

THESIS

DOES INCREASED CUE FAMILIARITY DRAW ATTENTION AWAY FROM THE
SURROUNDING CONTEXT?

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ABSTRACT

DOES INCREASED CUE FAMILIARITY DRAW ATTENTION AWAY FROM THE SURROUNDING CONTEXT?

Cognitive psychology research delineates attention into two domains: external attention, which targets environmental stimuli, and internal attention, which selects and modulates mental representations. The familiarity-flip-of-attention theory posits that a familiar external cue redirects attention inward toward memory retrieval. This shift inward toward retrieval should reduce encoding of the surrounding visual context. The present study investigated this hypothesis. To systematically manipulate cue familiarity, participants were presented with cues featuring varying degrees of detectable familiarity from graphemic feature overlap (High Overlap vs. Low Overlap vs. No Overlap) to previously studied words. Each cue was overlaid onto a unique background wallpaper that served as the surrounding environmental context. For this cue phase, half of the participants were assigned to an external/encoding orientation task (counting vowels in the cue), while the other half were assigned to an internal/retrieval orientation task (using the cue to try to retrieve a resemblant studied word from memory). Participants then completed a recognition test for the wallpapers that had accompanied each cue. The hypothesis that cue familiarity-detection redirects attention away from the external environment and encoding toward the internal world and retrieval was supported in that later wallpaper recognition was significantly lower in the High Overlap (high familiarity) cue condition than in the Low and No Overlap conditions. This reduced wallpaper encoding in the

High Overlap condition was unaffected by the assigned attentional orientation (external vs. internal), suggesting that familiarity-detection may redirect attention inward toward retrieval and away from encoding automatically, irrespective of the top-down orientation in which one is engaged.

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Chapter 1 - Introduction

External vs. Internal Attention

Attention is a fundamental mechanism for selection and modulation of both environmental information and the internally generated responses to external cues (such as a familiar face) or internal cues (such as attempting to retrieve an anniversary date). Although classic selective attention research from the first few decades of cognitive psychology focused primarily on external attention, which is the ability to focus on a subset of information in the environment (see Ashcraft, 2009, for a review), the past two decades or so have seen a growing interest in examining internal attention –the ability to focus on a subset of information in one’s mind (see (Chun & Most, 2021), for a review). This leads to the present-day classification of attention into two main categories: external and internal attention.

External Attention

External attention refers to the cognitive mechanisms behind selecting and modulating sensory information as it initially enters the mind from the environment (Ashcraft & Radvansky, 2009; Chun et al., 2011; Chun & Most, 2021). It is an environmentally-oriented form of attention, perceptual in nature, directed toward information perceived through the senses. External attention involves the prioritization of a subset of externally available information to facilitate further processing and guide action selection, often organizing the sensory data by specific features or objects (Chun et al., 2011; Verschooren et al., 2026). This selective prioritization is necessary because multiple stimuli in the visual field compete for finite neural processing resources; some argue that attention serves to protect the brain's limited-capacity system from information overload by selecting a subset of inputs for enhanced processing (Kastner & Ungerleider, 2000; Wickens, 2008). External attention can operate through two

distinct modes: covert attention, which increases processing of information at peripheral locations without shifting gaze, and overt attention, which redirects gaze to bring a stimulus onto the fovea via eye movement (Bisley, 2011). Both modes can act simultaneously and jointly determine behavioral responses (Zhou et al., 2017).

The process of resolving competition among the multiple external inputs is managed by two distinct control mechanisms: the first is top-down, or goal-oriented attention –also known as endogenous attention– which prioritizes information consistent with current behavioral goals, such as searching for a specific LEGO piece by color or looking for a friend’s face in a crowd. The second is bottom-up, or stimulus-driven attention–also known as exogenous attention–which is captured by external events, such as an alarm or a flashing light in a cockpit (Chun et al., 2011; Narhi-Martinez et al., 2023; Wickens, 2021).

Internal Attention

In contrast to external attention, internal attention involves the selection, modulation, and maintenance of information residing inside one’s mind. Specifically, internal attention is directed toward mental representations—such as memories, images and thoughts—and often involves searching for or retrieving relevant information from memory networks (Cleary et al., 2023; Fortney, 2020). It allows individuals to reflect on past experiences, plan future actions, and engage in self-regulation. Often referred to as "reflective" attention (e.g., Chun et al., 2011), and what was once called by William James as “intellectual attention” (James, 1890), it is a key component in decision-making and problem-solving by facilitating the integration of personal experiences with current information (Chun et al., 2011; Fortney, 2020). This mechanism operates over a broad spectrum of cognitive content, including representations held within working memory, long-term memory, task rules, and response selections. For instance, the

effortful retrieval of an author's name or a specific anniversary date represents a direct application of internal attention (Chun et al., 2011).

Like external attention, internal attention can be deployed both voluntarily and involuntarily (Cleary et al., 2023; Gresch et al., 2024). Voluntary internal attention is goal-directed: it is the deliberate, executive-controlled allocation of processing resources to a specific internal representation in service of a current task—such as intentionally rehearsing a phone number or using a retro-cue to prioritize one memory over others (Gresch et al., 2024; Kam et al., 2022; Long, 2023). Involuntary internal attention, by contrast, is primarily stimulus-driven: it occurs when an external stimulus automatically captures the internal focus by matching features already held in memory, redirecting attention to that representation without intention (Cleary et al., 2023, 2025; van Ede et al., 2020). For example, hearing a familiar melody may automatically trigger a specific autobiographical memory, drawing internal attention to it regardless of current goals, but also one internal thought can cue another internal thought sequentially activating different representations. Ultimately, internal attention serves as the cognitive process of directing the "mind's eye" inward, allowing the individual to focus on internal goals and mental representations rather than immediate environmental stimuli (Han & Long, 2025).

How do External and Internal Attention Interact?

It is crucial to study how external and internal forms of attention interact, what interfaces between them, and how the mind switches from one to the other form of attention. As one means of examining these questions, some researchers have focused on how the contents of working memory bias the information we process when attention is oriented outwardly, and how the brain—consciously or automatically—decides where to focus (Nobre & Gresch, 2025). Other researchers have focused on how environmental conditions impact the current allocation of

resources, and how the characteristics of stimuli interact with top-down mechanisms following the SEEV (Saliency, Effort, Expectancy, and Value) model: Saliency, or the physical distinctiveness of a stimulus and how much it stands out from its background through properties like contrast or movement; Effort, representing the inhibitory cost or the physical and cognitive resources required to move attention from one location to another; Expectancy, a factor based on the observer's prior knowledge regarding the frequency and location of information; and Value, which reflects the importance or relevance of that information to the user's specific goals, this framework supports at the same time the Noticing-SEEV (NSEEV) model, predicting the probabilities of that stimuli, described with SEEV, being noticed (Wickens, 2015). While some researchers argue for the existence of independent mechanisms for external and internal attentional selection, others maintain that attention is a unitary system directed either externally or internally. For a comprehensive review of the arguments supporting both independent and unitary mechanisms, see Verschooren and Egner (2023).

What Causes Attention to Switch?

Behaviorally, the characteristics of internal and external stimuli compete to draw attention toward whichever is most relevant to the individual at any given time in a similar fashion following frameworks like NSEEV. Neurobiological evidence indicates that the hippocampus plays a central role in coordinating these transitions between internal and external attentional orientations. Specifically, tasks requiring high levels of internal attention—such as memory-guided retrieval—are characterized by increased functional connectivity between the hippocampus and the Dorsal Attention Network (DAN). This suggests that the DAN is the primary system utilized by the hippocampus to voluntarily "steer" focus toward internal mental representations. In contrast, the Ventral Attention Network (VAN) maintains a consistent level of

involvement across both internal and external states. This reflects the VAN's stable role in bottom-up attentional processing, ensuring that the individual remains capable of registering salient environmental stimuli regardless of whether their primary focus is directed internally or externally (Poskanzer & Aly, 2023).

Switches Across the External Environment

External attention allocation is based on specific characteristics described in the NSEEV model (Wickens, 2015): This framework explores external attention as a dynamic result of these environmental and cognitive variables working in tandem. However, external attention is not infallible, and the components of the mentioned model are not deterministic in isolation; rather, they represent a probabilistic combination of factors where no single variable guarantees awareness, nor does fixating on an object ensure full cognitive processing of its constituent features. Research indicates that our perception of a visual scene is incomplete and partially constructed over time, allowing even prominent changes to go unnoticed if they do not specifically capture attention, regardless of eye fixation— a phenomenon that frequently leads to a reduction in the detection of environmental changes (Simons & Chabris, 1999). A classic demonstration of this occurs when participants fail to detect a gorilla walking through a scene because their attention is occupied by a primary task, such as counting basketball passes. Recent research into attention and awareness in dynamic, naturalistic tasks—such as the performance of magic tricks—further reveals that awareness is a selective construction rather than a direct outcome of gaze. This dissociation means that individuals frequently fail to notice stimuli that appear at fixation when preoccupied with an attentionally demanding task (Kuhn et al., 2008; Kuhn & Tatler, 2005; Smith et al., 2012).

