceed to the next section.

The initial section of the survey included a demographics questionnaire with basic and standard inputs (age, gender, ethnicity), followed by a brief explanation of the study's goals and an overview of the tasks. The researcher read additional details aloud and explained that there was an SE survey participants would need to complete on the following screen. If participants had no further questions, the researcher instructed them to click the "Next" button and left the room to let them focus on the tasks.

The Qualtrics platform randomized the presentation order of the three distractor conditions (Absent, Non-focal, Focal). Each level included a specific decoding legend and a corresponding set of numbers to translate (see Appendix C for a complete list of legends and numbers used). Participants completed one task (of five rows by five columns) per condition, each displayed on a separate page.

After finishing the tasks, participants completed a post-task survey to assess perceived distraction levels. When they submitted the survey, the debriefing screen instructed them to notify the researcher. The researcher returned to the room, read the debriefing information aloud, and concluded their participation.

Results

The research used a 3x3 mixed factorial design, including three levels of the within-subjects factor—distractor condition (control, non-focal, focal), and three levels of the between-subjects factor—self-efficacy (low, moderate, high). The design allowed analysis of the main effects of distraction and SE and their interaction.

Before running the main analysis, the study tested the normality assumptions, homogeneity of variance, and sphericity. The Shapiro-Wilk test indicated a significant deviation from normality in the Non-Focal Task Performance condition ($W(82) = 0.924$, $p < .001$). Despite this, ANOVA is generally robust to violations of normality, particularly with larger sample sizes ($n = 82$), so the results were interpreted accordingly. Levene's Test of Equality of Error Variances assessed the assumption of homogeneity of variances across task performance conditions. The assumption was met for the control ($F(2, 79) = 1.26$, $p = .290$) and non-focal distractor conditions ($F(2, 79) = 0.95$, $p =.392$). However, it was violated for the focal condition ($F(2, 79) = 3.83$, $p = .026$), indicating significant variance differences across groups. Mauchly's Test of Sphericity was conducted to assess the assumption of sphericity for the distractor condition. Results indicated that the assumption was violated ($W = 0.914$, $\chi^2(2) = 6.995$, $p = .030$). Consequently, the Greenhouse-Geisser correction ($\epsilon = 0.921$) was applied to adjust the degrees of freedom for subsequent analyses of within-subjects' effects.

Statistical analysis revealed significant differences in task performance across distractor conditions: control ($M = 76.71$, $SD = 2.58$), non-focal ($M = 87.60$, $SD = 3.48$), and focal ($M = 81.38$, $SD = 3.12$). The main effect of the distractor reached significance after applying the Greenhouse-Geisser correction ($F(2, 146) = 3.173$, $p = .049$, $\eta^2 = .039$). Pairwise comparisons also showed a significant difference between the control and non-focal conditions ($p = .042$). Still, no significant differences emerged between the focal condition and the other two ($p > .05$)(See Table 1 presenting the ANOVA summary for within-subjects effects and Table 2 summarizing the results for between-subjects effects).

Hypothesis 1 predicted that task performance would be highest in the control condition, lower in the non-focal condition, and lowest in the focal condition. It was tested using a repeated-measures ANOVA to examine the main effect of the distractor condition on task performance. The analysis revealed a significant main effect of the distractor condition after applying the Greenhouse-Geisser correction ($F(2, 146) = 3.173$, $p = .049$, $\eta^2 = .039$). Pairwise comparisons showed a significant difference between the control condition ($M = 76.71$, $SD = 2.58$) and the non-focal condition ($M = 87.60$, $SD = 3.48$, $p = .006$). However, no significant differences emerged between the focal condition ($M = 81.38$, $SD = 3.12$) and the other two conditions ($p > .05$). These results suggest that while the non-focal condition significantly impacted task performance compared to the control, the anticipated decline in performance under the focal condition did not occur as predicted. Therefore, Hypothesis 1 was only partially supported. Post-hoc analyses using Bonferroni-adjusted pairwise comparisons indicated that task performance was significantly higher in the non-focal condition than in the control condition but showed no significant differences between the focal and the other two distractor conditions.

