Received: 29 April 2021 | Revised: 19 February 2024 | Accepted: 22 February 2024

DOI: 10.1002/job.2787

RESEARCH ARTICLE

WILEY Journal of Organizational Behavior

A neurocognitive framework of attention and creativity: Maximizing usefulness and novelty via directed and undirected pathways

Gillian B. Yeo[1] | Nicole A. Celestine[1] | Sharon K. Parker[2] | March L. To[3] | Giles Hirst[4]

[1]Business School, University of Western Australia, Crawley, Western Australia, Australia

[2]Centre for Transformative Work Design, Curtin University, Perth, Western Australia, Australia

[3]Graduate School of Business and Law, RMIT University, Melbourne, Victoria, Australia

[4]Research School of Management, Australian National University, Canberra, Australian Capital Territory, Australia

Correspondence
Gillian B. Yeo, Business School, University of Western Australia, Crawley, Western Australia 6009, Australia.
Email: gillian.yeo@uwa.edu.au

Funding information
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Summary

Coming up with creative ideas is not easy. In this conceptual article, we integrate organizational behavior, cognitive psychology, and neuroscience literatures to propose that different forms of attention may be a key to maximizing creative usefulness and novelty. Specifically, we develop a neurocognitive framework of attentional control to propose differential pathways from creative goal-directed attention (a narrow and selective focus) to deliberate information processing, and from undirected attention (a wide and unconstrained focus) to spontaneous information processing. These propositions have implications for creative usefulness and novelty, respectively—namely, that creative goal-directed attention should facilitate the usefulness of creative outputs to a greater extent than their novelty, whereas undirected attention should promote the novelty of creative outputs to a greater extent than their usefulness. Our framework further suggests that time spent experiencing creative goal-directed attention followed by undirected attention is the optimal sequence for maximizing both the usefulness and novelty of creative outputs. In combination, our framework advances theoretical understanding of attentional pathways to creative outcomes and offers practical implications for maximizing creative potential at work.

KEYWORDS
attention, creativity, information processing, neurology

1 | INTRODUCTION

Creative ideas underpin organizational and industry transformation and have huge payoffs (Amabile et al., 1996; Berg, 2016). There is consensus that truly creative ideas possess both usefulness and novelty (Boot et al., 2017; Harvey & Berry, 2023; Litchfield et al., 2015). Examples like Tesla's battery technology, the Apple iPhone, Walt Disney animations, Canva graphic design, and Medtronic medical devices all demonstrate how ideas that are useful and novel can underpin commercial success. However, there is consensus that organizations often fail to reach their creative potential (Bloom et al., 2020). Statistics have evidenced the decline of creativity globally ("It's not just a fiscal fiasco," 2023), and particularly in the West (Naudé, 2019), with some examples suggesting a lack of novelty (e.g., an insufficient number of breakthrough ideas being generated, such as in mobile phone technologies; Petro, 2019) and others

suggesting a lack of usefulness (e.g., Facebook's Metaverse and Google Glass, both of which were abandoned by investors in the technology sector after lacking a clear case for utility; Zitron, 2023). This landscape points to the importance of understanding the processes that maximize creativity (Harvey & Berry, 2023).

The organization- and industry-level transformations we illustrate are ultimately seeded from the creative ideas of individuals (Hua et al., 2022). Consequently, the approaches by which employees generate creative ideas, and the degree to which these approaches maximize creative usefulness versus novelty (Harvey & Berry, 2023), are important for valued outcomes such as downstream innovation and commercial success. Several fields, including organizational behavior (OB; Anderson et al., 2014; Zhou & Shalley, 2003), neuroscience (Dietrich, 2004), and cognitive psychology (Tierney & Farmer, 2002), have taken an interest in such individual-level antecedents of creativity. Integrating these literatures suggests consensus that different modes of attention may play a central role in shaping creative outcomes by facilitating distinct pathways to usefulness and novelty, thereby delineating the primary focus of this paper.

Attention reflects a cognitive resource that can be directed toward various entities to process information (Esterman & Rothlein, 2019) and has long been considered a core building block of human functioning (James, 1890) and creativity (Zabelina, 2018). Research from various disciplines has shed light on this phenomenon. In the domains of OB and psychology, findings employing De Dreu and colleagues' (e.g., De Dreu et al., 2008; Nijstad et al., 2010) dual pathway model reveal that attention can be shaped by momentary stimuli or affective states—positive activation is presumed to foster creativity by broadening attention to multiple cognitive categories, while negative activation is presumed to foster creativity by narrowing attention to goal discrepancies. Relatedly, several studies have shown that goals (i.e., attention directed toward a desired state; Asplund et al., 2010) enhance creativity (Madjar & Shalley, 2008; Schweisfurth & Greul, 2023; Shalley, 1991). The OB literature also suggests that some mental states likely underpinned by undirected attention (see *Distinguishing Attention from Mental States*) may facilitate certain aspects of creativity. For instance, daydreaming (Christoff et al., 2016) has been linked with "aha!" moments (Baer et al., 2021; Dane, 2018). In the cognitive psychology and neuroscience literatures, research points to differential effects for creativity when attention is task-focused versus non-task-focused (understood in terms of the extent to which attention is governed by top-down cognitive control; Benedek et al., 2014; Benedek & Fink, 2019), and there is a growing interest in mapping this task versus non-task focus to activation in different brain regions (Koechlin & Summerfield, 2007). Relatedly, there is an increasing suggestion across each of the abovementioned literatures that two forms of information processing (how attended-to information is processed; deliberate vs. spontaneous) are both important for creativity yet may lead to different creative outcomes (Dietrich, 2019a; George, 2007; Xie et al., 2021).

Despite this converging evidence that attention is an important antecedent of creativity, we see two key issues hindering progress. First, much research has considered attentional antecedents of creativity in contexts where there is a goal (even if implicit) to be creative, such that the goal invokes attention governed by top-down cognitive control and deliberate information processing (Christoff et al., 2016; O'Reilly et al., 2010). This is evident in the laboratory, when tasks require participants to be creative (e.g., Beaty et al., 2015; Sunavsky & Poppenk, 2020), and in the field, when engagement in creativity (at both between-person and within-person levels) implies the existence of a creative goal or problem to be solved (To et al., 2012; Zhang & Bartol, 2010; e.g., "I think about the problem from multiple perspectives" and "I spend considerable time trying to understand the nature of the problem"). This approach aligns with the view that creativity is usually goal directed (Madjar & Shalley, 2008; Shalley & Koseoglu, 2013) but does not account for the potential importance of non-goal-directed forms of attention for creative output. Second, most research has conceptualized and/or operationalized creativity "overall" rather than disentangling characteristics of usefulness versus novelty. For example, Zhou and George's (2001) extensively cited that measure of creativity assesses the degree to which employees champion creative ideas in general (e.g., in R&D, Shin & Zhou, 2003; software development, Gumusluoglu & Ilsev, 2009). Similarly, divergent thinking tasks (e.g., the Alternative Uses Test, Guilford, 1967; also extensively cited) have been used to assess generated ideas for fluency, originality, flexibility, and elaboration.[1] These approaches do not distinguish novelty and usefulness (see Dietrich, 2019b; Runco, 2008; Stevenson et al., 2021) despite such a distinction now being recognized as important in advancing theory in individual creativity (Harvey & Berry, 2023).

Taken together, the current research landscape is relatively silent about the attentional antecedents of creativity in contexts not characterized by deliberate intent to be creative (i.e., silent about contexts characterized by the absence of top-down cognitive control and associated spontaneous information processing; Mok, 2014), and even in contexts characterized by deliberate intent, we know little about the antecedents of usefulness versus novelty. Given growing recognition that uncontrolled processing and associated spontaneous information processing are important for creativity (Marron et al., 2020; Mok, 2014; Xie et al., 2021), this landscape represents a large knowledge gap. In parallel, the failure to disentangle usefulness and novelty points to the existence of an implicit yet untested assumption that these two components of creativity share the same antecedents—an omission that represents poor scientific practice (Hempel, 1966). As will unfold in this manuscript, these knowledge gaps represent, at best, missed opportunities and, at worst, the risk of drawing erroneous conclusions regarding the attentional processes required to

[1] *Fluency* pertains to the number of generated creative ideas, *originality* the unusualness of creative ideas, *flexibility* the number of categories to which creative ideas pertain and *elaboration* the amount of detail in creative ideas (Torrance, 1966). These assessments do not differentiate between usefulness and novelty. Despite the overlap between originality and novelty, they have distinct essences. Current approaches to investigating originality do so in the context of specific tasks, such as the *Unusual Uses* task, in which, given the prompt, "possible uses for a tin can," an answer of "foot stool" may be a more original answer than "garbage can" (Lubart, 1994). In contrast, investigations treat novelty as a defining component of creativity and with reference to broader domains than those of such creativity tasks (e.g., within the context of broader industry trends), thereby distinguishing these two concepts.

maximize the usefulness and novelty of creative outcomes. We therefore seek to advance understanding regarding attentional processes, governed by both the existence and absence of top-down cognitive control, on creative usefulness and novelty.

We achieve these overarching aims by developing a neurocognitive framework of attentional control. This framework leverages recent advances in the neuropsychology of creativity to understand the role of attention (Erickson et al., 2018; Saggar et al., 2021; Sunavsky & Poppenk, 2020) in shaping creativity at work (Madjar & Shalley, 2008; Schweisfurth & Greul, 2023). In brief, we propose two distinct attentional pathways—*directed* and *undirected*—arguing that each has a different propensity to generate ideas characterized by usefulness versus novelty (Anderson et al., 2011; Dietrich, 2019a; Marron et al., 2020). Directed attention refers to the narrow or selected focus of attention toward one or more stimuli at a time (Mountcastle, 1978). Decades of research have highlighted the antecedents and largely adaptive consequences of goal-directed forms of directed attention, which are governed by top-down cognitive control (Christoff et al., 2016; Kastner et al., 1998; Posner, 1980) and neurologically reflected by activation of the brain's central executive network. We illustrate how this control and activation is associated with deliberate processing in pursuit of a creative goal. It involves the conscious, effortful leveraging of personal schemas and limited working memory in a narrow solution space. These processes, we propose, are particularly beneficial for the purposeful problem solving that underpins the discovery of solutions that are useful, even if at the expense of novelty (Dietrich, 2019b). In contrast, undirected attention refers to attention which moves around widely in any and all directions. This lesser-studied form of attention coincides with the absence of top-down control, reflected neurologically by the activation of brain networks indicative of a resting state (the default mode network; Hellyer et al., 2014). We illustrate how this absence of control and pattern of activation should be associated with spontaneous processing of information. This processing involves the unconscious, effortless combination of loosely connected associations in a broad solution space in ways we propose are particularly beneficial for the unique or unusual insights that underpin the discovery of novel solutions but may offer less utility (Dietrich, 2019a; Harvey & Berry, 2023; Yeo & Parker, 2018).