Smith et al. (2012) provided a compelling demonstration of this effect experimenting with a paradigm involving a video-recorded magic trick where a coin's identity was altered—such as a silver coin transforming into a copper one—in plain view of the observer. The participants failed to notice this change despite eye-tracking data confirming they were fixating on the object throughout the entire transformation. This suggests that fixation can be focused on an object without processing its identity or specific features, reinforcing the idea that awareness is a selective construction with multiple interacting elements rather than a direct result of gaze (Smith et al., 2012). Complementing these findings, Kuhn and colleagues also have provided evidence of object detection—or the lack thereof—through a series of studies using again magic tricks (Kuhn et al., 2008; Kuhn & Tatler, 2005). Their research, which involved recording eye fixations during both live and pre-recorded magic performances, found that the eccentricity of gaze had no significant effect on the detection of the event critical to the trick. Specifically, in one study, participants' detection of a dropping cigarette in plain view was largely independent of how far their eyes were looking from the cigarette at the moment it dropped. These findings further support the idea that fixation and attention can be dissociated: even when people look directly at an object, they may not necessarily be aware of it.

Switches from an Internal to an External Orientation.

The SEEV and NSEEV models provide again a robust framework for delineating the various mechanisms that facilitate the transition of attention from an internal orientation to external stimuli. Within a limited-resource scheme, this shift typically occurs when an internal thought or memory becomes less relevant, prompting a reallocation of processing resources toward more pressing external cues. Saliency, for example, serves as a primary bottom-up driver in this transition; for instance, a sudden loud noise or a flashing light can abruptly interrupt

internal processing and redirect focus toward the environment. Beyond pure physical saliency, top-down factors such as expectancy and value further modulate this shift. If an individual is waiting for a friend to arrive, the high expectancy and value associated with that friend's face will prioritize it over other faces in the environment, drawing the "mind's eye" outward more effectively than irrelevant external stimuli (Wickens, 2015).

Understanding this dynamic interplay is particularly vital in human factors in critical, high-reliability environments such as operating rooms or aircraft cockpits. During monotonous phases of operation—such as a pilot maintaining steady-state cruise altitude and speed—it is highly probable for an operator to drift into a state of decoupled internal attention. In these moments, the intentional design of salient external cues, such as auditory alerts or visual flashing lights, is necessary to successfully capture the operator's attention and return it to the external task environment (Wickens, 2015).

Switches Across the Internal Environment

Internal attention switches between thoughts through a dynamic and often unpredictable process, characterized by the inherent variability of internal cognition (Mills et al., 2018). When the mind is not occupied by specific task demands or intense emotional states, it tends to wander, transitioning between topics in a spontaneous manner. This continuous shift is considered an adaptive mechanism that enhances episodic memory efficiency and facilitates the integration of memories into broader semantic structures (Mills et al., 2018). By allowing thoughts to evolve, the mind can effectively de-correlate individual memories, aiding in their long-term retention and creating optimal conditions for interleaved learning.

This generation of novel mental content is thought to be fundamentally driven by hippocampal structures, from which thoughts emerge continuously. During retrieval, partial cues

(internal or external) can trigger subsequent associations, resulting in a constant stream of internal ideas. Furthermore, because consecutive spontaneous simulations tend to be de-correlated, each mental state leads to a unique cognitive pattern, distinct from the previous one (Hintzman, 2004; Mills et al., 2018). These spontaneous thoughts and involuntary autobiographical memories are inextricably linked to mind-wandering, where attention decouples from the external task to follow an internal flow (Smallwood & Schooler, 2006). This process serves a functional role in creative problem-solving by bridging unrelated concepts and fostering insight (Baird et al., 2011, 2012). Neuroscientific research confirms that these processes engage the Default Mode Network (DMN), which facilitates both the retrieval of personal history and the mental construction of future scenarios (Chen et al., 2025; Kam et al., 2022).

The emergence of a triggering cue is not strictly dependent on the presence of an external environmental cue; it can also arise spontaneously from internal cognitive processes. For example, According to Berntsen (2021), one can experience internal processes triggered by internal cues (thoughts and feelings) while mind wandering, entirely devoid of any deliberate retrieval intention. In these instances, the signal is generated through an automatic, unintentional internal association rather than a goal-directed external prompt.

Switches from an External to an Internal Orientation

Attention can dynamically shift between external and internal focuses based on situational demands and cognitive tasks, when the need arises to reflect on personal experiences, retrieve memories, or to plan future actions, attention can transition inward, engaging internal cognitive processes (Cleary et al., 2023; Fortney, 2020). This shift is often facilitated by cues that prompt introspection, such as familiar faces, a particular memory mentioned in a conversation or a math problem, which require individuals to match external perceptions with

internal representations (Cleary et al., 2025; Han & Long, 2025). The ability to switch between these attentional states is vital for effective cognitive control, enabling individuals to adapt their focus according to the context and their internal goals (Chun et al., 2011). Current research supports the Internal Dominance over External Attention (IDEA) hypothesis, which suggests an inherent cognitive bias toward internal information, this bias likely evolved because humans often operate in stable, predictable environments that allow for a heavy reliance on internal models and memories rather than constant environmental monitoring (Verschooren & Egner, 2023). Furthermore, this relationship is characterized by asymmetrical shielding; internal thought processes appear more stable and are more efficiently protected from external interference than the reverse (Narhi-Martinez et al., 2023; Verschooren et al., 2020).

External and internal attention exist in a dynamic and competitive relationship, as both processes rely on a single, limited-capacity attentional resource. This interaction is governed by a "winner-takes-all" principle at the highest level of selection, creating a cognitive bottleneck where only one source of information—whether sensory data from the environment or internally generated thoughts—can occupy the focus of attention at any given moment. To model the discrete selection mechanisms underlying this competition, the Strategic Task Overload Management (STOM) framework describes how the cognitive system manages competing tasks under high workload. STOM posits a fundamental cognitive inertia, characterizing a baseline switch avoidance where there is a heightened probability—estimated at approximately 60%—of remaining engaged in an ongoing task rather than shifting to an alternative one. In an external, perceptually driven environment, this inertia typically keeps attention anchored outwardly. However, some cues can act as strong elements that attract attention and break this cognitive inertia. Familiarity—a phenomenon where an individual senses that a current stimulus has been

encountered before, despite a failure to consciously retrieve the specific memory trace (Cleary et al., 2016) – can be one of these strong cues. As a highly salient trigger generated through global feature-matching, a powerful memory-driven familiarity signal can compete for these limited resources and disrupt the baseline switch avoidance, forcing an immediate reallocation of processing priorities toward internal retrieval. Once attention is successfully pulled inward, the retrieval process becomes the new ongoing task, inheriting a high degree of task "stickiness" and cognitive resistance due to the heavy workload of memory search and the asymmetrical shielding characteristic of internal representations. (Narhi-Martinez et al., 2023; Verschooren et al., 2020; Wickens et al., 2015).

Consequently, when internal attention is engaged, external sensory input is typically suppressed, a phenomenon known as perceptual decoupling. This necessity for frequent switching between domains incurs measurable task-switching costs, leading to slower performance and increased error rates when cognitive demands require shifting focus between the outside world and internal representations. While internal attention is essential for higher-order cognition, it can simultaneously impede optimal performance by consuming the finite resources required for external awareness. This cost is most clearly evidenced by the phenomenon of inattention blindness; as Simons and Chabris (1999) established, individuals often fail to notice significant environmental stimuli when their cognitive focus is directed elsewhere. Notably, in classic paradigms—such as the "invisible gorilla" experiment and studies involving magic tricks—the attentional competition occurs primarily between competing external stimuli. To date, however, there is comparatively little research exploring the specific mechanisms involved when attention is pulled inward.

A robust theoretical explanation for the mechanics of this perceptual decoupling can be derived from the Chris Wickens' (2015) NSEEV while the baseline SEEV model distributes steady-state visual fixations, NSEEV explicitly accounts for the fact that fixation does not guarantee awareness. The model emphasizes that detecting an external event is heavily modulated by internal cognitive workload; thus, the NSEEV framework accounts for circumstances where peripheral or concurrent events go unnoticed due to situational variables. Most notably, the model provides a precise mechanism for the modulating role of internal cognitive workload. According to Wickens, when non-visual cognitive demands increase—such as during an effortful internal memory search—the observer's functional field of view shrinks. Under this framework, an elevated internal cognitive load conceptually diminishes the probability of noticing surrounding environmental changes. This provides a clear account for how an intense inward focus essentially decouples the individual from their surroundings, making them more likely to miss elements in the environment that would otherwise be salient. Consequently, this internal-external attentional switch remains an underexplored area and represents a significant gap in the literature, offering a broad opportunity for future empirical investigation.

The functional role of this inward shift is particularly evident in the study of "insight" during problem-solving. Research by Salvi et al. (2015) indicates that internal attention is a prerequisite for the "Aha!" moment. Electroencephalogram (EEG) data shows that roughly one second before an insight solution enters consciousness, there is a sudden surge of alpha-frequency activity over the right posterior cortex. Because alpha activity in the visual cortex represents the active suppression of external input, this "alpha burst" suggests that the brain intentionally shields itself from visual distractions to facilitate internal processing (Salvi et al.,

2015). Furthermore, distinct patterns of brain activity can predict a person's solving style even before a problem appears: heightened activity in the anterior cingulate cortex (ACC) is associated with solving via insight, while stronger activity in the visual cortex correlates with a more analytical approach (Salvi et al., 2015). This neurophysiological shift may be closely related to the feeling of familiarity, from a functional perspective, it may act as the metacognitive signal that initiates this shift toward internal attention. When a stimulus shares a high degree of feature overlap with a stored representation—even if that representation is not fully accessible—the resulting sense of familiarity may trigger the suppression of external sensory noise (the alpha burst) to allow for a more intensive internal search. but the question of what properties of stimuli in the environment can prompt an inward-directed switch has not been a topic of mainstream research. a recent proposal (Cleary et al., 2023, 2025) is that the detectable familiarity of a stimulus is a factor that can drive attention from external to internal.