Hypothesis 2 predicted that participants with high SE would perform better than those with low SE across all distractor conditions. It was tested using a mixed-design ANOVA, where SE was included as a between-subjects factor. The analysis revealed no significant main effect of SE ($F(2, 79) = 0.039$, $p = .961$, $\eta^2 = .001$). Mean task performance scores did not differ significantly between SE groups. These findings suggest that SE levels did not influence task performance across distractor conditions. Hypothesis 2 was not supported, so no further post-hoc analyses were conducted as no significant effects were found.

Hypothesis 3 predicted that participants with high SE would maintain task performance across distractor conditions, while participants with low SE would show greater declines. It was tested by examining the interaction between distractor condition and SE levels using a repeated-measures ANOVA. The interaction effect between the distractor condition and SE did not reach statistical significance ($F(2, 146) = 1.766$, $p = .144$, $\eta^2 = .043$). Trends observed in pairwise comparisons and estimated marginal means suggested that participants with high SE tended to perform slightly better under certain distractor conditions, but these trends were not statistically robust (see Figure 2). The lack of significant interaction indicates that SE did not moderate the impact of distractors on task performance as hypothesized. As a result, Hypothesis 3 was not supported. While post-hoc analyses did not yield statistically significant findings, the trends suggested a potential divergence in task performance between SE groups under the non-focal condition.

Discussion

This study investigated how self-efficacy interacted with varying levels of distraction in a cognitively demanding decoding task, addressing a gap in the existing literature. It examined whether individuals with high SE were better equipped to resist the negative effects of distractions. By focusing on the role of SE in mitigating interference from distractors with different spatial relevance, the study provided novel insights into the interplay between internal beliefs and external challenges in shaping cognitive performance. This research had practical applications across education, the workplace, health, and sports. In education, classroom designs and teaching methods could have been tailored to account for varying levels of distractibility and SE, fostering more inclusive learning environments. Similarly, training programs could have incorporated SE-boosting techniques, such as Cognitive Behavioral Therapy (CBT) and performance coaching, to help employees and clients improve focus, manage distractions, and enhance productivity.

The purpose of this study was to examine how self-efficacy, as a quasi-independent variable, interacted with three levels of distraction—control (no distractors), non-focal, and focal—and influenced task performance. The dependent variable, task performance, was operationalized through accuracy and response time during a cognitively demanding decoding task. The mixed design provided a solid starting point for investigation into the moderating role of SE across challenging tasks posed by such conditions.

The first hypothesis predicted that task performance would be highest in the no-distractor condition, lower in the presence of a non-focal distractor, and lowest when a focal distractor was present. The hypothesis was rooted in attention and the corresponding theory, which posits that focal distractors—by their proximity and relevance to the primary task—should create greater interference than non-focal distractors (Lavie, 2005; Eysenck et al., 2007). Prior research has demonstrated that visual and spatial distractors disrupt attentional resources more significantly when centrally placed, as they compete directly with task-relevant stimuli (Rosenberg et al., 2013). This highlights the critical importance of distractor placement and modality when it influences attentional capacity, signifying that even individuals with potentially enhanced cognitive abilities, such as bilinguals, may struggle with managing centrally placed distractions. Young (2018) observed that bilingual individuals' ability to manage distractions was not significantly better than that of monolinguals, aligning with this study's findings that high SE alone does not guarantee resilience to distraction. Consequently, we anticipated a clear decline in task performance as the distractor conditions became more intense.

The results partially supported this hypothesis. While the non-focal distractor condition significantly impacted task performance compared to the control condition, the anticipated decline in performance under the focal level didn't quite happen. Instead, there were no significant distinctions between task performance and the other two conditions. The partial support for Hypothesis 1 suggests that the non-focal condition was sufficiently disruptive to affect task performance, aligning with expectations. However, the lack of degradation due to the focal distractor may indicate that the design and intensity of the focal distractors didn't capture participants' attention or simply were easy to ignore. It shows the complexity of the interaction between distractions, the focused mind, and the variability in responses from interference. As previously mentioned, one potential design flaw was the placement of the focal distractors. While the placement location was optimized for the most distraction, their blinking rates and size may not have been sufficiently disruptive to override participants' attentional control. Additionally, while blocking possible order effects, the randomization of task order may have introduced learning effects instead, reducing the impact over time.

