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Attention Drifting In and Out: The Boredom Feedback Model

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Abstract

We synthesize established and emerging research to propose a feedback process model that explicates key antecedents, experiences, and consequences of the emotion boredom. The proposed Boredom Feedback Model posits that the dynamic process of boredom resembles a feedback loop that centers on attention shifts instigated by inadequate attentional engagement. Inadequate attentional engagement is a discrepancy between desired and actual levels of attentional engagement and is a product of external and internal influences, reflected in objective resources and cognitive appraisals. The model sheds light on several essential yet unresolved puzzles in the literature, including how people learn to cope with boredom, how to understand the relation between self-control and boredom, how the roles of attention and meaning in boredom can be integrated, why boredom is associated with both high- and low-arousal negative emotions, and what contributes to chronic boredom. The model offers testable hypotheses for future research.

Keywords

boredom, emotion, attention, boredom proneness, self-regulation

The commonplace experience of boredom has fascinated scholars, both modern and contemporary. In recent decades, clinical, experimental, social, cognitive, educational, and personality psychologists have amassed a sizable body of research that places this familiar yet far from trivial emotion in the spotlight. Basic questions—how one gets bored, how boredom and its consequences are resolved, whether boredom has benefits—enjoy increasing theoretical and empirical treatment.

Among the various lines of inquiry, a particularly noteworthy insight is that failure in attentional engagement has been proposed (Eastwood et al., 2012) and demonstrated as a salient characteristic of boredom experiences (e.g., Danckert & Merrifield, 2018; Hunter & Eastwood, 2016; Merrifield & Danckert, 2014). Standing on the shoulder of this and other seminal work, we propose the Boredom Feedback Model (BFM), which characterizes boredom with a psychological feedback loop that centers on attention shifts instigated by inadequate attentional engagement (IAE)—a discrepancy between desired and actual levels of attentional engagement. The model highlights the role of cognitive appraisals and postulates that the antecedents, experiences, and consequences of boredom are rooted in the interaction between attention shifts and these cognitive appraisals that unfold as part of an emotion-feedback loop. This synthesis can help solve several long-standing theoretical puzzles and explain empirical discrepancies in the studies of boredom.

This review focuses on boredom as a transient affective state. We first offer a synopsis of relevant existing theoretical accounts and focus on five unresolved issues in boredom research. We then present BFM and its contribution to integrating existing evidence vis-à-vis the five unresolved issues. Finally, we offer unique hypotheses that stem from the model and outline directions for future research.

Existing Theoretical Models on Boredom

Boredom is an emotion that can be, and should be, distinguished from other affective states (Van Tilburg & Igou, 2017a); it features a unique configuration of affective, cognitive, physiological, expressive, and motivational characteristics (see Nett et al., 2010; Van Tilburg & Igou, 2012). It is an unpleasant experience (e.g., Martin et al., 2006; Smith &

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Ellsworth, 1985; Van Tilburg & Igou, 2017a), in which people perceive time as passing slowly, and feeling restless, trapped (Martin et al., 2006), unchallenged, and perceiving the situation, and perhaps life, as meaninglessness (Chan et al., 2018; Van Tilburg & Igou, 2011, 2012, 2017a).

Researchers have examined boredom from diverse perspectives, focusing on its functions (e.g., Bench & Lench, 2013; Elpidorou, 2018a; Van Tilburg & Igou, 2011, 2019), its underlying attentional mechanisms (e.g., Eastwood et al., 2012; Fisher, 1998; Leary et al., 1986), its preceding appraisals (Pekrun, 2006), or its relation with self-control (Wolff & Martarelli, 2020). These different accounts each have their strengths and unique contributions. There are several excellent extensive reviews (e.g., Ros Velasco, 2019) of boredom research. We focus ours on approaches that are of particular relevance to (a) the role of attention under boredom, (b) the function of boredom within behavioral psychological feedback loops, and (c) the role of appraisals in the unfolding of boredom. These processes constitute the pillars of BFM.

Attentional Accounts of Boredom

Early attentional accounts of boredom posit that difficulties in sustaining attention on a task are central to the experience of boredom (e.g., Damrad-Frye & Laird, 1989; Fisher, 1993, 1998; Leary et al., 1986). Boredom is here conceptualized as an "affective consequence of effortful maintenance of attention to a particular stimulus event" (Leary et al., 1986, p. 968). Put differently, boredom is an unpleasant, transient state in which people struggle to maintain their attention on the current activity (Fisher, 1993). Furthermore, attentional difficulties were suggested to be a major cue for recognizing oneself as bored (Damrad-Frye & Laird, 1989).

While these early attentional accounts offer important insights into the relationship between boredom and attentional processes, they primarily focus on boredom as a consequence of the unsuccessful act of exerting *effortful* concentration. Research has shown, however, that people can feel bored when they are not doing anything in particular (Fisher, 1987; Harris, 2000). Overcoming the limitation of these previous explications, Eastwood and colleagues (2012) define boredom at its core as an "aversive state of wanting but being unable to engage in satisfying activity" (p. 484). They propose that the presence of an unfulfilled desire (Fahlman et al., 2013), instead of the effortful control of attention, is central to the experience of boredom.

Until recently, attention theories had not elaborated in detail on the potential antecedents of attention failures and their consequences, aside from facilitating boredom. Other aspects of boredom, such as its role in regulating goal pursuit, have been less central to these models. Eastwood and Gorelik's (2019) unused cognitive potential (UCP) model, however, makes a notable advancement in this regard. The UCP model posits that boredom is "the feeling associated with a failure to engage our cognitive capacity (desire bind) such that cognitive capacity remains under-utilized (unoccupied mind)" (p. 57). This definition of boredom emphasizes the under-utilization of cognitive capacity and suggests that "desire bind" and "unoccupied mind" are necessary and sufficient conditions for boredom. By proposing that boredom signals cognitive slack and motivates people to engage in meaningful activities, the UCP model makes a helpful connection between attention-based and functional theories.

Functional Accounts of Boredom

Functional theories posit that, like other emotions, boredom informs and regulates behaviors. These accounts are broadly in line with research emphasizing the role of affect in self-regulation processes (Carver & Scheier, 2001), where emotions take a pivotal place in steering and offering feedback on progress in goal pursuit or goal achievement (e.g., Carver, 2006). For example, one line of research on such behavioral regulation has treated boredom as a *meaning threat*, signaling a deficiency in task- or life-meaning (e.g., Chan et al., 2018; Van Tilburg & Igou, 2012), and driving a search for meaningful alternatives (Barbalet, 1999; Van Tilburg & Igou, 2012; for reviews, see Moynihan et al., 2020; Van Tilburg & Igou, 2019). This can facilitate (perceived) meaningful responses (e.g., prosocial tendencies, social identification, nostalgic reverie; Van Tilburg & Igou, 2011, 2017b; Van Tilburg et al., 2013) or attempts at escaping boredom by reducing self-awareness (Moynihan et al., 2015, 2017).

More broadly, Bench and Lench (2013) propose that boredom regulates behavior by serving as both a signal and a driving force for the pursuit of alternative goals. These researchers propose that boredom facilitates exploration, even if the resultant new experience may seem unpleasant (Bench & Lench, 2019). This seems consistent with Elpidorou's (2014, 2018a) theorizing on boredom. Elpidorou puts forward a meta-model of boredom that highlights its functions as informing the presence of an unsatisfactory situation while motivating more interesting, fulfilling, or meaningful engagement. Specifically, Elpidorou argues that boredom serves the informative role of highlighting one predicament state in the face of unsatisfactory goals while motivating the pursuit of other activities that are more in line with overall aspirations. According to Elpidorou (2018a), this places boredom in the role of potentially facilitating personal growth and the attainment of a meaningful life.

The above functional and attentional approaches to boredom focus primarily on boredom's regulatory roles or its relation to attention processes, respectively. The Meaning and Attentional Components (MAC) model by Westgate and Wilson (2018) prominently features both meaning (typically associated with functional accounts) and attention (typically associated with attentional accounts). The model posits that attention and meaning are two orthogonal predictors of boredom. It suggests that a lack of attention is sufficient but not necessary for boredom and proposes different profiles of

boredom as a function of meaning and attention. It explains how two types of attentional deficits, under-stimulation and over-stimulation, may produce boredom.

Cognitive Appraisal Accounts of Boredom

Different from the cognitive-attentional and functional accounts of boredom, treatises of boredom from the perspective of its cognitive appraisals are fewer and less integrated. Nonetheless, they are important for understanding in what settings boredom may occur and what responses may follow. Cognitive appraisal characterizes the interpretation of an environment in which emotions unfold, its significance for oneself, and corresponding motivational reactions (Sander et al., 2005; Van Tilburg, Bruder, et al., 2019), thereby forming an essential component of emotions (Frijda, 1993; Scherer, 2001).

Research on cognitive appraisals, including those of boredom, typically examines these by contrasting different emotions against each other; a unique cognitive appraisal "profile" is established for each emotion that delineates its differences from other emotions (Ellsworth & Scherer, 2003). This differentiation not only serves to understand what makes one emotion different from another but also offers tentative insights into the specific function of emotions in the context of self-regulation. To give an example, fear and anger, both negatively valanced high-arousal emotions, differ in appraised certainty; people evaluate their environment as more uncertain under fear than anger. Consistent with this difference in their cognitive appraisals, fear, relative to anger, reduces subsequent risk-taking (Lerner & Keltner, 2001). More generally, cognitive appraisals are critical in understanding how emotions unfold and what behaviors they may prompt within a given environment.