External-to-Internal Switch Prompts: The Familiarity-Flip-of-Attention Theory

The Primacy Effect in Memory for Repetitions

The primacy effect in memory for repetitions as described by DiGirolamo and Hintzman (1997) describes a cognitive bias where the initial presentation of a stimulus exerts a disproportionate influence on its long-term mental representation, particularly concerning perceptual details such as orientation and size. This phenomenon is underpinned by the concept of "registration without learning," wherein observers accurately track the increasing frequency of an item's occurrence across multiple repetitions while simultaneously failing to encode changes in its specific features. Consequently, details of an object, like its orientation, are significantly more likely to be retained from the first encounter than from any subsequent presentations. This suggests that the initial representation acts as a definitive template that biases all future encoding, effectively stalling the acquisition of new information once a stable mental trace is established. DiGirolamo and Hintzman's experiment used mirror-reversed drawings to demonstrate that participants were significantly more likely to attribute a specific orientation to an entire series if it appeared in the first instance rather than the last. They attributed this specific primacy effect to a top-down bias initiated by the initial encoding of a stimulus. They propose that once a mental representation is established during the first presentation, it serves as a dominant template that shapes how all subsequent encounters are processed, the cognitive system acknowledges the recurrence of an item—thereby successfully increasing frequency judgments—but fails to interrogate the stimulus for novel or altered details. Instead of updating the mental trace with new features such as changes in orientation, the brain processes subsequent repetitions as mere re-instantiations of the original instance. Consequently, while the perceived frequency of the object grows, the memory for its specific physical properties remains anchored to the first

impression, explaining why feature discrimination does not improve even after as many as fifteen repetitions.

The Familiarity-Flip-of-Attention Theory

The familiarity-flip-of-attention theory proposes a mechanism by which attention shifts from external stimuli to internal memory processes when something familiar is encountered (Cleary et al., 2025), unlike novelty, which draws attention outward for processing and encoding, familiarity acts as a signal that sends attention inward. This theory offers a more robust explanation for the primacy effect in memory for repetitions, detailing where attention is directed once a stimulus is recognized as familiar: inward toward memory. The process involves an initial outward focus of attention on a stimulus, which, upon detection of familiarity through feature matching, is then directed inward toward a memory search. This inward reorientation of attention can increase the likelihood that detail changes in the external environment will be missed, as attention is pulled away from further processing of the external stimulus

This inward shift of attention serves to reinforce memory for the attributes of the first presentation of a stimulus. When attention is directed inward for a memory search, the effort of this retrieval search increases the probability of successfully retrieving previously encoded instances of that item. Focusing attention on the internal instance, rather than the external stimulus, strengthens the memory for the details of the initial encounter. This concept aligns with findings in neuroscience suggesting that the same neural circuits can switch polarity depending on whether the orientation is external (for encoding) or internal (for retrieval) (Chun et al., 2011; Verschooren & Egner, 2023). The theory addresses the question of where attention goes once familiarity is detected and how this inward turn reinforces learning of the first presentation's attributes without interfering with reinforcement learning

Eye Gaze Evidence of Feature Extraction in Reading Processes

In their early studies on reading, the primary objective of Rayner et al. (1981) was to delineate the spatial and temporal boundaries of visual information extraction during the fixational pauses characteristic of reading. Specifically, the researchers sought to resolve disagreements regarding the size of the effective visual field and the minimum duration required for the cognitive system to fully acquire information from a printed stimulus. By employing a gaze-contingent moving window and foveal masking paradigm, they manipulated the availability of text in foveal and parafoveal regions to observe how these distinct areas contribute to semantic identification and the programming of subsequent eye movements.

The findings demonstrated that most of the visual information necessary for processing is acquired within the initial 50 ms of a fixation. While a typical fixation lasts between 200 and 250 ms, experimental data revealed that effective reading rates reached an asymptote at the 50 ms mark; increasing text availability beyond this window provided negligible gains in acquisition. This suggests that foveal and near-parafoveal information is extracted rapidly to facilitate word identification, while the remaining duration of the fixation is dedicated to higher-level cognitive integration and the calculation of the next saccade.

This 50 ms threshold provides a baseline for the current study, as it represents the timeframe in which the brain completes the extraction of essential features before potentially sending attention inward toward memory representations. Because we think that this brief exposure is sufficient to extract the features necessary to launch the global feature matching process thought to trigger a metacognitive feeling of familiarity, it marks the potential onset of attentional decoupling from external sensory input. By grounding the experimental design in this 50 ms window, we aim to isolate the moment where the "mind's eye" flips inward, utilizing the

already registered features to initiate an internal search, thereby suppressing or attenuating incoming visual inputs.

Familiarity Signaling from Global-Feature-Matching

Global matching theory posits that recognition memory decisions are based on a "global" familiarity signal generated by the parallel comparison of a test probe against all stored memory traces simultaneously. According to this framework, a sense of familiarity arises from a feature-matching process where the features of a test cue are compared to the features residing within the entire contents of memory, resulting in a familiarity signal whose intensity is determined by the cumulative degree of feature overlap (Clark & Gronlund, 1996; Digirolamo & Hintzman, 1997; Hintzman, 1988).

The third experiment in Ryals and Cleary (2012) utilized a cue familiarization methodology (a.k.a. the "POTCHBORK" paradigm) to investigate whether recognition without cued recall (RWCR)—the ability to recognize cues as familiar despite failing to recall their targets—is driven by a global feature-matching process. In this study, researchers manipulated the degree of feature overlap between non-word test cues (e.g., POTHCBORK) and studied items (e.g., PATCHWORK). For instance, a cue like "POTCHBORK" was designed to resemble either four previously studied words (e.g., PATCHWORK, PITCHFORK, PULLCORK, and POCKETBOOK), a single studied word (e.g., PATCHWORK), or no words at all. The findings revealed that cues having feature overlap with four studied items elicited significantly higher familiarity ratings during recall failure than cues having feature overlap with only one, providing empirical support for a global feature matching theory of RWCR. The results suggest that cue familiarity-detection results from a graded signal determined by the total feature overlap between the features of a cue and the features residing within the entire contents of memory. Thus, the

feature familiarization method used by Ryals and Cleary (2012) can serve as a method of examining how various degrees of cue familiarization impact other aspects of cognition. Indeed, the method has been used for this purpose in more recent research studies, such as to investigate the role of increasing levels of cue familiarity in illusory recollection (Huebert et al., 2022), and to investigate the role of increasing levels of cue familiarity in curiosity and information-seeking (Huebert et al., 2025).

The Present Study

The present study aimed to test a hypothesis born out of the familiarity-flip-of-attention theory (Cleary et al., 2025). Specifically, we asked whether systematically increasing the familiarity of a cue stimulus, via the POTCHBORK method, would decrease the likelihood of encoding its background environment into memory for later retrieval. The reasoning was as follows. If increasing cue familiarity leads to an increased likelihood of an attentional shift inward toward memory search effort, then there should be a corresponding attenuation of visual inputs around the time that attention shifts inward (Servais et al., 2023). Thus, we hypothesized that increasing cue familiarization would lead to a corresponding decrease in later remembering the surrounding background context accompanying the cue. Based on recent work by (Bair & Long, 2026), we further hypothesized that the ongoing task-related attentional orientation (External/Encoding vs. Internal/Retrieval Attentional Orientation conditions or modes) would interact with this effect. Specifically, we predicted that while in an internal attentional orientation (i.e., performing a task oriented toward trying to use the cues to retrieve information from memory), the shutting out of visual inputs with increasing cue familiarity would be lesser than while in an external attentional orientation (i.e., performing a perceptual task oriented toward processing the external environment). The reasoning was that during an internal retrieval task,

the person is already in a relative internal orientation by virtue of the task putting them into a top-down preparatory state for using the cue to search memory. Therefore, there is not as much need for a dramatic shift of attention going from outward to inward upon detecting familiarity with the cue because there is already a top-down push for it. However, during an external perceptual task, the person is in a relative external orientation by virtue of the task requiring perceptual decisions about the stimulus qualities; this was predicted to lead to a need for a more dramatic cue-based shift inward upon detecting familiarity with the cue.

To test these hypotheses, we employed the aforementioned POTCHBORK method of cue familiarization (Huebert, 2026; Huebert et al., 2022, 2025; Ryals & Cleary, 2012), which is grounded in Global Matching Theories of Memory (Clark & Gronlund, 1996; Digirolamo & Hintzman, 1997; Hintzman, 1988). The experiment consisted of three phases: 1) an initial encoding phase during which time the feature familiarization of later cues took place through the presentation of study list words (e.g., PATCHWORK, VOXEL, PITCHFORK, etc.); 2) a middle phase of cue presentation whereby the cues had varying degrees of feature familiarization from Phase 1 and were each overlaid onto a unique wallpaper background. During this phase, half of the participants were assigned to an Internal Attention orientation (i.e., using each non-word cue to try to retrieve a feature-overlapping word from the study list), and half of the participants were assigned to an External Attention orientation (i.e., deciding for each non-word cue how many vowels it contained); 3) a final test phase containing an old-new recognition memory test of the accompanying elements in the environment that were shown in Phase 2.

