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Mental Imagery Contributes to Loss Aversion by Amplifying Negative Emotions

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Abstract

Defined as the experience of sensory information without the presence of external stimuli, mental imagery is thought to play a role in memory, emotional regulation, and decision-making. Recent studies suggest that mental imagery varies widely across the general population, with approximately 2-4% of individuals having a reduction or complete absence of visual imagination, a phenomenon known as aphantasia. Individuals with aphantasia show reduced emotional arousal to fear-inducing imagery, raising the question of how variation in imagery affects cognitive processes that are influenced by emotion. Specifically, in economic decision-making it has been shown that the prospect of loss triggers negative emotions, leading to a tendency to avoid risky gambles with high potential losses, a concept defined as loss aversion. Although loss aversion varies across individuals, the effects of mental imagery ability on this behavior are unknown. Here we propose an experiment to address this question by measuring loss aversion in individuals as a function of mental imagery ability, as assessed by independent measures of imagery strength. Physiological arousal, an index of emotional response, will be measured using skin conductance response (SCR) while individuals decide whether to take risky gambles with varying magnitudes of gain and loss. We expect that participants with lower levels of mental imagery will have a reduced physiological arousal to loss magnitude, as measured through SCR, leading to higher tolerance for losses. If confirmed, these results would suggest that the amplification of emotional responses by mental imagery contributes to the avoidance of losses, providing new evidence for the role of mental imagery in decision-making and highlighting the complex relationship between neuroscience and economics.

Introduction

Close your eyes for a moment and envision your best friend. What color are their eyes? What is their hairstyle? Can you visualize their typical clothing and how they carry themselves? *Mental imagery* is defined as the representation of sensory information in the absence of external stimuli, allowing individuals to recreate experiences in the "mind's eye." Aside from offering a gateway to the inner workings of our minds, mental imagery is thought to play a role in a variety of cognitive processes including decision-making, emotional regulation, and memory (Pearson et al., 2015). However, there is growing evidence that mental imagery abilities vary across the population, with some people reporting that they have little to no visual imagination. This condition is referred to as *aphantasia*, the reduction or absence of voluntary imagery (Zeman et al., 2015). For an individual with aphantasia, attempting to visualize their best friend may produce a fuzzy, grainy mental image or nothing at all. Current estimates place the prevelance of aphantasia at approximately 2-4% (Dance et al., 2021), suggesting that a substantial portion of the population has limited mental imagery.

These findings raise the question of how individual differences in mental imagery abilities affect other aspects of cognition. One function that has been identified for mental imagery is that of amplifying the experience of negative emotions such as fear (Wicken et al., 2021). For example, a recent study found that individuals with aphantasia show less emotional arousal during the reading of frightening stories than a control group with normal mental imagery, even though both groups reacted similarly to frightening pictures (Wicken et al., 2021). Negative emotions are also known to influence economic decision-making, particularly for risky decisions such as trading financial securities or taking gambles. In particular, research suggests that individuals tend to avoid gambles with a potential loss component, a phenomenon known as *loss aversion.* Fearful emotions appear to amplify our aversion to potential losses, therefore playing a large role in our ability to make economic choices (Virlics, 2013; Sokol-Hessner & Rutledge,).

Like mental imagery ability, loss aversion has been found to vary across individuals (e.g., Sokol-Hessner et al., 2009). Factors in loss aversion include demographic characteristics such as gender, age, income and education level (Blake et al. 2021; Gächter et al. 2022). In particular, individuals with lower levels of income, education, and cognitive ability tend to show lower levels of loss aversion (Chapman et al., 2022). Although the mechanism of these effects is unclear, one pathway may be via the action of chronic stress on neural systems. In a study of young men, higher endogenous levels of the stress hormone cortisol were associated with lower levels of loss aversion (Chumbley et al., 2014), suggesting that chronic stressors such as poverty may blunt sensitivity to losses. Consistent with this idea, other researchers have found that higher cortisol levels led to a reduction in emotion-related activation of the amygdala (Jentsch et al., 2019). Emotions significantly influence decision-making abilities, ultimately playing a large role in how reactive an individual is to losses. However, how individual tolerance for losses is affected by mental imagery ability remains unexplored.

Although individual variation in mental imagery was first described as early as the 19th century (Marks, 2023), over the past decade there has been growing scientific interest in quantifying mental imagery ability across the population. One measure commonly used to assess mental imagery ability is the Vividness of Visual Imagery Questionnaire, or VVIQ (Marks, 1973). The VVIQ is a self-report scale in which the respondent is instructed to visualize “the picture that comes before your mind’s eye” when prompted to think about familiar people and places, as well as during guided imagery. Scores on the VVIQ reflect participants’ ratings of their mental imagery during these experiences on a 5-point scale from “No image at all, you only ‘know’ that you are thinking of the object” to “Perfectly clear and as vivid as normal vision” (Marks, 1973). Although additional self-report measures have been developed to measure mental imagery, including the Questionnaire upon Mental Imagery (QMI; Sheehan, 1967) and the Verbalizer-Visualizer Questionnaire (VVQ; Richardson, 1977), the VVIQ remains the standard among mental imagery questionnaires. Aphantasia is characterized by consistently low levels of self-reported mental imagery on the VVIQ, typically defined as a total score of 32 or less out of 80 maximum points (Zeman et al., 2015). Using this criterion, the prevalence of aphantasia in the general population has been estimated at approximately 3.9% (Dance et al., 2021).