What does the literature reveal about the cognitive appraisals of boredom? One of the earliest attempts to identify boredom's cognitive appraisals was performed by Smith and Ellsworth (1985). They found that boredom was characterized by comparatively low perceived control and responsibility, low uncertainty, low effort, and low attention relative to several other emotions. Other work on boredom's cognitive appraisals, for example, Van Tilburg and Igou (2012, 2017a), showed that its appraisal profile features a lack of perceived challenge, a lack of meaning, and low attentiveness. Work on control-value theory (Pekrun et al., 2007) emphasizes that boredom is characterized by low perceived control over an activity and its outcome as well as the low perceived value of them (Pekrun et al., 2010), which in turn explains why boredom undermines academic achievement (Pekrun et al., 2014).

While cognitive appraisal approaches to boredom seem more scattered than their attentional and functional counterparts, any model that seeks to lay out the antecedents and consequences of boredom should arguably incorporate cognitive appraisals as a central component.

Five Unresolved Issues

Although the aforementioned accounts offer key insights into boredom, five important questions remain unresolved. The first issue concerns boredom *coping* and regulation.[1] Research has shown that people may cope with or regulate boredom through adaptive, constructive means (e.g., prosocial tendencies; Van Tilburg & Igou, 2017b) and maladaptive, harmful ways (e.g., unhealthy snacking, pain administration; Havermans et al., 2015; Moynihan et al., 2015). When and why do people pick up undesirable strategies, such as compulsive smartphone use, to cope with boredom as opposed to more desirable alternatives? This is an important question with significant implications that warrants a deeper investigation.

The second issue is related to the relationship between boredom and *self-control*. Does failure in self-control give rise to boredom, or vice-versa, or do they co-occur? Whereas accumulating research has demonstrated a close linkage between them (e.g., Isacescu et al., 2017; Kılıç et al., 2020), there are emerging speculations that boredom is a confound in ego-depletion research (Milyavskaya et al., 2019; Wolff & Martarelli, 2020). This question needs to be examined to bridge the two lines of research.

The third issue revolves around *attention and meaning* as key features in the context of boredom. Separately, whether and how the lack of attention and meaning elicit boredom has been the subject of ample empirical inquiries. Yet, thus far, there seems to be only one theoretical account that explicitly postulates their relationship. Westgate and Wilson (2018) suggest that people experience "meaningless boredom" when a task involves high-level engagement but little meaning; people experience "enjoyment (low boredom)" when doing a meaningful task with low-level engagement (p. 693). In other words, according to them, people can experience boredom when they are fully attentionally engaged with a nonetheless meaningless task; people do not feel bored when they are doing a meaningful task, even though their engagement in it is low. Past research, however, has consistently demonstrated that attention failures typically characterize boredom (e.g., Danckert & Merrifield, 2018; Hunter & Eastwood, 2016; Merrifield & Danckert, 2014; Sánchez-Rosas & Esquivel, 2016). Furthermore, lay conceptions of boredom, the experiences of boredom, and individual differences in boredom are strongly characterized by the combination of low meaning and low attention (Van Tilburg & Igou, 2017a). Of course, the finding that low meaning and attention as *typical* characteristics of boredom does not rule out the possibility that boredom experiences are *exclusively* characterized by low meaning and attention—after all, individual and context-specific emotional experiences may deviate somewhat from their prototypes. Furthermore, the tendency of low attention and meaningless situations to produce boredom (e.g., Westgate & Wilson, 2018) should not be equated with the tendency of boring situations to be both low

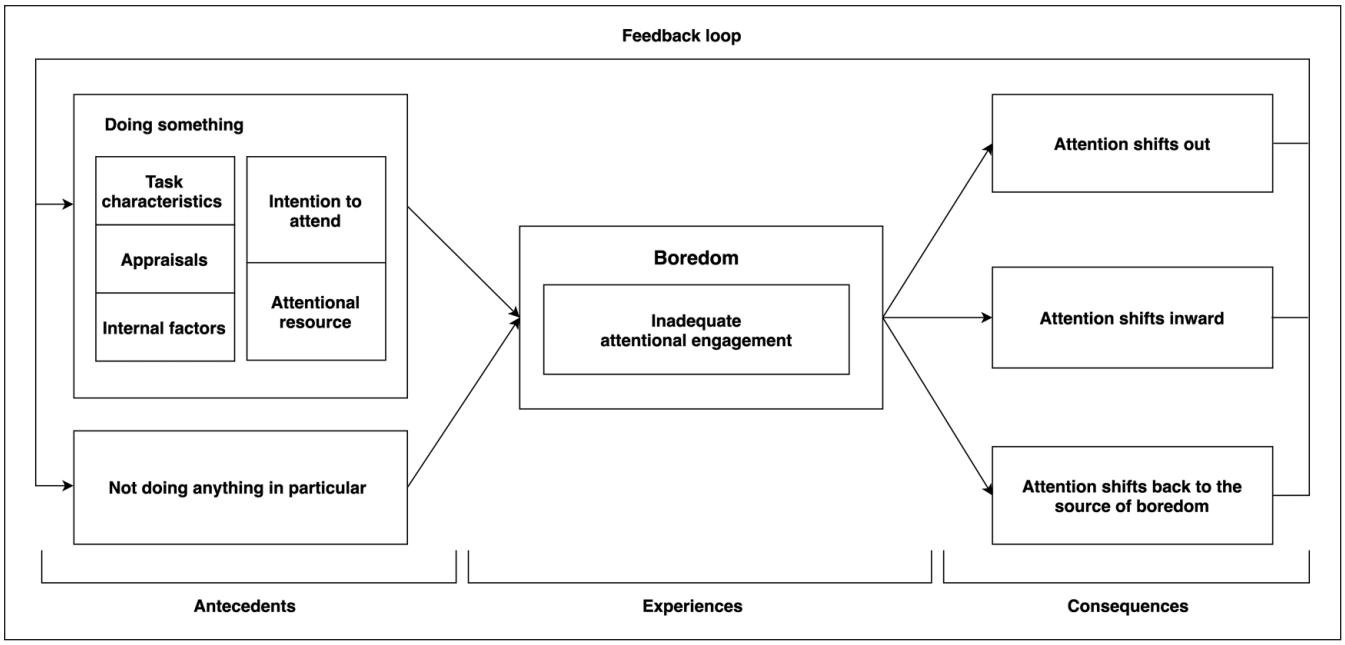

Figure 1. Boredom feedback model.
Note. This model conceptualizes boredom in terms of shifting attention and presents a hypothetical attentional mechanism underlying the emotion. A person may feel bored when there is a discrepancy between her actual and desired level of engagement (i.e., inadequate attentional engagement). Feeling bored, her attention will either shift to an external stimulus that is unrelated to the source of boredom, go inward, or return back to the current situation. If where the attentional focus ends up is not adequately engaging, the model starts from the beginning in the form of a feedback loop.

in meaning and low in attention (e.g., Van Tilburg & Igou, 2017a). Ultimately, the question remains how attention and meaning are exactly related in the context of boredom.

The fourth issue relates to the role of *arousal* in boredom, in particular, whether boredom is a high- or low-arousal emotion. The literature offers a mix of accounts, suggesting high arousal (Merrifield & Danckert, 2014), low arousal (e.g., Smith & Ellsworth, 1985), both high and low arousal (Danckert, Hammerschmidt, et al., 2018), or even fluctuations between the two (e.g., O'Hanlon, 1981). Furthermore, existing theoretical models of boredom do not yet account for why boredom tends to be associated with both high-arousal emotions such as frustration, anxiety, and anger (Fahlman et al., 2013; Van Tilburg, Igou et al., 2019), and low-arousal emotions such as fatigue (Havermans et al., 2015) and loneliness (Tam & Chan, 2019). Why does the profile of boredom appear to have such inconsistency?

The fifth issue concerns *chronic boredom*, reflected by the construct boredom proneness (i.e., people's general tendency to experience boredom; Farmer & Sundberg, 1986). A wealth of research on boredom proneness has been amassed across several decades. Notably, the construct appears to be associated with and even predicts an array of psychological and behavioral outcomes (e.g., Biolcati et al., 2016; Fahlman et al., 2009). Owing to its potential implications, researchers have called for a deeper theoretical explication of this construct (e.g., Gana et al., 2019; Struk et al., 2017). At any rate, chronic boredom is widely discussed in the literature, yet few existing models provide a clear account of its association with state boredom.

BFM

Boredom, as a momentary transient state, is associated with a number of cognitive-attentional and appraisal processes. BFM builds on the thesis that shifts in attention are essential in state boredom and that they feature in a feedback loop. As will become apparent, this model provides tentative resolutions to the five aforementioned theoretical problems by incorporating insights from attentional, functional, and appraisal approaches to boredom. The purpose of the model is not to provide a new definition of boredom but rather to integrate the current empirical knowledge on boredom and, in so doing, suggesting possible explanations for unsolved puzzles and proposing new avenues for investigation. BFM (Figure 1) is a componential model with the features and components described below.

Humans desire to be optimally engaged (Eastwood & Gorelik, 2019). BFM proposes that boredom would typically arise when there is a discrepancy between one's desired and actual levels of attentional engagement. When bored, one's attention tends to (a) shift to an external stimulus that is unrelated to the source of boredom (e.g., staring out of the window), (b) turn inward (e.g., mind-wandering, self-reflection), and/or (c) return to the source of boredom (e.g., reading this paper). If where the attention then lies is not adequately

engaging, the model starts from the beginning in the form of a feedback loop. While this loop may direct attention toward a rewarding pursuit (e.g., attending to an alternative cue that is appraised as more meaningful and thus worth the investment of attentional resource than one's current situation), if the loop runs for some time without resolve, then, we theorize, boredom would amplify through operant conditioning, eventually impairing self-control under specific circumstances, eliciting other negative emotions (e.g., frustration) and resulting in fluctuating levels of low- or high-arousal response. In the long term, chronic boredom may develop into clinical issues or problematic behaviors. We turn to each component of the model in detail next.