Based on prior research (e.g., Huebert, 2026; Huebert et al., 2022, 2025; Ryals & Cleary, 2012), the intensity of the cue familiarity signal in Phase 2 was expected to be determined by the degree of feature overlap between the cue and the Phase 1 studied items in memory (Clark &

Gronlund, 1996; DiGirolamo & Hintzman, 1997; Hintzman, 1988). Following our hypothesis, the more familiar a Phase 2 cue is, the more likely it is that attention would shift inward toward memory search effort, and that this degradation would be more pronounced among participants assigned to the External Attention orientation in Phase 2 than among participants assigned to the Internal Attention orientation. Grounded in the Strategic Task Overload Management (STOM) framework (Wickens et al., 2015) and the principle of asymmetrical shielding (Verschooren et al., 2020), when a powerful signal of cue familiarity disrupts the ongoing task orientation, the subsequent internal memory search should become a highly resilient ongoing task. This internal state should actively suppress the allocation of attention toward processing the concurrent external environment. Following the Noticing-SEEV (NSEEV) model, the heavy cognitive workload induced by this internal retrieval search was expected to cause a significant shrinkage of the observer's functional field of view. Consequently, as resources are redirected inward toward memory search, there would be a decrease in the encoding of details in the presented background environment due to the shutting out of visual inputs during the internal shift (Servais et al., 2023; Wickens, 2015). The temporal dynamics of the attentional shift inward are not yet fully understood; however, aforementioned evidence from eye-tracking research suggests that the brain can extract the features of a word and assess familiarity within the first 50 ms of a fixation, after which attention may shift inward, causing changes in the external environment to go unnoticed (Rayner et al., 1981). For this reason, a 50 ms stimulus onset asynchrony (SOA) was utilized for the presentation of the background wallpaper after the cue was displayed in Phase 2. Based on the work of Rayner et al. (1981), the features of the cue could be extracted within 50 ms to feed into a global feature-matching mechanism. This was predicted to lead to a higher likelihood of missing the background, as measured by later memory for it in Phase 3.

Chapter 2- Experiment

Method

Participants

A total of 143 undergraduate students from Colorado State University (CSU) were initially recruited for the experiment via ResearchAssist, the CSU Department of Psychology's participant pool platform. Participants received course credit for their involvement in the study. All participants were native-level English speakers and had normal or corrected-to-normal vision. The initial sample size was determined based on previous research conducted by Ryals and Cleary (2012, Experiment 3) and Huebert et al. (2022, 2025), which successfully identified cognitive familiarity effects using the POTCHBORK framework with sample sizes ranging between 50 and 60 participants per between-subjects condition.

Materials

The experiment was programmed using PsychoPy (Peirce et al., 2019) and hosted virtually on the Pavlovia platform (Pavlovia.org) to facilitate remote data collection. The institutional review board (IRB) approved informed consent document was hosted independently via Qualtrics. Utilizing automated URL redirection, only participants who explicitly reviewed and accepted the digital informed consent on Qualtrics were automatically forwarded to the Pavlovia platform to initiate the experimental tasks.

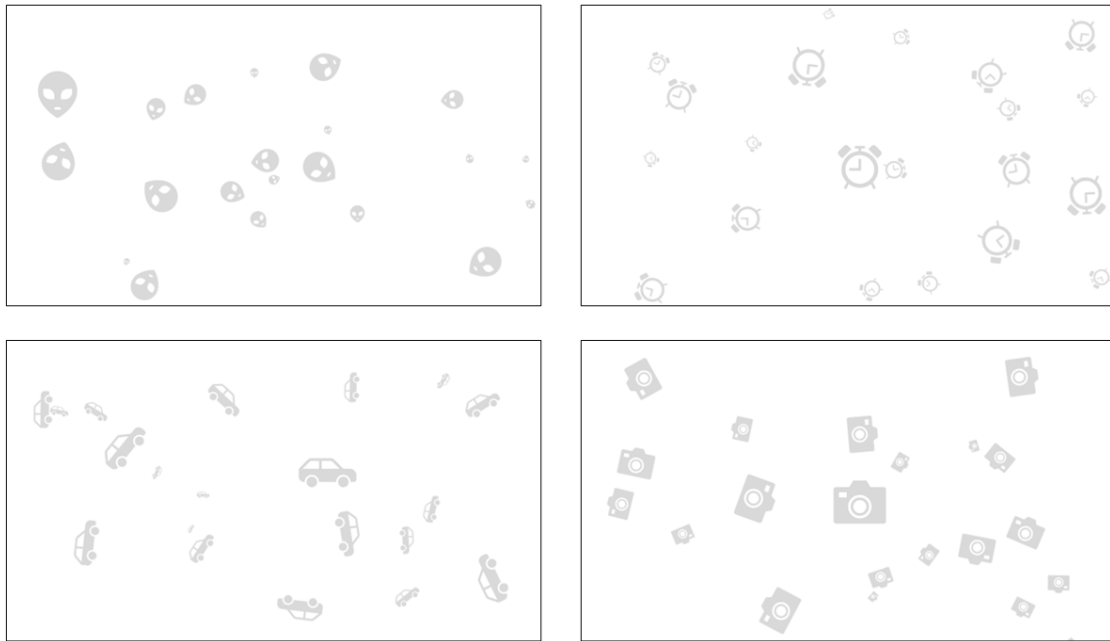
Stimulus materials were adapted from the paradigm developed by Ryals and Cleary (2012). From a pool of 96 cue-target sets, each set consisted of four words that graphemically resembled a target non-word (e.g., PATCHWORK, PITCHFORK, POCKETBOOK, and PULLCORK resembling the target non-word POTCHBORK). These 96 sets were organized into

three distinct stimulus versions to counterbalance the items across the three experimental conditions of graphemic feature overlap: high-overlap, low-overlap, and no-overlap.

Additionally, a pool of unique backgrounds was generated for the cue phase of the study using Microsoft PowerPoint (see Figure 1). Easily identifiable icons were selected from the software's native icon library to serve as the base stimuli for these background displays. To construct the backgrounds, a custom Visual Basic for Applications (VBA) macro was utilized to automate and randomize the icon parameters. For each individual background, the macro first standardized a single source icon to a base height of 4 cm and recolored it to a uniform light gray (RGB: 217, 217, 217) with no outline. The macro then automatically generated 20 duplicates of this source icon. To ensure visual uniqueness and prevent predictable patterns, the script systematically randomized three parameters for every duplicated icon: size (scaling randomly between 30% and 100% of the 4 cm base), rotation (ranging from 0° to 360°), and spatial position within the screen boundaries.

Figure 1

Examples of Generated Background Used in Phase 2



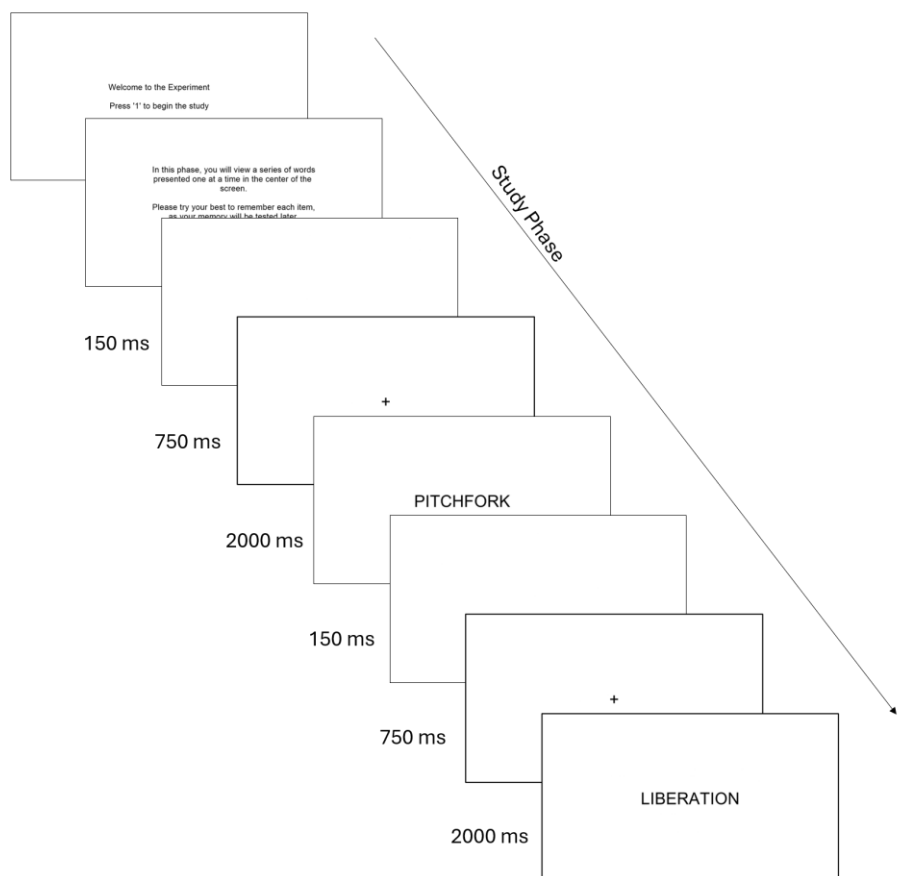
Procedure

The experiment utilized a mixed-factor design whereby cue feature-overlap condition (high vs. low vs. no feature overlap) was a within-subjects variable and attentional orientation (internal vs. external attention) was a between-subjects variable. Data collection was conducted remotely from April 23 to May 8, 2026. Prior to beginning the experiment, all participants read and signed an electronic informed consent form. Each participant completed four consecutive study-test blocks, each containing a study list of 40 words (Phase 1) followed by a test list containing 24 cues (Phase 2). Before the first study phase, participants read the following instructions on the screen: "In this phase, you will view a series of words presented one at a time in the center of the screen. Please try your best to remember each item, as your memory will be tested later. Press '1' to begin". Within each study-test block, each study list included a total of 40 words, divided as follows: 8 sets of 4 words (e.g., PITCHFORK, PATCHWORK,

POCKETBOOK, PULLCORK) that shared graphemic similarities with each other (32 words in total), and 8 unique words that shared no resemblance to each other. As illustrated in the trial sequence (see Figure 2), once the instruction screens concluded, each subsequent word was presented for 2,000 ms within a continuous trial loop; each individual word onset was preceded by a 150-ms blank screen and a 750-ms central fixation cross.