Our framework and associated propositions make four key contributions. First, this framework describes how to foster creativity without requiring the purposeful, controlled approaches frequently implied in existing frameworks (e.g., De Dreu et al., 2008; Nijstad et al., 2010). Specifically, we put the spotlight on an understudied pathway to creative novelty (relative to usefulness) from undirected attention, explained by the uncontrolled use of attention and supported neurologically by the default mode network. Second, and relatedly, these dual attentional pathways allow us to address the question of how to maximize creative usefulness and novelty (see Harvey & Berry, 2023 for a review). We elucidate that not only do the attentional pathways differ for usefulness and novelty, but their enactment must also be considered in tandem in order to maximize each (rather than maximizing one while stunting the other). Third, we extend and add precision to claims that contrasting modes of processing are important for creativity (Dietrich, 2019a; George, 2007) by demonstrating differential antecedents and consequences of deliberate versus spontaneous information processing. Finally, our framework uncovers a series of practical recommendations for enhancing creativity at work, specifically pointing to ways in which time can be used to foster different attentional modes in order to maximize both usefulness and novelty.

In what follows, we define creative usefulness and novelty and then conceptualize directed and undirected forms of attention, describing their neurological and cognitive bases in attentional control. Doing so offers the foundation for a conceptual analysis to generate propositions regarding differential pathways from goal-directed versus undirected attention to usefulness and novelty as a function of deliberate vs. spontaneous information processing, respectively. Finally, we conclude with a discussion of our framework's implications for theory, practice, and future research.

2 | CONCEPTUALIZATION OF CREATIVITY AND ATTENTION

Creativity as an overarching concept is defined as the generation or production of ideas that are novel and useful for enhancing products, processes, and/or other work outcomes (Amabile, 1996; Harvey & Berry, 2023; Shalley & Gilson, 2004; Woodman et al., 1993). This definition includes both usefulness and novelty as the two constituent elements of creativity (Amabile et al., 1996; George, 2007). Usefulness refers to a new idea's practicability, effectiveness, or appropriateness (Zhou & Hoever, 2014) and requires ideas to be "relevant to a proposed problem or acceptable within the standards of a relevant domain" (Harvey & Berry, 2023). The characteristic of novelty reflects the extent to which an idea "departs from current practice" (Harvey & Mueller, 2021, p. 293). Novel ideas are "unique or rare" in a domain (Diedrich et al., 2015, p. 35), representing a departure from common thinking to produce ideas that are unusual or original (Amabile et al., 1996; George, 2007). We adopt the maximization view of creativity put forward by Harvey and Berry (2023, p. 509), which holds that "creativity is maximized when both novelty and usefulness are at their highest levels." According to this view, usefulness and novelty may be "distant from one another so that creative products may have high novelty and low usefulness, or vice versa" (Harvey & Berry, 2023, p. 508). This view further indicates that both usefulness and novelty are independent contributors to judgments about an idea's overall creativity. Each can thus be independently optimized, emphasizing the importance of understanding the respective antecedents of each. We therefore focus our framework on the independent pathways that maximize creative usefulness and novelty. In the remainder of this section, we conceptualize two forms of attention that function as precursors to these elements of creativity—goal-directed and undirected attention.

2.1 | Goal-directed and undirected attention

Here, we follow best practice guidelines (Podsakoff et al., 2016) to conceptualize goal-directed and undirected forms of attention, thereby laying the foundation to consider attentional pathways to creativity. To ensure a comprehensive depiction of the overlaps and distinctions between these constructs, we also define a third form of attention—stimulus-driven attention. We describe these constructs' essential attributes related to breadth and movement, their cognitive bases in attentional control, and the brain regions thought to support these types of control (see also Table 1).

Goal-directed attention reflects attention voluntarily directed toward the discrepancy between a current and desired state (Asplund et al., 2010; Carver & Scheier, 1981). A form of attention is "directed" when attention is aimed narrowly toward a specific entity and selected information is preferentially processed or "attended to" (Asplund et al., 2010; Kastner et al., 1998). The direction of attention is controlled via attention-orienting mechanisms (also referred to as selective attention or attentional orienting; Asplund et al., 2010; Kastner et al., 1998). Here, we specifically focus on *goal-directed attention in creativity*, defined as *the voluntary and selective focus on creative goals or tasks* (hereon referred to as creative goal-directed attention). An example of creative goal-directed attention is an employee designing a new product who directs attention toward improving the product's specifications, such as its battery life. The individual may focus their attention on finite goals and improvements (e.g., battery run time), leading them to seek to develop solutions that enhance this (e.g., greater charge storage or optimizing efficiency through lighter components). In all these activities, attention is focused on a goal, and the individual directs their attention purposefully to narrow the distance between aspirations and reality. Neurologically, goal-directed attention of this sort is governed by top-down directives from the central executive network (responsible for cognitive control and decision-making) that determine where the dorsal attention network (responsible for spatial attention and task-related focus) holds attention for a task's duration (Corbetta & Shulman, 2002; Dosenbach et al., 2006).

We define *undirected attention* as *that which moves around in any and all directions in a wide and drifting fashion*. An example of undirected attention is when an employee's attention floats around without a particular purpose, perhaps while taking a walk outside during a lunch break. This definition reflects the notion from a range of literatures that undirected attention is an unselective or unfocused mode entailing two characteristics: a broad attentional span, described as an open and diffuse mode of attention, and a "drifting" mode, whereby attention floats in an unguided way or moves "without direction" (Irving, 2016; Vartanian, 2009; von Hecker & Meiser, 2005). This form of attention has been discussed in literature on psychoanalytic therapy (e.g., free-floating attention; Freud, 1912), mental illness and creativity (Yamaoka & Yukawa, 2020), depression (e.g., defocused attention; von Hecker & Meiser, 2005), and philosophy (e.g., unguided attention; Irving, 2016). Investigations of undirected attention tend to be de-prioritized relative to those of directed forms of attention, despite long-running speculation about the benefits of a "broad" attentional span (Mendelsohn, 1976) or defocused attention (Kasof, 1997; Martindale, 1981).

Despite this progress, the neurological underpinnings of undirected attention are the subject of research discussion and debate (Benedek et al., 2018). Among the possible processes, the deactivation of the dorsal attention network and central executive network is recognized as coinciding with a reduced top-down hold on attention (Posner & Rothbart, 2007), reduced cognitive control (Dosenbach et al., 2006), and a weakening of top-down biases from the prefrontal cortex (Dietrich & Haider, 2017; Weissman et al., 2006). This situation may thus create the opportunity for the occurrence of undirected attention, where attention moves without being directed toward, or constrained by, anything in particular (Caparos & Linnell, 2010). Given that the central executive network and dorsal attention network are known to be anticorrelated with the default mode network (associated with mental drifting and self-referential thoughts; Fox et al., 2005; Schendan, 2019), it is plausible that the default mode network is implicated in a wide and drifting mode of attention.

Although not directly relevant to our aims and propositions, at this point we introduce and define the concept of *stimulus-driven attention* in order to ensure comprehensive understanding of goal-directed and undirected attention. Stimulus-driven attention is a form of directed attention. However, in contrast to goal-directed attention, control over the attention is involuntary, such as when attention is "captured" by salient events (e.g., the telephone ringing). The neurological distinction between stimulus-driven and goal-directed attention is that when attention is involuntarily captured, the ventral attention network (responsible for rapid, bottom-up shifts in attention) interrupts the dorsal attention network's hold over attention, facilitating an attentional switch (Corbetta et al., 2008). This form of

TABLE 1 Defining features of directed versus undirected attention.

	Directed attention		
	Goal directed	**Stimulus driven**	**Undirected attention**
Breadth	Narrow	Narrow	Wide
Movement	No	No	Yes
Attentional control	Controlled (voluntarily)	Controlled (involuntarily)	Uncontrolled
Brain regions	Central executive network (CEN), dorsal attention network (DAN)	Ventral attention network (VAN)	Default mode network (DMN)

directed attention is not relevant to the focal pathways to creativity proposed in our framework. Thus, we do not formulate propositions about its effect.

2.1.1 | The dynamic nature of attention

Consistent with Podsakoff et al.'s (2016) recommendation to consider a construct's level of stability, we conceptualize these forms of attention as fluctuating within individuals, though possessing meaningful between-person average differences, too. At this point, it is important to note that our conceptualizations are most meaningful when considered over a period of time (Yeo & Parker, 2018) because attention is dynamic, switching back and forth among its different forms (Christoff et al., 2016). Within a person, over time, attention may be deliberately directed toward a goal state (goal-directed attention), then be captured by a noise (stimulus-driven directed attention), then drift freely (undirected attention) and then be directed back to a goal. It follows, then, that we conceptualize these forms of attention as dynamic constructs (Christoff et al., 2016) that vary within people over various time scales (e.g., hours and days). However, we also expect between-person differences, such that individuals vary from each other concerning their average level of experienced directed or undirected attention. To illustrate, consider undirected attention. On average, some people (e.g., retirees and non-carers) are likely to experience more compared to others (e.g., full-time employees and working parents).

2.1.2 | Distinguishing attention from mental states

A crucial part of conceptualizing a construct is differentiating it from related constructs (Podsakoff et al., 2016). Here, we distinguish goal-directed (and stimulus-driven for completeness) and undirected forms of attention from five mental states that have received considerable research attention (i.e., mind-wandering, daydreaming, two types of mindfulness, and rumination). Mental states are transient cognitive states that can be defined by their content (such as the cognitive materials/representation they contain; Christoff et al., 2016). Definitions of the five focal mental states are provided in Table 2. Also shown in Table 2 is that a mental state can be further characterized by the form of attention (i.e., goal directed, stimulus driven, or undirected) that underpins its mental content.

Specifically, we have drawn on our neurocognitive framework of attentional control to demonstrate the overlaps and distinctions between mental states and their underpinning form of attention in Table 2 by way of example. These examples illustrate that mental states and forms of attention are distinct rather than isomorphic. Although a mental state can only be underpinned by one form of attention at any given time point, different instances of a mental state can be underpinned by different forms of attention (e.g., see Table 2 for three examples of mind wandering that are each underpinned by a different form of attention) Likewise, any given attentional form can underpin multiple mental states (e.g., see Table 2 for two examples of goal-directed attention, one of which underpins mind-wandering and the other mindfulness (present-moment awareness). In combination, this conceptual analysis provides further demonstration of the distinctiveness of undirected attention versus directed forms of attention, as well as their distinctions from the mental states they can underpin.