IAE as Key Condition for Boredom

Be it waiting in line or sitting through a tedious lecture, the typical boredom experience involves being compelled to stay in a situation where there is little or nothing of interest to keep one's mind occupied (Smith & Ellsworth, 1985). Building on Eastwood and colleagues' (2012) and Eastwood and Gorelik's (2019) work, BFM maintains that boredom tends to be experienced when there is IAE, which, we propose, is the discrepancy between one's *actual level* (i.e., objectively measurable) of attentional engagement and subjectively *desired level* of attentional engagement. We argue that IAE is a key condition for boredom; it instigates attention shifts that form the feedback process underlying boredom.

Whether one's attentional engagement is adequate is, therefore, the function of both an objective state (where one is) and subjective desired level (where one wants to be). The actual level of attentional engagement can be defined (a) neurophysiologically, as the level of activity in the dorsal attention network (DAN) relative to the level of activity in the default mode network (DMN); or (b) in terms of cognitive behavior, as assessed by dual-task inference. As in cognitive studies of dual-task performance (e.g., Irwin-Chase & Burns, 2000; Newman et al., 2007), if a task engages attention successfully, it implies that there is a cognitive cost to doing another task of similar difficulty simultaneously, where cost is defined as slowing of reaction time, increase in error rates, and the like (Verhaeghen et al., 2003).

On the contrary, the desired level of attentional engagement is subjective and context-dependent. As (in)adequate attentional engagement is relative to the desired level, what is adequate may vary from person to person and from context to context. For instance, doodling on scrap paper may not be adequately engaging when one has a range of entertainment to choose from; but it may be in the middle of a meeting you cannot skip. Indeed, an experiment found that participants who were placed in a room full of possible affordances but told to entertain themselves with their thoughts reported higher levels of boredom than those placed in an empty room (Struk et al., 2020). BFM explains these findings by suggesting that the presence of affordances increased participants' desired level of attentional engagement, which enlarged the discrepancy between the desired and actual levels of attentional engagement, and thus heightened the likelihood of boredom.

This robust relationship between boredom and IAE has been demonstrated in correlational, psychophysiological, and neuropsychological research. For example, boredom is associated with low attention (Sánchez-Rosas & Esquivel, 2016) and with attention problems such as lack of concentration, distractibility, and task-irrelevant thinking in classroom settings (Pekrun et al., 2010). Hunter and Eastwood (2016) also found that attention failure is accompanied by boredom. In their study, participants completed three blocks of the Sustained Attention to Response Task and reported their boredom level immediately before and after each block. Their results indicated that attentional errors on a given block were correlated with levels of boredom reported before and after completing that block.

Boredom also shares very similar psychophysiological patterns with that of impaired attentional performance. Empirical data show that boredom is associated with rising heart rate as well as decreasing skin conductance levels over time (Merrifield & Danckert, 2014). This is indicative of a failure in attentional engagement in prior research, where people have slower heart rates and higher skin conductance levels when their attention is engaged (e.g., Bradley, 2009; Frith & Allen, 1983). In a functional magnetic resonance imaging (fMRI) study (Danckert & Merrifield, 2018), participants were subjected to one of four conditions: interest mood induction, boredom mood induction, sustained attention, or resting state. Participants in the interest mood condition watched an interest-inducing video; participants in the boredom condition watched a boring video; participants in the sustained attention condition completed a measure of sustained attention; whereas those in the resting-state condition were instructed to relax and viewed a black fixation on a white background for 8 min. Across the boredom, sustained attention, and resting-state conditions, the posterior regions of the DMN were consistently activated. This suggests that participants were not focusing their attention on some external tasks as DMN has been shown to be activated during internally directed tasks (e.g., mind-wandering) and deactivated when attention is externally directed (Fox et al., 2018). The DMN regions were activated while the anterior insula cortex was deactivated (i.e., anticorrelated activity) in both the boredom and the sustained attention task condition. Co-activation of the anterior insula and the DMN regions (i.e., correlated activity) was found in the interest mood condition, whereas any activity was absent (correlated or anticorrelated) in the anterior insula in resting-state condition. Explaining these findings, the authors suggest that the similarly anticorrelated activation in both boredom mood condition and sustained attention task condition reflects a failure in attentional engagement with the boredom-inducing stimuli. In other

words, similar neuropsychological activities occur in both boredom and inattention, further suggesting that boredom reflects a failure in attentional engagement.

Moreover, in Danckert and Merrifield (2018), while self-reported boredom was comparatively low in the interest mood condition, it was consistently high across the other three conditions. Participants did not feel significantly different levels of boredom when they were watching a tedious video, when they were doing sustained attention tasks, or when they had nothing with which they could engage. This aligns with BFM, which postulates that boredom arises in an inadequate level of attentional engagement, both when one has nothing in particular to do and when one has something to do but fails to engage his or her attention. Boredom stems from the discrepancy between the desired and actual levels of attentional engagement. This suggests that even when one's attention is "objectively" engaged, a discrepancy still exists if the desired level of attentional engagement is greater. This explains why people may still feel bored when they are engaged in activities that demand high levels of attention (e.g., video games or piloting military drones; Ohl, 2015).

Taken together, substantial evidence from various research methodologies supports the notion that people feel bored when there is a failure in attentional engagement. BFM further proposes that such failure reflects the discrepancy between one's desired and actual levels of attentional engagement (i.e., IAE), which is a typical condition for boredom. IAE triggers the shifts in attention which form a feedback process underlying boredom.

Antecedents of Boredom

Before we embark on a detailed account of where attention shifts to and of the feedback loop, we discuss what leads to IAE, and in doing so, we make the case that the precursors to boredom commonly found in past research, such as repetitiveness and a lack of meaning in a task, are in fact precursors to IAE. Both when one has something to do or nothing in particular to do, boredom arises when there is a discrepancy between desired and actual levels of attentional engagement. Here we suggest two scenarios of boredom in terms of attentional engagement:

Scenario 1: IAE with something to do and
Scenario 2: IAE with nothing in particular to do.

Scenario 1: IAE with something to do. When people have something to do, boredom arises when the particular situation fails to engage their attention at an adequate level. In this context, Fisher (1993) theorizes three boredom causes: external factors, internal factors, and the interaction between two. For external factors, she suggests that certain objective external features, such as constraints and low stimulation, can make a situation boring to most people, regardless of individual differences. For internal factors, keeping the situation constant, people could experience different levels of boredom due to differences in subjective states or personality traits, such as extraversion and sensation seeking. She then argues that people most likely experience boredom due to an interaction of both external and internal factors in everyday life.

Extending this, BFM specifies that, in the presence of environmental constraints (i.e., "I have to do this"), one's (a) intention to attend and (b) attentional resource, coupled with (c) the characteristics of the task at hand, and the (d) appraisals of them, as well as (e) other internal factors influence the level of attentional engagement and thus boredom. We do not mean to imply that these five factors form an exhaustive list of boredom antecedents. Rather, we categorize existing findings into these five main factors and postulate how they are interrelated in influencing IAE and boredom. We elaborate on each of these factors below.

Attentional resource and intention to attend. We propose that two proximal internal factors—attentional resource (i.e., can one attend to it?) and intention to attend (i.e., does one want to attend to it?)—are interrelated in determining whether one could adequately engage their attention to the task in question. Attentional resource refers to the amount of cognitive resource one has; it is finite, it can be depleted and replenished, affecting one's ability to focus on a stimulus (e.g., Boksem et al., 2005; Franconeri et al., 2013; Johnston & Heinz, 1978; Warm et al., 2008). Intention to attend refers to the extent to which one wants to attend to the stimulus. Research on visual attention has shown that people have malleable priority and biases in directing their attention (e.g., Bisley & Goldberg, 2010; Chelazzi et al., 2014; Klink et al., 2014; Todd & Manaligod, 2018).[2]

In BFM, these two proximal factors—attentional resource and intention to attend—influence attentional engagement and the potential experience of boredom. Attentional resource and intention to attend are not orthogonal; they can influence each other. Whereas intention to attend may determine the amount of attentional resource available for a certain task, the availability of or the demand on attentional resource could probably also affect one's attention intention. Indeed, mental fatigue reduces goal-directed attention, leading to automatic shifting of attention to irrelevant stimuli (Boksem et al., 2005). Figure 2 illustrates the interplay between these two proximal factors, as well as other internal factors, task characteristics, and cognitive appraisals, in predicting IAE.

Below, we further sketch four settings (high/low resource by high/low intention) that help illustrate how the two factors may interact. Each of the settings rests on two assumptions: (a) all task characteristics, appraisals, and other internal factors are held constant and (b) there is an environmental constraint such that the person *has to* keep working on the task; otherwise, the person could redirect attention elsewhere and, provided a satisfactory source of attentional engagement is then obtained, boredom would not arise.