Despite the widespread usage of subjective questionnaires such as the VVIQ, one concern about these measures is their inability to distinguish poor mental imagery from other aspects of metacognition, or awareness of one’s thought processes. Behavioral tasks avoid this issue by directly assessing the effects of mental imagery on perception and decision-making. One such approach leverages the phenomenon of binocular rivalry to measure mental imagery in aphantasia (Keogh & Pearson, 2018; Wicken et al., 2021). Binocular rivalry occurs when a different visual stimulus is presented to each eye: for example, displaying a face to the left eye and a house to the right eye. Rather than perceiving a mishmash of the images to the left and right eyes, the visual system perceives only one stimulus at a time (e.g., either a face or a house), with the two stimuli alternating over time. Importantly, the dominance of the two stimuli during rivalry can be changed by briefly viewing, or even imagining, one of the stimuli before exposure to the rivalry display (Brascamp et al., 2007; Pearson, Clifford & Tong, 2008; Pearson, 2014). The extent to which imagery biases the subsequent perception of the binocular stimulus can be used as an index of the individual's sensory strength of visual mental imagery. This approach provides an objective measurement that bypasses the subjective limitations of self-report measures of imagery vividness, offering insights into the sensory aspects of mental imagery and its impact on visual perception (Keogh & Pearson, 2018; Wicken et al., 2021).

Given that mental imagery can be tied to both subjective and objective measures of perceptual experience, what is its functional significance? According to one influential model, visual mental imagery allows better prediction of the future by contributing to the re-experience of prior events through memory (Pearson et al., 2015; Schacter et al., 2007). Consistent with this idea, a recent study found that individuals with aphantasia specifically reported weaker visual imagery when remembering prior events (Dawes et al. 2022). One mechanism by which visual imagery is thought to contribute to this process is through the amplification of emotions, such as fear (Ji et al., 2016). Previous studies have demonstrated that dual task paradigms, in which participants are asked to complete another visuospatial task while engaging in visual imagery, can blunt the emotional impact of negative memories in healthy individuals (Andrade et al., 1997; Kavanagh et al., 2001). However, these studies did not measure the mental imagery abilities of the participants.

Wicken and colleagues (2021) explored how individual variation in visual imagery affects emotional reactions by comparing physiological responses in individuals with aphantasia to those with intact imagery capabilities. The study was structured around two primary experiments: the "imagery experiment," where participants read and imagined frightening stories, and the "perception experiment," where participants viewed frightening images. The emotional response to these stimuli was measured in terms of the skin conductance response (SCR), a change in electrical skin conductance due to activation of the sympathetic nervous system (Figure 1). Associated with the "fight-or-flight" response, sympathetic nervous activity is triggered by strong emotions and linked to activity in affective brain regions such as the amygdala. Wicken and colleagues (2021) found that aphantasics exhibited a significantly dampened physiological fear response during the imagery experiment, in contrast to the control group. However, when presented with actual frightening images, both groups showed similar increases in physiological arousal as measured with SCR. These results support the idea that aphantasics' diminished emotional response in the imagery task is specifically tied to their inability to generate visual imagery, rather than a general emotional or physiological dampening (Wicken et al., 2021). Along with previous research, this finding suggests that visual mental imagery works as an emotional amplifier, highlighting the role of visualization in enhancing emotional responses.

Yet, while the link between mental imagery and emotional experience has been well-studied, less is known about how individual differences in mental imagery affect other aspects of cognition that are influenced by emotion. In the realm of decision-making, numerous studies have explored the intricate relationship between negative emotions and loss aversion. Combining cognitive strategies with physiological measurements of SCR, Sokol-Hessner et al. (2009) investigated how emotional arousal contributes to loss aversion. Participants were asked to make choices between certain rewards and monetary gambles that could result in gains or losses. Critically, participants were instructed to choose either as they normally would or while adopting a specific cognitive strategy aimed at reducing emotional responses to potential losses. On average, individuals exhibited higher SCR responses to losses compared to gains, with the difference in arousal correlating with behavioral loss aversion across subjects. Most notably, employing the cognitive regulation strategy significantly reduced both physiological arousal to losses and behavioral estimates of loss aversion, suggesting a distinct role for emotion in loss aversion (Sokol-Hessner et al., 2009). Similarly, when physiological arousal is decreased chemically through the administration of the drug propranolol, participants show a selective reduction in loss aversion (Sokol-Hessner et al., 2015). Propranolol blocks the action on the brain of epinephrine and norepinephrine, hormones that increase arousal during sympathetic nervous activation. Thus, targeting the neurohormonal basis of arousal can selectively reduce loss aversion without affecting other components of decision-making. Together, these studies support a relationship between physiological arousal linked to negative emotions and the avoidance of financial losses.