3 | CONCEPTUAL FRAMEWORK AND PROPOSITIONS

In this section, we use our neurocognitive framework of attentional control (Christoff et al., 2016; Dietrich, 2019a; George, 2007; Harvey & Berry, 2023) to develop a theoretical model (Figure 1) and associated propositions for understanding creative goal-directed versus undirected attentional pathways to creative outcomes via distinct modes of information processing. Information processing refers to the manner in which information is organized, combined and stored, and can take place either deliberately or spontaneously (Dietrich, 2019a; George, 2007; also, the dual-process perspective, Barr et al., 2015; analysis vs. intuition, Shirley & Langan-Fox, 1996; and explicit vs. implicit, Ashby & Isen, 1999). As elaborated below, information processing is inherently associated with our theoretical model's two attentional forms and underlying neurocognitive bases and is thus well-placed to explain our framework's distinct pathways to creative usefulness and novelty.

3.1 | Directed attentional pathway to creativity

First, we propose that the experience of creative goal-directed attention promotes creative usefulness to a greater extent than novelty as a function of deliberate information processing. As conceptualized above, creative goal-directed attention is underpinned by a top-down or voluntary form of attentional control governed by the central executive network (Dosenbach et al., 2006). When directing attention to a creative goal, a person's voluntary agency is reflected by activation of the central executive network, which is responsible for task execution and decision-making (Benedek et al., 2014; Dosenbach et al., 2007; Frith et al., 2021). Once active, the central executive network directs attention-related networks in the brain to focus on the creative goal (Bressler & Menon, 2010; Corbetta & Shulman, 2002).

This neurocognitive conceptualization of creative goal-directed attention indicates that it should be associated with the processing of attended-to information in a deliberate manner. In a context characterized by a creative goal, deliberate information processing involves intentional, effortful cognitive attempts at generating creative ideas or solutions to targeted problems (e.g., Hirst et al., 2011; To et al., 2015) in ways conscious to an individual (i.e., represented in working memory; Dosenbach et al., 2007). It typically entails defining and redefining a focal issue, retrieving information from semantic memory or other knowledge sources and thinking abstractly to integrate ideas and evaluate their adequacy and utility (Zhang & Bartol, 2010). Consistent with our framework, deliberate processing is considered to be constrained around specific goal states and thus adaptive for generating ideas that are appropriate or relevant to the goal(s)

TABLE 2 Definitions of mental states and examples illustrating their underpinning form(s) of attention.

		Examples		
		Directed attention		
	Definition	Goal directed	Stimulus driven	Undirected attention
Mind-wandering	A shift in thought content away from an ongoing task (i.e., "off-task") to thought content irrelevant to a focal activity (Smallwood & Schooler, 2015).	Thought content has shifted away from a work meeting, such that attention is directed voluntarily toward solving an unrelated work problem.	Thought content has shifted away from a work meeting, such that attention is directed involuntarily toward the contents of a smartphone notification.	Thought content has shifted away from a work meeting, such that attention is drifting aimlessly.
Daydreaming	Mental content that appears bizarre or "departs from reality" (Klinger, 2009, p. 225) and is independent of current environmental stimuli (Singer, 1975).	N/A	N/A	While sitting at one's desk, attention drifts aimlessly during an imagined scenario in which the office flips upside down.
Mindfulness (*present moment attention*)	An open and receptive awareness, or quality of consciousness characterized by a clear awareness of the present moment (Brown & Ryan, 2003).	During a focused breathing exercise, attention is directed toward the breath and internally arising sensations.	N/A	N/A
Mindfulness (*open monitoring*)*	"The nonreactive monitoring of experience from moment to moment, primarily as a means to recognize the nature of emotional and cognitive patterns" (Lutz et al., 2008, p. 163).	N/A	N/A	During meditation practice, attention drifts aimlessly across the expansive array of external and internal experiences (e.g., floating thoughts, physical sensations, ambient sounds, and features of the physical space).
Rumination	A form of emotion-focused coping where attention is repetitively devoted to processing or fixating on setbacks and regrets often outside one's control (Dane, 2018; Nolen-Hoeksema et al., 2008).	N/A	Attention is directed involuntarily toward painful memories about someone whose name was just mentioned in passing.	N/A

Note: Where "N/A" appears, we do not expect that mental state to be underpinned by that form of attention.
*This form of mindfulness (as compared to present moment attention) is often thought to be achieved via non-directive meditation practice and thus more relevant for highly experienced meditators (Lippelt et al., 2014).

(Koechlin & Summerfield, 2007; Miller & Cohen, 2001; Müller & Knight, 2006), albeit effortful or resource-depleting (Kanfer & Ackerman, 1989) due to required regulation (Kaplan & Berman, 2010).

Extending this logic, we suggest that even though creative goal-directed attention and its associated deliberate processing are well-placed to deliver creative outcomes characterized by usefulness, this pathway may be less effective for facilitating the novelty of such outcomes. We propose this for two key reasons. First, the "top-down" effects exerted by the central executive network and implicated in deliberate processing are believed to retain one's pre-existing values and belief systems in its rule-based approach to searching for and evaluating ideas and information (Damasio, 1994; Miller & Cohen, 2001). This has been evidenced across neuroimaging studies showing that prefrontal regions forming part of the central executive network are implicated in selective memory retrieval (for reviews, see Cabeza & Nyberg, 2000; Hasegawa et al., 1999) and rule-following in classic tasks (e.g., the Stroop Task; Miller & Cohen, 2001). Although not empirically demonstrated in the context of creativity, theory suggests that when leveraged for deliberate processing toward creative outcomes, this reliance on "built-in" predispositions (e.g., personal theory and schemas) leads one toward closer (relative to remote) associations of ideas within a narrowed solution space due to the central executive network (Dietrich, 2019a). Second, cognitive theories assume that working memory, which emanates from the central executive network and is involved in deliberate processing (Dosenbach et al., 2007), has limited capacity and that different mental activities compete over its resources (Baddeley, 1986; Van Dillen & Koole, 2007). Therefore, the more working memory capacity is occupied by one's focal deliberate

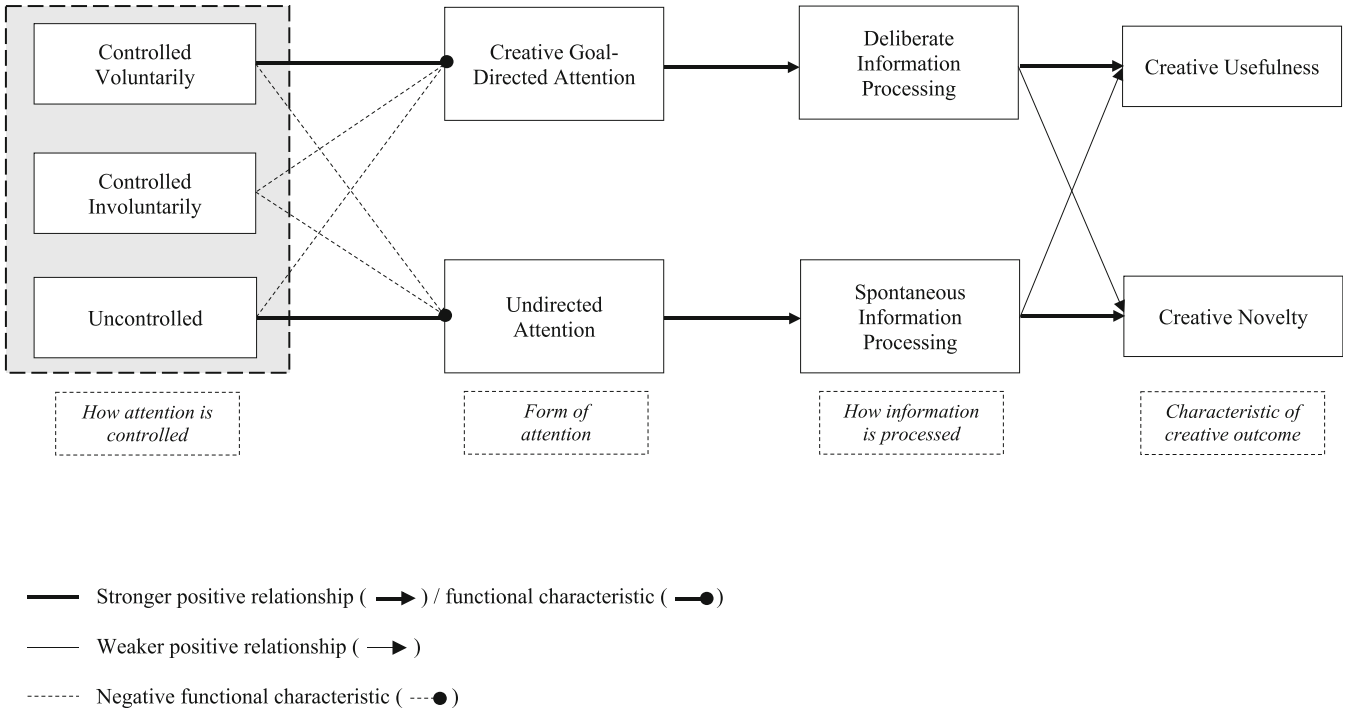

FIGURE 1 Conceptual framework.

activities, the less room remains for other distal materials to be processed and generated in other brain regions, such as the default mode network (Baddeley, 1986; Dietrich, 2019a).

Further neurocognitive evidence indicates that, despite their distinct features, the central executive network and default mode network can be activated in parallel during deliberate processing, reinforcing our framework's proposition that creative goal-directed attention will facilitate usefulness to a greater extent than novelty due to the imposition of goal-relevant constraints. An important line of supporting evidence suggests that deliberate information processing coincides not only with activation of the central executive network but also the default mode network (Beaty et al., 2015; Jung et al., 2013; Sunavsky & Poppenk, 2020). The default mode network is thought to generate many possible alternatives (variability) having potential benefit for novelty but is blind to their suitability or usefulness within a given context (Jung et al., 2013; Simonton, 2010). However, the central executive network sustains voluntary attention in pursuit of the focal goal; it remains available to perform processing functions, including the selective retrieval of information, manipulation of that information in working memory, and the retention (omission) of ideas more (less) suitable for the immediate environment (Dietrich, 2019a). In this regard, although the central executive network enables executive control to facilitate an idea's usefulness and appropriateness, it is believed to constrain the default mode network's provision of remote and potentially novel and unusual materials to a focal concern or situation.