Figure 2

Study Phase Sequence



Immediately following each study phase, participants completed a test phase (Phase 2). The following instructions marked the transition: "You will now begin the test phase. You will see a series of word-like stimuli. Following each item, you will answer questions about your experience with it. Press '1' to continue." The test phase consisted of 24 non-words (e.g., POTCHBORK) that systematically varied in the degree to which they overlapped graphemically

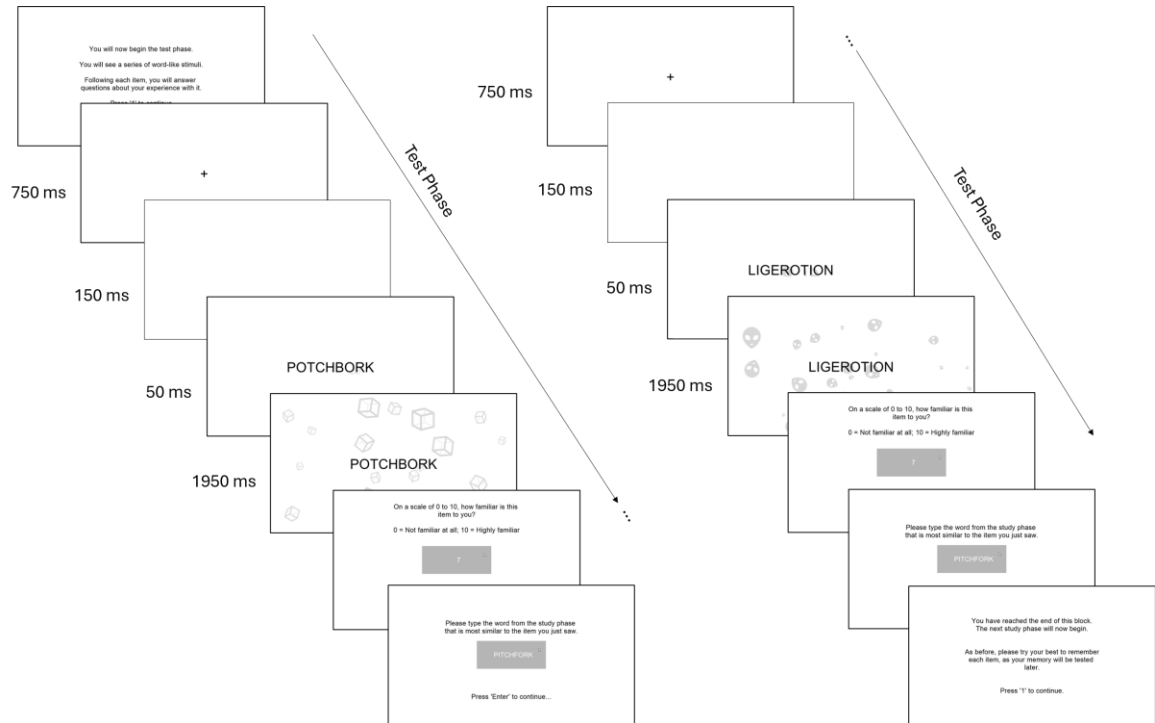
with words from the preceding study list (e.g., PITCHFORK, PATCHWORK, POCKETBOOK, PULLCORK). Eight of these non-word cues closely resembled four different study words (the high-overlap condition), eight resembled only one study word (the low-overlap condition), and eight shared no similarity with any of the study words (the no-overlap condition). This manipulation was designed to produce graded levels of familiarity based on the number of shared features between test cues and previously studied words, consistent with global matching theory.

During the test cue trials, each trial began with a 750-ms fixation cross, followed by a 150-ms blank screen. Subsequently, a non-word cue was presented alone in black text on a white background for 50 ms (following Rayner et al., 1981). Immediately thereafter, a unique background appeared behind the word for the remainder of a 2,000-ms stimulus window (i.e., 1,950 ms).

What occurred next depended on the between-subjects attentional orientation condition to which the participant was assigned, for participants assigned to the Internal Attention condition, the program prompted them to rate the familiarity of the cue using the following prompt: "On a scale of 0 to 10, how familiar is this item to you? (0 = Not familiar at all; 10 = Highly familiar)". Following this rating, a cued-recall prompt appeared on the screen: "Please type the word from the study phase that is most similar to the item you just saw." A 1,000-ms blank screen separated this typed response from the onset of the next test trial. The complete trial sequence for this condition is illustrated in Figure 3.

Figure 3

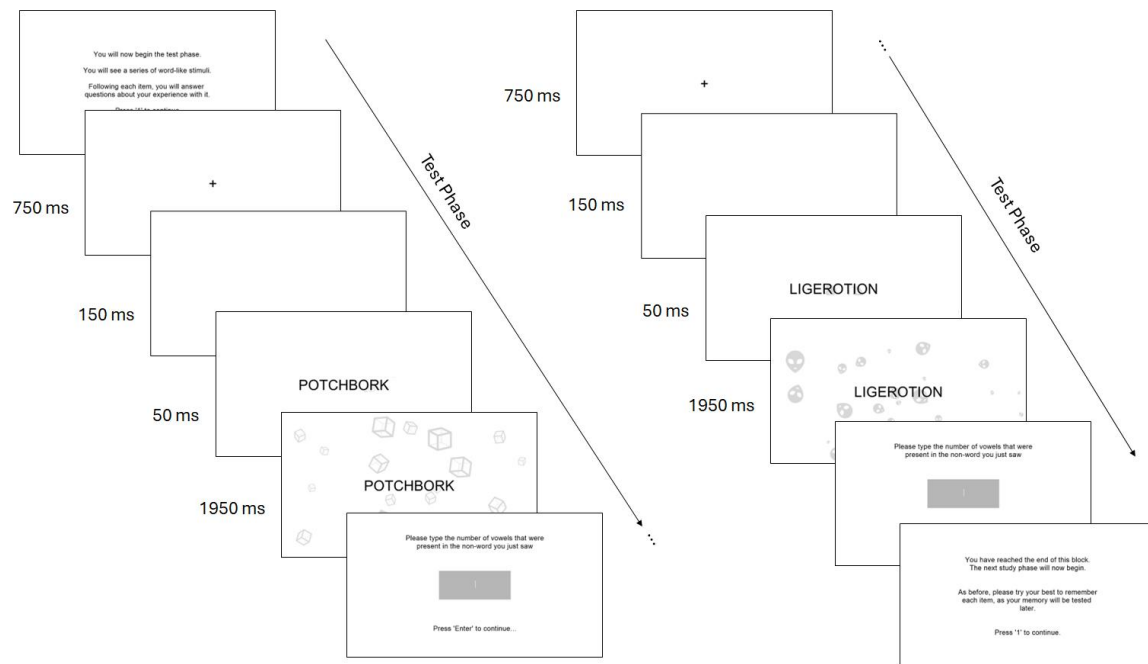
Test Phase Sequence for the Internal Attention Orientation Condition



For participants assigned to the External Attention condition, the program prompted them to perform a vowel-counting task using the following prompt: "Please type the number of vowels that were present in the non-word you just saw." A 1,000-ms blank screen separated this typed response from the onset of the next test trial. The complete trial sequence for this condition is illustrated in Figure 4.

Figure 4

Test Phase Sequence for the External Attention Orientation Condition



Regardless of the assigned attentional condition, at the conclusion of each of the first three blocks, the software presented participants with the following transition message: “You have reached the end of this block. The next study phase will now begin. As before, please try your best to remember each item, as your memory will be tested later. Press 'I' to continue.”

Following the completion of all four study-test blocks, all participants completed a final, cumulative phase (Phase 3). For this phase, participants first viewed a transition screen stating: "Please pay close attention to the following instructions. Press 'Space' to continue." To advance past this specific screen, participants were required to press the spacebar rather than the 'I' key. This key change was intentionally implemented to disrupt the motor conditioning established during the previous phases, ensuring that participants did not inadvertently bypass the critical

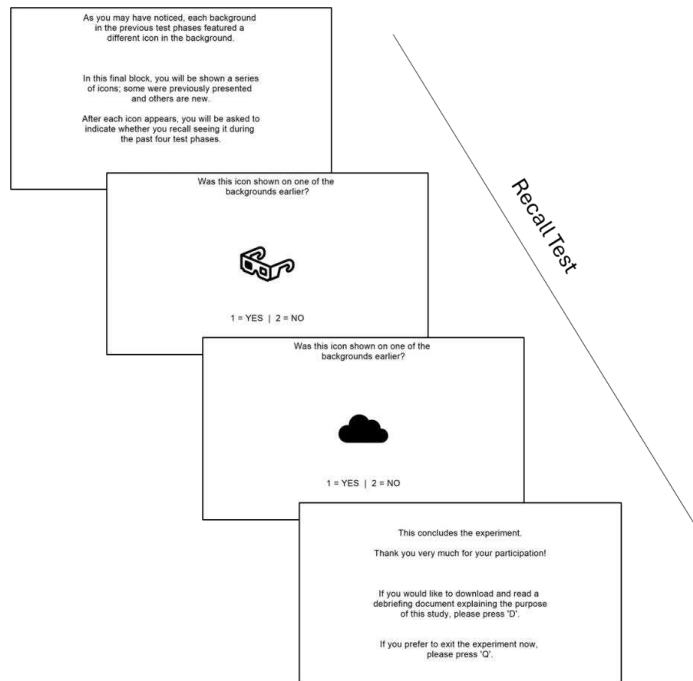
upcoming instructions due to habitual key pressing. The specific phase instructions immediately followed: "As you may have noticed, each background in the previous test phases featured a different icon in the background. In this final block, you will be shown a series of icons; some were previously presented and others are new. After each icon appears, you will be asked to indicate whether you recall seeing it during the past four test phases. Press '1' to begin the phase."