In line with this idea, other studies examining the neural correlates of loss aversion have found a link between loss attitudes and the response of the amygdala, a brain region linked to emotional processing (Baxter et al. 2012). Amygdala activity is heightened during fear conditioning (Wicken et al., 2021), and correlates with increases in SCR (Cheng et al., 2006). On a structural scale, De Martino et al. (2010) examined the role of the amygdala in generating loss aversion by studying responses to mixed gain-loss gambles in individuals with focal bilateral amygdala lesions. Two patients with focal bilateral amygdala lesions were compared with controls matched on age, education, and gender. The individuals with amygdala lesions exhibited a significant reduction in loss aversion, accepting gambles that controls typically avoided. However, these individuals still displayed a normal sensitivity to the magnitude of potential rewards and risks, indicating that their overall decision-making capacity was intact. This provides compelling evidence that the amygdala plays a critical role in mediating loss aversion, likely by encoding the negative emotional value of potential losses (De Martino et al., 2010). Similarly, a functional neuroimaging study by Sokol-Hessner and colleagues (2013) found that amygdala activation in healthy normal participants was correlated with behavioral loss aversion, and that this activity was reduced by emotional regulation.

Building on these foundational insights, we propose an experiment to test the role of individual variation in mental imagery capabilities in the behavioral phenomenon of loss aversion. To quantify emotional arousal associated with loss aversion, this experiment will combine behavioral estimation of loss aversion with physiological measures of SCR. We hypothesize that a reduction in mental imagery capabilities, as seen in individuals with aphantasia, would be associated with lower SCR to losses and a diminished behavioral experience of loss aversion. This stems from the understanding that mental imagery enhances the emotional impact of potential losses, thereby intensifying our aversion to losing. Without the vivid mental images to amplify the emotional weight of potential outcomes, individuals with diminished mental imagery may exhibit less emotional reaction to the prospect of loss, potentially altering their risk assessment and decision-making strategies.

Proposed Methods

Participants

A total of 60 participants with varying levels of mental imagery will be recruited from the local college community. In order to find enough variation in mental imagery abilities, we will first conduct extensive prescreening in the Claremont Colleges and local community using the VVIQ, and then select equal numbers of participants from the bottom tercile (aphantasia, N = 30) and top tercile (normal mental imagery, N =30) of our sample. Participants will be between 18 and 30 years of age, ideally with similar numbers of male and female participants. Participants should have normal or corrected vision with no diagnosed color deficiency. Participants will receive monetary compensation for their participation. All study materials and procedures will be approved by the Claremont McKenna College Institutional Review Board, and all participants will provide written informed consent prior to participation.

Mental Imagery Assessment

To recruit individuals with a range of mental imagery abilities, we will advertise the study widely across the Claremont Colleges and surrounding community using printed flyers, posts to student mailing lists, and the campus experimental psychology study pool. Participants will be incentivized to complete the initial prescreening by being entered in a lottery for the chance to win a $50 Amazon gift card. Participants will complete an online version of the VVIQ as a prescreening measure. The VVIQ serves as a subjective measure, assessing individuals' ability to visualize mental images through a series of questions that participants answer based on the vividness of their visual imagination and is evaluated using a five-point Likert scale. Scores range from 16 to 80 points with lower scores on the scale indicating diminished vividness in visual imagery. An individual with a total test score between 16 and 32 is categorized as an aphantasic (Dance et al., 2021). From this initial sample, we will contact participants from the lowest tercile (aphantasia) and highest tercile (normal mental imagery). One potential concern is that the lowest tertile may include individuals above the numerical cut-off of 32 used in prior studies; in that case, we would run a separate analysis of only the participants under the previously-defined threshold for aphantasia.

Upon successful recruitment, the next step involves the objective verification of participants' self-reported mental imagery ability to confirm their classification into the respective groups (Figure 2). This verification process employs the binocular rivalry paradigm described above (Wicken et al., 2021). Different images will be presented to the left and right eyes using red-green anaglyphic glasses, inducing a perceptual alternation that is thought to be influenced by the strength of visual imagery. Specifically, participants will view a red horizontal stripe pattern with one eye and a green vertical pattern with the other eye. Individuals capable of generating strong visual imagery can, to some extent, modulate this rivalry through mental visualization, affecting the perceptual dominance of the images. In contrast, individuals with aphantasia are expected to exhibit a diminished ability to influence this rivalry, thereby providing an empirical basis for distinguishing between those with and without this condition (Wicken et al., 2021).