Hypothesis 2 predicted that participants who self-rated with high SE would achieve higher task performance scores than those with low SE. The hypothesis was grounded in SET, a theory that suggests that individuals with higher SE are more likely to stay the course and succeed in challenging tasks (Bandura, 1977) because SE enhances focus and reduces cognitive load, enabling more efficient allocation of mental resources (Riggs & Knight, 1994). The findings did not support Hypothesis 2. Task performance did not significantly differ between SE groups across any distractor conditions, implying that SE levels did not influence participants' ability to manage distractions or maintain accuracy and speed during the task.

The dearth of significant differences contrasts with prior research, signifying a positive relationship between SE and task performance. This discrepancy may stem from the nature of the decoding task, which required sustained attention and cognitive load that could have exceeded the buffering capacity typically provided by high SE. When casually asked verbally after the post-survey was finished if they struggled with focus, a small percentage of participants admitted a high level of difficulty, which required more time to finish. On the same token, a majority informed me that they had no trouble mentally "blocking out" the distractors. Additionally, the self-reported measure of SE may not have captured task-specific confidence effectively. A possible limitation lies in the operationalization of SE. The Modified SE Scale may not have been specific enough to the cognitive task, potentially reducing its predictive validity. Future studies should consider task-specific SE measures to capture nuanced variations in participants' beliefs about their abilities. In addition, a couple of questions needed to be omitted from the analysis to improve internal reliability.

The third hypothesis predicted a significant interaction between SE and distractor conditions, such that participants with high SE would maintain relatively high task performance across distractor conditions. In contrast, participants with low SE would show a decrease in performance when distractors were present. This hypothesis was informed by both SE theory (Bandura, 1977) and attention control theory (Eysenck et al., 2007). Self-efficacy has been shown to buffer against performance declines in high-pressure or challenging situations, fostering resilience and focus (Locke et al., 1984). However, the lack of significant interaction in this study suggests that the effects of SE may be more pronounced in tasks where participants can exert greater control over the conditions or strategies they employ. Similarly, attention control theory signifies that individuals with greater attentional resources can mitigate the effects of distraction, maintaining cognitive performance under stress (Eysenck et al., 2007). These theoretical frameworks led to the expectation that high SE participants would demonstrate superior attentional control, reducing performance degradation across distractor conditions.

The interaction effect between the distractor condition and SE was not statistically significant. Trends in the data suggested that participants with high SE performed slightly better under certain distractor conditions, particularly in the non-focal condition. However, these differences were not statistically robust, and overall task performance did not vary significantly between SE groups or across the distractor conditions. The lack of a significant interaction may challenge the theoretical premise that high SE is a buffer against distraction's detrimental effects. While trends in the data suggest a potential relationship, the findings indicate that SE alone may not be sufficient to moderate the impact of distractions on complex cognitive tasks. It could reflect the task's difficulty level or the possibility that other factors, such as baseline working memory capacity or cognitive load, played a more significant role in shaping performance.

Several design limitations may have influenced these results. First, the sample size may have been insufficient to detect subtle interaction effects, particularly given the variability in self-reported SE scores. Second, the distraction manipulation, while effective in creating group differences, may not have been potent enough to fully test the moderating role of SE. Finally, the between-subjects measure of SE may have lacked the specificity to capture task performance under distraction.

Strengths and Limitations

The study was controlled to reduce confounding variables, particularly by employing a mixed design that balanced within-subjects and between-subjects factors. The randomization of distractor conditions minimized order effects, ensuring that observed differences were attributable to the manipulation of distractor focality rather than sequence or fatigue. Using a real-world-inspired decoding task enhanced the ecological validity of the findings. While conducted in a laboratory setting, the study's design reflects scenarios where individuals must manage distractions in high-stress cognitive tasks similar to studying or problem-solving. The SE and distraction constructs were both operationalized using established, psychometrically reliable scales and manipulations. Once the problematic questions were removed, the Modified Self-Efficacy Scale demonstrated high internal consistency, while the distractor conditions were designed to align with existing research on focal and non-focal interference.

