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Same Same but Different – What is Boredom Actually?

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Abstract

Boredom poses a fascinating riddle: Although it is a ubiquitous experience, lay people and researchers often struggle with expressing what boredom actually *is*, and how it should be *differentiated* from related or opposite psychological phenomena. In this chapter, we address this riddle in two parts. First, we define boredom and its function. We propose that boredom is a state of inadequate function utilization that occurs when reward prediction error has been minimized. Boredom's suggested evolutionary function is to drive exploration. Boredom is therefore understood to have a critical role for the effective regulation of behavior. Second, we differentiate boredom from a host of emotions and states it has frequently been likened to (or even been equated with), such as depression, amotivation, apathy or boredom being the polar opposite of flow.

Introduction

Boredom is interesting: For centuries it has been a topic in philosophy or literature. Its relevance has been readily acknowledged by great minds, such as Roman philosopher and statesman Seneca. Seneca laments (as quoted in Danckert and Eastwood, 2020, p. 17[1]): "How long the same things? Surely I will yawn, I will sleep, I will eat, I will be thirsty, I will be cold, I will be hot. Is there no end? But do all things go in a circle? Night overcomes day, day night, summer gives way to autumn, winter presses on autumn,

which is checked by spring. All things pass that they may return. I do nothing new, I see nothing new. Sometimes this makes me seasick [nauseous]. There are many who judge living not painful but empty." Its particularly revealing that a stoic philosopher – late Stoicism being at its core concerned with being able and prepared to deal with anything life throws at one – would lament in such a way about boredom. Clearly, to the stoic, boredom might be worse than actual pain. As can be inferred from this quote, the bored person wishes for something new, something that can add value. This wish is echoed very prominently in Lev Tolstoy's famous book *Anna Karenina*, where Ekaterina Alexandrovna Shcherbatskaya "began to be very much bored (…). She took no interest in the people she knew, feeling that nothing fresh would come of them"[2]. In the same book, Tolstoy beautifully characterizes boredom as the "desire for desires" (p. 487). Critically, while boredom seems to be aversive and trigger the desire for something else, boredom is far from a mere nuisance. In his Nobel lecture[3], Bertrand Russel states: "Experience shows that escape from boredom is one of the really powerful desires of almost all human beings." Thus, boredom is understood as a powerful motivator that calls people to action[4–6]. The urgency this desire can assume is exemplified in the German Faust legend, where Johann Georg Faust - a bored scholar – bargains with the devil: In exchange for his soul, the devil shall alleviate Faust of his boredom by allowing him to acquire further knowledge and pleasure[7]. This is very concisely put in the opening verses of Alexander Pushkin's *Scene from Faust* where Faust laments "Demon, I'm bored (…). The joke is stale" and demands "Distraction's what I want, So find me some (sic)"[8]. Faust experiences boredom to be so aversive that he strikes a deal with the devil that might cost him his soul but grants him immediate distraction. Why is it that boredom triggers such a powerful drive to escape from it? According to the pessimistic German philosopher Arthur Schopenhauer, human life is generally miserable and "life swings like a pendulum backward and forward between pain and boredom." More precisely, humans are either facing conditions where things are lacking (leading to the experience of pain) or where everything is achieved and one's "idle powers become a burden" and boredom ensues (as quoted in [9]).

These examples offer just a glimpse into the large and very rich body of work from the arts and humanities that has addressed the nature and power of boredom. They offer a vivid illustration of boredom as a powerful sensation that humans have had to cope with (and make sense of) for millennia already. This is in striking opposition to the longstanding scarcity of dedicated empirical research on boredom[10]. Thus, while several philosophers, poets, and politicians have gone to great lengths to characterize and understand boredom, psychological research had - with few exceptions - largely ignored it as a topic for scientific study or had addressed it only superficially and in a cursory fashion. For example, by foregoing its very definition despite including it in theoretical and/or empirical work[11–14], by subsuming it among

other psychological concepts[15,16], or by positioning boredom as the polar opposite of other psychological concepts that were deemed more focal[17].

Fortunately, this has started to change, and boredom research has drastically increased in recent years. The foundation of the *International Society of Boredom Studies* and the launch of the *Journal of Boredom Studies* will hopefully facilitate this growth. Substantial advancements have been made with respect to defining boredom, differentiating it from other psychological concepts[1,4,18], by formulating dedicated boredom theories (see Chapters ###, ###, & ###), and by investigating the neuroscience of boredom (Chapter ###). In this chapter, we will review these advancements by focusing on matters of definition, and differentiation from other psychological concepts.

Part I: What is boredom?

Recent years have seen substantial progress in defining and understanding boredom. Researchers have defined boredom as a feeling state[1], or as an emotion[19], have differentiated state[20] from trait boredom[21], and have defined boredom with relation to specific domains, such as academic[19], sport-specific[22], or social boredom (Chapter ###). Further, it has been suggested that the experience of boredom can be understood along five interacting facets (Chapter ###): namely, the motivational, cognitive, physiological, expressive, and affective components of boredom. In addition, researchers have embedded boredom in the circumplex model of affect – which organizes emotional states along the two dimensions of positive-negative valence and low-high arousal[23]. From this point of view, boredom is often described as having negative valence and being a low arousal emotion[24]. However, others have found boredom to be a high arousal state[25], and there is even evidence in favor of boredom as a mixed arousal state[26]. In sum, depending on the specific research focus and background, boredom has been conceptualized in many ways.

Clearly, the field of boredom research is flourishing. However, the many different perspectives on boredom also coincide with a somewhat inconsistent or contradictory body of literature on boredom. We illustrate this inconsistency with two examples. First, while trait boredom – usually measured as boredom proneness – has been robustly linked with negative outcomes (e.g., breaking COVID-19 containment measures, gambling)[27–29], such a robust picture has not emerged for state boredom. Likewise, boredom proneness and state boredom have been found to correlate only moderately, indicating that people with high trait boredom are not necessarily bored more quickly in a supposedly boring situation[30,31]. To account for this, it has been argued that boredom proneness as it is currently understood and assessed is no pure measure of boredom as a trait, but rather captures repeated self-regulatory failures in effectively dealing with boredom[32]: Beyond capturing one's susceptibility to get bored easily and often, boredom proneness

