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„Bored to Action?
The Effect of Boredom on the Evaluation of Effort“

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Abstract

Langeweile verursacht Aufmerksamkeitsverschiebungen zu Reizen hin, die der Ursache der Langeweile entgegengesetzt sind. Das bedeutet, dass Langeweile, wenn sie durch Unterforderung verursacht wird, Aufmerksamkeitsverschiebungen in Richtung anstrengenderer Situationen und Aktivitäten verursachen könnte. Ziel dieser Arbeit war es, herauszufinden, wie sich Langeweile aufgrund von Unterforderung auf die Bewertung von Anstrengung auswirkt, insbesondere auf das Gefühl des psychologischen Wollens („Wanting“) im Vergleich zum psychologischen Mögen („Liking“) von Anstrengung. Folgende Hypothesen wurden aufgestellt: Langeweile aufgrund von Unterforderung verstärkt „Wanting“, aber nicht „Liking“ von Anstrengung; und Sensation Seeking verstärkt die Wirkung von Langeweile auf „Wanting“, nicht aber auf „Liking“. Diese Hypothesen wurden in einem Laborexperiment mit n=111 Teilnehmern getestet. Die Teilnehmer wurden in zwei Gruppen eingeteilt, anschließend wurde Langeweile durch ein Video manipuliert. Daraufhin absolvierten die Teilnehmer zwei IATs, die „Liking“ respektive „Wanting“ messen. Sensation Seeking wurde mit der Brief Sensation Seeking Scale (BSSS) erfasst. Die d-Scores der IATs wurden einer ANOVA unterzogen, um sie auf Gruppenunterschiede zu prüfen. Wanting zeigte signifikante Gruppenunterschiede, allerdings in der entgegengesetzten Richtung der Hypothese, d. h. gelangweilte Teilnehmer zeigten geringeres „Wanting“ hinsichtlich Anstrengung. Für „Liking“ wurde kein Unterschied festgestellt. Die BSSS-Werte wurden einer Moderatorenanalyse unterzogen; es wurde kein Einfluss auf „Wanting“ oder „Liking“ festgestellt. Die Ergebnisse dieser Studie deuten darauf hin, dass Langeweile in der Tat mit einer Veränderung von „Wanting“, nicht aber von „Liking“ gegenüber bestimmten Hinweisreizen verbunden ist. Die konkrete Art dieses Zusammenhangs bleibt jedoch unklar.

Abstract

Boredom has been found to cause attentional shifts towards cues that are opposite from the cause of boredom, which means that, if boredom is caused by understimulation, it might cause attentional shifts towards more effortful situations and activities. The aim of this paper was to find out how boredom due to understimulation affects the evaluation of effort, specifically the feeling of psychological wanting vs. psychological liking towards effort. It was hypothesized that boredom due to understimulation enhances wanting, but not liking towards effort, and that sensation seeking as a trait enhances the effect of boredom on wanting, but not on liking. These hypotheses were tested in a laboratory experiment with n=111 participants. The participants were assigned into two groups, subsequently boredom was manipulated through a video. Afterwards the participants completed two IATs that measure liking and wanting, respectively. Sensation seeking was assessed via the Brief Sensation Seeking Scale (BSSS). The d-scores of the IATs were subjected to an ANOVA to check for group differences. Wanting showed significant group differences, but in the opposite direction of the hypothesis, meaning that bored participants showed a lower feeling of wanting towards effort. No difference for liking was found. The BSSS-scores were subjected to a moderator analysis; no effect on either liking or wanting was found. The findings of this study suggest that state boredom is indeed linked to shifts in wanting, but not liking towards certain cues. The concrete nature of this relationship remains, however, unclear.