Despite its strengths, the study faced challenges related to variability in self-reported SE scores. The reliance on self-reports may have introduced bias, as participants could overestimate or underestimate their abilities, potentially diluting observed effects. One could argue that a self-confidence overestimate is par for the course regarding the current study—and they would be right, but outliers with super high confidence were not addressed regarding that specificity during the research. The sample consisted of university students, limiting the generalizability of the findings to other populations, such as older adults or individuals in professional settings. Additionally, the laboratory setting, while controlled, may not fully capture the complexity of real-world distractions.

The focal and non-focal distractors may not have been strong enough to test the full range of their potential impact. Moreover, the SE measure, while reliable, may not have adequately captured task-specific SE, which could differ from participants' general confidence in cognitive tasks. In other words, it is one thing to report efficacy during a survey with no cognitive demands and another to give those same answers with integrity while simultaneously being drilled with very complex questions with mental calculations. That doesn't suggest that the study required any different surveys or additional post-surveys of self-reflection. Instead, it shows a more robust way to move the 'attentional' needle by increasing the quality and quantity of cognitive load during the task. Another limitation involves the variability in individual attentional control, as

Rummel et al. (2023) highlighted, which could have influenced participants' responses to distractors. For instance, participants with stronger attentional control may have been less affected by focal distractors, potentially masking the hypothesized performance differences across conditions. This variability, while beyond the scope of this study, certainly stresses the need for future research to account for baseline attentional capacities when examining distraction effects.

An additional limitation stems from the temporal constraints inherent to conducting research within the framework of an academic semester. The limited timeframe may have restricted the opportunity for deeper exploration, refinement of methods, and more extensive data collection. With additional time, further development and testing could have enhanced the study's design and execution.

Implications

This study contributes to the growing body of literature on self-efficacy and cognitive performance by introducing a novel exploration of how SE interacts with distractor focality in mentally demanding tasks. The findings highlight the need for further investigation into individual differences, particularly how beliefs about one's abilities influence task outcomes under varying cognitive loads. Additionally, the study raises questions about the potential moderating role of task-specific SE in managing distractions, suggesting new avenues for research in attention and cognitive resilience, several of which have already been listed.

The results of this study have practical applications in educational, professional, and therapeutic settings. In education, findings could inform strategies to optimize learning environments by minimizing distractions and fostering SE through targeted interventions. While Hoffman and Schraw (2009) found that SE reliably predicts problem-solving efficiency, the lack of significant results in this study suggests that the complexity of the task or the operationalization of SE may have diminished its moderating effect on performance. Training programs could leverage SE-boosting techniques in the workplace to improve focus and productivity, particularly in high-distraction environments. Additionally, integrating SE training in cognitive-behavioral therapy or performance coaching could empower individuals to better manage distractions and enhance task performance across diverse contexts. The findings of this study align with Gibney et al. (2017), who demonstrated that even non-focal distractors can significantly interfere with task performance, signifying that the perceptual characteristics of distractors are critical in determining their impact on cognitive tasks.

Future Research

A logical next step would be to explore the effects of modality-specific distractions, such as auditory versus visual, or even multitasking scenarios where many types are presented simultaneously with various delays for practicality. If user integrity rises as an issue, researchers could enhance the manipulation check (or any other part of the design) by incorporating objective measures, such as eye-tracking or physiological metrics, to corroborate self-reported perceptions. A long-term exploration of SE's role in managing distractions over time and across diverse populations would provide broader generalizability and insights. Understanding how self-efficacy develops and functions under varying conditions could inform strategies for cultivating resilience across the lifespan. Some pilot studies could certainly be done that systematically tested where and when visual and auditory distractions were most and least distracting. The full gamut of distraction levels from none to overwhelmed (with safety in mind) would have to be employed. Ultimately, future research should build on these findings by using this study's design and taking it to the other extreme of over-distractions. It should include visual and audio distractors, plus longer-term, self-investing types of distractors, like being forced to relocate and then return to complete the task.