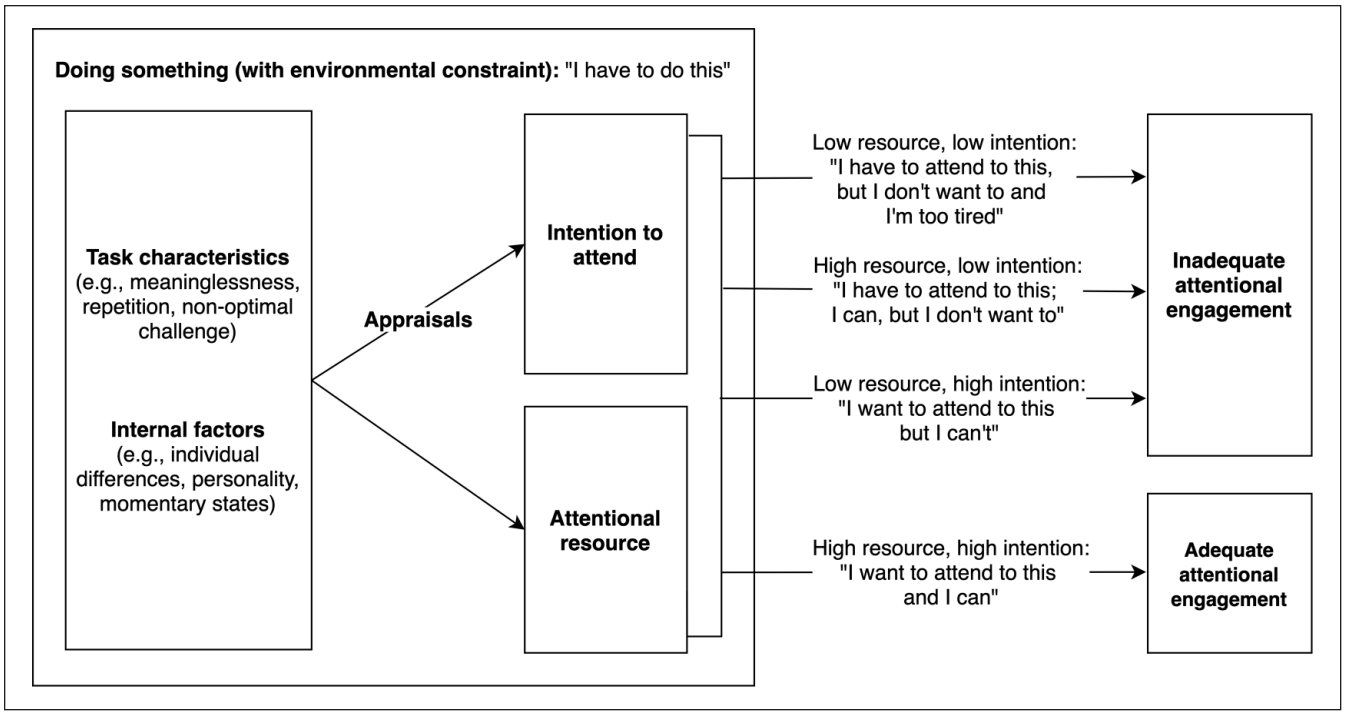

Figure 2. The interplay of attentional resource, intention to attend, and other factors in influencing attentional engagement.
Note. An illustration of how attentional resource, intention to attend, task characteristics, the appraisals of them and internal factors may interact to influence attentional engagement and thus boredom. Assuming all other external and internal factors are held constant while there is an environmental constraint that people have to attend to the current task, they would not be able to engage their attention adequately if they do not have high attentional resource *and* strong intention to attend.

First, IAE may occur when a person has to but does not want to and cannot attend to the current situation (i.e., low attentional resource and low intention to attend). For example, in Boksem et al. (2005), participants had to work on a visual attention task for 3 hr without rest. As mental fatigue and diminished goal-directed attention took hold of these unfortunate participants, their performance on the attention task also deteriorated. Second, IAE may occur when people have sufficient attentional resource but are unwilling to attend to the current situation (i.e., high attentional resource and low intention to attend). An example might be attending to an uninteresting seminar after a particularly invigorating cup of coffee. Third, IAE may occur when people are willing to attend to the current task, but they are unable to (i.e., low attentional resource and high intention to attend). For instance, an exam is approaching, and a student wants to excel in it, yet she is too tired to stay focused after hours of revision. In these three settings, IAE will lead to a shift in attention, which potentially triggers boredom. The only setting that people may be able to engage attention and thus not feel bored is when they want to and have enough resource to focus on the current situation (i.e., high attentional resource and high intention to attend). As such, BFM specifies why people can feel bored not only when they want to but are unable to engage attention, but also when they do not want to—but have to—engage their attention while having their efforts in vain.

Task characteristics and cognitive appraisals. The settings described above rest on the assumption that all other factors are held constant. In real life, attentional resource and intention to attend vary with task characteristics and cognitive appraisals to influence one's attentional engagement and thus boredom. Appraisals are considered central to the experience of emotion in many theories of emotion; appraisals characterize how emotions unfold (e.g., Frijda, 1988; Lazarus, 1982; Schachter & Singer, 1962; Scherer, 2001; see a review by Moors et al., 2013). For example, whether an unpleasant situation is accompanied by low or high appraised certainty may mean the difference between the unfolding of fear versus anger (Lerner & Keltner, 2001).

Numerous studies demonstrate that boredom arises in situations that are perceived to be repetitive (e.g., Daschmann et al., 2011; O'Hanlon, 1981), uninteresting (e.g., Merrifield & Danckert, 2014), meaningless (e.g., Van Tilburg & Igou, 2012, 2017a), lacking in autonomy (e.g., Van Hooft & Van Hooff, 2018), too simple, or that are too challenging (e.g., Harris, 2000; Martin et al., 2006). For example, Smith and Ellsworth (1985) found that bored people might perceive the present situation as requiring low effort and attention. Van Tilburg and Igou (2012) also suggest the importance of interpretation of the situation for the affective experience of boredom; perceiving the situation as meaningless and finding a task not stimulating are some of the cognitive appraisals associated with boredom. In a qualitative study (Harris,

2000), participants were asked how they know they are bored. They responded that they would know by both appraisals of oneself and the external situation. They could tell that they were bored when they noticed themselves feeling restless, mind-wandering, focusing on their own mood, or when they perceived the situation as lacking challenge or things to do. Some participants reported that they never felt bored. Their boredom proneness scores did not differ from other participants. Yet, they scored significantly lower on mood monitoring, reflecting a lower tendency to direct their attention toward their affective experience. This finding suggests that how often individuals appraise their mood or situation may influence their tendency to experience boredom. BFM posits that cognitive appraisal of the situation and/or oneself plays a key role in contributing to how engaged one wants to be and how engaged she or he is, which in turn contributes to inadequate attention engagement. We unpack this process further.

Repetition leads to habituation, both of which have been proposed as boredom causes (O'Hanlon, 1981). Studies have demonstrated an association between perceived monotony and boredom (Daschmann et al., 2011; Perkins & Hill, 1985; Thackray, 1981). Repetitive vigilance tasks, such as monitoring the repetitive display of vertical lines (Scerbo, 1998), an air traffic control radar task (Thackray et al., 1977), or any unusual movement of a hand moving clockwise (Ralph et al., 2017), were found to elevate boredom. However, Barbalet (1999) proposes that people do not feel bored in all monotonous activities. He suggests that an *interpretation* of the activity is required for the affective experience of boredom. Repetition increases the likelihood of perceived monotony, which lowers one's intention to attend and thus leading to IAE.

It is also well established that boredom arises when a situation lacks meaning. Research has demonstrated a robust relation between low meaning and boredom (e.g., Fahlman et al., 2009; Van Tilburg & Igou, 2012, 2017a). Further support comes from findings of a positive association between meaninglessness and boredom in people's daily experience (Anusic et al., 2017; Chan et al., 2018) and an inverse association between the valuation of academic materials and boredom (Pekrun et al., 2010). Whether a situation is meaningful is, of course, dependent on one's appraisal of it. When a situation is deemed to lack meaning, the intention to attend to it will reduce and thus lead to IAE.

Lack of perceived autonomy has been demonstrated to be associated with boredom. Van Hooft and Van Hooff (2018) provided correlational and experimental evidence for the negative association between perceived task autonomy and boredom. In academic settings, students' perception of teachers' support for their autonomy in learning is negatively associated with academic boredom (Tze et al., 2014). It can be reasoned that low autonomy, a product of cognitive appraisal, also lowers one's intention to attend, which leads to IAE.

Non-optimal challenges are also major causes of boredom (Harris, 2000; Martin et al., 2006; Van Tilburg & Igou, 2012). People experience greater levels of boredom when a task is too easy relative to their skill, such as when information learning requirements are too low (Geana et al., 2016). Contrarily, when the task is too challenging, people can also feel bored. In work settings, people experience boredom and find it difficult to sustain their attention if the tasks are simple and monotonous or too difficult (Fisher, 1987). In academic settings, being under- and over-challenged are precursors of boredom (e.g., Acee et al., 2010; Daschmann et al., 2011). We posit that under-challenging or over-challenging tasks strain one's attentional resource and lowers one's intention to attend to the tasks, in turn, the level of attentional engagement.

Of course, features of the task or situation in question are not mutually exclusive. A task can be meaningless because it is too simple, whereas another task can be uninteresting because it is too difficult to comprehend. In fact, researchers have routinely manipulated some of these features in their experiments to induce boredom. For instance, in the form of behavioral tasks, boredom was manipulated by having participants copy references (Van Tilburg & Igou, 2012), count the number of letters in sentences (Van Tilburg & Igou, 2011), copy or read telephone numbers from a phone book (Mann & Cadman, 2014); in the form of video stimuli, participants were instructed to watch two men hanging laundry (Merrifield & Danckert, 2014), an 85-s clip of indoor tennis over and over again for 1 hr (Havermans et al., 2015; Nederkoorn et al., 2016), videos for learning fish farming (Moynihan et al., 2015) or English (Hunter & Eastwood, 2016; Mercer-Lynn et al., 2014). All these tasks successfully induced boredom in these experiments. These tasks are hardly interesting to participants, who likely consider (i.e., appraise) them too unchallenging and repetitive in nature, and arguably reduces one's intention to attend to them.

Notably, the aforementioned features that researchers have found to give rise to boredom are also task characteristics people find difficult to engage attention (e.g., Langner & Eickhoff, 2013; Manly et al., 2003; Robertson & O'Connell, 2010). People's vigilance, the attentional ability to maintain focused attention over prolonged periods (Warm et al., 2008), is usually tested by simple, repetitive, and uninteresting tasks (Langner & Eickhoff, 2013). In an experimental study (Jang, 2008), students participated in a 20-min lesson that was pilot tested to be relatively uninteresting. The result showed that students who were provided with a rationale for putting effort into the lesson (i.e., offering tentative meaning) were significantly more engaged during the uninteresting lesson than those who did not receive the rationale.