To generate the stimulus library for this final phase, the program first categorized all previously presented icons into three independent pools based on their experimental condition: high-overlap, low-overlap, and no-overlap. Next, the program completely randomized the order of the items within each independent pool. This procedure ensured that icons presented earlier or later in the experiment had an equal probability of selection. The script then extracted exactly 15 icons from each randomized pool. Finally, the software combined these extracted items with 15 completely novel icons—serving as a baseline—into a single master test list of 60 items that were once more randomized for a final stimuli pool.

During this final test sequence (see Figure 5), a recognition task was conducted using these 60 selected icons. The software presented each icon in black on a white background, accompanied by the prompt: "Was this icon shown on one of the backgrounds earlier? 1 = YES | 2 = NO". To prevent premature or accidental responses, the response prompt appeared only after a 1,000-ms delay. Keypresses were neither registered nor logged until this delay had elapsed.

Figure 5

Recall Test Sequence



To rule out potential confounding variables and to guarantee that any subsequent differences in memory performance were driven by the attentional manipulation itself rather than discrepant cognitive demands between groups, metrics of behavioral and subjective difficulty were established. The experimental software silently logged participants' response times (RT) during the test phases—specifically the latency of the familiarity rating in the Internal Attention condition and the vowel-counting task in the External Attention condition—to serve as an index of behavioral processing speed. Additionally, upon completing the experimental blocks, participants provided a subjective difficulty rating on a scale from 0 to 7 to evaluate the perceived difficulty of their overall task. This combination of online latency tracking and post-

experiment evaluation was implemented to monitor cognitive effort and task demands across both experimental groups.

Following the completion of the subjective difficulty evaluation, the software displayed a concluding screen to thank participants and offer a debriefing document. The screen presented the following message: "This concludes the experiment. Thank you very much for your participation! If you would like to download and read a debriefing document explaining the purpose of this study, please press 'D'. If you prefer to exit the experiment now, please press 'Q'". Depending on the key pressed, the program either presented the IRB-approved debriefing document on screen or terminated the experimental session. The entire experimental session for each participant lasted approximately 1 hour.

Chapter 3 – Results

Data Processing and Cleaning

Prior to the primary analyses, a two-step data cleaning procedure was performed on the initial sample of 143 participants following a multiple-hurdle approach (Curran, 2016) to identify non-compliant behavioral patterns of careless or insufficient effort responding, as well as extreme anomalies. First, response times (RT) were analyzed to identify non-compliant behavior, specifically targeting extremely short latencies that denote arbitrary or careless responding, as well as excessively long latencies that indicate a lack of concentration or engagement with the task. To address the inherent skewness of behavioral latencies, a natural log transformation was applied to the raw response times to normalize the distribution, and a culling procedure based on these transformed latencies was implemented. This filter led to the exclusion of one extreme outlier whose overall response time exceeded 3 standard deviations from the log-transformed ($\log(\text{RT})$) sample mean (i.e., $\log(\text{RT}) > 2.630$, which is equivalent to raw response times greater than 13.87 s) (Ratcliff, 1993). Second, following a LongString analysis (Meade & Craig, 2012), nine participants were excluded from the remaining 142 participants due to extreme response invariance. This was defined as selecting the exact same response option on 90% or more of the experimental trials, indicating arbitrary key-pressing rather than active cognitive processing. These sequential filters resulted in a final sample of $N = 133$ participants ($n = 68$ in the Internal Attention group; $n = 65$ in the External Attention group).

Data Analysis

Main Analysis

A 2 (Attentional Orientation: External Attention vs. Internal Attention) x 3 (Graphemic Feature Overlap: High Overlap vs. Low Overlap vs. No Overlap) mixed-factorial ANOVA was conducted to evaluate peripheral background (wallpaper) icon recognition performance, indexed by Phase 3 hit rates. Mauchly's test indicated that the assumption of sphericity was significantly violated, $p < .05$, and therefore, Greenhouse-Geisser corrections were systematically applied.

The analysis revealed a statistically significant main effect of Graphemic Feature Overlap, $F(1.89, 247.74) = 5.03$, $MSE = .016$, $p = .008$, indicating that systematic variations in cue familiarity in Phase 2 reliably altered peripheral memory encoding of the background details accompanying the cue (see Figure 6). In contrast, the main effect of Attentional Orientation was not statistically significant, $F(1, 131) = 0.50$, $MSE = .122$, $p = .480$, finding no evidence that an external or internal orientation task affected the encoding of the background details relevant for Phase 3 recognition performance. The interaction between Graphemic Feature Overlap and Attentional Orientation was not statistically significant, $F(1.89, 247.74) = 0.07$, $MSE = .016$, $p = .920$, indicating that the main effect of Graphemic Feature Overlap was not qualified by a significant interaction with task-driven attentional orientation (external vs. internal task orientation).

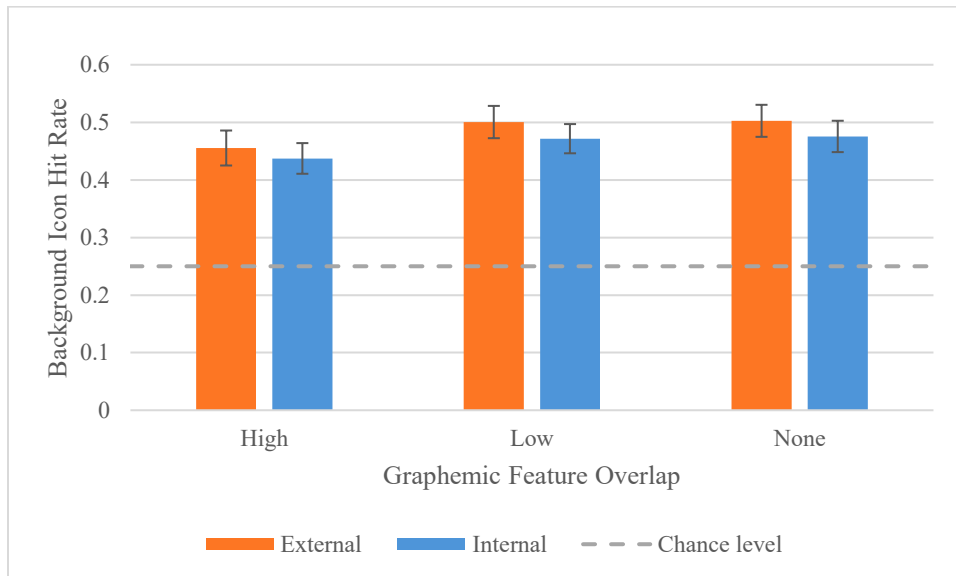
Pairwise comparisons reveal the nature and direction of the effect of Graphemic Feature Overlap (i.e. cue familiarization) condition on later background wallpaper icon recognition. For participants assigned to the External Attention condition (represented by the orange bars in Figure 6), the analysis confirmed that peripheral background memory degradation was driven selectively by crossing a high threshold of feature interference. Looking at the orange bars,

visual recognition performance was significantly lower in the High feature overlap condition ($M = .46$, $SD = 0.24$) compared to both the Low feature overlap condition ($M = .50$, $SD = 0.23$), $t(64) = -2.37$, $SE = .02$, $p = .021$, Cohen's $d = -0.29$, and the None baseline condition ($M = .50$, $SD = 0.22$), $t(64) = -2.15$, $SE = .02$, $p = .035$, Cohen's $d = -0.27$. In contrast, the comparison between the Low overlap and None baseline orange bars was far from statistical significance, $t(64) = -0.09$, $SE = .02$, $p = .926$, Cohen's $d = -0.01$, demonstrating that lower levels of graphemic overlap did not disrupt environmental encoding during the external perceptual task.

An identical descriptive trajectory was observed for participants in the Internal Attention condition (represented by the blue bars in Figure 6). Planned conditional post-hoc comparisons revealed a descriptive drop in background recognition performance for the High feature overlap condition ($M = .44$, $SD = 0.22$) relative to both the Low feature overlap condition ($M = .47$, $SD = 0.21$), $t(67) = -1.89$, $SE = .02$, $p = .064$, Cohen's $d = -0.23$, and the None baseline condition ($M = .48$, $SD = 0.22$), $t(67) = -1.73$, $SE = .02$, $p = .089$, Cohen's $d = -0.21$. Replicating the high-threshold pattern, no statistically significant differences were detected between the Low overlap and None baseline, $t(67) = -0.17$, $SE = .02$, $p = .869$, Cohen's $d = -0.02$, confirming that lower levels of graphemic overlap did not alter environmental encoding during the internal attention task.