Empirically, the neurological involvement of these two networks (the central executive network and default mode network) during deliberate information processing was evidenced in a recent study using a picture-completion task (Rominger et al., 2020). When participants were provided with an ambiguous picture fragment for open-ended ideas or possibilities, central executive network involvement decreased while that of the default mode network increased. However, when participants were required to work on a more confined task goal (elaborating their picture's details), central executive network involvement increased while that of the default mode network decreased, seemingly to accommodate the constraints imposed by their deliberate processing of information.

In combination, emerging neuroscientific evidence supports the notion that creative goal-directed attention and deliberate information processing are reflected neurologically by the activation of the central executive network and the default mode network simultaneously. Taken together, we propose that the experience of creative goal-directed attention facilitates creative usefulness to a greater extent than novelty. This is because this pathway is characterized by the generation of ideas that are close to, or consistent with, one's established mental scripts; conscious and governed by top-down control; derived with effort and intention; and are conventional and filtered, enabling solutions only within a narrow solution space to be reached. Consequently, the generation of creative ideas characterized by higher levels of usefulness (i.e., idea appropriateness, practicality and effectiveness) should be promoted, but these same ideas should be to a lesser extent characterized by novelty (i.e., unique and unusual) due to the presence of goal-relevant constraints involved in processing, reflected neurologically by the activation of the central executive network (Dietrich, 2019a).

> **Proposition 1.** Experience of creative goal-directed attention fosters creative usefulness to a greater extent than creative novelty via deliberate information processing.

3.2 | Undirected attentional pathway to creativity

As mentioned, most research has been conducted in the context of deliberate attempts to be creative (Mok, 2014). However, recognizing that many creative outcomes result from more intuitive (Simonton, 1975), insightful (Xie et al., 2021) or spontaneous (Erickson et al., 2018) processes that occur unconsciously, unexpectedly or by accident, there is a growing recognition of at least *two* modes of creativity—a deliberate mode (discussed in the previous section) and a spontaneous mode (Dietrich, 2019b; George, 2007). Moreover, theory and empirical research are beginning to demonstrate that these two modes coincide with different patterns of neurological activation (Dietrich, 2019a; Marron et al., 2020; Yang & Wu, 2022). Here, we leverage our conceptual framework to propose that the experience of undirected attention promotes creative novelty to a greater extent than usefulness as a function of spontaneous information processing.

As conceptualized above, undirected attention is characterized by the absence of attentional control. This absence of control is reflected neurologically by the deactivation of the central executive network and cessation of its control over the attention-related networks it directs (i.e., the dorsal attention network; Posner & Rothbart, 2007), while coinciding with the activation of the anticorrelated default mode network (Fox et al., 2005; Schendan, 2019; Weissman et al., 2006).

This neurocognitive conceptualization of undirected attention indicates that it should be associated with spontaneous information processing. Spontaneous information processing is characterized by unintentional and effortless processing of information—either in memory (i.e., attended to in the past) or among that temporarily falling under the present spotlight of attention—outside conscious awareness (Dietrich, 2004; George, 2007; Xie et al., 2021). In this way, cognitive materials can be retrieved, processed, and connected without the active use of reasoning (Dietrich & Haider, 2017; George, 2007). Such processing, in turn, involves the quasi-random combination of remote materials (i.e., generation of variability; Simonton, 2003) or loosely connected associations in a broad solution space (Dietrich & Haider, 2017; Evans, 2008). Consistent with this conceptualization, it is characterized by an absence of regulation (i.e., it does not consume resources), which is why it is assumed effortless (Kaplan & Berman, 2010; von Hecker & Meiser, 2005). Undirected attention and its neurological underpinnings should facilitate this spontaneous form of information processing due to the absence of constraints typically imposed by the central executive network (e.g., schemas and working memory limits) and unconstrained default mode network, which allow attention to wander widely and freely. This neurocognitive profile thus provides a broad span of attended to information, which is free to be processed unintentionally and effortlessly.

A key contribution of our framework is that it suggests that undirected attention and its associated spontaneous processing are well-placed to deliver creative outcomes characterized by novelty but less effective for promoting the usefulness of such outcomes. As will be elaborated below, this is because activation of the default mode network during undirected attention and spontaneous processing should allow flexibility in locating unique or unusual ideas outside an immediate context or solution space (Dietrich, 2019b; George, 2007). Deactivation of the central executive network during undirected attention and spontaneous processing means that the attended to information and its processing should not be limited to preconceived mental paradigms (Ritter & Dijksterhuis, 2014). However, due to deactivation of the central executive network, ideas and thoughts may be generated for topics unrelated to the problem at hand or lacking practical application. This should increase the extent to which attended to information and its processing are irrelevant to the context, thus limiting the extent to which generated ideas are suitable and useful.

Emerging neurological evidence supports the above arguments. Neuroimaging studies inferring the presence of undirected attention (see Fox et al., 2015) have shown that primary activation of the default mode network is associated with spontaneous processing of information occurring outside conscious awareness (Dietrich, 2004; Eysenck, 1995). It is believed that when attention is not directed toward a particular task, the default mode network continues its variability-generating function (Simonton, 2010) but in a way that is free of the constraints imposed by the central executive network's activation of schemas and working memory limits (Dietrich, 2019b). More specifically related to creativity (albeit using the Alternative Uses Task [AUT], which cannot disentangle deliberate from spontaneous processing; see Dietrich, 2019b), an MRI study (Kühn et al., 2014) showed a positive correlation between participants' gray matter volume in the default mode network (i.e., where spontaneous processing is assumed to take place) and idea novelty (Christoff et al., 2016).

In combination, emerging neuroscientific evidence supports the notion that undirected attention and spontaneous processing of information in memory are reflected neurologically by the activation of the default mode network and simultaneous deactivation of the central executive network. Taken together, we propose that the experience of undirected attention facilitates creative novelty to a greater extent than usefulness. This is because this pathway is characterized by the generation of ideas via remote associations that are further from, or less consistent with, one's established mental scripts; unconscious and lacking attentional control (until flashing suddenly into working memory); derived with no apparent effort or intention; and comparatively random, bizarre and unfiltered, enabling solutions in a broad solution space to be reached. Consequently, the generation of creative ideas characterized by higher levels of novelty (i.e., idea uniqueness and unusualness) should be promoted, but these same ideas should be to a lesser extent characterized by usefulness (i.e., appropriate, practical, and effective) due to the absence of goal-relevant constraints involved in processing, reflected neurologically by deactivation of the central executive network (George, 2007).

> **Proposition 2.** Experience of undirected attention fosters creative novelty to a greater extent than creative usefulness via spontaneous information processing.

3.3 | Sequencing directed and undirected attention to maximize creativity

Considering Propositions 1 and 2 in combination suggests that disproportionate activation of the attentional pathways creates a trade-off between usefulness and novelty. Namely, these propositions suggest that the directed (relative to the undirected) attentional pathway should maximize usefulness but stunt the potential for novelty, whereas the undirected (relative to the directed) attentional pathway should maximize novelty but stunt the potential for usefulness. This quandary raises the question of how time can best be allocated to foster the experience of both forms of attention in such a way that maximizes both usefulness and novelty.

Research on incubation (Sio & Ormerod, 2009) and attention restoration theory (Williams et al., 2018) suggests that there are benefits to spending time "off-task" following experiences of creative goal-directed attention. Our framework adds precision to these claims, suggesting it is the state of undirected attention and associated spontaneous processing that produces such benefits. Using our neurocognitive framework of attentional control, we suggest that the sequencing of time spent experiencing creative goal-directed versus undirected attention can be leveraged to offset the "trade-offs" made salient by Propositions 1–2 and thus maximize both usefulness and novelty. Namely, spending an initial period in a state of creative goal-directed attention followed by time experiencing undirected attention should maximize both the usefulness and novelty of creative outcomes. To understand why, we first highlight a key implication of Proposition 2, pertaining to the importance of ceasing goal-directed attention and creating opportunity for spontaneous processing via undirected attention. We then explain the role of task sets as they apply to periods of creative goal-directed attention and how diminishing task set inertia following these periods enables spontaneous processing to be guided by a simplified representation of these earlier goal states. Taken together, we propose that these cognitive phenomena may enable the generation of solutions that maximize usefulness by meeting goal constraints while also maximizing novelty due to their spontaneous derivation.

If creative goal-directed attention is sustained continually, or if one shifts from one goal-directed focus to the next without allowing attention to move around in an undirected form, the default mode network will remain constrained by the central executive network to deliberately process information (see Proposition 1; Rominger et al., 2020; Sunavsky & Poppenk, 2020). Consequently, the default mode network would be denied the opportunity to process a creative problem free from the central executive network's top-down constraints (i.e., spontaneous processing). This reasoning highlights the importance of alternating between both forms of attention. Extending this line of reasoning, we suggest that experiencing undirected attention after (relative to before) a period of creative goal-directed attention is the optimal sequence for creativity because the default mode network will be free from the strong top-down constraints of the central executive network (see Proposition 2) yet have guidance from a simplified representation of the creative problem in memory—a phenomenon explained by the concept of task-set inertia (Allport et al., 1994).

Before explaining the concept of task-set inertia, it is first necessary to consider the concept of task sets. *Task sets* are configurations of cognitive processes governed by top-down control (e.g., executive functions, problem-solving strategies) that pair with tasks and are maintained during states of goal-directed attention (Allport et al., 1994; Monsell, 2003). By facilitating particular task-relevant cognitive operations and inhibiting others, a task set "fixes the angle" from which one sees a creative problem and selectively defines aspects of the task to which one selectively attends via creative goal-directed attention (Dietrich, 2015). Neurologically, different task sets will activate different groups of neurons helpful for a creative task, and these will temporarily collaborate until deliberate efforts toward the creative goal have ceased (Anderson, 2010). Relatedly, *task-set inertia* refers to the notion that a simplified representation of that goal will linger in memory even after ceasing efforts on the task or conscious pursuit of the goal (Allport et al., 1994). This cognitive phenomenon reflects a gradual fading process whereby interacting groups of neurons take time to return to their baseline states (Allport et al., 1994; Dietrich & Haider, 2017), causing simplified representations of earlier goal states to linger in memory as processing transitions from a deliberate to a spontaneous mode and task sets gradually fade (Cowan, 1999, 2005). Importantly, this lingering mental representation, though less detailed, is still thought to guide the brain's activity as it switches processing modes (Dietrich & Haider, 2017).