BFM proposes that these cognitive appraisals of the situation and stimulus in question—being repetitive, uninteresting, lack of meaning, lack of autonomy, too simple, or too challenging—are features that make a situation difficult for people to adequately engage their attention, which

potentially gives rise to boredom. BFM explains that when one appraises a stimulus as repetitive, uninteresting, meaningless, unchallenging, or too challenging, one's intention to attend to it will decrease. This, in turn, lowers one's actual level of attentional engagement and thus enlarges its discrepancy with the desired level of attentional engagement—hence IAE.

Internal factors. By no means do cognitive appraisals of external situational and task-specific factors present an exhaustive list of boredom antecedents. Internal factors play a key role in the experience of boredom as well (Fisher, 1993; Martin et al., 2006; Mercer-Lynn et al., 2014). Whether a task is meaningful, interesting, or challenging is not necessarily objective or solely externally determined; it is, in part, subjective. Even if a task is comprised of all those situational features and is appraised as such, internal factors could affect one's attentional engagement and thus boredom. Individual differences, such as intelligence, skills, related experience, need for sense-making, and practice, can as well influence one's perceived task difficulty (Fisher, 1993) and the response to it (Cantarero et al., 2019). The relevance of the task to one's current concerns, schema complexity, and intrinsic motivation are other possible internal factors that influence boredom (Fisher, 1993). Empirical research in this area, however, is rather scarce; future investigation is needed to understand what kind of internal antecedents contribute to boredom.

Scenario 2: IAE with nothing in particular to do. Boredom can also arise when people have nothing to do; in other words, when there is little in the environment or on their mind to provide adequate attentional engagement. This state of "nothing to do" does not literally mean that there is nothing one is doing; one could say that waiting, sitting, or thinking is still *doing* something. Rather, this state is akin to Brissett and Snow's (1993) description of boredom, as "an experience of 'not fitting in', of 'not knowing what to do', of 'not wanting to do anything', or simply not being ready (or poised) to do anything" (p. 238). From the narrative reports of work boredom (Fisher, 1987), "having nothing to do" was most often identified as a precursor of boredom at work. Likewise, in Harris (2000), "lack of things to do" and "having to wait" were reported as two of the most frequent causes of boredom. Aligned with these qualitative findings, an experience-sampling study (Chin et al., 2017) showed that doing nothing, in particular, is one of the activities that correlated with the highest ratings of boredom; also, participants were most frequently bored when they were in medical facilities and airports, where people arguably have little to engage their attention with. According to BFM, when people desire to be engaged (i.e., high desired level of attentional engagement), they may feel bored when they have nothing, in particular, to engage with (i.e., low actual level of attentional engagement). This constitutes IAE. In this state of "nothing to do," they have the free time and autonomy to choose what they do (i.e., an absence of constraint), but they do not know what they want to do (i.e., an absence of the desired target of engagement).

To sum up the section on the antecedents of boredom, boredom can arise both when people have something or nothing to do. What is crucial is that, in both cases, the discrepancy between desired and actual attentional engagement may bring about boredom. When one has something to do, task characteristics and the appraisals of them (e.g., perceived repetition, meaninglessness, lack of interest, non-optimal challenge), coupled with the intention to attend, attentional resource, and other internal factors, affect one's desired and actual levels of attentional engagement. When the discrepancy reaches a noticeable threshold, boredom may engender.

Experiences of Boredom

When people are bored, they experience feelings of unpleasantness (Eastwood et al., 2012; Smith & Ellsworth, 1985; Van Tilburg & Igou, 2017a), restlessness, and lacking challenge (Van Tilburg & Igou, 2012, 2017a). They also experience time passing slowly (London & Monello, 1974; Martin et al., 2006) and feel trapped (Martin et al., 2006). Boredom is a state of non-optimal arousal, possibly fluctuating between low- (Mikulas & Vodanovich, 1993; Van Tilburg & Igou, 2017a) and high-arousal responses (Merrifield & Danckert, 2014). It is noteworthy that attentional engagement is related to each of these experiential components of boredom, discussed extensively in Eastwood and colleagues' (2012) seminal review.

Consequences of Boredom

In BFM, when bored, a person's attention would either shift outward, inward, or back to the source of boredom. This attention shift highlights how boredom serves a self-regulatory function of maintaining adequate attentional engagement and how it acts as a motivational force driving people to pursue something more meaningful, satisfying, or fulfilling (Elpidorou, 2018a; Van Tilburg & Igou, 2019). People's attention may shift out to external things that are unrelated to the source of boredom (i.e., the boring situation or the stimulus), shift inward (e.g., mind-wandering, self-reflection), or shift back to the source of boredom. These three routes are not mutually exclusive. For example, people's attention could shift inward, pondering on the task's meaning, and then shift out, switching to do a different task that is more meaningful or rewarding. People could also mind-wander and fiddle with their smartphones at the same time.

Attention shifts out. Boredom often accompanies a strong desire to escape from the boring situation (Smith & Ellsworth, 1985) to do something different (Van Tilburg & Igou,

2012). In Barbalet's (1999) theoretical account, boredom is a feeling that gives rise to curiosity and invention in the quest for novelty, variety, and meaning. When bored, people's attention may shift "outwards" to explore or look for more rewarding activities. This is supported by subsequent empirical research; boredom promotes exploration (Geana et al., 2016), curiosity (Lomas, 2017), and creativity (Mann & Cadman, 2014; Park et al., 2019). Likewise, boredom proneness also predicts exploration (Hunter et al., 2016).

Apart from the above, boredom drives people to seek stimulation, excitement, or challenge. Finding alternative activities is reported as the most common boredom coping method (Martin et al., 2006). People may stave off boredom through reading, socializing, watching TV, or physical exercises (Harris, 2000). In a boring lecture, one might cope with boredom by chatting with a neighbor, texting, doodling, or physically leaving (Mann & Robinson, 2009; Sharp et al., 2017). Several experimental studies found that boredom significantly promoted snacking behavior (e.g., Havermans et al., 2015). To disrupt tedium, bored participants consumed more *exciting* snacks, such as cherry tomatoes and sweets, instead of crackers (Moynihan et al., 2015). Bored participants even went for self-administering electric shocks (Havermans et al., 2015) and took more risks (Kılıç et al., 2020), with higher frequency and intensity than less bored participants (Nederkoorn et al., 2016). In line with these, boredom proneness was shown to be associated with emotional eating (Crockett et al., 2015), binge drinking (Biolcati et al., 2016), and gambling (Mercer & Eastwood, 2010).

People also react to boredom at a more symbolic level in search of meaning. Boredom was found to promote the evaluation of ingroup/outgroup (Van Tilburg & Igou, 2011), polarization of political orientation (Van Tilburg & Igou, 2016), and intentions to perform prosocial behaviors (Van Tilburg & Igou, 2017b). Boredom proneness is associated with increased levels of search for meaning in life, and thus more positive perceptions of heroes (Coughlan et al., 2017).

Attention shifts inward. Contrary to an outward direction of attention, people may shift their attention inward in response to boredom. This may especially be salient when people are restricted from doing something other than the current task. Respondents in Harris (2000) reported thinking or daydreaming as a usual strategy for coping with boredom. When people are bored, they mind-wander (Kane et al., 2007), engage in self-exploration (Lomas, 2017), daydream (Mann & Robinson, 2009; Pekrun et al., 2002; Sharp et al., 2017), or retrieve nostalgic memories (Van Tilburg et al., 2013).

Attention shifts back. Another response to boredom is to actively approach it by cognitively reappraising or behaviorally changing the boring situation. Cognitive reappraisal—the changing of one's subjective evaluations toward a situation—has been richly documented in the emotion regulation literature (e.g., Gross & John, 2003; McRae et al., 2012). To remedy boredom, people may refocus their attention on the task at hand (Harris, 2000) with effort (O'Hanlon, 1981) or employ strategies to transform a boring task into something more interesting (Sansone et al., 1992). Likewise, in educational settings, students may remind themselves of the importance of the lesson or ask their teacher for more interesting tasks to re-engage their attention (Nett et al., 2010). In a longitudinal study (Webster & Hadwin, 2015) examining students' strategies to regulate boredom while studying, three of the most frequently reported strategies were goal management, focusing on the task, and reminding oneself of the consequences for not finishing the task. More specifically, students would take breaks, modify their approach to tackle the task, or administering rewards for completing it. It appears that these strategies for regulating boredom help direct people's attention back to the task by either changing or breaking it down (behaviorally) for easier cognitive processing or reappraising (cognitively) its values, and thus increasing one's intention to attend. These strategies target the earlier discussed antecedents of boredom by making a task more interesting (Sansone et al., 1992) or raising the perceived meaningfulness of the task (Nett et al., 2010; Webster & Hadwin, 2015), both of which likely increases one's intention to attend. Or, one could take a break, which helps replenish the needed resource to engage their attention back to the task.

Based on the literature on where attention shifts to in response to boredom, we propose that the three aforementioned consequences of boredom—attention shifting out, inward, and back—are driven by the goal of reducing the discrepancy between the desired and actual levels of attentional engagement. Nevertheless, it is hard to predict where attention would go in a given setting. This is due to three main reasons. First, how one copes with boredom depends on a wide variety of factors, such as personal preferences (Martin et al., 2006), situational features like perceived causes of boredom, situational constraints, or the perceived value in persisting in the current task (Fisher, 1993). Being in class, at work, on a long-haul flight, or, perish the thought, somewhere without Wi-Fi would reduce one's options for boredom coping. Second, where attention shifts may not be the result of conscious choice. It can be intended or unintended; for example, people may not intentionally mind-wander. Third, it is uncertain whether these responses to boredom are out of a drive to escape, seek stimulation, regain meaning, or a mixture of the above.