Behavioral Procedure

After identifying aphantasic individuals based on subjective and objective measures, we will invite them to the laboratory for a behavioral decision-making task. Upon arrival at the laboratory, participants will be given $30 as an endowment for the task. To ensure feelings of loss aversion, participants will be explicitly told that the money is theirs to gamble during the experiment, and asked to place it in their wallet or purse. Participants will also be informed that their endowment will be adjusted at the end of the experiment by the amount they win or lose, based on the actual outcomes of their choices on 14 randomly selected trials (10% of all trials). The maximum amount of money that participants could lose will be $30, and the maximum they could win will be $572. There will be no deception; at the end of the experiment, the participant's endowment will be adjusted as described above. In addition, all participants will also receive a separate compensation fee for their participation in the experiment.

Loss Aversion Estimation

In order to assess individuals' loss aversion, we will adapt the task previously used by Sokol-Hessner et al. (2009). This paradigm consists of a series of monetary choices between 50/50 gambles and certain outcomes. Of the 140 total trials, 120 will consist of mixed gambles (gain and loss amounts) versus a guaranteed payoff of $0, and 20 choices will consist of gain-only gambles (zero and positive dollar amounts) versus guaranteed gains. The monetary value of the prospects in each gamble will range between a –$24 loss and a $30 gain, with exact values derived from the set used in Sokol-Hessner et al. (2009). Presentation order of gambles will be randomized for each participant.

On each trial, the participant would see a screen showing the two options, and then indicate their choice by responding on a keyboard. Figure 3 shows a schematic of the trial structure. The decision screen will be displayed for 2 s, followed by a 2-s period for the participant response. After the participant responds, the outcome of the trial will be displayed for 1 s. Additionally, there will be variable fixation periods of 8-11 s before and after the outcome screen is shown to enable isolation of the SCR to the outcome presentation.

Choice behavior will be estimated using a 3-parameter model (Sokol-Hessner et al., 2009). The utility function *u(x)* associated with decision-making will be derived from the following functions:

$$u(x) \ = \ x^{\rho} \ if \ x \geq 0$$
$$u(x) \ = \ -\lambda \ \times \ (-x)^{\rho} \ if \ x \ < \ 0$$

where x is the dollar amount, ρ indicates the curvature of the utility function, and λ indexes the degree of loss aversion. When λ equals 1, it indicates a neutral valuation of gains and losses, referred to as "gain-loss neutral." A λ value less than 1 implies that gains are overvalued compared to losses, or "gain-seeking." Conversely, a λ value greater than 1 suggests a tendency to overvalue losses, or loss aversion.

SCR Measurement

SCR will be integrated into the experimental design to capture the emotional arousal associated with the decision-making task (Sokol-Hessner et al., 2009). Each individual will be fitted with a pair of silver-silver chloride (Ag-AgCl) electrodes. These electrodes will be attached between the middle and distal phalanges on the index and middle finger. The electrodes will output the SCR signals to a desktop computer equipped with a BIOPAC skin conductance module. Recording frequency will be set to 200 samples per second.

SCR values will be expressed in microsiemens (μS), which is calculated by taking the maximum trough-to-peak amplitude difference within the interval consisting of 0.5 seconds following the onset of stimulus to 4.5 seconds after the stimulus is stopped. In order to ensure that the SCR signal is measured, a minimum response criterion of 0.02 μS will be established and anything below that will be considered insufficient and scored at 0. In order to minimize data skewness, the obtained data will be subjected to low-pass filtering at 25 Hz, smoothed using a 3-sample kernel, and transformed by taking the square root. Lastly, in order to measure physiological loss aversion, SCR values will be normalized based on the dollar value won or lost. This will produce measurements with units of $\sqrt{\mu S}/\$$, for which Loss – Gain outcomes will be compared to quantify physiological correlates of loss aversion.

Predicted Results

In this study, we plan to compare loss aversion in individuals with aphantasia versus normal mental imagery. By linking physiological responses during risky decision-making to mental imagery abilities, we aim to uncover the role of visual imagery in the emotional processing of gains and losses.

First, examining behavioral loss aversion, we predict that tolerance for loss will vary substantially across our participant sample. Figure 4 shows the predicted λ parameter derived for each individual participant regardless of mental imagery group. Bars are color-coded to indicate loss tolerance, with green indicating gain-seeking ($\lambda < 1$), blue indicating gain-loss neutrality ($\lambda = 1$), and red indicating loss aversion ($\lambda > 1$). Based on previous studies, we predict that on average, the λ parameter will fall between 1.4 and 2 (e.g., Sokol-Hessner et al., 2009), with substantial numbers of participants in each group. However, given the education and income of our college sample, we predict there will be a higher number of loss-averse participants overall, as these demographic factors are associated with higher loss aversion (Blake et al., 2021; Gächter et al., 2022).

Second, we will examine the role of mental imagery abilities in individual tolerance for loss. Based on previous research implicating mental imagery in the experience of negative emotions, we hypothesize that, compared to the aphantasia group, the control group will demonstrate substantially higher arousal levels associated with losses. Therefore, we project that the average SCR observed in the control group will be significantly higher than that recorded in aphantasics (Figure 5A). In order to verify the significance of these results between the two groups, we will conduct an independent t-test.