Yet-untested theorizing suggests that the simplified representation of earlier goal states left in working memory by creative goal-directed attention may unconsciously guide spontaneous processing triggered by a state of undirected attention to a degree that is not as constrained as when directing attention. The presence of this simplified representation may subsequently increase the likelihood that spontaneous processing yields a solution meeting goal constraints (Dietrich, 2015). In other words, if a simplified representation of a creative goal remains in memory after letting go of conscious control, this representation may increase the chances that spontaneous processes will yield a solution maximizing both usefulness and novelty. To gain this advantage would thus necessitate that creative goal-directed attention be experienced *before* a subsequent state of undirected attention. In sum, these arguments suggest that if time is allowed for undirected attention following an initial period of creative goal-directed attention, a solution yielding the combined benefits of these attentional modes is more likely to be realized, thereby maximizing creative usefulness and novelty.

> **Proposition 3.** Experience of creative goal-directed attention followed by the experience of undirected attention enhances the likelihood of maximizing both the usefulness and novelty of creative outcomes.

3.4 | Three propositions in visual format

In this section, we present a visual depiction of our three propositions. We depict these within a hypothetical "solution space," reflecting the range of possible solutions to a creative problem or challenge within a two-dimensional landscape (see Figure 2). In doing so, we reinforce the necessity of disentangling usefulness from novelty to understand their unique antecedents, while also showing the importance of considering both pathways in tandem to avoid stunting one at the expense of the other and instead to maximize both usefulness and novelty. As noted, most research and practice has concerned itself with creativity in contexts characterized by the deliberate attempt to be creative. However, even in these contexts (and as reflected in our propositions), there will inevitably be times when the creative goal is (a) active in working memory (i.e., purposefully approached with creative goal-directed attention; Proposition 1) and times when it is (b) inactive (Proposition 2), or (c) fading from memory (Proposition 3). We represent all three scenarios in turn (following the Section 3.4.1) in the upcoming subsections.

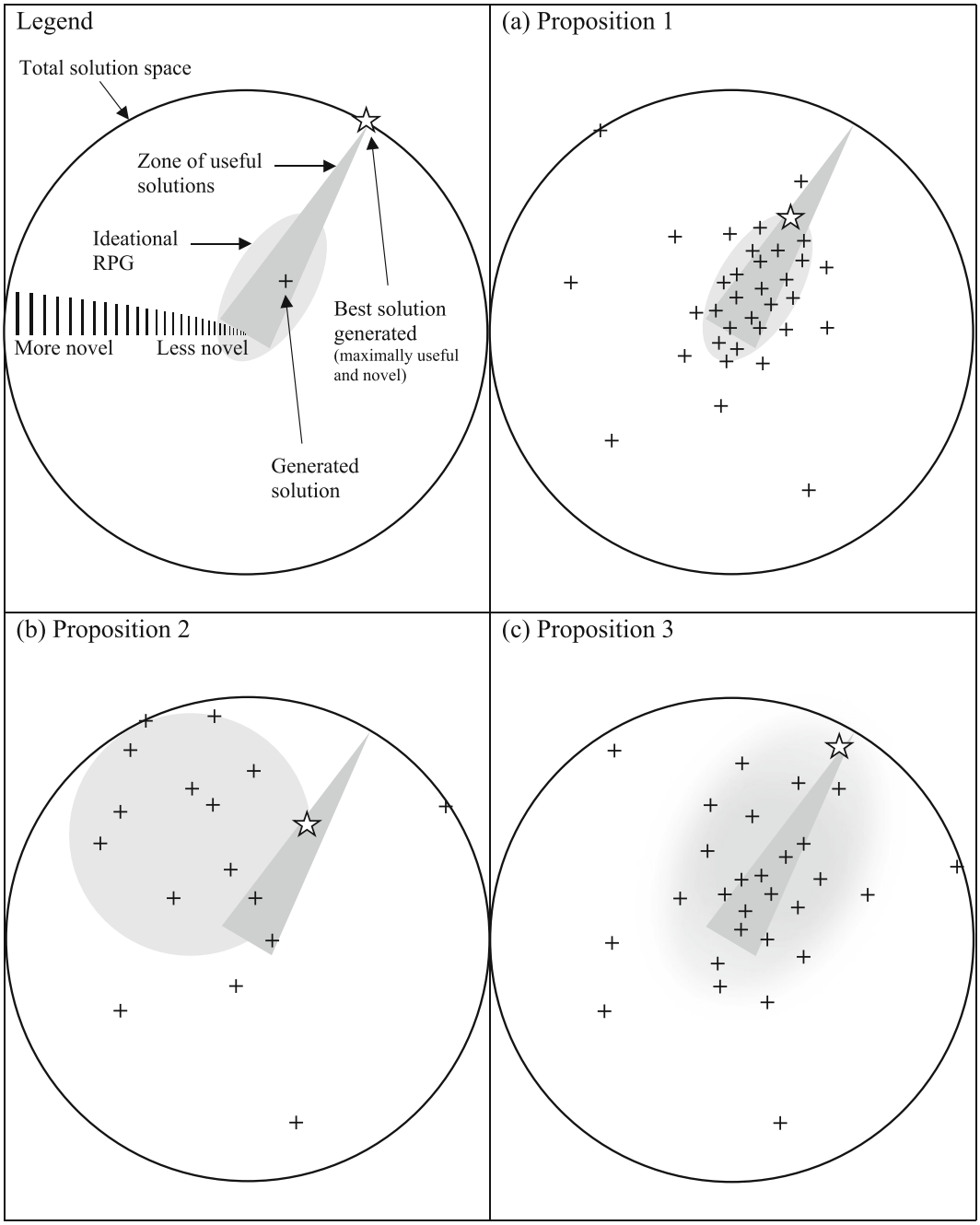

FIGURE 2 Three propositions in visual format. *Note*: RPG = representation of predictive goal.

3.4.1 | Legend

Suppose there is a creative problem to be solved by an employee. The white circles shown in Figure 2 (see *Legend*; top left) represent the total possible space within which a solution to the focal problem may be found. Represented as a dark-gray triangle is an area within which a solution meeting a pre-defined set of usefulness criteria (or fitness values for selection; Dietrich & Haider, 2017) may be found.[2] Any solution beyond this area lacks practicability, effectiveness, or appropriateness (Zhou & Hoever, 2014), making it a poor choice for selection. Represented by the graduating series of vertical lines, solutions toward the innermost region of the solution space are less novel, whereas solutions toward the edge are more so. As solutions move toward the outer edge of the solution space, the total area of useful solutions narrows, reflecting the trade-off between usefulness and novelty made salient across Propositions 1–2. In this way, the solution space is divided between novel ideas for which high usefulness exists, and novel ideas for which low/no usefulness exists (Harvey & Berry, 2023). The representation of the creative goal, known in the language of predictive processing as an *ideational representation of a predictive goal* (RPG; Dietrich, 2015) and represented in Figure 2 as a light-gray ellipses, acts as an "educated guess" containing fitness information with which to direct the occurrence of thoughts in advance. Finally, the optimally creative solution, represented by the star, can be found at a single point on the edge of the solution space, maximizing both usefulness and novelty.

3.4.2 | Proposition 1

First consider a period of time when the employee experiences creative goal-directed attention. Invoking the processes described in Proposition 1 (Figure 2, top right), the creative goal is represented in working memory, reflecting a strong task set underpinned by activation of the central executive network. In this scenario, the RPG constrains the search area a priori in the absence of a fully mapped-out solution space (Dietrich & Zakka, 2020). This RPG has the upside of increasing efficiency by reducing the area to be searched and also the downside of constraining the searched area to more useful solutions at the expense of novelty. Thus, the deliberately processed solutions flowing from creative goal-directed attention will mostly fall within this concentrated area, with one solution emerging as the most novel, while still falling within the area of usefulness.

3.4.3 | Proposition 2

Now consider a period of time when the employee experiences undirected attention. Invoking the processes described in Proposition 2 (see Figure 2, bottom left), the creative goal is not accurately represented in working memory, reflecting a weak task set due to deactivation of the central executive network. Any RPG is likely to be a poor match to the fitness requirements of the task as these requirements are not instantiated in working memory. On the upside, this means that any spontaneously derived solutions will be free to emerge in the more novel region of the solution space due to weak task constraints, but without a detailed representation of the goal in working memory, these solutions are likely to lack practical application or relevance to the focal problem due to an RPG that is unconstrained around fitness values for solution selection (i.e., the area of useful ideas). Nonetheless, some solutions spontaneously generated by the employee may fall within the area of usefulness, perhaps by chance, with one solution standing out as the most novel.

3.4.4 | Proposition 3

Finally, suppose the employee spent a period of time experiencing creative goal-directed attention and then subsequently spent a period of time experiencing undirected attention. Invoking the processes described in Proposition 3 (see Figure 2c), a gradually fading RPG (represented by the fading light-gray ellipses) is represented in memory. As the central executive network deactivates and processing shifts from the deliberate to the spontaneous processing mode, this RPG maintains some conscious properties that help guide brain activation toward a useful solution while broadening the search area to include more novel possibilities. Thus, any solution derived will be via the spontaneous mode but have an increased likelihood of meeting fitness criteria (i.e., relative to Proposition 2) due to the sequencing of creative goal-directed and undirected attention. Represented in Figure 2c, the star signifies a highly novel solution that falls within the area of useful solutions, derived during the process of task set fading.

4 | DISCUSSION

We developed a neurocognitive framework of attentional control to understand how and why different forms of attention relate to creative outcomes. Doing so offered theoretically driven conceptualizations of undirected attention and two forms of directed attention, distinguishing each from each other and various mental states they can underpin. Importantly, our framework illuminated differential pathways from creative goal-directed versus undirected attention to creative usefulness and novelty, explained by distinct neurocognitive underpinnings and associated information processing. Further, we drew on these underpinnings to argue that experiencing undirected attention following creative goal-directed attention should increase the chance of realizing a creative outcome that maximizes both usefulness *and* novelty. We now discuss our framework's implications and future directions for theory, methodology, and practice.

[2]Although usefulness is a unidimensional construct (i.e., ranging from high to low), we illustrate it in Figure 2 as a binary construct for ease of explanation.