Figure 6

Mean Background Icon Hit Rates as a Function of Graphemic Feature Overlap and Attentional Orientation



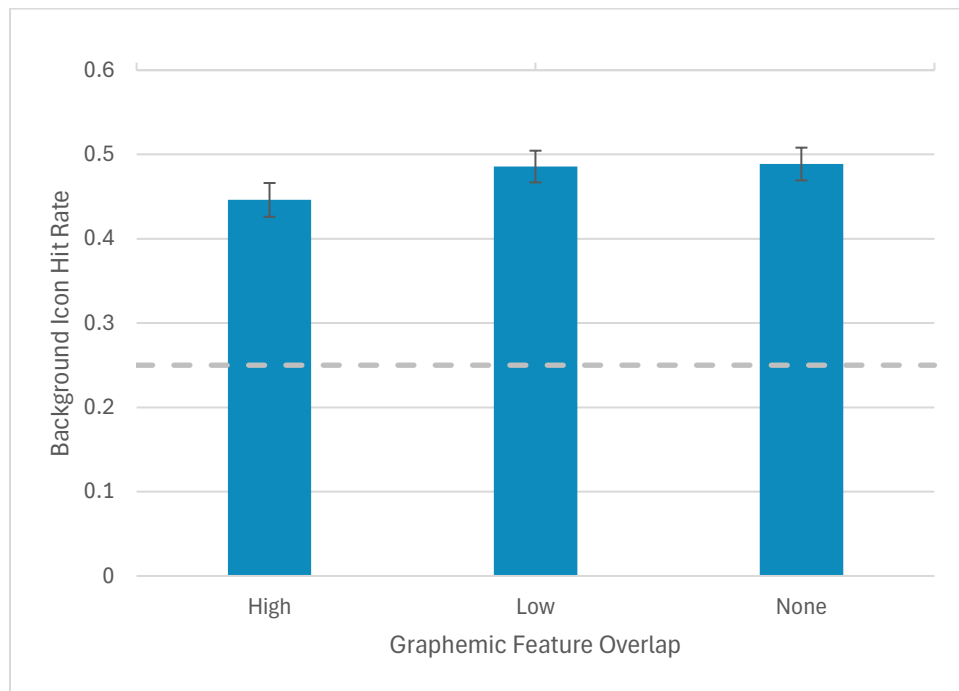
Note. Error bars represent standard errors of the mean. The grey dashed line indicates chance-level performance (.25), calculated based on the 25% proportion of new items in the recognition task, with an overall false alarm rate of .28 across conditions. A significant reduction in background hit rates is observed only when graphemic feature overlap reaches a high-threshold level.

Given that the mixed-factorial ANOVA revealed no significant main effect of Attentional Orientation on later visual icon recognition ($p = .480$) and that the interaction term was also not significant ($p = .920$), the data from the External Attention ($n = 65$) and Internal Attention ($n = 68$) conditions were collapsed into a single aggregate sample of $N = 133$ participants. Pooling the data in this manner eliminates redundant between-groups variance and maximizes statistical power, allowing for a unified assessment of the main effect of Graphemic Feature Overlap on background memory performance. To deconstruct this significant main effect, post-hoc pairwise comparisons were executed on the aggregate Phase 3 wallpaper icon hit rates utilizing the Holm-Bonferroni correction. The inferential analyses confirmed that this memory degradation was driven specifically by high levels of feature overlap, as peripheral background icon recognition performance was impaired only when the stimuli reached a high threshold of graphemic feature

overlap (see Figure 7). Specifically, participants demonstrated a statistically significant decrease in icon recognition performance when comparing the High feature overlap condition ($M = .45$, $SD = 0.23$) against both the Low feature overlap condition ($M = .49$, $SD = 0.22$), $t(131) = -3.02$, $SE = .01$, $p = .009$, Cohen's $d = -0.18$, and the None baseline condition ($M = .49$, $SD = 0.22$), $t(131) = -2.74$, $SE = .02$, $p = .014$, Cohen's $d = -0.19$. In contrast, the comparison between the Low feature overlap condition and the None baseline condition failed to reach statistical significance, $t(131) = -0.18$, $SE = .02$, $p = .854$, Cohen's $d = -0.01$, demonstrating that low-level overlap was insufficient to disrupt environmental encoding.

Figure 7

Main Effect of Graphemic Feature Overlap on Peripheral Background Recognition



Note. Aggregate Phase 3 background wallpaper icon hit rates as a function of graphemic feature overlap (cue familiarization) condition across the pooled sample ($N = 133$). Error bars represent standard errors of the mean. The grey dashed line indicates chance-level performance (.25), calculated based on the 25% proportion of new items in the recognition task, with an overall false alarm rate of .28. Paired-samples t-

tests revealed that recognition performance in the high-overlap condition was significantly lower compared to both the low-overlap and no-overlap baselines. There was no statistically significant difference between the low-overlap and no-overlap conditions.

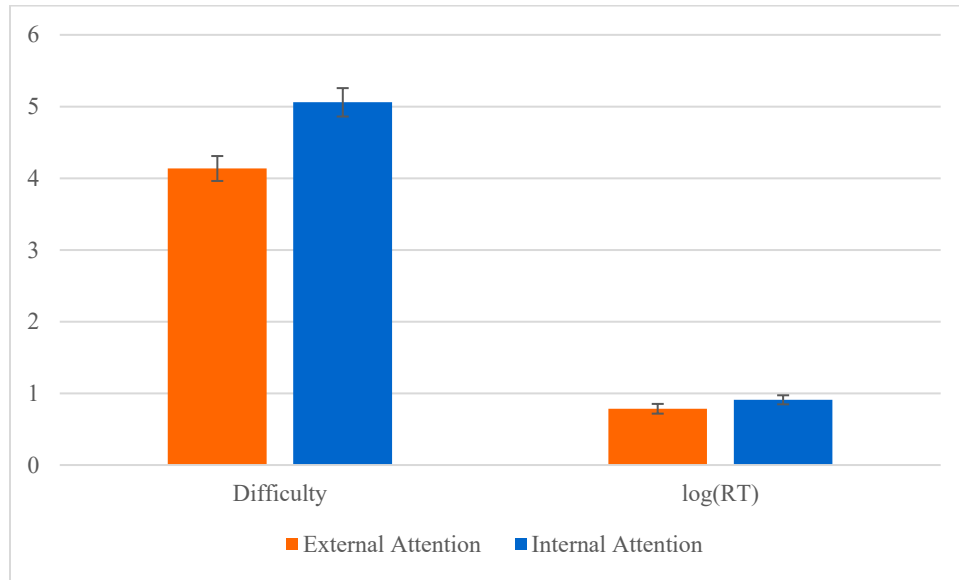
Perceived Difficulty and Response Times

To rule out the possibility that the observed lack of a significant main effect or interaction regarding Attentional Orientation was artificially obscured or confounded by discrepant cognitive demands between groups, a series of control analyses was executed. Independent samples t-tests were performed on both the log-transformed response times (log(RT)) and the subjective difficulty ratings. First, the assumption of homoscedasticity was evaluated; Levene's test confirmed equal variances across groups for both subjective difficulty, $F(1, 131) = 1.79$, $MSE = .122$, $p = .183$, and log(RT), $F(1, 131) = 0.47$, $MSE = .122$, $p = .493$, justifying the use of standard Student's t-tests.

The analysis of behavioral processing speed via log(RT) revealed no statistically significant differences between groups, demonstrating equivalent baseline processing latencies between the External Attention condition ($M = 0.80$, $SD = 0.58$; represented by the orange log(RT) bar in Figure 8) and the Internal Attention condition ($M = 0.94$, $SD = 0.54$; represented by the blue log(RT) bar in Figure 8), $t(131) = -1.45$, $SE = .10$, $p = .149$, Cohen's $d = -0.25$. This equivalence suggests that participants across both groups expended a comparable amount of behavioral effort and time when processing the experimental stimuli. In contrast, a highly significant difference emerged regarding subjective difficulty, $t(131) = -4.06$, $SE = .26$, $p < .001$, Cohen's $d = -0.70$. Participants in the Internal Attention condition rated the task as significantly more demanding ($M = 5.15$, $SD = 1.57$; represented by the blue Difficulty bar in Figure 8) than those assigned to the External Attention condition ($M = 4.09$, $SD = 1.42$; represented by the orange Difficulty bar in Figure 8).

Figure 8

Mean Subjective Difficulty Ratings and Log-Transformed Response Times as a Function of Attentional Orientation



Taken together with the non-significant terms of the mixed ANOVA, these control findings suggest that while the internal attentional orientation task successfully managed to impose a significantly higher subjective cognitive load, this perceived increase in difficulty did not confound or modulate performance between the two experimental groups and it could be a case of metacognitive disconnect between what the participant thinks is experiencing and the reality of an objective behavior (Cleary & Rhodes, 2023).

Chapter 4 – Discussion

The primary objective of the present study was to empirically test the familiarity-flip-of-attention theory (Cleary et al., 2025) by determining whether encountering a highly familiar cue redirects attention inward, thereby reducing the likelihood that accompanying background visual details will be registered. This hypothesis was supported in that cues that had been highly familiarized through a high degree of graphemic feature overlap with previously studied items had their accompanying background wallpaper details more poorly encoded for later recognition than cues that had only been slightly familiarized or not familiarized at all. This pattern persisted regardless of whether the assigned task required an external or an internal orientation, suggesting that the effects of high cue familiarization on directing attention inward and away from encoding the perceptual environment accompanying the cue were relatively automatic in nature, occurring regardless of whether the attentional focus had been on external stimulus properties (counting vowels) or on internal retrieval effort (using the cue to try to retrieve something similar from the earlier viewed study list). Thus, high familiarity appears to redirect attention inward toward memory regardless whether the top-down orientation had been external or internal.

This outcome offers empirical evidence that the detection of familiarity--driven by a global feature-matching process (Hintzman, 1988)--acts as a powerful metacognitive trigger. Within just 50 ms of visual exposure (Rayner et al., 1981), this familiarity signal is sufficient to break the baseline cognitive inertia described by the STOM framework, forcing the cognitive system to reallocate limited resources away from external sensory processing and inward toward episodic retrieval.