If increased emotional arousal contributes to loss aversion, then we predict that our estimates of lambda (λ) will be significantly different for the two groups as well, with a higher mean value for the control group compared to the aphantasia group (Figure 5B). In order to verify the prediction, we will conduct an independent t-test with similar parameters to the statistical test for SCR. This means that the aphantasic group will be more willing to take gambles with a substantial risk of loss, resulting in an average λ at or below the gain-loss neutral value of 1. In contrast, we expect that the control group will have an average λ significantly greater than 1, indicating a degree of loss aversion. We will test these predictions by comparing each group's average λ value to the reference λ value of 1 ("gain-loss neutral") using the one-sample t-test.

Lastly, we will examine whether the relationship between mental imagery ability and behavioral loss aversion is present at the level of individual participants. Specifically, we predict that VVIQ scores will be positively correlated with λ (Figure 5C), suggesting that individuals with more vivid mental imagery exhibit a stronger behavioral aversion to potential losses. In order to assess the correlation, we will be using a Pearson correlation coefficient. With a strong correlation, we can confidently conclude that a high VVIQ score is greatly associated with a low tolerance for losses.

Discussion

Although the ability to create mental images of perceptual input is thought to contribute to a number of cognitive functions, growing evidence suggests there is substantial individual variation in mental imagery abilities (Zeman et al., 2015). In particular, the lack of mental imagery, or aphantasia, has been associated with reductions in emotional arousal to fear-inducing imagery (Wicken et al., 2021), suggesting that one function of mental imagery is to amplify negative emotions. In the decision-making domain, negative emotions have been shown to affect risky decision-making, especially in terms of the tolerance for losses. However, the role of mental imagery in loss aversion has yet to be fully explored.

This study aims to bridge the gap in our understanding of the cognitive mechanisms underlying economic decision-making, particularly how variation in mental imagery can influence an individual's decision-making. We predict that mental imagery ability will affect emotional arousal to gain and losses. This is grounded in the fact that participants with aphantasia, who have a reduced ability for visual imagery, exhibit lower physiological arousal to fear-inducing imagery (Wicken et al., 2021). Therefore, we expect that when experiencing losses, the aphantasic group will show lower physiological arousal as measured with SCR. Because emotional arousal has previously been shown to correlate with loss aversion (Sokol-Hessner et al., 2009), we further predict that the aphantasic group will have a higher tolerance for losses. This correlation may even be visible at the individual level, with loss aversion parameter λ varying as a function of self-reported mental imagery, as measured by the VVIQ. If our predicted results hold true, they would support the idea that mental imagery acts as an emotional amplifier to enhance sensitivity to potential losses.

Future research could expand on this study to include neuroimaging measures such as functional magnetic resonance imaging (fMRI), which would allow for the observation of the neural correlates involved during the decision-making process. In particular, current evidence suggests that visual mental imagery engages the amygdala, a brain region heavily involved in emotional processing (Cheng et al., 2006). Activations in the amygdala to losses relative to gains are also correlated with the degree of behavioral loss aversion in healthy individuals (Sokol-Hessner et al., 2013). Notably, damage to the amygdala is associated with increased tolerance for losses (De Martino et al., 2010), and the use of emotional regulation to reduce loss aversion is correlated with decreased amygdala response to losses (Sokol-Hessner et al., 2013). Therefore, we would hypothesize that individuals with aphantasia would also demonstrate lower amygdala activity to losses, in line with their predicted reductions in SCR.

Another research question is how mental imagery ability interacts with the variety of outside factors that are known to influence loss aversion, including age, education, and income. Previous research indicates that these characteristics can have a profound effect on economic decision-making behaviors (Blake et al., 2021; Gächter et al., 2022). For instance, older individuals may exhibit different loss preferences compared to younger individuals as a result of financial stability or cognitive loss. Similarly, individuals with higher levels of education and income are more likely to have a higher level of loss aversion, whereas lower education, income, and cognitive ability are associated with higher tolerance for loss (Chapman et al., 2022). One physiological mechanism for these differences is the role of chronic stress, which results in higher endogenous cortisol and reduced loss aversion (Chumbley et al., 2014). Therefore, although our proposed study is focused on the local college community, it would be of interest to examine the interaction of socioeconomic status and mental imagery ability in a larger, more representative sample. Low mental imagery abilities may offset the effects of education, income or age, producing lower loss aversion than expected from demographic factors alone. Conversely, mental imagery and demographic factors could combine synergistically, leading to higher loss aversion than predicted from either mental imagery or demographic factors.

If our predictions are supported, this study would be the first to link mental imagery capabilities to economic decision-making. Aside from our focus on loss aversion, other types of economic decision-making have been proposed to have a connection to emotional regulation. For example, delay discounting refers to the common behavioral pattern that, when presented with choices between two options in time (intertemporal choice task), individuals will opt for smaller but sooner rewards over larger, later rewarding outcomes. Although delay discounting is often assumed to reflect stable time preferences, Lempert et al. (2016) found that emotional arousal could indicate whether or not a person will choose to be patient during an intertemporal choice task when presented with a delayed award. It has also been established that positive autobiographical memories have been seen to reduce the urge to take an immediate award as opposed to waiting for a better one (Lempert et al., 2017). Given that aphantasics show reduced mental imagery when remembering prior events (Dawes et al., 2022), one natural question is how reductions in mental imagery ability affect patience for future rewards.