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Table 1

ANOVA Summary for Within-Subjects Effects

Source		SS	df	MS	F	Sig.	Partial η²
Distractor	Sphericity Assumed	4785.423	2	2392.712	3.173	.045	.039
	Greenhouse-Geisser	4785.423	2	2597.944	3.173	.049	.039
Distractor * Self-Efficacy_Tri	Sphericity Assumed	5325.330	4	1331.333	1.766	.138	.043
	Greenhouse-Geisser	5325.330	4	1445.526	1.766	.144	.043
Error(Distractor)	Sphericity Assumed	119132.987	158	754.006			
	Greenhouse-Geisser	119132.987	146	818.680			

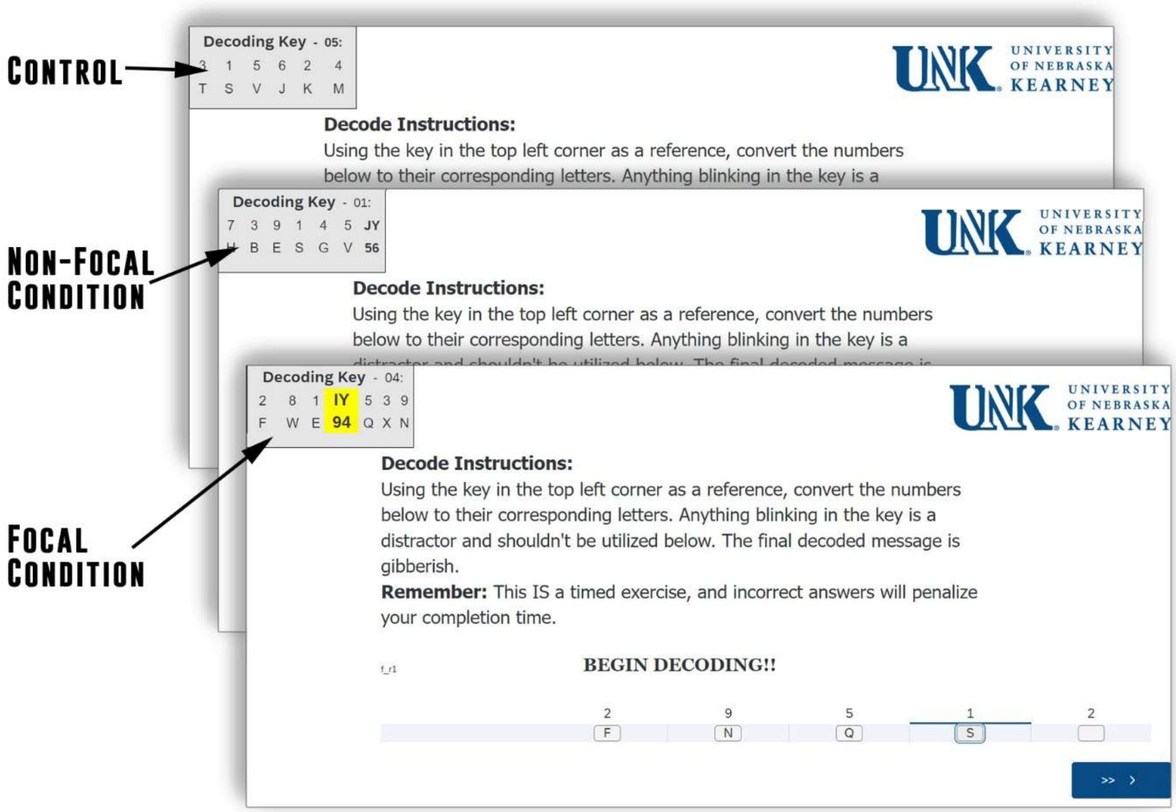
Table 2

ANOVA Summary for Between-Subjects Effects

Source	SS	df	MS	F	Sig.	Partial η^2
Self-Efficacy_Tri	60.681	2	30.341	.039	.961	.001
Error	60991.026	79	772.038			