might also tap into affective and behavioral consequences of experiencing one's life as boring. In turn, researchers have put forward additional measures that try to capture boredom as a trait[32,33] (for a comprehensive account on boredom proneness, please see Chapter ###). With respect to state boredom, researchers have called to differentiate how boring a situation is from how bored a person actually is in this situation[34]: A measure of state boredom might produce different results if one assesses how boring a task is rated (e.g., watching a boring movie) versus how bored a person actually is (e.g., not bored at all because the person might enjoy thinking about her evening plans while being exposed to the video). Second, research on the physiological signature of boredom – for example by assessing heart rate variability (HRV) or galvanic skin response (GSR) – has produced inconsistent results[35]. For example, boredom has been linked to increases in GSR[25], but also to lowered GSR[36]. Physiological measures, such as HRV, and GSR tap into the autonomous nervous system, and variations in these measures reflect changes in arousal. In turn, research on whether boredom is a high, low, or mixed arousal state has yielded inconsistent results, too. This has been met with calls to conceptualize boredom independently from arousal[37], while other research has hinted at different types of boredom based on different arousal-valence configurations[38]. Thus, while boredom research is clearly flourishing, a heterogenous body of literature leaves many open questions. Such inconsistencies might be the result of different definitions, and the resultant differences in how boredom is measured. In this chapter, we focus on conceptual and definitional aspects of boredom and refer the reader to Chapter ### for measurement aspects of boredom.

Boredom: Conceptual Considerations

To advance boredom research, it seems worthwhile to further unpack boredom's constituents (i.e., what *is* boredom?) from its antecedences, correlates, and consequences. In the spirit of recent functional accounts on boredom[39] (See also Chapter ### and Chapter ###), we focus on the mechanisms that constitute boredom. We strive to elucidate how these mechanisms can afford boredom the function it is understood to have. With this approach, we hope to account for some of the inconsistencies in the literature and invite new research questions on the mechanisms that underly boredom.

One potential reason for some of the heterogeneity in research on boredom might lie in how fine-grained its conceptualization is, and how much researchers zoom in or out of the conditions under which boredom occurs. The effects of such differences are most clearly illustrated when looking at the way in which results from research on state boredom and on boredom proneness differ. While experiencing boredom is linked to negative outcomes, such as depression[20,21,40,41], amotivation[42–44], drug use[45], or gambling[29,46], a more nuanced picture emerges when we look at state boredom. For example, research shows that the response to being bored depends on why one got bored in the first place. In a series of three studies, Bench and Lench[47] showed that people preferred hedonically positive things if they got bored by a

hedonically negative stimulus. However, they were drawn to hedonically negative things if they got bored by a hedonically positive stimulus. Thus, isolated instances of boredom might trigger substantially different behavioral responses – and such responses are neither consistently adaptive nor maladaptive. These differential associations between negative outcomes and trait vs. state boredom suggest that being boredom prone is qualitatively different from a mere accumulation of numerous isolated boredom episodes. In turn, research on boredom proneness might conclude that boredom is inherently maladaptive and leads to bad things, whereas research on state boredom is agnostic to this issue and concludes that boredom motivates a change in behavior[5].

In the same vein, the aforementioned inconsistencies with respect to the relationship between boredom and arousal point towards different physiological correlates of being bored. One reason for this inconsistency could be that arousal is an unspecific correlate of what triggered boredom (e.g., an early morning lecture during which the student's arousal has dropped), or of the specific response that boredom triggers (e.g., a sudden increase in arousal as the student tries to re-engage with the lecture because she knows today's topic is relevant for the exams), but not necessarily a defining feature of boredom itself.

A granular conceptualization of boredom

Here, we propose a fine-grained definition of what boredom is. We argue for a narrow definition of boredom that is agnostic to various known antecedents (e.g., meaningless activity, attentional mismatch[4,48]), responses (e.g., increased mental effort, attentional failures[49], arousal, affect[49], and specific consequences of boredom (adaptive or maladaptive behaviors[32]). We believe this allows for a clear understanding of the boredom concept while still facilitating the investigation of the various antecedents, correlates, response to and consequences of boredom (i.e., such a reduced definition is not at odds with current boredom theories' predictions, see Chapter ###, ###, and ###). In addition, by making specific predictions regarding boredoms constituents and consequences, this provides testable and ultimately falsifiable propositions about boredom. This definition can therefore be put to further empirical scrutiny. We are optimistic that such scrutiny will lead an even more refined and precise conceptualization of boredom in the future.

In defining boredom, we merge Schopenhauer's core take on boredom[9,50,51] with emerging evidence on boredom's unique evolutionary function as a driver for exploration in situations that are low in informational value[5,6,52,53]. Schopenhauer – ever the great pessimist – describes human life as a pendulum between pain and boredom[4]. According to this approach, organisms have an inherent will to use their faculties (e.g.,, do things with one's physical and mental capacities). In humans, this is particularly manifested in the will to cognize (i.e., use one's mental functions)[9]. However, according to Schopenhauer's

conceptualization, the different parts of the human body all have specific functions, and organisms have the will to use their body parts according to their functions (i.e., use one's limbs for bodily movement). Accordingly, boredom is a state where an organisms' functions are not adequately utilized. How we use the terms ***adequately***, ***utilized***, and ***function*** warrants clarification[9].

First, **adequately** refers to inter-individual, intra-individual, and cross domain variations of an organism's preferences, capabilities, and perceived energy levels. This reasoning is schematically expressed in Figure 1. The shaded inner zone of the ellipses in the Venn diagram visualizes what other researchers have aptly referred to as the "Goldilocks Zone" - in other words a condition that is *just right*[54]. Activities in this zone