One potential limitation of the study is our ability to recruit participants with aphantasia. Given that it is not an established medical condition, individuals with aphantasia are likely to have little to no knowledge regarding their status and may not be proactively aware of their mental imagery deficits. There is also no clear mechanism behind lower visual imagery as it is currently defined solely by behavioral symptoms as opposed to physical or structural changes to the brain. With an estimated prevalence of aphantasia of 2-4% of the general population, this may pose a significant challenge in assembling a statistically significant group that can provide viable data. The fact that we are relying on the VVIQ, a self-report measure, to pre-screen individuals for visual imagery capabilities may also fail to fully capture the complexity or range of aphantasia, possibly excluding individuals that may otherwise have low imagery capabilities because they do not meet the strict scoring criteria. To ensure access to a larger pool of potential participants, it may be better to advertise our study more broadly on internet message boards and interest groups for individuals with aphantasia, a strategy that has been used in previous research (Wicken et al., 2021).

Finally, although we predict that we will find significant differences in SCR and loss aversion between aphantasics and controls, our actual results may diverge from these hypotheses in a number of ways. For instance, we may see that aphantasics are just as loss-averse as the control group. This could indicate that there is substantial heterogeneity in loss aversion, meaning that tolerance to losses arises from multiple factors beyond mental imagery abilities alone. Also, while individuals with intact mental imagery may rely on visual imagination to make decisions, those with reduced imagery may use other routes (e.g., verbal descriptions) to generate representations for decision-making. In other words, an aphantasic may understand the repercussions of their decisions similarly to a person using imagery, leading to similar loss aversion despite a lack of mental imagery. This could also contribute to noise within the correlation between VVIQ scores and λ parameter estimates.

It may also be the case that we would not find a significant difference in SCR levels to loss between the aphantasic and control groups. Despite extensive evidence linking emotional arousal to amygdala function, these two factors may be dissociable in some individuals. Past research has found that patients with lesions in the amygdala were, in some cases, able to generate SCR responses despite having little to no activity within the brain region (Knight et al., 2005). This could be the case in our study as well, as aphantasics may be eliciting a SCR in the absence of emotional arousal as generated through amygdala activity.

Nonetheless, this proposal provides a first experiment to examine the link between mental imagery abilities and economic decision-making behavior. Should our results be confirmed, future research could explore other groups of people and sample a more diverse population to capture generalized conclusions about the effects of mental imagery ability on loss aversion. Future work may include seeing how the association between mental imagery and loss aversion evolves with age, via longitudinal studies, or as a function of changes in cognitive capacity. By doing so we can help identify susceptibilities to adverse decision-making in individuals who have a very high tolerance for losses or those with low mental imagery, allowing us to enhance the quality of economic outcomes.

Conclusion

In conclusion, the proposed study would be the first investigation linking mental imagery abilities to economic decision-making. By testing physiological and behavioral measures of loss aversion in neurotypical and aphantasic individuals, the proposed research offers a significant contribution to understanding the cognitive perspective on economic behavior. The insights gained from the study will potentially have profound implications in fields ranging from behavioral economics to clinical psychology, ultimately providing a deeper understanding of the human imagination on financial decisions, offering new perspectives on the interplay between cognition, emotion, and economic behavior.

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Figures

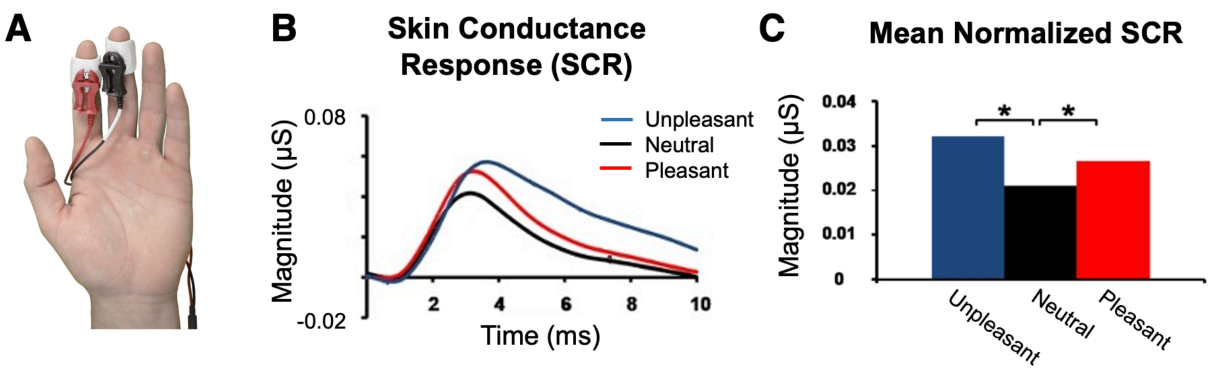

Figure 1. Measurement of physiological arousal associated with emotions via skin conductance response (SCR). (A) Example of SCR recording set-up. (B) Average SCR for emotional vs. neutral content over time. (C) Average mean normalized SCR magnitude for emotional vs. neutral content (* $p < 0.05$). A: © BIOPAC. B-C: Modified from D'Hondt et al. (2010).