Feedback Loop

BFM specifies that when bored, one's attention may either shift out, shift inward, or shift back to the source of boredom. If where attention lies sufficiently engages their attention, boredom diminishes at that moment. This lasts until their attention shifts away again due to IAE, returning to the beginning of the model. The model also specifies that the

amplification of boredom, both in terms of frequency and intensity, is in part due to learning; that through classical and operant conditioning, both the cues that elicit boredom and their consequence become generalized. Below, we unpack this point further. The above processes form a feedback loop that may explain boredom's dynamic nature and fluctuation over time (Mills & Christoff, 2018; Van Tilburg & Igou, 2017a) and how boredom serves a self-regulatory function of maintaining an adequate attentional engagement. Consistently, empirical findings using the Sustained Attention to Response Task showed that attentional errors were correlated with levels of boredom reported *both* before and after completing each block (Hunter & Eastwood, 2016). This suggests a dynamic relationship between attention and boredom, such as the feedback loop specified in BFM. The feedback loop of shifting attention is a novel proposition and the central component of BFM as it offers possible explanations for the five central unresolved issues in the literature.

BFM's Answers to the Five Unresolved Issues

We raised five open questions in the empirical literature for which we claimed our model could explicate, integrate, and offer a way forward. First, how people learn to cope with boredom? Second, how do boredom and self-control relate to one another? Third, what are the relationships between attention, meaning, and boredom? Fourth, why has boredom been found to co-occur with different high- or low-arousal negative feelings? Fifth, what forms chronic boredom? Below we apply the model to each of these five questions and elaborate on its theoretical implications.

Implications for Boredom Coping

BFM, especially its feedback loop, provides fundamental insights into boredom coping, offering possible explanations for the development of maladaptive behaviors (e.g., obsessive smartphone use; Elhai et al., 2018) in regulating boredom. BFM proposes that people learn how to cope with boredom in a more effective (not necessarily adaptive) manner through a trial-and-error process, testing which strategies can bring adequate attentional engagement and exit of the loop. However, if the loop runs for some time, that is, if people keep on trying to engage their attention yet failing to do so, we propose that the feeling of boredom may amplify by the process of operant and classical conditioning. When people employ a particular avoidance strategy (*attention shifts out*; for example, pulling out their smartphones) that successfully lowers state boredom, the strategy is negatively reinforced. This, over time, increases the likelihood of using the same strategy and may lead to a generalized pattern of experiential avoidance of state boredom. The model further speculates that, in the longer-run, the drop in attentional engagement becomes the conditioned stimulus sufficient to trigger avoidance, the conditioned response. For example, people may pull out their smartphones to avoid the potential experience of boredom once their attentional engagement drops, irrespective of their actual level of boredom.

Implications for the Relation of Boredom and Self-Control

Boredom seems to be closely related to self-control. Frequent experience of it is linked to impulsivity (Mercer-Lynn et al., 2013) and a range of impulsive behaviors such as risky driving (Oxtoby et al., 2019), binge drinking (Biolcati et al., 2016), and emotional eating (Crockett et al., 2015; Mercer-Lynn et al., 2013). Situationally, bored people are more likely to take risks, even for those with high trait self-control (Kılıç et al., 2020). There is an emerging discourse on the relationship between boredom and ego-depletion (e.g., Francis et al., 2018; Inzlicht et al., 2014; Milyavskaya et al., 2019). In the only review thus far that attempted to provide an integration of these two lines of research, Wolff and Martarelli (2020) propose that boredom may confound the results in ego-depletion research by placing an unwanted self-control demand and instigating behavioral change. In what follows, we highlight the implications of BFM on the relationship between boredom and self-control.

Ego-depletion research suggests that acts of self-control at Time 1 give rise to a subjective experience of mental effort and impair the performance in subsequent, unrelated self-control tasks at Time 2 (e.g., Hagger et al., 2010; Muraven & Baumeister, 2000). There are several accounts for this phenomenon. The strength model of self-regulation (Baumeister et al., 2018; Baumeister & Vohs, 2016) posits that self-control failure is rooted in the depletion of limited resources of energy, similar to the limited resources that are available to a muscle. Alternatively, the process model (Inzlicht & Schmeichel, 2012; Inzlicht et al., 2014) posits that apparent self-control failure in allocating cognitive effort to tasks results from shifts of priorities from "have-to" to "want-to" goals affecting shifts in attention, emotion, and motivation. The construal-level account of self-control (Fujita, 2008; Fujita et al., 2006) suggests that high-level construals of a situation, compared with low-level construals, facilitate self-control. Despite the ongoing debates regarding existing models (Baumeister et al., 2018; Friese et al., 2019), our model is able to offer explanations for the relationship between boredom and self-control by integrating crucial elements of these self-control models.

To recapitulate, BFM conceptualizes boredom in terms of shifting attention in the form of a feedback loop. It highlights the importance of appraisal in the unfolding of boredom. Here we illustrate the relationship between boredom and self-control with a hypothetical scenario: a person had to grade some assignment (first self-control task) and then prepare teaching materials (second self-control task). When she was grading the assignment, she failed to engage her

attention on it; she felt bored and tried to direct her attention back on the task by reminding herself of the deadline (i.e., the first feedback loop). She continued to feel bored over time and struggled to direct her attention back to grading (i.e., experiencing the feedback loop a number of times consecutively). We theorize that this continual direction of attention back to the current task (rather than directing attention inward or outward) in the feedback loop of boredom would impair self-control over time.

There are three possible explanations for this. First, such redirection of attention (back to the task) in itself is an act of effortful attention control. Based on the strength model (Baumeister & Vohs, 2016), such effortful attention control undermines subsequent self-control by depleting the resources for it (see a review by Schmeichel & Baumeister, 2010). With a reduced capacity of self-control, the person would perform poorer in the subsequent task. Second, based on the process model (Inzlicht & Schmeichel, 2012; Inzlicht et al., 2014), the feedback loop over time might increase the difficulties in exerting self-control due to a shift in attention from the current "have-to" task toward "want-to" goals. Consistent with this, whereas exercising self-control was shown to increase attention toward reward-related stimuli (Schmeichel et al., 2010), neuropsychological evidence suggests that boredom leads to a sense of fatigue and heightened reward sensitivity (Milyavskaya et al., 2019). When the person tries to prepare teaching materials (the second self-control task), she might fail to notice cues signaling the need to control as she had directed her attention toward rewarding possibilities, failing in self-control (Inzlicht & Schmeichel, 2012). Unhealthy snacking is an example of rewarding possibilities; both bored (Havermans et al., 2015; Moynihan et al., 2015) and depleted (Haynes et al., 2016) participants were found to consume a greater amount of unhealthy snack. Third, based on the construal-level account (Fujita, 2008; Fujita et al., 2006), if the person focuses on her feelings of tiredness and the limited resources she has for preparing teaching materials (the second self-control task), which is a low-level construal, she would exert less self-control (Bruyneel & Dewitte, 2012; Kim et al., 2015). If, however, she reminds herself of the goals or the importance of preparing teaching materials as a responsible teacher, which is a high-level construal, she might be able to exert greater self-control (Agrawal & Wan, 2009; Fujita et al., 2006; Schmeichel & Vohs, 2009; Wan & Agrawal, 2011) and experience a lower level of boredom (Nett et al., 2010; Nett et al., 2011), which, according to BFM, can be attributed to a higher intention to attend and corresponding attentional engagement.

In short, according to BFM, the feedback loop of attention shift in boredom might impair self-control over time through depleting resources (strength model, Baumeister & Vohs, 2016) or shifting the attention away from the need to control toward reward possibilities (process model, Inzlicht & Schmeichel, 2012). As appraisals inherently influence attentional engagement and thus the experience of boredom in BFM as well as for exerting self-control (construal-level account, Fujita et al., 2006), high-level (vs. low-level) construals could promote self-control and reduce boredom. To clarify, we are not suggesting that every instance of boredom involves self-control or every occasion of self-control is accompanied by boredom. We instead theorize that, as the two seem to build on basic attention processes, they may co-occur under certain circumstances. Specifically, we argue that the direction of attention back to the task in the feedback loop of boredom may trigger unsuccessful self-control; instead, the replenishing of cognitive resources and some form of reappraisal (e.g., reward, construal-level) might yield better results.

One insight our model might offer the research on ego-depletion is the distinction we make between engagement and effort. Ego-depletion has been suggested to result from prior self-control effort, which depletes resources (Baumeister & Vohs, 2016) or motivates shifts in motivation and attention (Inzlicht & Schmeichel, 2012). In BFM, IAE instigates the redirection of attention back to the task at hand, which may then impair subsequent self-control through resource depletion or shifts in motivation and attention. In this sense, ego-depletion might result from the failure to attain adequate attentional engagement rather than prior self-control effort. This possibility has been hinted at in past research, where mental effort was argued to result from a computation mechanism that assesses the opportunity cost of *engaging* in the current task (Kurzban et al., 2013), or from *sustaining focused attention* during self-regulation (Molden et al., 2016, 2017).

We note that these are theoretical suppositions that require future empirical tests. In addition, given that boredom may co-vary with ego-depletion manipulations research (e.g., Milyavskaya et al., 2019; Wolff & Martarelli, 2020), further work is needed to disentangle the two and elucidate their relationship.

Implications for the Relationships Between Meaning, Attention, and Boredom

Attention and meaning often feature in boredom research. In fact, the low attention and lack of meaning that characterize boredom distinguish it effectively from other emotions across the levels of concept, state, and individual differences (Van Tilburg & Igou, 2017a). However, thus far, only one theoretical model, MAC model (Westgate & Wilson, 2018), has explicitly postulated the relationship between meaning, attention, and boredom. Compared with MAC model, BFM takes a different stance on how they relate. Whereas MAC model suggests that people experience "meaningless boredom" when they are engaged in something with little meaning, BFM postulates that it is likely impossible for people to feel bored while being adequately engaged in something. Whereas MAC model proposes meaning and attention as

two independent determinants of boredom, BFM argues that perceived meaningfulness is a precursor to IAE and hence boredom; BFM's position appears to be supported by Westgate and Wilson's (2018) experimental evidence showing that the meaning manipulation had a significant main effect on attentional difficulties; that is, the two are not orthogonal. BFM explains that the meaning manipulation changes one's intention to attend and thus attentional difficulties.