4.1 | Theoretical implications for attention and creativity

First, we consider the implications of our framework for theories of creativity. Theory and research on creativity stemming from the OB literature suggest that attention, particularly that is goal directed, has positive effects for creativity (Christoff et al., 2016; Shalley, 1991; Shalley & Koseoglu, 2013), with some findings suggesting benefits for both usefulness and novelty (Madjar & Shalley, 2008). In parallel, there is speculation that activation of two different processing paths may be required to maximize creativity (Dietrich, 2019a; George, 2007; Xie et al., 2021) and that switching between tasks or taking breaks may support this activation (Madjar & Shalley, 2008; Schweisfurth & Greul, 2023). Nevertheless, existing theory and empirical evidence predominantly focuses on goal-directed contexts and fails to effectively disentangle usefulness and novelty. Our research, which adopts a neurocognitive perspective, carries significance as it uncovers distinct attentional pathways leading to usefulness and novelty in creativity. In particular, our framework posits that a creative goal-directed pathway alone maximizes usefulness while stunting novelty, whereas an undirected attention pathway alone maximizes novelty but stunts usefulness. This implies that periods of engaging in creative goal-directed attention should be followed by periods of undirected attention to enhance the probability of generating creative outcomes that maximize both usefulness and novelty.

These theoretical insights have important implications for creativity theories because they both change and add nuance to existing understanding. Take, for example, De Dreu et al.'s (2008) dual pathway model. The flexibility and persistence pathways proposed in this model largely align with the directed attention pathway in our framework as theorizing and empirical tests of this model assume the presence of a creative goal to be addressed. In such scenarios, the central executive network and default mode network are both activated, with the default mode network generating variability while the central executive network constrains this variability in line with the established goal. The theory argues that negatively versus positively valenced states of activation have differential benefits for creativity. Namely, negatively activated states are assumed to be more effective for creativity requiring a narrowing down on specific details and appropriate solutions to discrete problems, whereas positively activated states are assumed to be more effective for creativity requiring the breaking of established sets and flexibly processing a wide range of unconventional solutions to open-ended problems (De Dreu et al., 2008; To et al., 2012). An implication of our framework for the dual pathway model is that the positive versus negative valence of activated states may be distinguished neurologically by varying degrees of default mode network co-recruitment. Positively activated states (relative to negatively activated states) may coincide with greater co-recruitment of the default mode network, permitting more spontaneous processing and unconstrained thoughts. These potential differences in neurological profile could thus explain the differential benefits of positive versus negative affective states for broadening thought-action repertoires versus narrowing in on goal discrepancies, respectively. Our framework, therefore, offers an opportunity to add nuance to the dual pathway model by advancing understanding of the likely neurocognitive underpinnings of activated pathways to creativity.

Next, consider existing theorizing regarding the need to activate two pathways in order to maximize creativity (Dietrich, 2019a; George, 2007). In the OB literature, researchers have speculated two different forms of information processing are important for creativity, with one pathway being characterized by conscious processing and the other unconscious processing (George, 2007; for similar arguments in the neurocognitive literature, see Dietrich, 2019a). According to this perspective, taking a break from creative goal-directed attention and allowing attention to be focused on something else may yield superior creative outcomes in some circumstances (e.g., depending on the nature of the task or problem) by enabling unconscious processing of information (or *unconscious thought*; Dijksterhuis & Nordgren, 2006). Our framework clarifies the specific neurological underpinnings of these theorized pathways and, in doing so, makes clear that it is not merely a break from a creative task that promises to strengthen creative outcomes. Rather, it is a break from directed attention that enables the neurological processes that underlie spontaneous processing and therefore the maximization of novelty.

Our research addresses calls from a recent meta-theory of creativity in organizations (Harvey & Berry, 2023) to put forward clear conceptualizations of creativity. Specifically, our framework calls for examinations of usefulness and novelty as components of creativity that can be independently optimized and suggests exploring the relationship between them according to a maximization perspective. Doing so is important given empirical observation that antecedents across usefulness and novelty may differ, so treating these as a single dimension risks obscuring effects (Ford & Gioia, 2000; Perry-Smith & Coff, 2011).

More broadly, we chose to adopt a maximization perspective in this work due to our interest in creativity's downstream impacts on innovation alluded in our introduction. In innovation contexts, which require a dramatic shifting from a comparison set (e.g., of products and services), the maximization perspective is considered most suitable (Harvey & Berry, 2023). However, the propositions of our framework also have relevance to Harvey and Berry's (2023) balance perspective of creativity. According to this perspective, usefulness and novelty are diametrically opposed, implying that creativity is optimal when ideas possess moderate levels of usefulness and novelty. An example is when novel game mechanics must be balanced with playability in the context of game development (Goh et al., 2013). In such contexts, it may be that a target level of novelty would lie between the center and the edge of the circular solution spaces depicted in Figure 2. Likewise, repeat cycles of creative goal-directed and undirected attention, aligning with the frequent shifting back and forth between enhancing usefulness versus novelty that tends to characterize the pursuit of balanced creative outcomes (Harvey & Berry, 2023), may support the discovery of optimal solutions.

Our equal emphasis on creative goal-directed and undirected attention also has major implications for attention theories. Theories

of attention emphasize the benefits of directed attention (e.g., resource allocation theory, Kanfer & Ackerman, 1989; cognitive energetics theory, Kruglanski et al., 2012; executive attention theories, Posner & Rothbart, 2007). These perspectives assume that controlled regulation of limited attention is the key to success. Conversely, undirected attention has largely been ignored or viewed negatively (e.g., as "cognitive miserliness," Kruglanski et al., 2012; an "executive failure," Randall et al., 2014).

While these theories of attention have aided understanding of human functioning, the dominant role afforded to controlled regulation of attention is problematic because it only paints half the picture (Hirst et al., 2020). By bringing the concept of undirected attention to the forefront of organizational research, our framework has the potential to change the way we think about the use of one's limited attention. It challenges the assumption—which has dominated for decades—that directed attention is the main road to success by theorizing that allowing some time for undirected attention can maximize human potential. The benefits of undirected attention do not negate the benefits of directed attention, but we cannot ignore the latter's limitations—one of which is that it gains success by narrowing the scope of attention. Undirected attention offsets this limitation by indicating that a broader and less constrained scope of attention is not always an executive failure and is sometimes necessary for maximizing human potential. Indeed, for working professionals whose time at work is overwhelmingly characterized by directed attention, our framework suggests that creating time for moments of undirected attention is likely to be important for maximizing creativity. Further, this view paves the way for considering potential benefits for other attention-relevant outcomes, such as recovery (see Section 4.3.3).

4.2 | Methodological implications

The first step for future research is to translate our framework's propositions into testable hypotheses and create appropriate research designs. Doing so will require interdisciplinary research that crosses OB, cognitive psychology, and neuroscience (e.g., Beugré, 2018; Parincu et al., 2020). Key will be disentangling different forms of attention and associated information processing, as well as different creative outcomes, necessitating methodological development and empirical testing. Aiming to catalyze this, we offer a guide describing some considerations and related decisions.

First, within-person designs will likely offer new insight, given that the proposed attentional pathways reflect dynamic processes (Christoff et al., 2016). Such designs will necessitate repeated measures of the constructs from each individual, and multilevel analysis techniques can account for such designs (Csikszentmihalyi & Larson, 2014). Second, there will be a need for the continued evolution of new and emerging paradigms (e.g., Marron et al., 2018), operationalizations, and associated neuroscientific technology. In the case of creativity, for example, operationalizations will need adapting given that existing measures tend to assume deliberate attempts to creatively solve a problem (e.g., Zhang & Bartol, 2010). In the case of creative goal-directed and undirected attention and associated information processing, our framework underscores the importance of incorporating neurological measurement (e.g., fMRI, EEG) to assess activation within and between brain regions associated with each pathway, such as the central executive network and default mode network. Such measures can likely be augmented by self-report measures, given that attention is an internal experience. However, such self-report measurement of attention will need to be sufficiently brief to be conducive to repeated measurements (Gabriel et al., 2019; Yeo & Neal, 2004).

We see two emerging lines of research in neuroscience and OB that provide promising starting points for these methodological advances with the potential for integration. First, in neuroscience, Marron et al. (2018, 2020) have developed behavioral measures that can be carried out within fMRI scanners, enabling the measurement of spontaneous processing capabilities separate from deliberate ones. This paradigm employs chain-free association, whereby participants are asked to verbalize "chains" of single-word associations, with each association relating to the previous one (e.g., wax, candle, fire, hot, summer, and love; Benedek et al., 2012). The behavioral measures derived from this task capture associative fluency, flexibility, and semantic remoteness between associations and are believed to be indicative of unconstrained, spontaneous processing. In one neuroimaging study (Marron et al., 2018), default mode network activation was shown to be higher when performing the chain-free association tasks compared to other tasks believed to require more controlled forms of cognition. Increased activation of the default mode network and reduced activation of a major node of the central executive network (the left interior frontal gyrus) were also associated with higher scores on these tasks. Similarly, higher performers on chain-free association tasks have been shown to have stronger resting state functional connectivity within the default mode network and weaker connectivity between the default mode network and central executive network, suggestive of the central executive network's non-involvement in processing (Marron et al., 2020). These tasks thus represent a promising avenue for isolating the role of spontaneous processing stemming from undirected attention and its flow on consequences for creative usefulness and novelty.

Second, the work breaks literature in OB shows promise for examining creative goal-directed and undirected attention within the context of "attention breaks" (Albulescu et al., 2022; Fritz et al., 2013). For example, researchers could ask participants to take different types of breaks with instructions designed to initiate creative goal-directed versus undirected attention. This could be done in the laboratory (e.g., by taking breaks from a laboratory task) while simultaneously capturing neurological-cognitive measurements, or potentially in the field, especially with rapid advancements in wearable technology for measuring neurological/physiological processes (Khakurel et al., 2018). In combination, the aforementioned methodological innovations have great potential for examining the effects of goal-directed versus undirected attention on creative usefulness and novelty, as well as the benefits of different sequences of attention.

4.3 | Theoretical extensions

Our framework offers a platform for extending theoretical understanding regarding attentional pathways to creativity and other valued work outcomes, thereby offering more nuanced knowledge to guide practical intervention. In this section, we discuss potential extensions in relation to the likely antecedents, moderators, and additional outcomes of the proposed attentional pathways.