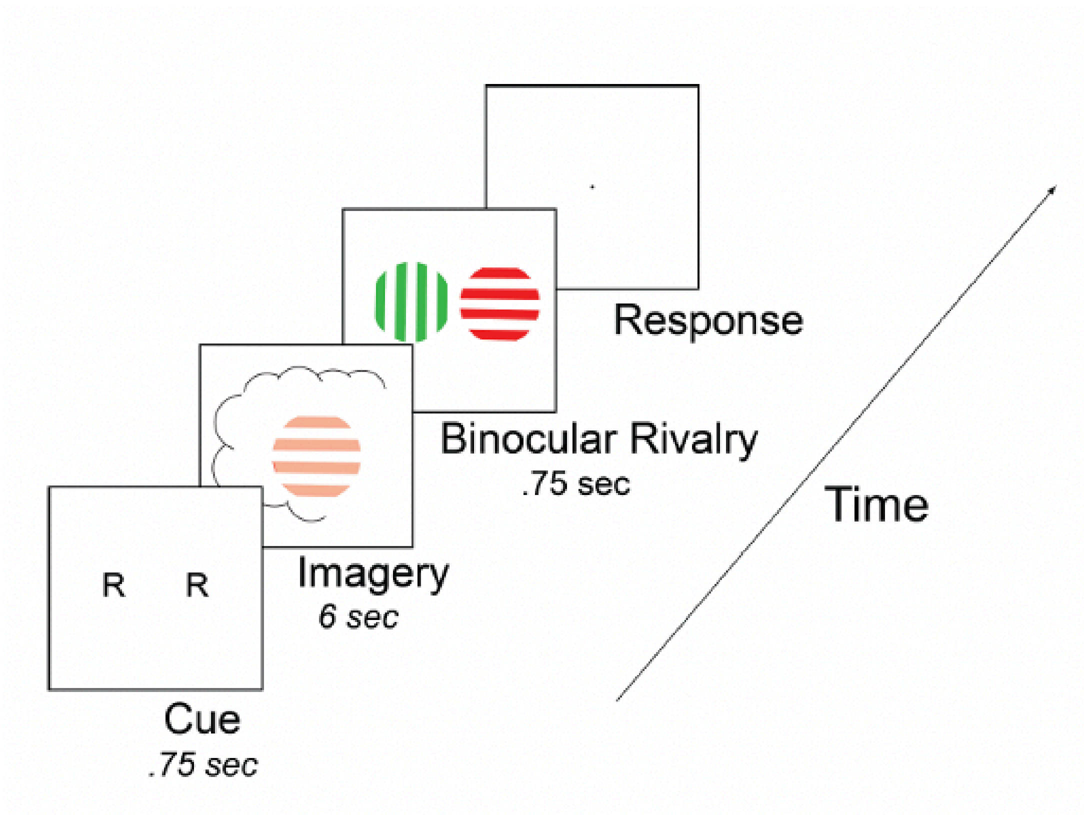

Figure 2. Sample trial of binocular rivalry priming. From Wicken et al. (2021).

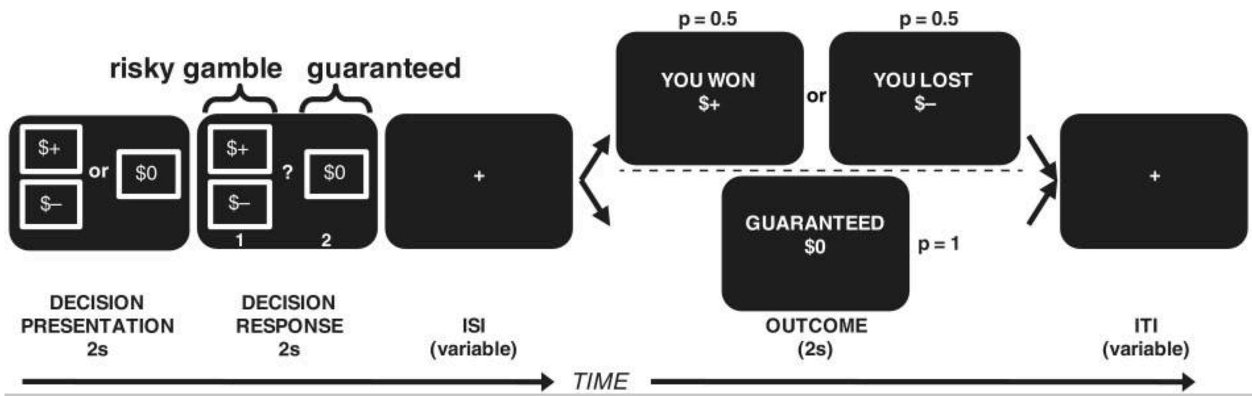

Figure 3. Schematic of a single trial in the gambling task presented to participants. From Sokol-Hessner et al. (2013).