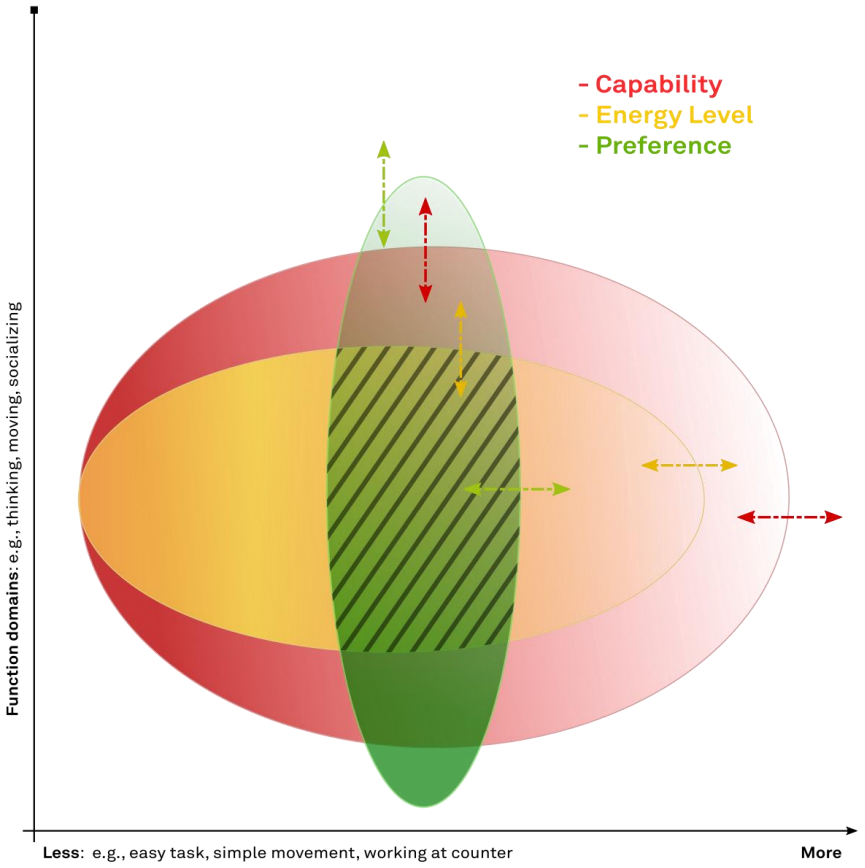

Figure 1. Schematic and non-exhaustive Venn diagram of the overlapping organism's preferences, capabilities (defining the objective action space), and perceived energy levels (defining the actual action space). Axes in Venn diagram represent the difficulty of the task (x-axis) and the domain (categorical variable). Non-shaded areas (green, red, and golden) are likely to elicit boredom, i.e., an organism is bored when its functions are not adequately utilized. Inter-individual and intra-individual (across domains, over time) differences are represented by green (preferences), red (capabilities), and golden (perceived energy) arrows. The area of the perceived energy ellipse is smaller than the area of the capability ellipse (is nested within the capability ellipse), as perceived energy refers to how much one can tap into its potential capabilities at any given moment. Capabilities set an objective outer boundary for what a person can do in principle, while the energy level sets the actual boundary for what the person currently feels able to do. Note that the actual action space can be altered by the individual as well as external factors (e.g., contextual constraints that are not depicted here).

are characterized by an adequate utilization of an organism's functions, in the sense that the current activity is consistent with one's preferences (green ellipse) and within the scope of one's general capabilities (red ellipse), and one's perceived current energy levels (golden ellipse). Importantly, preferences, perceived energy level, and capabilities should not be seen as fixed but are prone to intra- and inter-individual differences and changes in shape, size, and localization. This implies, that humans differ in a state and trait like fashion in their propensity to experience boredom. For example, one person might get bored during a math class because math is not consistent with her preferences or capabilities, while another person might not be bored in the same class (it matches her capabilities and preferences) but could be bored in the next math class because she feels particularly tired that day (it still matches her preferences but her perceived energy levels lower her capacity that day and the class does not allow her to adequately use her faculties). Here, capability, energy level, and preference characterize the potential action space at any given time. What one is capable of doing (across all function domains, i.e., not restricted to mental operations) defines the **theoretical action space**. Across the lifespan this space should follow a negative quadratic function: At very young age, very few routes of action are possible (e.g., due to restricted mobility, language etc.) and the action space is small; the action space then vastly increases until it starts to shrink again with age. Interestingly, this developmental trajectory of the objective action space is mirrored by empirical evidence on the developmental trajectory of boredom: from young age to early adulthood, experienced boredom increases, then it drops until it rises again around the age of 60[1]. We propose that one's perceived energy level at any given point in time is what defines the **actual action space**. Thus, when perceived energy levels are particularly low, e.g., after a long day at work, the actual action space shrinks and one has less possible routes of action, thereby shrinking the possible space of overlap between preferences and actual behavioral options. Indeed, higher fatigue is strongly related to higher boredom[55]. Lastly, preferences refer to the **activities a person values** at any given point in time. Here, a small range of preferred activities restricts the size of the possible overlap with the actual action space, which is nested within the objective action space. Consistent with this, being open to new experiences is linked to lower boredom proneness[56].

Second, **utilized** refers to the degree to which the faculties are engaged by the task at hand. In Schopenhauer's work under-utilization is a threat primarily for organisms for whom "mere existence" is not challenging enough to allow for an adequate utilization of their faculties. While prototypically, boredom is equated with an under-utilization of one's faculties (think of a monotonous simple task, such as monitoring a flight monitor), it has frequently been shown that boredom can also occur when a task would require over-utilization of faculties (e.g., when a math class is way too challenging)[4]. Likewise, faculties might also be considered under-utilized if the way they are utilized is not consistent with one's preferences. In this case, one's energy would feel wasted, a feeling that is linked to boredom[30]. Taken

together, boredom should not occur when the degree of **function utilization** is situated in the shared variance of the three ellipses. The shaded area emphasizes that many non-boring states/activities are possible, and that these non-boring activities might vary in terms of how much energy they demand and how close they are to the edge of one's capabilities. In addition, it highlights that many states might cause boredom[i] (see also[4]). It further indicates that the size of the shaded area should covary with boredom susceptibility and boredom proneness. Thus, a large overlap between preferences, objective, and actual action space (defined via individual capabilities and perceived energy levels) should be characteristic of someone who is rarely bored. The size of the actual action space highlights how boredom and fatigue can co-occur: If energy levels drop and fatigue rises, boredom should become more likely as the three ellipses' shared variance decreases. Lastly, Figure 1 implies that boredom can occur due to various mismatches between capability, perceived energy level, and preferences, and that this mismatch can be met with various responses that go into different directions. For example, when fatigued, one can become bored because one feels the energy to do something that is consistent with one's preferences is lacking[57]. On the other hand, a person might get bored because she has to engage with a task that she is capable of doing and also has the energy engaged in, but the task in question is not compatible with her preferences (e.g., making the reference list for this chapter).

How does an organism "notice" boredom?