4.3.1 | Antecedents

Our framework can be used as a platform for considering the factors likely to be barriers versus enablers of the initiation and maintenance of each attentional pathway to creativity. First, we consider how our framework can be used to consider factors likely to be conducive (vs. not conducive) to both the experiences of creative goal-directed and undirected attention. Our framework indicates that even if time is allotted for experiencing creative goal-directed or undirected attention, the desired form of attention will not be sustained to the extent that attention is redirected (away from the creative goal in the case of creative goal-directed attention and directed to anything in the case of undirected attention). We suggest that work design features such as multitasking, task switching, time pressure, or deadlines, which prompt direction/redirection of attention to competing tasks, are likely to be potential barriers. The task switching involved in multitasking, for example, requires controlled processing that not only uses up limited resources, leaving fewer for subsequent tasks (e.g., time reserved for creative goal-directed or undirected attention), but carries the cost of "attention residue"—that is, attention devoted to that task even after moving to the next task (Leroy, 2009). Thus, multitasking and associated task-switching likely undermine the effectiveness of any attempts to experience creative goal-directed or undirected attention. On the flip side, these arguments suggest that work design features such as single or sequential tasking, reduced workload, and relaxed deadlines may provide a context more conducive to experiencing creative goal-directed or undirected attention when desired, enabling the optimal sequencing put forward in Proposition 3. Future research could test the effectiveness of these types of interventions on the usefulness and novelty of generated ideas and test the mediating role of attention and associated neurological underpinnings. Doing so would address calls for more theoretically driven intervention research to enhance understanding of the creative process while simultaneously having direct practical implications (Lambert et al., 2022).

In parallel to identifying factors that are conducive to each attentional pathway, future theoretical development should be cognizant of the possibility that such drivers may cancel each other out. This is because our framework suggests that, besides indicators of involuntary control being barriers to both, the enablers and barriers for each pathway can be in opposition to each other. Namely, factors conducive to operating under voluntary attentional control should be enablers of creative goal-directed attention but barriers to the experience of undirected attention, whereas factors conducive to "letting go of control" should be enablers of undirected attention but barriers to creative goal-directed attention. This situation suggests that the chronic presence of any one factor may produce an inability to switch attentional forms, thereby missing the opportunity to maximize both usefulness and novelty as per Proposition 3. Consider leaders' expectations for creativity (Carmeli & Schaubroeck, 2007). These may promote voluntarily controlled attention toward creative problem solving because they encourage focus on finding solutions to known problems. However, they may simultaneously act as a barrier to the experience of undirected attention because meeting high expectations necessitates the allocation of considerable yet limited attentional resources toward well-defined goals. This requirement is at odds with the notion of creating time to "let go of control" which, moreover, may be viewed as lazy, a waste of time, or boring (Chinander & Schweitzer, 2003; Wilson et al., 2014). In contrast, organizations or leaders who espouse free time, like Google's 20% time (Bock, 2015) and paid sabbaticals (Kane, 2015), may give employees the license to "let go of control," allowing free thought and exploration, but at the extreme would run the risk of stalling progress or stunting utility on creative projects that require more focused problem solving. Our framework clarifies that alternating between the two attentional modes inferred by these approaches, and thus adopting an alternating sequence of approaches (Proposition 3), may help resolve the trade-offs inherent in any single approach in order to maximize usefulness and novelty (Berg, 2016; Harvey & Berry, 2023).

4.3.2 | Moderators

In addition to identifying factors (i.e., antecedents) that are likely to be barriers vs. enablers of the initiation and sustainment of attentional pathways, it will also be important to consider potential boundary conditions. In this section, we discuss three potential moderators of the attentional pathways—practice, dynamic characteristics of the attention episodes, and more stable person/work environmental factors.

Just as practice is required for people to learn the skill of initiating and maintaining a state of present moment awareness (Eby et al., 2019), practice may be required to learn how to sustain states of creative goal-directed and undirected attention and unlearn the habituated practices that inhibit the access to and effectiveness of these states. We speculate that it will be particularly challenging for undirected attention to be initiated and maintained without practice in "letting go of control." This is because it is arguably the norm in workplaces to operate in a mode of controlled processing, such that it has become a habit to do so (Leshed & Sengers, 2011; Wood et al., 2005). Thus, being able to experience undirected attention may require learning how to relinquish control while simultaneously breaking the habit of directing attention. Self-regulation theories of habit (Oulasvirta et al., 2012) and skill acquisition (Kanfer & Ackerman, 1989; Yeo & Neal, 2004) suggest that barriers must be removed to break the habit of directing attention, and practice is

needed to acquire the skill of "letting go." Therefore, we suggest that repeated attempts to intentionally engage in undirected attention in the absence of obvious factors likely to "hijack" attention (i.e., direct it toward an entity, such as smartphones) should enhance the likelihood of those "attention breaks" being experienced as intended.

Reflecting on the notion that practice may be important for learning how to initiate and sustain various forms of attention raises theoretical and practical questions concerning the moderating role of an attention episode's dynamic characteristics (e.g., its precise content and structure) in determining its effectiveness in promoting creativity. That is, the initiation, maintenance, and effectiveness of a given form of attention may depend on specific features of these practice experiences. For example, how frequently should we experience episodes of creative goal-directed or undirected attention? How long should these attention episodes be when trying to maximize usefulness and novelty via their sequencing? What time of day should we make time for each form of attention? The work breaks literature suggests that short, frequent breaks in the early part of a workday are most beneficial (Bennett et al., 2020; Kim et al., 2018; Parker et al., 2017; Zacher et al., 2014). Thus, initial investigations could examine creative goal-directed and undirected attention according to these parameters, and then examine variations (e.g., related to the time of day, length, and frequency).

Beyond consideration of these relatively dynamic concepts, more stable person or work environment factors are also likely to influence the initiation, maintenance, and effectiveness of the attentional pathways. According to our framework, personality or environmental characteristics prone to prompting the voluntary or involuntary (re) direction of attention elsewhere will likely be barriers, thus disrupting the experience of creative goal-directed or undirected attention. Such characteristics might include aspects of personality, such as time urgency (Mohammed & Harrison, 2013) and trait rumination (Trapnell & Campbell, 1999), and relevant features of work such as time pressure (Ohly & Fritz, 2010). We speculate that these individual and environmental factors might be particularly detrimental to employees switching to undirected attention episodes following creative goal-directed attention episodes, thereby reducing their likelihood of maximizing the usefulness and novelty of creative outcomes (Proposition 3).

4.3.3 | Additional outcomes

There is potential to extend our framework's propositions to consider the downstream implications of creative usefulness and novelty. In this section, we focus on such potential implications for radical versus incremental creativity and recovery.

Radical versus incremental creativity

Radical creativity involves set-breaking frameworks or ideas that differ substantially from an existing practice or process, whereas incremental creativity involves adaptive ideas that offer relatively minor improvements or modifications to existing practices and products (Harvey & Berry, 2023; Madjar et al., 2011). Considering this distinction, radical creativity (e.g., automation, mRNA vaccines, and other technological breakthroughs) might benefit most from the maximization principle of our framework, whereby usefulness and novelty are maximized via intervals of creative goal-directed and undirected attention according to our proposed temporal sequencing. This process may enable employees to generate and realize more radical creative solutions that are truly novel, unusual, and also practical. In this regard, creative potential is maximized by both its novelty (e.g., a major paradigm shift in thinking) and the practical value of the breakthrough. In contrast, incremental creativity (e.g., adding a new flavor to an existing soda to serve customers' preferences) might still benefit even if a directed pathway dominates at the expense of an undirected pathway, thereby restraining novelty. This would manifest as a condition where emphasis is placed on ensuring an idea's usefulness, while simultaneously acknowledging that novelty may not be maximized, although it is maintained at a certain level. In this case, the potential benefits of creative goal-directed attention may be sufficient because these adaptive changes primarily require a specific focus on the appropriateness of ideas and suitability for the product and environment, while novelty plays a secondary role.

Recovery

Our framework introduced the concept of undirected attention and explored the role of this attentional state in relation to creative outcomes. However, given that this concept has not previously been considered in research, further theorizing may reveal that it drives additional outcomes, having benefits for individuals and organizations. Intuitive among these may be recovery—a psychological state that is reached after a process of resource replenishment (Sonnentag et al., 2017). Recovery theories assume that humans have a limited resource capacity which needs periodic replenishing. One way of replenishing resources is to facilitate the body's natural replenishment process by conserving resources (whereas the other means is to generate new resources, which is assumed to require resource investment; Hobfoll, 1989; Meijman & Mulder, 1998).

The undirected attention pathway of our framework, characterized by its specific neurological underpinnings, may be well-placed to address calls to understand the mechanisms underlying recovery via resource conservation (Sonnentag et al., 2017). Characterized by the absence of attentional control and regulation, this pathway does not consume resources and feels effortless (Kaplan & Berman, 2010; von Hecker & Meiser, 2005). Thus, both the neurological and information-processing underpinnings of undirected attention suggest that resources are conserved when experiencing this type of attention, thereby potentially fostering recovery.

4.3.4 | Mental states

Our conceptualization of undirected attention has significant implications for research on mental states. Notably, prior conceptualizations have not considered the content of mental states separate from their

underpinning form of attention, characterized by specific breadth, movement, and control. Considering underlying forms of attention separate from content may thus help to advance research and increase construct clarity. In what follows, we consider implications for two mental states garnering significant attention in recent research—mind-wandering and mindfulness.

Mind-wandering

Our framework adds precision to the likely effects of mind-wandering on creative outcomes by considering the form of attention that underlies the content of these off-task thoughts. It indicates that when the mind wanders (i.e., when there is a shift in the content of thought away from an ongoing task; Smallwood & Schooler, 2015), the associated thoughts will maximize the usefulness of creative ideas if underpinned by creative goal-directed attention, maximize the novelty of ideas if underpinned by undirected attention, and will not help (or may harm) creative outcomes if being directed by unrelated goals or controlled involuntarily (e.g., when ruminating and consuming rather than freeing up attentional resources). Given a taxonomy positing the existence of at least six types of mind wandering, likely driven by a mixture of underlying attentional forms (Dane, 2018), as well as further conceptual and empirical evidence demonstrating varying impacts on creativity associated with different types of daydreaming (Baer et al., 2021), we stress the importance of further research. This should extend beyond the exploration of thought content and delve into the conceptual and empirical distinctions of mind wandering in terms of its underlying attentional forms, as well as its positive or negative effects on usefulness and novelty.