Figure 1

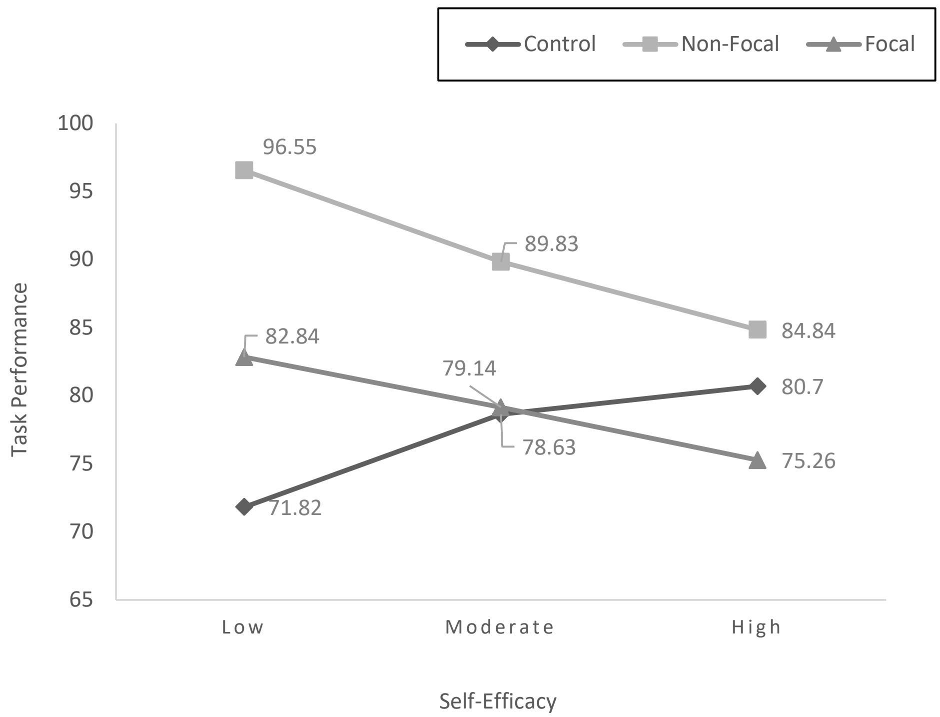
Display of Focality Manipulation



Note. Depicted is a comparison via a collage of the three distractor design implementations and their placements on the page. Each condition's screen capture is left and top aligned and then cropped on the right and bottom for space.

Figure 2

Means Plot Displaying the Interaction between Task Performance and Self-Efficacy



Appendix A

HTML/CSS Necessary for Replication

Remember, in HTML, IDs are unique and can only be used once. "QID104" is an ID unique to my Qualtrics survey. Yours will have an ID that is different from this.

How to find the HTML IDs: Using a Chromium-based browser, you will have to open the Qualtrics page you want to modify in preview mode, then press Ctrl+Shift+C (or Cmd+Opt+I on Mac) to open the developer tools, and then you can select the DIVs you want to modify. Please take note of the necessary HTML IDs and replace mine with yours. The `#question-display-wrapper-QID104` hides the empty question boxes of the task block. `#question-display-QID105` This ID hides another aspect of the text question box. Again, you must search for your own identifier and replace mine. This CSS has been slightly minified to save on space. You can use an online beautifier to re-expand and see all the code (see https://codebeautify.org/css-beautify-minify). Modifications to cascading style sheets (CSS) should be applied in the "Style" sub-menu of "Look and feel" in the input box labeled "Custom CSS":

Custom CSS:

```
/* Hide the question display wrappers to collapse box spacing */
.question-display-wrapper#question-display-wrapper-QID104 {display: none;}
/* Puts our question key/legends in the top right of the page */
#question-display-QID105 {position: fixed;top: -80px;left: 200px;}
.text-input {text-align: center;text-transform: uppercase;}
.question {margin: 0;padding: 0;}.question .question-error-wrapper {padding: 0;}
.sbs-table {margin: 0;}.sbs-table .text-input {padding: 0;width: 35%;min-width:
2rem;}.sbs-table .sbs-scale-points {padding: 0;}.sbs-table .sbs-column-header
{padding: 0;}.sbs-table .sbs-statement {padding: 0;}.sbs-table .sbs-column .sbs-
column-cell .grid-cell-input {width: 25%;padding: 0;}
.empty-column .sticky-header {height: 10px;}
/* SPECIAL TEXT FX */
.blink {-webkit-animation: blink 1s step-end infinite;animation: blink 1s step-end
infinite;}
@-webkit-keyframes blink {50% {visibility: hidden;}}
@keyframes blink {50% {visibility: hidden;}}
```