As follows from the above, an organism is bored when its functions are not adequately utilized. This begs the question, how does the organism *notice* that this is the case? Here, we merge Schopenhauer's understanding of boredom with current research and theorizing on predictive coding in the brain[5,58,59]: We suggest that the state of insufficient function utilization is a state where reward prediction error has been minimized. This proposition warrants clarification of what is meant by **reward prediction error**. A reward prediction error refers to the difference in the reward utility that is predicted for a state and the actual reward utility of this state[ii]. Contemporary theories of learning conceptualize the human brain as a Bayesian agent that uses its knowledge about states to predict future states. Simply put, I use my previous knowledge about how rewarding it is to format a book chapter according to the guidelines, in

[i] If many non-boring configurations and many boring configurations exist, at least two things become clear. First, defined by an inadequate function utilization, boredom can be a high or low arousal state (and any arousal level in between) without the need for making arousal part of the definition of boredom. Second, depending on preferences, capability and energy level, non-boring states might be energetic high-performance states (e.g., flow) or non-performance states (e.g., calm relaxation). Therefore, it is unlikely to have one specific state (e.g., flow) as the one exact opposite of boredom.

[ii] This process is tightly coupled to phasic firing of dopamine neurons, which have been shown to respond to reward prediction errors, and not to correct reward predictions[60].

order to predict how rewarding it will be to format this chapter. When a state turns out to be different from the prediction, this returns a reward prediction error. This prediction error can be negative (formatting was worse than expected), positive (formatting was more rewarding than predicted), or close to zero when prediction and outcome align. Control theory states that ideally prediction error is minimized[60]. However, for positive prediction errors this might not be the most adaptive form of learning. It has been argued that reward systems should not minimize positive errors, but rather maximize them[60]. Simply put, if I repeatedly manage to put myself in situations that generate more rewards than predicted (i.e., are positively surprising), then this should be advantageous, compared to when my learning is optimized towards never experiencing such positive surprises. We propose that boredom occurs when positive (but also negative[iii]) reward prediction errors are minimized. I.e., an organism is bored when utilizing its functions does not produce an outcome that differs from expectations and everything is perfectly predictable[52] (in this vein, please see also: [1,5,6]). The claim that a minimized reward prediction error offsets optimal learning is supported by computational work. Here, artificial agents that were designed to treat predictable states (i.e., states where prediction error was minimized) as non-rewarding and boredom inducing outperformed curiosity driven agents in terms of learning[61]. Further indirect support for the mechanistic link between boredom and reward prediction error comes from one study that investigated electrophysiological markers of reward prediction error[62]. Here, prediction errors were only observed in experimental trials where participants had to actively indicate if they would receive a reward compared to a condition where they passively waited if they would be rewarded or not. Interestingly, the authors report that participants in the passive condition made the experience of boredom. Thus, although this study was not designed to test the proposition of boredom's link to prediction error, only when participants were bored, no reward-prediction error was observed.

Lastly, the timescale over which the minimization of reward prediction error leads to boredom matters. It is likely that this is subject to high inter-individual, intra-individual, and cross-domain variations (see Figure 1). For example, research shows that there is a large variation in the time it takes non-human animals[63] to habituate on a variety of behavioral, affective, and physiological responses to a stimulus after repeated presentation. More specifically, recent work has shown that people differ in how sensitive they are to low informational value (i.e., indicative of a situation that is low in prediction error), and that this difference predicts choice behavior when bored[64]. Or to put it in the words of Pushkin's Faust, people differ in how long it takes until the "joke is stale". Taken together, we propose that a state of inadequate

[iii] Negative reward prediction errors are situations that generate less rewards than predicted (i.e., are negatively surprising) and will thus lead to aversive emotions, such as frustration[60].

function utilization is characterized by a near-zero reward-prediction error[iv] and the timescale of this state's occurrence is highly individualized.

What is the function of boredom and how is it implemented?

Consistent with other researchers, we propose that boredom's evolutionary function is to drive exploration[52,53,58]. This implies that boredom is an inherently adaptive signal indicating that a current state is not valuable (i.e., functions are not utilized; reward prediction error is minimized) and serves as a push to put one's functions to adequate use which will yield prediction errors that differ from zero. We suggest that this push of boredom is an undirected one that triggers undirected exploration. Exploration is undirected if it is not directed at a specific goal. For example, a bored child might stroll aimlessly through its room, in undirected search of *something*. This process of undirected exploration is different from directed exploration[65]. Thus, boredom is understood to trigger an undirected response in search of *anything* that yields a better utilization of one's functions. This would explain why boredom has been linked to adaptive and maladaptive behavioral responses.

Boredom triggers motion

More specifically, we argue that boredom creates motion in order to alter reward prediction error by means of increased entropy. Such undirected motion might represent spontaneous alleviation of boredom. Here, **motion refers to motor or mental changes** away from the state that caused boredom. Incidentally, the link between boredom and motion is the topic of a very early (semi-)empirical publication on boredom: In an 1885 *Nature* publication Francis Galton reported that he had observed increased fidgeting in the audience of an academic talk and attributed this increase in motion as a sign of boredom[66]. This assumption has subsequently received empirical support[67]. In addition to motion in the motor domain, boredom-induced motion can occur in the mental domain too. This is prototypically exemplified by an academic who - after writing a paragraph of a chapter - for no apparent reason switches to his Social Media feed. Beyond such anecdotal evidence, a large body of empirical research has linked boredom to attentional failures[49], which can be seen as mental motion away from an ongoing task (see Box 1 for a different view on the link between boredom and attentional failures). Mental motion does not need to occur overtly. As an example for inner mental motion, research shows that people who are frequently bored also engage more frequently in spontaneous mind-wandering, whereas the link to deliberate mind-wandering is less strong[68]. This suggests that boredom is indeed more associated with undirected exploration (e.g., spontaneous mind-wandering) compared to directed exploration (e.g., deliberate mind-

[iv] Please note how well this ties into the Seneca or the Faust quote.

wandering). Importantly, even if circumstances negate overt mental or motor motion, boredom might still enable exploration via internal routes of mental motion.

As the assumed function of boredom is to drive undirected exploration, this mechanism can be expressed in terms of increasing entropy. In information theory, **entropy** refers to the predictability of one's current environment. If entropy is very low, the environment is predictable and reward-prediction error is minimized, and we would expect that the organism is bored. Indeed, a recent study that experimentally manipulated entropy and then assessed choice behavior showed that experienced entropy predicted behavior. Consistent with our reasoning, low entropy predicted a behavioral response that was geared at avoiding further instances that were low in informational value. Consistent with the proposed role for boredom, these findings "underline the relevance of boredom for driving behavioral responses that ensure a lasting stream of information to the brain" (p. 1)[64].