An interesting nuance revealed by the data is the non-linear, high-threshold nature of this perceptual decoupling. While the high-overlap condition produced a significant deficit in

peripheral background memory, the low-overlap condition failed to produce any measurable degradation compared to the completely novel baseline. This suggests that familiarity-driven memory suppression does not operate on a simple continuous gradient where any degree of feature similarity proportionally distracts the observer. Instead, the mechanism appears to require a critical mass of global feature overlap to successfully "hijack" the attentional system. If the familiarity signal does not cross this high threshold, the cognitive system successfully maintains its outward focus, allowing for the uninterrupted encoding of the visual scene. This threshold effect aligns with the concept of STOM (Wickens et al., 2015); the mind will only incur the high cognitive cost of switching to an internal state if the bottom-up familiarity signal is sufficiently overwhelming. Once initiated, attention remains protected by asymmetrical shielding, thereby hindering the encoding of information from the environment.

Another important theoretical implication of the present study concerns the lack of statistical evidence for an interaction between cue familiarity and the participants' ongoing, task-driven attentional orientation. We originally hypothesized, drawing from Bair and Long (2026) , that participants already engaged in an internal, top-down retrieval task would experience less perceptual decoupling than those engaged in a purely external, perceptual task. However, the data did not support this prediction: the background memory degradation caused by high-overlap cues did not differ significantly across both the internal and external attention groups. This null interaction suggests that the familiarity-flip-of-attention operates as an independent, highly automatic bottom-up mechanism. When a stimulus breaches the high-overlap threshold, the resulting inward pull of attention may be obligatory, such that it completely overrides the observer's current task regardless of the top-down orientation. That is, the familiarity signal may

force a momentary disruption unmodulated by what the person was intentionally trying to achieve in that exact moment.

To fully understand the mechanics of this apparent high-threshold perceptual decoupling, the familiarity-flip-of-attention can be mapped directly onto the four parameters of the SEEV (Saliency, Effort, Expectancy, Value) model of attention allocation (Wickens, 2015). First, regarding Saliency, the data suggests that familiarity acts as a powerful form of internal, cognitive saliency. Second, regarding Expectancy, this signal likely triggers a predictive cognitive state; because the brain inherently operates as a predictive engine, an existing representation—or one that overlaps enough features—becomes an expected stimulus more than the stimuli that is non-existent as a representation. The dynamics of Effort and Value explain both the threshold nature of the effect and its possible immunity to task modulation. In terms of Effort, shifting attention away from an ongoing external task involves a significant inhibitory cost, or cognitive inertia (Wickens et al., 2015). The finding that only the high-overlap condition induced memory suppression indicates that low-level familiarity lacks the "activation energy" required to overcome this effortful barrier. However, once the high threshold is breached, the principle of asymmetrical shielding (Verschooren et al., 2020) takes effect: it is cognitively easier to be pulled into an internal state than to break out of it, locking the observer into the retrieval mode reducing the likelihood of registering elements from the environment. Finally, regarding Value, the absence of statistical evidence for an interaction with the task-driven attentional state suggests that the value of familiarity is not determined by transient experimental instructions. Whether a participant was instructed to count vowels (low internal value) or retrieve a memory (high internal value), the high-overlap cue altered performance comparably across conditions. This suggests that familiarity may hold an intrinsic, highly prioritized evolutionary

value for the human brain. The imperative to identify and process known entities in the environment appears to be sufficiently fundamental to navigating the world that its intrinsic value overrides and supersedes the value of any concurrent, task-specific goals.

The automaticity of this familiarity-driven perceptual decoupling carries significant implications for applied human factors, particularly within high-reliability environments such as aviation, driving, or surgical settings. In these domains, operators are often required to maintain sustained external attention to monitor dynamic, fast-paced systems. However, our findings demonstrate that if a highly familiar stimulus abruptly enters the visual field, the resulting inward shift of attention is not merely a voluntary reallocation of resources, but an involuntary and mandatory cognitive reflex. This suggests that an operator cannot simply "choose" to ignore a powerful familiarity signal to maintain external vigilance, importantly, as established in the introduction, this disruptive familiarity signal need not originate exclusively from external environmental cues; a spontaneous internal thought or association can possibly trigger a powerful sense of familiarity. Whether prompted by an external object or an internal thought, if the familiarity signal crosses the critical threshold, the operator's cognitive system may momentarily attenuate the processing of external sensory input, regardless of their primary task demands. Consequently, this automatic internal shift provides a mechanistic explanation for severe, real-world instances of failing to notice external events, detailing exactly how and why operators might experience a lower likelihood of detecting critical visual warnings or sudden environmental changes simply because their "mind's eye" has been involuntarily hijacked by a familiarity-induced memory search.

Furthermore, this threshold effect provides a novel theoretical lens through which to interpret the established dissociation between visual fixation and conscious awareness, a

phenomenon extensively documented in the literature on magic performance. Research by Kuhn and Kuhn et al. (2008; 2005) and Smith et al. (2012) has consistently demonstrated that observers can fixate directly on a changing object, yet remain completely unaware of the physical alteration due to cognitive misdirection. While traditional misdirection often relies on manipulating external, bottom-up saliency to draw the eyes away, our findings suggest that internally-directed attention can act as a covert form of cognitive misdirection. If an environment or a performer introduces a highly familiar cue, the observer's cognitive could be automatically pulled inward to process the familiarity signal. During this brief temporal window of internal retrieval, the functional field of view shrinks, and a form of perceptual decoupling occurs. Thus, even if the observer's eyes remain physically fixated on the critical external event, the reduction in the encoding of external sensory input prevents information from reaching conscious awareness, confirming that conscious seeing is not merely a function of physical gaze direction, but relies on a critical interplay between where the eyes look and where internal attention is allocated.

Chapter 5 – Future Directions

While the present study provides robust evidence for the automatic, high-threshold nature of familiarity-driven perceptual decoupling, several avenues remain open for future empirical investigation. First, future work should systematically manipulate the temporal dynamics of initial cue exposure to test the boundaries of early feature extraction. Although the current paradigm successfully utilized a fixed 50 ms stimulus onset asynchrony (SOA) based on reading-rate baselines (Rayner et al., 1981), future studies should vary the exposure interval. As noted by Rayner (2009), human visual exploration typically operates at a scanning rate of approximately three times per second (~300 ms windows). Therefore, future research should examine whether a 50 ms window represents an ideal threshold or if longer exposure durations alter the effect, tracking the micro-temporal dynamics of attention as it toggles back and forth between internal and external states to determine how long it takes for cognitive resources to turn back outward once an inward redirection has been triggered. Systematically altering these temporal windows would clarify how the speed of feature extraction directly impacts global feature-matching and the subsequent encoding likelihood of surrounding elements. Investigating these dynamics could lead to the identification of optimal temporal windows during which peripheral information can be safely presented in the visual workspace in critical tasks. Additionally, future work should explore whether intensifying the cue familiarization protocol even further could cross an extreme threshold capable of inducing a more severe phenomenon akin to “inattention blindness” (Simons & Chabris, 1999).

Second, future research should integrate high-resolution eye-tracking methodologies to precisely delineate the visuo-spatial and oculomotor dynamics underlying this attentional switch. Eye-tracking would allow researchers to investigate the occurrence of gaze aversion –the

systematic tendency for individuals to look away from central fixation (Servais et al., 2023). Tracking whether the magnitude of gaze aversion (eccentricity and time) correlates with the degree of graphemic feature overlap would provide a real-time behavioral indicator of the exact moment the attention flips inward.

Third, to broaden the generalizability of these findings, future studies should transition from static 2D computer displays and theoretical word-based stimuli to 3D environments or Virtual Reality (VR) simulations, moving toward more ecologically valid testing environments is crucial for human factors applications. In a more immersive atmosphere, researchers could introduce different levels of environmental changes (e.g., a warning light shifting color or an object appearing/disappearing from the periphery) during high-threshold familiarity triggers. Testing this mechanism in high-fidelity simulations could clarify how familiarity-driven attentional redirection impacts performance during complex, multi-modal tasks, such as simulated flight or driving operations, where the costs of perceptual decoupling are highest.

Fourth, future designs should manipulate external and internal ongoing task difficulty. Implementing a more demanding (higher cognitive cost) outward-directed perceptual task or inward-directed cognitive load in phase 2, this could clarify whether the engaged processing mode modulates the subsequent encoding of environmental information.

Fifth, while the current experiment focused exclusively on visual inputs, previous research has successfully demonstrated the robustness of the POTCHBORK paradigm using auditory stimuli (Cleary et al., 2016; McNeely-White et al., 2021, 2022). This cross-modal transition opens critical questions regarding whether auditory familiarity signals possess the same powerful, high-threshold capacity to override ongoing tasks, flip attention inward, and attenuate the processing of surrounding auditory details. Furthermore, future research should

explore intermodal attentional capture by combining sensory modalities. Specifically, it remains to be determined whether an intense, internally directed memory search triggered by visual familiarity can impair the concurrent processing of auditory inputs, or conversely, whether an auditory familiarity trigger can reduce detail encoding in the visual modality. Investigating these cross-modal and intermodal dynamics would clarify whether familiarity-driven perceptual decoupling operates as a localized, modal-specific suppression mechanism or as a centralized, multi-modal cognitive bottleneck that temporarily insulates the internal world from external sensory streams.

Finally, future investigations should combine the POTCHBORK framework with neurophysiological measures, such as electroencephalography (EEG), to map the neural time-course of this automatic mechanism. Specifically, researchers could analyze whether breaching the high-overlap familiarity threshold triggers an immediate post-stimulus surge in alpha-frequency activity over the posterior visual cortex, which serves as a neurophysiological marker for the active suppression of external sensory noise (Salvi et al., 2015).

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