Appendix B

JavaScript Necessary for Replication

I created three text question boxes, one to house the code for each distractor level. The legends were placed in tables six wide by two high, each in their own question box. I copied and pasted the code for the tables so they would be identical. This didn't cause any problems because each legend was in its own unique box. I doubled up each JavaScript (JS) box with added task instructions just to efficiently utilize the space. Remember, in Qualtrics, when using JS, they split up the event injection possibilities of pre-load, runtime (after loading), and unload. You will have to turn off any repeating code in the last section. Qualtrics does a self-check whenever you try to save and will warn you of syntax errors. To add JS, click JavaScript in Question behavior with the box selected, or if you've already added code, click the "</>" symbol on the top right of the box. It was easier to use JS to inject AJAX than to modify only CSS. Make sure to create a DIV in the legend box and name it something unique. For the control, I used the question-display-ID to manipulate the legend's appearance. Non-focal, I named the div "nf_key," and the focal div I named "f_key." Again, these DIVs are all separate items in distinct question boxes; otherwise, the JS will conflict with itself, causing runtime errors. All the JS has been minified and must be re-expanded and beautified to properly view it.

Control JS:

```
Qualtrics.SurveyEngine.addOnReady(function(){
// stickies div to the proper spot
var divElement=document.getElementById("question-display-
QID133");if(divElement){divElement.style.position="fixed";divElement.style.top="0px";d
ivElement.style.left="10px";divElement.style.width="auto";divElement.style.height="aut
o";divElement.style.backgroundColor="rgba(230, 230, 230,
1)";divElement.style.border="1px solid black";divElement.style.zIndex="9999"}});
```

Non-Focal JS:

```
Qualtrics.SurveyEngine.addOnReady(function(){
// stickies div to proper spot
var divElement=document.getElementById("nf_key");
if(divElement){divElement.style.position="fixed";divElement.style.top="0px";divElement
.style.left="10px";divElement.style.width="auto";divElement.style.height="auto";divEle
ment.style.backgroundColor="rgba(230, 230, 230, 1)";divElement.style.border="1px solid
black";divElement.style.zIndex="9999"}
// ----- Adding Cells to Table ------
var table=document.getElementById("keypair");
if(table&&table.classList.contains("kptable")){
// Find the rows in table
var rows=table.getElementsByTagName("tr");if(rows.length>=2){
// Add two new cells to right side / each row
for(var i=0;i<1;i++){var newCell1=rows[0].insertCell(-1);//Adds cell to end / row 1
var newCell2=rows[1].insertCell(-1);//Adds cell to end / row2
// Style new cells
newCell1.style.width="31px";
```

```
// Generate rand 2-digit # between 10-99
var randomNumber=Math.floor(Math.random()*90)+10;
// Generate 2 rand uppercase letters (A-Z)
var randomLetter1=String.fromCharCode(65+Math.floor(Math.random()*26));var
randomLetter2=String.fromCharCode(65+Math.floor(Math.random()*26));var
randomLetters=randomLetter1+randomLetter2;
// Add random content to new cells
newCell1.innerHTML="<span style='font-
size:16px'><b>"+randomLetters+"</b></span>";newCell2.innerHTML="<span style='font-
size:16px'><b>"+randomNumber+"</b></span>"}
// ---- Strobing Effect for New Cells ----
var strobeIntervalId=setInterval(function(){
// Toggle visibility for new cells
for(var i=0;i<1;i++){var cell1=rows[0].cells[rows[0].cells.length-1];//Get cell/row1
var cell2=rows[1].cells[rows[1].cells.length-1];// Gets last cell / row2
// Toggle visibility by adjusting opacity
cell1.style.opacity=cell1.style.opacity==="1"?"0":"1";cell2.style.opacity=cell2.style.
opacity==="1"?"0":"1"}},800);// Strobe fx every 2 secs
}}});Qualtrics.SurveyEngine.addOnUnload(function(){
// ---- Unload Function -----
this.addOnUnload(function(){clearInterval(strobeIntervalId);// Clear strobe on unload
})});
```