Box 1. Our conceptualization of boredom offers a differentiated view on the oft-found link between boredom and attention. A very consistent body of research has linked boredom to attentional failures. That is, when bored we fail to keep our attention engaged with the task at hand[49]. In turn, failures to keep attention engaged have been incorporated into the conceptualization of boredom as a defining feature[49]. While we in no way negate the close link between boredom and attention, we argue that in the context of boredom, attentional disengagement does not represent a failure. We suggest that disengaging attention from a situation that yields only uninformative reward-prediction errors (i.e., minimized near zero) is the very function of boredom. By triggering exploration via increased mental or motor motion, boredom is intrinsically designed to engage attention elsewhere. Thus, attentional disengagement is not the bug of boredom, but one of its core features. Clearly, people frequently find themselves in situations where attentional disengagement is problematic and where boredom-induced attentional failures can produce catastrophic consequences (e.g., boredom while flying an airplane[69]). However, we argue that in navigating the plethora of choices people make in life (simply put: where do I devote my time and attention?) boredom serves as an adaptive function in helping people disengage from a course of action that is too low in subjective utility. Consistent with this, people who are frequently bored (i.e., score high in boredom proneness) scored lower on a measure of trait disengagement.[70] Supporting the notion that, rather than being a pure measure of trait boredom, boredom proneness might reflect the dispositional self-regulatory failure to adaptively respond to boredom.[70]

Boredom-induced mental and motor motion in the service of undirected exploration is often expressed in terms of attentional failures[49] or restless movements[v]. Such motion can be triggered by external events (e.g., gaze away from the target stimulus[vi] [71]), appear to be rather aimless (e.g., restless motion on a chair[66]), and/or reflect habitual behavioral responses (e.g., the author who habitually accesses Social Media when bored of writing). These effects of boredom seem to be either externally controlled, aimless, or habitual. We propose that such **very immediate effects of boredom reflect a stimulus-driven response to boredom**. Importantly, this implies that boredom might theoretically occur – in the sense of inadequate function utilization which is reflected in minimized prediction error and triggers exploration – outside one's conscious awareness. Simply put, in many instances boredom might cause alterations of our behavior before we are aware that we were bored.

Unattended boredom and the "desire for desire"

Boredom is an everyday experience and almost everyone feels bored sometimes[72]. In addition, research shows that people can report various ways of responding to boredom[20]. Clearly, boredom not only exerts its effects via spontaneous responses that might evade conscious awareness, but also via more controlled processes. **We propose that boredom manifests itself in an aversive "desire for desire" when boredom is not alleviated via spontaneous responses**. This feeling state is characterized by wanting to engage with something but failing to do so[1]. Importantly, this state is assumed to be clearly noticeable by the person who can now verbally report that she is bored and that this experience feels aversive. The aversive feeling of discomfort that accompanies the experience of boredom is likely to intensify the longer the person remains bored. This is consistent with research showing that monotonous increases of boredom covary with respective increased perceived aversiveness over time[73].

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[v] Interestingly, cage animals also tend to exhibit abnormal motion patterns in situations where entropy is low, and boredom is likely.

[vi] Unpublished data from our lab (see https://osf.io/xg4dj/) reveal changes in eye-data associated with the experience of boredom. More specifically, 40 participants were tasked with a boring task, i.e., they were presented with a random dot task and had to decide whether the dots seemed to move up, down, left, or right (each minute, a total of eighteen responses per participant was collected). However, there was no explicit direction of the dots in the random movement. A timer that displayed the elapsed seconds since the start of the experiment (count-up) was presented in the upper right part of the screen. During the eighteen repetitions of one-minute-long random dot display we measured subject's gaze behavior with an SMI Red500 eye tracker. After each one-minute subjects were additionally prompted to report their feeling of boredom ("How bored are you right now?"). We found a positive association between the experience of boredom and the gaze away from the target stimulus (i.e., the percentage of time spent on the timer, Spearman $r = .319$, $p = .045$).

How people deal with feeling bored is sometimes incorporated in the adopted definition of boredom. For example, boredom has been defined by the failure to stay engaged with an ongoing task or by high mental effort that is invested while trying to stay engaged with the task[49]. The link between boredom and attentional failures, as well as with mental effort or self-control is robustly established in the literature[5,28,74–76]. Importantly, we propose that this link does not necessitate the latter to be part of the definition of the former. More specifically, by focusing on how people consciously deal with boredom, we leave the realm of defining boredom, and move to the intricate consequences neglected boredom can produce. It is plausible that some of the heterogeneity in the boredom literature is introduced by adding such consequences to the definition and assessment of boredom. First, the boredom proneness scale – the leading measure of trait boredom – asks participants to respond to statements such as "I sit around, nothing to do", thus incorporating passivity in the definition of boredom. However, this aspect does not need to be specific to the state of boredom, and might explain the differences between trait and state boredom that are sometimes observed[30,77]. Further, it is conceivable that the response to boredom in terms of passivity, effort, or failure to sustain attention elicit different arousal pattern in the bored person, thus leading to mixed results – despite boredom being a unitary construct[37].

Part II: Differentiation of boredom from other constructs

In the first part of this chapter, we have put forward a definition of boredom. We have focused on defining what boredom is, how its occurrence manifests itself, and what it does. In the second part of the chapter, we focus on how boredom differs from other psychological constructs. The chosen constructs are those that have been likened to boredom on conceptual and empirical grounds with relative frequency. Thus, the list of constructs we use for contrasting purposes is not an exhaustive one but focuses on those that are the most relevant based on our reading of the literature. We will keep our presentation short, given that the interested reader can find entire chapters devoted to some of these concepts and their interplay with boredom in this book (see Chapter ###, ###, and ###).

Boredom in the context of affect and emotion

Some researchers conceptualize boredom as an emotion, and boredom is frequently studied in the context of affect and emotions (e.g.,[4,18,78–84]). Such research is usually informed by the circumplex model of affect[23], or theories of discrete emotions[85,86]. According to the circumplex model, affective states can be described along their position on two orthogonal axes: valence (positive or negative) and arousal (low or high)[23]. For example, frustration is characterized by negative valence and high arousal, or feeling depressed is characterized by negative valence and low arousal. Although prototypical depiction and empirical evidence have linked boredom to relatively low arousal[18], research shows that boredom can also

be a mixed or even a high arousal state[35,67]. With respect to valence, research shows that boredom tends to co-occur with negative affective states[78,79], and can even cause people to voluntarily seek out highly aversive sensations[87]. This is at odds with the observation that people describe boredom only as mildly negative in valence when compared to other negative emotions. Taken together, when approached through the lens of the circumplex model of affect, boredom seems harder to pin down than other affective states or emotions.