Contents

Introduction

In our everyday lives, boredom and effort are often seen as somewhat interlinked – we try to strike a balance and range between activities that feel effortful and activities that feel boring. In psychological research, this apparent link has received very little attention. Both the concept of boredom and the concept of effort are traditionally characterized negatively: Boredom is defined as an "[…] aversive state of wanting, but being unable, to engage in a satisfying activity" (Eastwood et al., 2012, p. 483), and models of volitional control see the extension of effort as the consumption of cognitive resources that individuals always try to minimize. There are, however, instances in which effort can be perceived as intrinsically rewarding, like for example arduous sports activities such as mountain climbing or creative endeavours like crafting or assembling objects (Inzlicht et al., 2018). Finding out in which contexts the evaluation of effort varies would likely refine our understanding of human motivation as a whole and open up possibilities for promoting and supporting the maintenance of effort and effortful activities. One context that causes such variance might be the psychological state of boredom. Even though boredom is a universal and ubiquitous experience across time and cultures, it has received relatively little attention in psychological research up until recently. While most earlier research focused on boredom as a trait and linked it to harmful behaviour like self-harm and substance abuse (e.g. Havermans et al., 2015), recent studies that look at boredom as a state define it as a discrete emotion, which steers our cognition and actions by conveying information about our environment and psychological state. When we are bored our attention shifts and we seek out novel stimuli or activities that are different from the ones which caused the bored state (Elpidorou, 2018). These stimuli and activities can even be negative, as long as they differ from the boring stimuli and activities (Bench & Lench, 2019). Consequentially, the state of boredom might affect how people evaluate effort depending on the cause of the bored state – concretely, boredom caused by a mismatch between the cognitive resources of a person and the cognitive

demands of an activity due to understimulation would cause that person to seek out an activity that is more demanding.

When gauging the motivational valence of activities, there is a difference between wanting and liking something: Different neural systems are responsible for wanting and liking, and in some situations these two concepts do not proportionally correspond to each other. The incentive sensitization theory (IST) posits that addiction is one such situation, but very little research has been done outside of that context. Boredom might be another such situation and cause the aforementioned attentional shifts by influencing the feeling of wanting regarding certain cues. This study tries to shed light on the relationship between effort and boredom and attempts to answer the question: *How does boredom due to understimulation affect the evaluation of effort?*

To this end, a laboratory experiment with two groups was conducted, where the psychological state of the participants regarding boredom was manipulated: one group received a boring intervention, while the other group received a neutral intervention. Subsequently, the evaluation of effort was measured via two Implicit Associations Tests (IATs) that differ between wanting and liking, and analysed for group differences. Finally, the trait sensation seeking was assessed via the Brief Sensation Seeking Scale (BSSS) and its potential influence on the relationship between boredom and effort was analysed through a moderator analysis.

Theoretical and Empirical Background

Boredom as an Emotion

While early psychological research surrounding the topic of boredom mainly focused on boredom proneness as a trait and linked it to potentially harmful behaviour such as substance abuse, risk-taking behaviour and self-harm, the causes and consequences of boredom as a psychological state have only gotten more attention since the early 2010s

(Westgate & Steidle, 2020). Functional theories of boredom look at the state of boredom as a discrete emotion with a regulatory function. Traditionally, boredom was not defined as an emotion: It was seen as a neutral state that does not fit the definition of emotions as "situated affective states" (Clore & Ortony, 2013), or it was even seen as the absence of emotions altogether. Since then, studies have shown that the state of boredom is actually not neutral, but severely aversive (Westgate & Steidle, 2020). For example, people prefer even negative stimuli such as the admission of mild electric shocks (Wilson et al., 2014) or looking at disturbing imagery (Bench & Lench, 2019) to being bored. Van Tilburg and Igou (2012) demonstrated that boredom can be differentiated from other related emotional states like sadness and frustration by showing that boredom produces unique experiences and sentiments. Merrifield and Danckert (2014) showed that the psychophysiological signature of boredom, which was measured via heart rate, skin conductance levels and cortisol levels, is distinct from other emotional states as well. These findings indicate that boredom should indeed be treated as a discrete emotion (Elpidorou, 2018).

The regulatory function of boredom follows from adaptive theories of emotion, which argue that all emotions shape our behaviour and cognition by giving us feedback about our activities, tasks and goals in the form of specific affective qualities. In the same way happiness or anger affect what activities we seek out, maintain or stop, boredom causes attentional shifts towards new goals and activities. Boredom does not generally discriminate the valence of the goal or activity we should switch to – that valence depends on the preceding activity that caused the bored state (Bench & Lench, 2013). In other words: Boredom causes us to seek out goals and activities that are different from the goals and activities that made us bored. Bench and Lench (2019) demonstrated this effect in a series of three experiments: In each experiment, they bored the participants by showing them the same images repeatedly. In the first experiment, the participants subsequently got to choose if they wanted to continue watching the same images or switch to negative, disgusting images. 55%

of the participants chose the new, negative images. In the second experiment, the participants could choose between different novel images with different valences. Still, 23% of the participants chose the negative images. In the third experiment, boredom was induced by either showing positive or negative images repeatedly, and the participants could choose to view new positive as well as new negative images afterwards. When shown negative images first, 92% of the participants chose positive images afterwards (1% chose new negative ones), when shown positive images first, 42% chose negative images afterwards (14% chose new positive ones).