Focal JS:

```
Qualtrics.SurveyEngine.addOnReady(function(){
// stickies div to proper spot
var divElement=document.getElementById("f_key");
if(divElement){divElement.style.position="fixed";divElement.style.top="0px";divElement
.style.left="10px";divElement.style.width="auto";divElement.style.height="auto";divEle
ment.style.backgroundColor="rgba(230, 230, 230, 1)";divElement.style.border="1px solid
black";divElement.style.zIndex="9999"}
// ---- Adding Cells to Middle of Table ----
var table=document.getElementById("keypair");
if(table&&table.classList.contains("kptable")){
// Find rows in table
var rows=table.getElementsByTagName("tr");if(rows.length>=2){
// Determine insertion index (between columns 3 - 4)
var insertIndex=3;// Insert after column 3 (index 2) and before column 4 (index 3)
// Add two new cells to middle of each row
for(var i=0;i<1;i++){var newCell1=rows[0].insertCell(insertIndex);// Adds cell between
column 3 and 4 in row1ar newCell2=rows[1].insertCell(insertIndex);// ""    ""  row2
// Style new cells
newCell1.style.width="41px";newCell1.style.backgroundColor="yellow";//Set init bg
newCell2.style.backgroundColor="yellow";//Set init bg color
// Generate rand 2-digit # between 10 - 99
var randomNumber=Math.floor(Math.random()*90)+10;
// Generate 2 rand uppercase letters (A-Z)
```

```
var randomLetter1=String.fromCharCode(65+Math.floor(Math.random()*26));var
randomLetter2=String.fromCharCode(65+Math.floor(Math.random()*26));var
randomLetters=randomLetter1+randomLetter2;
// Add random content to new cells
newCell1.innerHTML="<span style='font-
size:20px'><b>"+randomLetters+"</b></span>";newCell2.innerHTML="<span style='font-
size:20px'><b>"+randomNumber+"</b></span>"}
// ---- Strobing Effect w/Different Speeds, Times
// Strobe first new cell (Cell in first row)
var strobeInterval1=setInterval(function(){var cell1=rows[0].cells[insertIndex];// Get
newly added cell in first row
cell1.style.opacity=cell1.style.opacity==="1"?"0":"1"},846);//Strobe 800ms in cell 1
// Strobe second new cell (Cell in second row) with different speed
var strobeInterval2=setInterval(function(){var cell2=rows[1].cells[insertIndex];// Get
newly added cell in second row
cell2.style.opacity=cell2.style.opacity==="1"?"0":"1"},513);// Strobe 500ms cell 2
// Optional: Adding delay to second strobe
setTimeout(function(){
// delay second cell's strobe start 1 second late
clearInterval(strobeInterval2);strobeInterval2=setInterval(function(){var
cell2=rows[1].cells[insertIndex];// Get newly added cell in second row
cell2.style.opacity=cell2.style.opacity==="1"?"0":"1"},513);// Keep interval at 1200ms
but start after delay
},1e3);// Delay second strobe effect by 1000ms (1 second)
}}});Qualtrics.SurveyEngine.addOnUnload(function(){
// ---- Unload Function ----
clearInterval(strobeInterval1);// Clear first strobe interval
clearInterval(strobeInterval2);// Clear second strobe interval
});
```

Appendix C

Translation Key Sets

TKS inside tables with hidden borders
(for preformatted copy & paste into Qualtrics)

Decoding Key 01:

7 3 9 1 4 5

H B E S G V

Decoding Key 02:

9 4 1 7 2 3

Q N Z W F S

Decoding Key 03:

0 5 9 8 7 6

E W Y C L X

Decoding Key 04:

2 8 1 5 3 9

F W E Q X N

Decoding Key 05:

3 1 5 6 2 4

T S V J K M

Decoding Key 06:

4 0 8 2 5 9