Mindfulness

Here, we consider the implications of our framework as it pertains to two forms of mindfulness—present moment awareness and open monitoring. *Present moment awareness*, which underlies activities or interventions such as focused breathing exercises (e.g., Hafenbrack et al., 2020; Hafenbrack & Vohs, 2018), is the most common form of mindfulness examined in the OB literature. Noteworthy is that our framework does not point to this form of mindfulness as having the neurocognitive features required to maximize either usefulness (because the focus of voluntarily directed attention is not creative) or novelty (because it is directed rather than undirected). This implication adds nuance to speculation from researchers (e.g., Mooneyham & Schooler, 2013) and writers in the popular press (e.g., Zomorodi, 2017) that mindfulness alone, despite its stress-reduction benefits (e.g., Querstret et al., 2016; for a review, see Eby et al., 2019), may not always be sufficient to spark creativity. In contrast, a key implication of our framework is its indication that an *open monitoring* form of mindfulness (Lippelt et al., 2014) may be fruitful for maximizing the novelty of ideas via an undirected attentional pathway to creativity. This indication is noteworthy given that this form of mindfulness, studied in psychology (Lippelt et al., 2014; Lutz et al., 2008), has not to our knowledge been examined in the OB literature. To this end, there is an opportunity for theory development and empirical research on open monitoring in work contexts with the potential for uncovering a concrete pathway to novelty. Such work may have important practical implications regarding the role of workplace training to equip employees with the skills to initiate and sustain the experience of undirected attention, such as that presumed to underlie open monitoring.

4.4 | Practical implications

A key practical implication of our framework is that employees need to spend time experiencing both creative goal-directed attention and undirected attention to maximize the usefulness and novelty of their ideas. This implication is particularly important given that time is frequently described as knowledge workers' most valuable work asset in the creative process (Yu & Wang, 2022), yet anecdotal and research speculation suggest that creative goal-directed attention and, in particular, undirected attention are relatively rare experiences. Indeed, increasing intensification of work means there is less time and a scarcity of opportunities for anything other than "reactive" tasks (e.g., meetings, answering emails; Newport, 2016). Practitioners, for example, are documenting increasing evidence that employees are succumbing to the "busy trap" (Kreider, 2012) and lamenting that they have "no time to think" (Zomorodi, 2017), which is a problem given such "busy-ness" is assumed to thwart creativity (Byron et al., 2010). Indeed, a flurry of books, social media, and whole movements in practitioner circles resonate with the notion of needing to carve out more time to unleash ideas, such as "Take Back Your Time" (n.d.) and #boredandbrilliant (Zomorodi, 2017). These concerns are echoed by researchers who underscore the importance of making time for mindless work (Elsbach & Hargadon, 2006), unconscious processing (George, 2007), and independent thinking time (Tengblad, 2002). Thus, researchers (Boot et al., 2017; Dietrich, 2019a) and practitioners converge on the view that useful and novel creative ideas will be stunted at best or, at worst, missed completely, if we do not reserve time for both creative goal-directed and undirected attention within our busy working lives.

The importance of making time for experiencing creative goal-directed and undirected attention, and the apparent rarity of doing so, suggests there is much to be gained by increasing periods of time experiencing these two forms of attention. At the same time, this situation begs the question of how practitioners can intervene in order to facilitate the initiation and maintenance of these two forms of attention.

First, consider the more specific implication of our framework regarding the sequencing of these forms of attention—namely, that a period of undirected attention should follow a period of creative goal-directed attention. At face value, this may align with recommendations from the micro job design literature (Albulescu et al., 2022; Fisher & To, 2011) regarding micro-breaks (e.g., Breslin, 2019; de Vries et al., 2022) and mindless activities (i.e., tasks with low cognitive difficulty and performance pressure; Elsbach & Hargadon, 2006) that both should be incorporated in daily work schedules to enhance creativity. Our framework provides a level of theoretical precision that, in

turn, offers more tangible and practical guidance. It suggests the importance of not only taking a break from work or engaging in mindless tasks but specifically taking a break from directed attention. For example, despite being less demanding in nature, some mindless activities (e.g., sorting paperwork) may still be conducive to a directed form of attention, which may undermine novelty. Likewise, the vast range of work breaks that have been espoused as beneficial (e.g., relaxation activities, like stretching; nutrition-intake activities, like snacking; Kim et al., 2018; Parker et al., 2017; Zacher et al., 2014) arguably differ in their suitability for fostering different forms of attention, so breaks likely to support a state of undirected attention should be intentionally selected. Examples of such mindless activities or work breaks may include photocopying or taking a light walk outside.

Next, we consider the practical implications of our framework for creative goal-directed attention more specifically. Consistent with our earlier discussion of theoretical implications and extensions, our framework suggests that factors (or a combination of factors) that support the voluntary direction of attention toward creative goals while inhibiting or being unrelated to the involuntary direction of attention elsewhere should support the initiation and maintenance of creative goal-directed attention. Beyond existing literature which points to the importance of goal setting for creative outcomes (Madjar & Shalley, 2008; Shalley, 1991), our framework underscores the importance of simultaneously preventing that goal-directed attention from being hijacked and redirected elsewhere. Integrating these insights with our previous discussion on mindfulness implies that a potentially effective tool for assisting employees in achieving the intended state of creative goal-directed attention is the practice of focused breathing exercises or related techniques that cultivate present-moment awareness mindfulness (e.g., Hafenbrack et al., 2020). This is because an initial period experiencing focused breathing is expected to have the benefit of deactivating competing forces for goal-directed attention (e.g., Brown & Ryan, 2003).

Our discussion of theoretical extensions points to other interventions showing promise for facilitating the initiation, maintenance, and effectiveness of periods of time allocated for creative goal-directed or undirected attention. In particular, training programs that encourage directing attention to particular aspects of the creative process (e.g., design thinking; Micheli et al., 2019) or allow attention to be undirected (e.g., open monitoring meditation; Lutz et al., 2008), and various work design interventions (e.g., innovation rituals, Atlassian, n.d.; email-free days, Imber, 2017) appear promising, particularly for employees likely to be vulnerable to attention being hijacked (e.g., those characterized by hyper-reactivity—a high sensitivity and responsiveness to stimuli or distractors; Engel & Gunnar, 2020).

Leaders may also critically affect how employees focus their attention. This is because leaders' actions, conveyed through their allocation of work and promotion of norms, signal to employees what is important and how things should be done. Prior research has revealed how leaders may most directly engage in and foster creative exploration by posing questions, intellectually stimulating followers, encouraging different ways of looking at problems, and equipping team members to direct and focus their attention on problem resolution (Mumford et al., 2023). Our research adds a new mechanism to these well-established modes of encouraging creative problem solving by identifying the benefits of leveraging and promoting what previously might have been considered "down-time" or "slack." A leader may encourage their direct reports to consider time as a resource to invest in activities not characterized by creative goal-directed attention. They may encourage employees to use free time between meetings, in working hours, and traveling to open their minds to engage in less directed activities with the exploratory benefits of undirected attention. Thus, leaders may stipulate the benefits of carving out meeting-free time and consider time not as a resource to be expended in employment relationships, but rather one where greater consideration is afforded in how time is used (e.g., supporting breaks to allow time for different forms of attention). Such leader interventions may benefit not just employee creativity directly but may also help mitigate the impacts of stress and excess work demands that challenge and undermine creative thought.

4.5 | Conclusion

Our neurocognitive framework of attentional control contributes both to the conceptualization of creative goal-directed and undirected attention, as well as their distinct underlying processes that have implications for maximizing creative usefulness and novelty. These contributions advance theories of both creativity and attention, as well as our understanding of various mental states. Moreover, the theoretical insights offered by our framework have direct implications for considering how to promote different forms of attention and thus maximize creativity in practice. In combination, our framework and its implications set the stage for advancing research in this area, providing a platform for new lines of inquiry. The interest in and need for advanced understanding of distinct attentional pathways to creative usefulness and novelty, combined with new technology for understanding neurological-cognitive mechanisms, underscore that the time is both ripe and exciting for research in this space.

ACKNOWLEDGEMENTS

We would like to acknowledge Sabine Sonnentag, Ingrid Fulmer, James Beck, and Rajiv Amarnarni for providing feedback on earlier versions of this manuscript as well as Stacey Parker, Andrew Neal, Hannes Zacher, and Tim Ballard for providing feedback on grant applications related to this work. Open access publishing facilitated by The University of Western Australia, as part of the Wiley - The University of Western Australia agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST STATEMENT

The authors have no potential conflict of interest to declare.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current research.

ORCID

Gillian B. Yeo https://orcid.org/0000-0001-9173-6096
Nicole A. Celestine https://orcid.org/0000-0001-7362-2714
Sharon K. Parker https://orcid.org/0000-0002-0978-1873
March L. To https://orcid.org/0000-0002-6621-3776
Giles Hirst https://orcid.org/0000-0001-6296-7821

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AUTHOR BIOGRAPHIES

Gillian B. Yeo is a Professor and Woodside Chair in Leadership and Management at the UWA Business School. She is currently serving as an Associate Editor of *Journal of Applied Psychology*. Her research relates to self-regulation. She examines individuals' motivation, emotions, and cognitions over time in learning, performance and well-being contexts.
UWA Business School, University of Western Australia, 6009, Australia. Email: gillian.yeo@uwa.edu.au

Dr. Nicole A. Celestine is a researcher and writer based at the University of Western Australia Business School. Her research interests lie at the intersection between well-being, attention, and positive psychology. Her work appears in several top business journals, including the *Journal of Organizational Behavior* and *Journal of Business Ethics*.
UWA Business School, University of Western Australia, 6009, Australia. Email: nicole.celestine@uwa.edu.au

ARC Laureate Fellow Sharon K. Parker is a John Curtin Distinguished Professor at Curtin University, Director of the Centre for Transformative Work Design, and named a Web of Science 2019 Highly Cited Researcher. She has published over 200 articles in leading journals on topics including work design and proactive behavior.
Centre for Transformative Work Design, Curtin University, 6000, Australia. Email: s.parker@curtin.edu.au

March L. To is an Associate Professor of RMIT University. His research interests include emotion, creativity, well-being, and team dynamics. He has published in top journals in the domain and is serving on the Editorial Boards of the *Journal of Applied Psychology* and *Journal of Organizational Behavior*.
Graduate School of Business and Law, RMIT University, 3004, Australia. Email: march.l.to@rmit.edu.au

Giles Hirst is a Professor of Leadership at the Research School of Management, ANU. He studies employee creativity, leadership, and enhancing humanitarian migrant success in work. Giles has published in *The Academy of Management Journal*, *Academy of Management Review*, *Leadership Quarterly*, *Journal of Management*, and *Journal of Applied Psychology*. Research School of Management, Australian National University, 2601, Australia. Email: giles.hirst@anu.edu.au

How to cite this article: Yeo, G. B., Celestine, N. A., Parker, S. K., To, M. L., & Hirst, G. (2024). A neurocognitive framework of attention and creativity: Maximizing usefulness and novelty via directed and undirected pathways. *Journal of Organizational Behavior*, *45*(6), 912–934. https://doi.org/10.1002/job.2787