In contrast to the circumplex model, theories that conceptualize emotions as discrete propose that emotions differ qualitatively in their expression and function and should therefore be investigated specifically[86]. In a very influential study, Van Tilburg and Igou[18] set out to assess if boredom differed from various discrete emotions. Specifically, they investigated how boredom differed from negatively valenced emotions, such as sadness, anger, frustration, fear, disgust, feeling depressed, guilt, shame, regret, and disappointment. Moving beyond a bivariate correlational approach, they applied multidimensional scaling to produce a spatial model of distances among boredom and these other negative emotions. This approach is used to find the optimal spatial model of evaluated emotions (in terms of lay concept, state experience, and individual differences) with the lowest possible dimensionality. The modelled distance between emotions can be interpreted as the difference among them (the larger the distance, the higher the difference). In their analyses, the authors were further interested in localizing boredom with respect to *affective valence*, *arousal*, *relevance to morality*, *engagement of attention*, *perceived challenge,* and *perceived meaningfulness*. Those concepts were chosen because they had either been investigated in the context of boredom in prior research or were linked to the investigated negative emotions[18]. Consistent with the idea that boredom differs from other emotional states, it was located the furthest away from the other measured emotions – some of them clustering together (see Figure 2 in the original paper). Thus, boredom differed more from other emotions with negative valence than they differ from each other. The analysis also revealed that boredom differs from the aforementioned emotions in that boredom involves relatively low arousal and a less negative valence. This aligns well with the proposition that boredom is a push to act that is not per definition coupled with a specific arousal and valence configuration: In our conceptualisation of boredom, changes in valence and arousal are a consequence of how one deals (or fails to deal) with boredom. In line with this, van Hooft and van Hooff[84] showed that boredom correlates moderately with both frustration (high arousal) and depressed affect (low arousal).

Frustration

We now turn to frustration, to further unpack how boredom differs from emotions and affective states. Boredom and frustration seem to share certain similarities and their relationship has been studied frequently[18,82–84]. Frustration is a negative emotion that arises from disappointment when people perceive their need or goal pursuit to be blocked[88,89]. Similar to boredom, frustration arises when the current

situation is not satisfying and then acts as a signal that something needs to be changed[88]. However, boredom and frustration are not the same, the experience of boredom and frustration do not consistently co-occur in empirical studies (e.g.,[4,18]). In addition, boredom can be manipulated without affecting frustration[82]. In some cases, opposing patterns have been revealed (e.g.,[4,90]). For example, when the difficulty of a game was increased, frustration has been reported to increase, but boredom to decrease[90]. In the same vein, Westgate and Wilson[4] observed a linear effect of task difficulty on frustration, i.e., increased difficulty of a task was associated with greater frustration. In contrast, they reported a quadratic effect of difficulty on boredom, indicating that boredom was high when cognitive demands were too low, but also when they were too high. The authors proposed that boredom and frustration can co-occur under certain conditions: When overstimulation leads to boredom and this results in failing to achieve a desired outcome, the bored person might also become frustrated. However, if someone's goal is blocked not due to the cognitive resources of the individual (e.g., a flight delay), frustration can arise without being accompanied by the sensation of boredom[91]. While frustration and boredom can co-occur as described above, it is also conceivable that frustration may occur due to a prolonged experience of boredom. As boredom is understood to signal that something has to be changed, the experience of boredom leads to a new goal, namely, to end it. But when there is no possibility to stop boredom, this new goal as well as the individual get frustrated.

Expanding on affective disorders and its symptoms

Early boredom research has investigated the link between boredom and psychopathologies, such as depression, attention-deficit hyperactivity disorder, psychosis, and borderline personality disorder[21,40,92–97]. This research tends to find that boredom is high in such conditions. Specifically the overlap between depression and boredom has received considerable research interest[21,40,41,79]. In the following, we unpack this in more detail.

Depression

Depression is an affective disorder which is characterized by feelings of sadness and hopelessness, as well as loss of joy and interest in activities[98]. Depression has been shown to correlate positively with boredom proneness[21,40,41,79,99] and state boredom[20,41]. Depression and boredom proneness overlap in terms of their relationships to other constructs. For example, both are positively related to hopelessness[21], hypersensitivity to rejection and criticism (e.g., perceiving others as unfriendly)[40,100], to anxiety[40,101,102], and to stress[27,103,104]. The relationship between boredom proneness and depression seems to be largely driven by a more pronounced reliance on stimulation from the external environment and a failure to satisfy this reliance[105]. In addition, similar cognitive mechanisms, such as attention and memory deficits play a role in depression and boredom[72,106]. Despite those apparent similarities, boredom and depression differ on definitional and on empirical grounds.

Conceptually, depression and boredom differ for example with respect to the attributions people make: a depressed person tends to attribute negative events internally and stable, whereas a bored person will attribute an aversive situation as being externally caused and unstable[49]. In a very simplified sense: when depressed, we fault ourselves for not enjoying things; when bored, we fault the situation for not being enjoyable. Thus, the cause of boredom is seen in the situation and not in the bored person herself. Since being bored feels aversive but is attributed towards unstable external factors, boredom can act as a catalyst for change, and has been ascribed a crucial role as a driver of exploration[5,6,10,52]. Consistent with this, boredom is related to reduced interest in the current situation and characterized by an increased search for more rewarding activities, an increase in reward sensitivity[57], and an increase in physical and mental motion[66,67,107]. In contrast with this, depression is often accompanied by a loss of energy[98], reduction of physical movement, and a diminished interest in almost all activities for most of the day and nearly every day[98].

In an effort to empirically differentiate boredom from depression, one influential study employed structural equation modelling and showed that statistical models that treated boredom and depression as distinct yielded a better data fit than a statistical model that did not[41]. More specifically, a latent variable that consisted of state boredom, boredom proneness, and coping with boredom was differentiated from depression, and other negative affective states. This shows that despite high correlations between certain boredom measures and depression both latent constructs are empirically distinct.