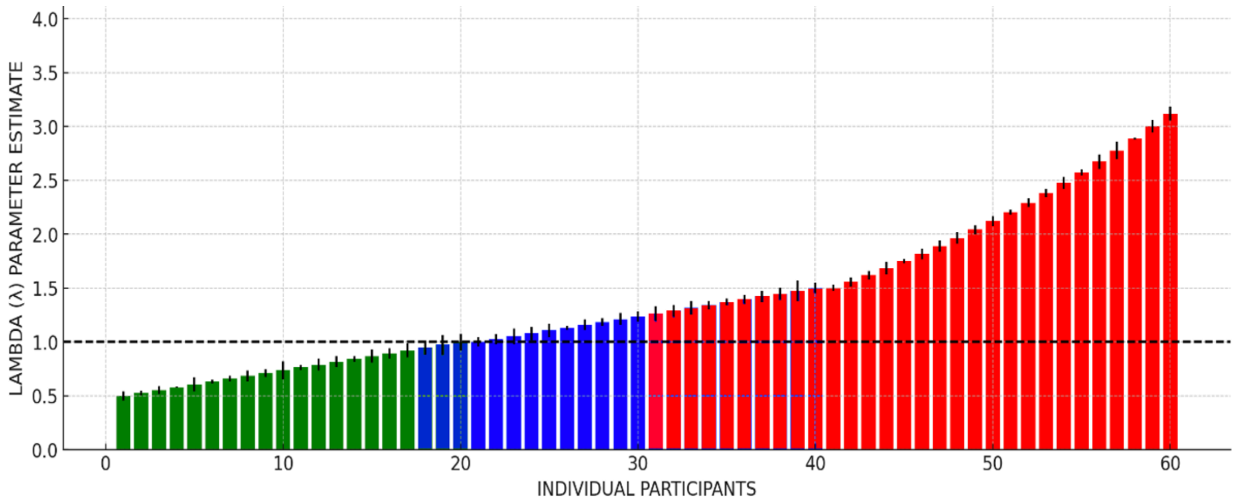

Figure 4. Predicted individual loss aversion coefficients (λ) measured by the gambling task. Behavior is classified as gain-seeking ($\lambda < 1$, green), gain-loss neutral ($\lambda = 1$, blue), or loss-averse ($\lambda > 1$). Modified from Sokol-Hessner et al. (2009).

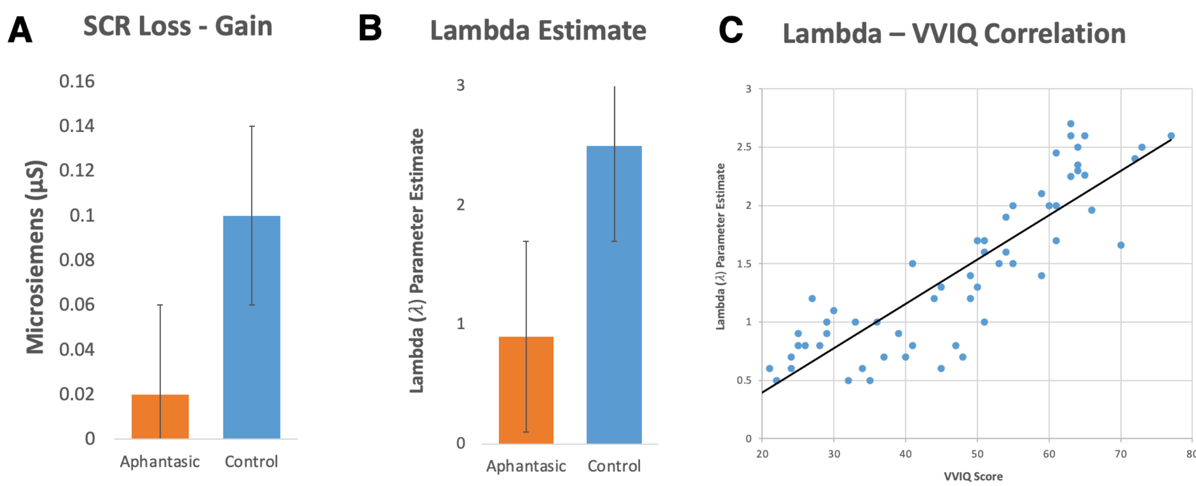

Figure 5. Predicted results for physiological and behavioral loss aversion in aphantasic (n = 30) and control (n = 30) groups. (A) Predicted SCR response between aphantasic and control group for Loss - Gain. (B) Predicted average lambda parameter estimate for aphantasic and control group. (C) Predicted correlation of lambda parameter estimate with VVIQ score (0-80) amongst all individuals (n=60).