It is important to note that the present synthesis does not downplay the significance of meaning in the affective experience of boredom. In fact, it highlights the centrality of this existential component in boredom. Functional accounts of boredom suggest that boredom signals the meaninglessness of the current situation and motivates people to engage in something more meaningful (Elpidorou, 2014; Van Tilburg & Igou, 2017b). The emotion informs people that their cognitive resources are not engaged (Danckert, Mugon, et al., 2018; Eastwood & Gorelik, 2019). BFM is not only in line with, but also complementary to, these accounts by highlighting the role of attention shift in self- and behavioral regulation. Given that attention is a limited and valuable resource that reflects where people's time and energy are spent, boredom can prompt people to allocate their attention to something more meaningful (i.e., rewarding in the broad sense). To master a skill, attention has to be devoted to practicing; to develop an interpersonal relationship, attention has to be placed on social interaction and communication; to process information, attention is needed. Boredom serves a vital function of prompting individuals to direct their attention to and engage in something that is of value.

Implications for the Relationships Between Boredom and Other Emotions

Boredom can co-occur with other emotions, and it has been found to correlate with both high-arousal ones such as anxiety, anger (Fahlman et al., 2013; Van Tilburg, Igou et al., 2019), and frustration (Havermans et al., 2015; Perkins & Hill, 1985), and low-arousal states like fatigue (Havermans et al., 2015) and loneliness (Tam & Chan, 2019). A study found that boredom was associated with higher levels of frustration when perceived task autonomy was low, and it was associated with a more intense depressed mood when perceived autonomy was high (Van Hooft & Van Hooff, 2018).

Whether boredom itself is a high- or low-arousal emotion remains a contested question. Theoretically, boredom was defined as a state of low arousal by some researchers (Baratta & Spence, 2018; Mikulas & Vodanovich, 1993), but defined with its characteristics of irritability and restlessness by others (Barbalet, 1999). Indeed, some studies suggested boredom is a low-arousal state (Smith & Ellsworth, 1985; Van Tilburg & Igou, 2017a; Yik et al., 2011), while others suggested it as a high- or mixed-arousal state (Merrifield & Danckert, 2014). There is also evidence showing that boredom is both a high- and a low-arousal state (Danckert, Hammerschmidt, et al., 2018). The Multidimensional State Boredom Scale (Fahlman et al., 2013) has subscales on "agitated affect" and "dysphoric affect." Given the mixed findings, researchers have suspected that different arousal levels may suggest the existence of different types of boredom (Goetz et al., 2014), or it occurs at different temporal stages of state boredom (Eastwood et al., 2012; O'Hanlon, 1981; Van Tilburg & Igou, 2017a). Bored people may fluctuate between low and high arousal, at a level of non-optimal arousal (Martin et al., 2006).

BFM hypothesizes that if the feedback loop of the model is repeated without resolve, that people keep struggling to attain an adequate level of attentional engagement to no avail, other emotions would arise. Disengagement is unpleasant and aversive (Eastwood et al., 2012); repeated failed attempts might result in high-arousal (e.g., frustration, anger, anxiety) or low-arousal reactions (e.g., apathy, sadness). If people direct their attention to ruminate on negative thoughts or life experiences when feeling bored, low-arousal reactions (e.g., sadness, worry) might arise. If they turn to others, such as reaching out to friends, to cope with their state of boredom only to realize the discrepancy between their actual and desired interpersonal relationships, this might give rise to loneliness (Peplau & Perlman, 1979). Whether boredom results in high-arousal (e.g., frustration, restlessness, irritability) or low-arousal (e.g., sadness, loneliness) responses probably depends on where their attention is directed. This postulation, and more generally BFM, helps shed light on the mixed findings on boredom as a high- or low-arousal emotion, as well as the co-occurrence of boredom with other emotions. Previous accounts do not interpret these findings as a result of a feedback loop or integrate them in a mechanistic account of shifting attention.

Implications for Chronic Boredom

Above, we discussed the short-term consequences of the feedback loop of the model. We now turn to its long-term consequences: chronic boredom. Long-term boredom and people's propensity for boredom have been conceptualized as *boredom proneness* (Farmer & Sundberg, 1986). The accuracy and appropriateness of this conceptualization are debated (e.g., Gana et al., 2019), but, for the purpose of our thesis, it suffices to underscore that the construct is associated with an array of health and at-risk behaviors, such as depressive symptoms (Fahlman et al., 2009; Goldberg et al., 2011; Malkovsky et al., 2012), anxiety (Fahlman et al., 2009), apathy, anhedonia (Goldberg et al., 2011), binge drinking (Biolcati et al., 2016), and problematic internet use (Skues et al., 2016). Given substantial evidence on the relationship between chronic boredom and well-being, it is important to understand what makes one chronically bored, whereby we may develop potential interventions.

BFM may help provide insights on this. Chronic boredom may result from dysfunction of the regulatory feedback loop, that people repeatedly fail to attain adequate attentional engagement and thus being stuck in the loop for prolonged periods of time. This is consistent with Elpidorou's (2018b) proposition that boredom proneness may be a dysfunction of state boredom, as well as Struk and colleagues' (2017) suggestion that the construct "is characterized by an individual's capacity (or failure) to engage in sufficiently satisfying activities" (p. 356).

What keeps people from attaining adequate attentional engagement? BFM further suggests that it can be attributed to two main factors, trait-like attentional factors and long-term influences. Chronic boredom is likely influenced by trait-like factors (e.g., chronic weakness of attention systems, chronic hyposensitivity, or hypersensitivity to stimulation; Eastwood et al., 2012), which may affect especially whether attentional resource is available. We also emphasize that other long-term influences that are indirectly related to attention processes likely exist as well, such as whether one appraises regular tasks, as well as the enduring situations these tasks occur in (e.g., routine activities in one's job), as valuable (e.g., instrumental to desired career progress) that is worth their attention. Such factors may relate to what one *wants* to engage in their lives, including searching for such activities, and identifying obstacles. Such differentiation has not been made by past researchers. Both trait and long-term factors can sustain the feedback loop, leading to the prolonged experience of boredom.

In terms of trait attentional factors, research shows that there are individual differences in the ability to sustain attention (e.g., Gaertner et al., 2008; Van de Weijer-Bergsma et al., 2008) or to regulate attention allocation with attention shifting and attention focusing (i.e., attentional control, Derryberry & Reed, 2002; Posner & Rothbart, 2000); these trait factors would probably affect how likely a person feels bored across different settings. A wealth of evidence has demonstrated the relationship between trait boredom and inability to sustain attention (Cheyne et al., 2006; Ferrari, 2000; Gerritsen et al., 2014; Hunter & Eastwood, 2016; Malkovsky et al., 2012; Struk et al., 2017). Further evidence comes from the findings that boredom proneness is associated positively with mind-wandering (Isacescu et al., 2017; Struk et al., 2017) and negatively with flow proneness (Harris, 2000).

BFM also suggests that chronic boredom might reflect a relatively unattainable desired level of attentional engagement. The model postulates that IAE is the discrepancy between desired and actual levels of attentional engagement. If one's desired level is unrealistically high, one might be prone to boredom because such desire is not satiable, even if one's attention seems objectively engaged. Why would one's desired level of attentional engagement be unrealistically high requires further research, but one potential mechanism might be chronic exposure to rewarding tasks that demand high attentional engagement. This is akin to the allostasis load in the stress and homeostasis literature (e.g., McEwen, 2006).

Other than trait attentional factors, BFM suggests that some factors that constituted "trait boredom" in prior research are, in fact, long-term factors that are not ingrained in one's personality. If people do not know what they want to engage in their lives in general or do but cannot engage in them, they will experience chronic boredom. In other words, their desired level of engagement is continuously or frequently not met. These long-term factors are malleable and can be intervened. For instance, a person may experience chronic boredom as she finds her job immensely boring. Her inability to identify alternative careers that are compelling to her (i.e., not knowing what one wants) or a weak economy with limited job opportunities (i.e., not being able to pursue what one wants due to obstacles) could prolong her boredom in life. Congruent with our argument, whereas an increase in life-meaning predicted a decrease in boredom proneness in a longitudinal study (Fahlman et al., 2009), in a qualitative study (Bargdill, 2000), people expressed becoming chronically bored when they had compromised their life goals for less desirable ones. A study also found that the common measures of boredom proneness (and by extension, the construct itself) should in fact be conceptualized as perceived life boredom; those high on boredom proneness are those who see their life, in general, as boring, and not simply because they feel bored more frequent or intensely (Tam et al., 2021). This kind of long-term boredom could potentially be ameliorated through searching for life purpose and engaging in something meaningful. This helps explain the findings that boredom proneness can actually fluctuate and change over time (Fahlman et al., 2009; Martin et al., 2006).

Trait-like attentional factors and long-term factors are not differentiated by their malleability; attention ability can be improved by attention training (e.g., Peng & Miller, 2016; Tang & Posner, 2009), and long-term factors can be changed (e.g., finding life goal, quitting a boring job). Neither are they demarcated as internal versus external factors; while trait-like attentional factors are internal, long-term factors can also be internal (e.g., lack of life goal) or external (e.g., a repetitive job). A simpler way to interpret their difference is that one is trait-like attentional factors the other is not. We argue that, given the importance of adequate attentional engagement in the experience of boredom, it is helpful to differentiate trait-like attentional factors from other possible long-term factors which influence chronic boredom. Such differentiation has an important implication: It suggests novel predictions on potential intervention for chronic boredom.