Lastly, some of the empirical overlap between depression and boredom – boredom proneness in particular – might be a measurement artifact. This might be due to how broadly boredom is measured by the boredom proneness scale: it emphasizes the negative consequences of being frequently bored and focuses less on how easily and intensely people get bored. Thus, emphasis is put on the self-regulatory failure of dealing effectively with boredom (i.e., perceiving one's life as boring)[27]. By focusing on these consequences, the boredom proneness scale[21] taps into topics that are also included in measures of depression[108]. For example, both focus on lack of interest, lack of acting (in order to change the situation), and on feeling unhappy or bored. To address this, "purer" measures of trait boredom that decouple boredom from its consequences have been put forward in recent years[27,32]. It will be interesting to see if measures that are more in line with the current understanding and definition of boredom are less strongly correlated with depression.

Apathy

Apathy is a symptom that often co-occurs with depression but that can also occur on its own[109]. Similar to the link to depression, boredom proneness and apathy correlate[41], seem to share certain conceptual

similarities, but are clearly differentiable constructs. Apathy is characterized by a loss of interest and motivation[110] towards all kind of stimuli [111], and both concepts seem to overlap with respect to reduced interest[56,110,112]. Going one step further, exploratory analyses of the boredom proneness scale have even identified apathy as one factor of a three-factor solution of this instrument[113]. However, this three-factor solution has not been consistently replicated and current research on boredom proneness tends to rely on a one-factor solution. Thus, again, some of the overlap seems to be due to the way the boredom proneness scale conceptualizes boredom and is less consistent with the current understanding of boredom as a functional state.

Indeed, although apathy and boredom are accompanied by a decrease in interest[111], in boredom this decrease in interest is directed at the current situation (i.e., is specific to the current experience, and increases with respect to other stimuli resulting in a shift of attention). This is markedly different to a decrease in interest with respect to most stimuli that occurs in apathy[39,111]. Similar observations can be made with respect to motivation. While apathy is associated with a decrease in motivation with respect to all stimuli, boredom may lead to an increase in motivation for seeking other stimuli[10,39,111]. Lastly, statistical analyses revealed that boredom represents a latent construct that differs from apathy[41].

Amotivation

Amotivation has been characterized as "the absence of motivation"[114]. Like apathy[109] and boredom[20,21,40,41,92–96], amotivation co-occurs with depression and other mental disorders[115]. Research shows that amotivation and boredom often occur together, decreases of motivation are often accompanied by increases of boredom (e.g., in traumatic brain injury[105,116,117]) and both concepts are moderately to highly positively correlated (e.g.,[42–44]). Sometimes both concepts are used interchangeably (e.g.,[118]). However, boredom and amotivation should be distinguished from each other. Looking at the conceptual description of both concepts, they substantially differ with respect to desire. While amotivation can arise from the lack of any desire[119], boredom in contrast even leads to desire. In fact, the lack of motivation that a bored person feels, applies only to the current activity or experience, not to all the other activities the person could follow instead. Therefore, in contrast to an amotivated person, when a person is bored, he or she will feel the desire or the motivation to do something (else).

To sum up, although boredom is linked to the occurrence of various psychopathologies and their symptoms, it should not be equated with them. The differences are particularly relevant for symptoms and states that are characterized by a lack of motivation and a generalized depreciation of the external and internal world. This contrasts with boredom's function as a motivator for change that is triggered by specific boring situations. Nevertheless, being consistently bored – either due to being unable to successfully reduce boredom, or simply by being very susceptible to get bored – is closely linked to affective and motivational symptoms. This indicates that a chronic failure to regulate boredom should

not be taken lightly and the temporal order (simply put, does one beget the other or are they the joint result of a higher order psychopathology[120]) of the interplay between high boredom proneness and depressive symptoms should be further investigated by future research.

Other boredom related constructs

Given its centrality in governing human affect, cognition, and behavior, boredom has also been discussed in context of psychological concepts that do not neatly fall into the categories of "affect/emotion" or "psychopathologies and symptoms". In the last part of this chapter, we briefly discuss this "other" category. Specifically, we focus on self-control, curiosity, mind-wandering, sensation-seeking, and flow.

Self-control

Self-control refers to the efforts people make to override default behaviors and habits[121,122]. Recent empirical and theoretical work on boredom shows that self-control and boredom both play a role when it comes to steering goal-directed behavior[5]. Boredom has been linked to undirected exploration[58], whereas self-control is highly relevant when it comes to exploitation[6]. Thus, both concepts are relevant for promoting a balance between exploration and exploitation. Crucially, boredom can act as a self-control demand in its own right (continuing with a boring task is self-control demanding per se) and recent work has shown that both self-control and boredom play a joint role as triggers of goal-directed behavior (e.g., leading a physically active life[28]). Consistent with the above, an inverse association between trait self-control and boredom proneness has been frequently reported (e.g.,[123]). While boredom and self-control clearly differ in their function and their operating mechanisms, it is apparent that their interplay is intricate, highly relevant for the regulation of goal-directed behavior but is still far from fully understood. With respect to these questions and a comprehensive account on boredom and self-control, we refer the interested reader to Chapter ### in this book.

Curiosity

Curiosity refers to the desire for new knowledge and experiences, including openness toward whatever is attended ([124,see 125] for a current framework unifying novelty-based and complexity-based theories of curiosity). Curiosity and boredom have sometimes been defined as epistemic emotions and have been jointly investigated in the school setting (typically revealing a moderate negative relationship[126]. Attesting to both concepts proximity to each other Berlyne[127], already linked boredom and curiosity, by distinguishing four forms of curiosity, including "diversive curiosity", which is an unspecific stimulation seeking out to escape boredom. Thus, one aspect of curiosity might be a response to boredom. In addition, boredom and curiosity have been discussed as reward-oriented triggers of exploration[39,128]. However, boredom motivates attentional disengagement from the task at hand, whereas curiosity motivates attentional engagement with other more rewarding tasks[53]. Consistent with this, empirical work has

differentiated between boredom and curiosity, the first having been characterized as an aversive experience working as an undirected information-seeking trigger and the second as a positive experience working as a trigger for directed information-seeking[64]. Computational studies have tried to disentangle the effects boredom and curiosity have on learning. Interestingly, this research shows that boredom outperforms curiosity in terms of information-seeking behavior[61]. Thus, it is possible to create artificial agents that can get bored or are curious and this leads to differences in learning behavior. This further highlights that boredom and curiosity differ, despite their apparent similarities.

Mind-wandering

Mind-wandering, also referred to as task-unrelated thought[129], stimulus-unrelated thought[130,131], and spontaneous thought[132], has been studied extensively during the past 20 years (see [133] for a review). During mind-wandering, attention drifts away from the external perceptual world and is directed to self-generated thoughts. This off-task behavior is common to both boredom and mind-wandering, indeed bored individuals experience difficulty in sustaining attention[49]. On a state level, different researchers found a positive association between boredom and mind-wandering[134–136] – an association that was also revealed by studies investigating trait variables[68,75]. However, associations are not perfect, and distinct phenomenological experiences connected with the two constructs[vii] rather suggest that they have dynamical inter-relationships with mind-wandering being a possible exploratory response to boredom when no other behavioral alternative is available. We refer the interested reader to Chapter ### for a review of similarities and differences between mind-wandering and boredom.

Sensation seeking

Sensation seeking refers to the "tendency to seek novel, varied, complex, and intense sensations and experiences and the willingness to take risks for the sake of such experience"[139]. Sensation seeking and boredom (sexual boredom[140] and boredom proneness[80]) are sometimes positively correlated and the most frequently used measure of sensation seeking even includes a boredom susceptibility subscale[141]. This suggests that these constructs are not only related but boredom is subsumed within a broader sensation seeking construct. Nevertheless, not all studies find correlations between those concepts. For example, one study did not find correlations of boredom proneness with the experience seeking subscale and not even with the boredom susceptibility subscale[21]. In some cases even negative correlations have been found between boredom proneness and sensation seeking[79,140]. Upon closer inspection, the empirical association between both concepts is a modest one, primarily driven by the boredom subscale of the sensation seeking scale. This can be underpinned by studies finding no correlation to sensation seeking

[vii] E.g., time passing slowly during boredom[137] vs. time passing fast during mind-wandering[138] or high effort experienced during boredom[73] vs. low effort experienced during mind-wandering[132].

but positive correlations to boredom susceptibility[140]. In addition, both concepts differ on a conceptual level: Sensation seeking is by definition linked to the search for „novel, varied, complex, and intense sensations". Boredom has not been linked to such a directed search. Boredom as a state is understood to signal that one is in unsatisfying state and acts as a catalyst for *any* change of state. In addition, boredom proneness has been described as a "failure to launch"[76] (p. 1), highlighting that boredom prone people are frequently in unsatisfying states.

High and low sensation seekers are considered to differ in their normal levels of arousal, with high sensation seekers being probably under aroused and therefore in need for more stimulation[15], and always in search for something new[16]. In a similar vein, high boredom prone individuals tend to habituate quicker to repeated exposure to the same stimuli than low boredom prone individuals[142]. As a result, both sensation seekers and boredom prone people might find themselves in situations where they want to get exposed to novel stimulations more often than others. But while high boredom prone individuals do not necessarily also score high on the other sensation seeking subscales (and are therefore not high sensation seekers), sensation seekers tend to show higher susceptibility to boredom as this subscale is part of the whole sensation seeking construct[143]. Thus, it is very plausible that higher sensitivity to boredom plays a role in sensation seeking, however boredom proneness does not need to be linked to sensation seeking. In fact, boredom seems to covary with psychological concepts that differ drastically from each other (compare for example apathy and sensation seeking), which is consistent with the general signaling function we have proposed for boredom in part 1.

Finally, considering state boredom and sensation seeking more closely, one notices that seeking challenge or stimulation is one possibility to reduce boredom[144]. However, in contrast to sensation seekers, bored individuals do not necessarily show sensation seeking behavior. They could for example stop the sensation of boredom by changing something about the situation (e.g., change the topic of a conversation) but without necessarily showing sensation seeking behavior.

Flow

An experience diametrically opposed to boredom is flow. Flow is an experience during which one is entirely involved in the present moment. In early flow theories[145], the experience of boredom is modeled as a state occurring in underload situations[viii] (i.e., when the task is too easy regarding individual capabilities). Flow has been defined as an intrinsically rewarding experience of deeply focused attention, in which one is in control of its own actions and time seems to fly[146]. This characterization is opposed to current definitions of boredom. Flow theories put forward that it is not possible to make the experience of boredom and

[viii] In this model, overload situations are linked with the experience of anxiety, rather than boredom. However, more recent work associate boredom with both situations of underload and overload (e.g.,[4]).

flow simultaneously[147], and empirical work has for example revealed a negative relation between boredom proneness and flow proneness[72]. It seems reasonable to consider boredom and flow as opposing constructs because flow is a state of *high* engagement, boredom is a state of disengagement. However, it is probably reductive to consider boredom *the* opposite of flow. This would negate the function and the mechanisms that are inherent to boredom (see part 1), and that allow for a plethora of non-boring states to occur (i.e., for a plethora of opposites of boredom). This cautions against pitting boredom at the end of a flow-boredom continuum. For deeper theorizing on the link between boredom and flow we refer the interested reader to Chapter ### of this book.

Conclusions

In this chapter, our purpose was to define boredom by unpacking its constituents from its antecedents, correlates, and consequences. We suggest that conflating boredom with these aspects can explain some of the inconsistencies that characterize boredom theorizing and research. Based on an integration of Schopenhauer's definition of boredom and concepts from predictive coding, we suggest that boredom is a state of insufficient function utilization, in which reward prediction error has been minimized. One of the major benefits of this definition is that it permits for differences between state and trait boredom and can explain mixed findings e.g., regarding arousal. We further reviewed the most important constructs that have been shown to be associated with boredom. The review is not meant to be exhaustive but illustrative. It clearly appears that boredom is different. For example, boredom is not *just another negative emotion*. Research shows that boredom can beget various negative emotions, whereas boredom is rarely the result of specific discrete emotions. This is consistent with our conceptualization of boredom as a core state that can prompt a diverse range of affective, cognitive, and behavioural responses, but that does not fully fit the mould of negative emotions. Despite boredom being associated with different constructs (some yet to be formally investigated), boredom is different – it is at the centre of human behaviour – including physical, mental, and social activities. We believe a critical direction for future research is to investigate and distinguish regulation of boredom across different time-scales: When do we become consciously aware of our boredom and how does this alter the regulation of boredom? Finally, we hope that this chapter will support and invite future research to understand this fascinating sensation in ever more detail.

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