BFM hypothesizes that attention training would reduce the frequency of boredom for those who are chronically bored due to attentional trait factors, while finding satisfactory life engagement or removing obstacles for such search would ameliorate chronic boredom for those who are bored

frequently due to long-term factors. We speculate that specific interventions targeting these two general factors would be more effective in reducing chronic boredom and, hopefully, its accompanying psychological issues. Lee and Zelman (2019) provide preliminary evidence that dispositional mindfulness moderates the relationship between boredom proneness and well-being, that boredom proneness was associated with symptoms of depression, anxiety, and stress only among those who scored low in the tendency to focus one's attention on the present measured with the Act with Awareness subscale of the Five Facet Mindfulness Questionnaire. In other words, the detrimental effect of boredom proneness on psychological health is only salient among those who are less able to engage attention.

The Explanatory Advantages of BFM

BFM does not seek to substitute past work but rather to supplement it as part of an integrative account, through which it proposes possible explanations toward the five questions regarding boredom that existing theoretical models may not have very effectively addressed. A thorough comparison of all theoretical models of boredom is beyond the scope of the present review. Below we highlight some of the key similarities and differences of our model and related models.

We view BFM as consistent with the functional models (Bench & Lench, 2013; Elpidorou, 2018a; Van Tilburg & Igou, 2012). We emphasize the regulatory function brought by shifting attention in boredom in particular. While Elpidorou's (2018a) meta-model focuses on the experience of boredom and its function, BFM explains the dynamic, multi-component process of boredom from its antecedents, experiences, and consequences to its feedback loop.

Multiple attentional accounts (e.g., Eastwood et al., 2012; Fisher, 1998; Leary et al., 1986) underscore the pivotal role of attention for boredom; however, they focus less on the antecedents and consequences of failed attention and the existential approach of boredom (Westgate & Wilson, 2018). Eastwood and colleagues emphasized the presence of a subjective unfulfilled desire (Eastwood et al., 2012) and unfulfilled cognitive potential (Eastwood & Gorelik, 2019) for the experience of boredom. However, thus far, none of these theories have conceptualized boredom in a process account of attention shift. Integrating research findings on the antecedents, experience, and consequences of boredom, BFM proposes a dynamic process of shifting attention in the form of a feedback loop. The model emphasizes that IAE is a typical condition for boredom and offers novel predictions for the five unresolved issues.

Compared with MAC model (Westgate & Wilson, 2018), BFM has a different conceptualization of the relationships between attention, meaning, and boredom. Whereas MAC model suggests that attention and meaning are independent determinants of boredom and that lack of attention is sufficient but unnecessary for boredom, BFM posits that IAE is a typical condition for boredom and that lack of meaning contributes to IAE and thus boredom. Therefore, according to BFM, it is impossible for people to be adequately engaged in something—meaningful or not—while feeling bored. If people are working on a goal-incongruent (meaningless) activity but are able to engage their attention on it, they will not feel bored until their attention fades. This is what many previous studies have invariably demonstrated (Danckert & Merrifield, 2018; Hunter & Eastwood, 2016; Merrifield & Danckert, 2014). We acknowledge that these differences between MAC model and BFM might be attributable to the differences in how engagement is defined. Whereas Westgate and Wilson (2018) define cognitive engagement as "the result of successful attentional fit, which occurs when cognitive demands are balanced by available mental resources" (p. 693), we define IAE as the gap between one's objectively measurable level of attentional engagement and subjectively desired level of attentional engagement.

To our knowledge, Westgate and Wilson (2018) is the only study that directly tested potential interactive effects of attention and meaning. We have reservations regarding the conclusiveness of evidence on the potentially orthogonal nature of attention and meaning. Specifically, in their meta-analysis (Study 1, Westgate & Wilson, 2018), "attention" was operationalized as participants' tendency to focus on their thoughts, which seems to be more akin to mind-wandering than the typical task-related attention measures used to investigate boredom—such as sustained attention tasks (e.g., Danckert & Merrifield, 2018; Hunter & Eastwood, 2016). In their experimental study (Study 2, Westgate & Wilson, 2018), while the attention manipulation had a main effect on attention difficulties but not meaning, the meaning manipulation had significant effects on both meaning and attentional difficulties. This finding seems to be consistent with our argument that meaning could be a precursor to attentional difficulties, and thus boredom. Considering these methodological limitations and findings in the studies, the relationship between boredom, meaning, and attention proposed by MAC model is not unequivocal. Whereas MAC model proposes that meaning and attention play orthogonal roles, BFM proposes that they are interrelated in the dynamic process of boredom and that boredom experiences tend to be characterized by low attention. Low meaning influences how much one intends to engage their attention, which in turn affects the degree of attentional engagement. In other words, the two are not typically separable. These are testable, competing hypotheses; future research is needed to resolve this debate.

A theoretical model with a more specific focus in the academic context is presented by Pekrun (2006), the control-value theory of achievement emotions. It accounts for a number of emotions in academic settings, with boredom included as one of them. The theory posits that the appraisals of subjective control over achievement activities and their outcomes and the subjective values of them are central to

achievement emotions. Boredom is experienced if the current activity lacks value and possesses a mismatch in the task demand and individual capabilities, either when the task demand exceeds individual capabilities (i.e., low control) or when it is lower than individual capabilities (i.e., high control). BFM is in line with Pekrun's (2006) control-value theory, which proposes how value and control appraisals give rise to boredom. BFM further incorporates appraisal into the attentional mechanism and underscores its importance and in relation to the intention to attend in particular.

Summary and Future Directions

In sum, BFM conceptualizes boredom as characterized by a mechanism of shifting attention (Figure 1); attentional engagement at an inadequate level is a typical condition for the experience of boredom. Feeling bored, people's attention shifts outward, inward, or back to the boring situation. If where attention lies is not adequately engaging, the model starts from the beginning in the form of a feedback loop. While this loop may direct attention toward meaningful pursuit, if it runs for some time without resolve, it potentially brings adverse outcomes. Our model posits that, in the short term, boredom might amplify through operant and classical conditioning, elicit other negatively valanced emotions, contribute to fluctuating levels of low- or high-arousal responses, and impair self-control under specific circumstances; in the long term, chronic boredom may develop into clinical issues or maladaptive behaviors.

BFM points to several areas for future basic and applied research and offers corresponding hypotheses. First, the differentiation between IAE with something to do and nothing to do highlights some research gaps. Existing empirical evidence suggests that people feel bored when they are doing something that is repetitive, uninteresting, meaningless, and so on. Yet, less is known about the state of being bored with nothing to do, even though it often appears in the descriptions of boredom experience (e.g., Brissett & Snow, 1993; Chin et al., 2017; Conrad, 1997; Harris, 2000). For example, what makes people not knowing what they want to do although they have free time and autonomy to choose what they do? This is related to the research on leisure boredom (e.g., Iso-Ahola & Weissinger, 1990; Wegner & Flisher, 2009) and perhaps touches on deeper existential questions.

Second, the model specifies that the feedback loop can result in fluctuation of arousal and other emotions over time. Specifically, those who are unable to sustain attention should see a change in arousal, from low to high. Furthermore, manipulation of where attention is directed when bored (e.g., reflection on social relationships vs. unjust social issues) should result in emotions of different arousal levels (e.g., loneliness vs. anger).

Third, as discussed above, chronic boredom is likely caused by both trait-like ability in sustaining attention and non-trait longer-term factors. The model hypothesizes that there are different profiles of chronic boredom. Some individuals might be chronically bored mainly because of their inability to sustain attention, and some might be due to the lack of satisfactory life engagement. Still, some might be chronically bored because of both. In addition to empirically demonstrating these different profiles, future studies can also identify interventions that might be most suited and efficacious for these different profiles. For example, attention training might be suitable for those who are chronically bored because of attention-related issues.

Fourth, the model specifically claims that IAE, but not meaning per se, is a typical condition for boredom. As such, the model predicts that people in conditions with high reward activities can be bored, whereas those in conditions where attention is adequately sustained cannot. Any evidence of the experience of boredom while adequate attentional engagement will warrant modifications of the model.

Fifth, the model speculates that, over time, IAE is sufficient to elicit the conditioned response to boredom, especially avoidance behavior. This can be examined empirically. Given the centrality of appraisal in re-engaging attention, reappraisal-related interventions should also be an efficacious intervention for reducing the frequency of boredom.

Conclusion

Attentional processes under boredom are complex and dynamic. We present the BFM to integrate diverging findings in the empirical study. The model conceptualizes the antecedents, experiences, and consequences of boredom in a feedback loop of attention shifts. It proposes novel explanations for (a) how people may learn to cope with it, (b) how it may be linked with self-control, (c) how the role of attention and meaning in it can be integrated, (d) why it is associated with different emotions and how it manifests as high- or low-arousal state, and (e) how boredom magnifies over time and potentially becomes chronic. The model was designed to enhance our understanding of boredom concerning dynamic attentional processes and to inspire future research.

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Notes

1. Coping and emotion regulation are closely related constructs (e.g., Compas et al., 2017). They can both refer to the effort and processes to manage, modify, or modulate emotions. Broadly speaking, they differ in whether the effort or processes are in response to a stressor. If so, coping is the more commonly used term. In this paper, we treat coping and emotion regulation interchangeably.
2. Note that intention to attend and desired level of attentional engagement are two different concepts. When one works on a task, they may or may not want to attend to it (i.e., intention to attend); they would not feel bored if they are engaged in it (i.e., actual level of attentional engagement meets the desired level). Intention to attend is task- and context-specific (e.g., in relation to a particular activity that is available in a situation). Instead, desired level of attentional engagement might vary from situation to situation or person to person (e.g., based on dispositional sensation seeking), but intention to attend can vary from potential task to potential task within a given situation.

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