The MAC Model of Boredom

Westgate and Wilson (2018) tried to integrate existing theories of boredom within the Meaning and Attention Component Model (MAC). As the name of the model suggests, they posit that there are two separate components that can cause boredom independently: The meaning component and the attention component. The meaning component refers to the extent the current activity of an individual matches their values and goals. If there is a mismatch between the two, the individual feels bored. The attention component refers to the extent the cognitive demands of a task match the respective resources of an individual. Again, the individual feels bored if there is a mismatch. This means that both the combination of high resources and low demands (i.e. understimulation) and the combination of low resources and high demands (i.e. overstimulation) can cause boredom. Another central proposition of the MAC model is that different profiles of boredom with different motivational and behavioural consequences will arise depending on the constellation of the components and their specific nature. Meaningless boredom will make a person seek out a more interesting or enjoyable activity, while attentional boredom due to understimulation will make a person try to increase the demands of their activities, and attentional boredom due to overstimulation will make them try to increase their resources.

Westgate and Wilson (2018) substantiated these propositions with a series of four studies. The first of these studies was a meta-analysis which analysed 14 experimental studies and found evidence for the supposed connection of both components with boredom. The second study consisted of an experiment with a 2 (Attention: low vs. high) x 2 (Meaning: low vs. high) design and found significant main effects for both components on boredom with no significant interaction between attention and meaning. The third study examined the relationship between cognitive demand and boredom on a correlational level and, in accordance with the propositions of the MAC-model, showed evidence for it being curvilinear: Both low demand and high demand were correlated to boredom, while moderate demand was not. The fourth and final study reanalysed a prior experiment (Westgate et al., 2017) where the cognitive demand of a given task was manipulated. This analysis found that making demanding tasks easier to perform also lowered boredom as a result. In sum, the findings of all four of these studies support the MAC-model and its propositions.

In this study, the attention component of boredom is of central concern. More specifically, we induce attentional boredom through understimulation due to the fact that the MAC model predicts that this type of boredom will make the participants want to increase the demands of their activities, which in turn should lead to a more positive evaluation of activities with high demands – in other words, activities that take effort.

Psychological Liking vs. Psychological Wanting

In order to understand how boredom affects the evaluation of effort we have to take a look at what constitutes the valence of activities from a motivational perspective. On a neural level, dopamine plays a critical role in this regard by influencing incentive salience (Loganathan & Ho, 2021). Incentive salience describes a type of motivational drive towards certain cues, actions and rewards due to both physiological processes and learned associations that expresses itself as a feeling of wanting on an affective level (Hyman, 2005).

For a long time, it was believed that this feeling of wanting, i.e. motivational incentive salience, is always proportional to another component of subjective valence: The feeling of liking, i.e. hedonistic pleasure. Increased wanting was thought to always correlate with increased liking and vice versa. The idea that different neural systems are responsible for these two feelings was first proposed by Berridge, Venier and Robinson in 1989 and is widely accepted today (Berridge & Robinson, 2016): The mesolimbic dopamine system is responsible for the former, while smaller and more fragile neural systems are responsible for the latter. Consequently, there are situations in which increased wanting does not correspond with increased liking. The incentive sensitization theory (IST) of addiction describes one such situation, namely addiction. In addiction, the neural dopamine systems responsible for the feeling of wanting related to the specific addictive substance or activity are hypersensitive towards cues that trigger that wanting – in other words, the neural dopamine system is triggered much more easily by such cues. The same is, however, not true for the neural systems responsible for the feeling of liking. This means that these cues trigger enhanced wanting for addicted people in comparison to non-addicted people, while liking proportionally stays the same in both groups (Berridge & Robinson, 2016).

This deviation predicted by the IST was, for example, shown by Grigutsch et al. (2019). They compared wanting and liking for smoking-cues in smokers and non-smokers. Using an Implicit Associations Test (IAT) for liking and a different one for wanting they showed that the feeling of wanting and liking for smoking-cues was heavily correlated in non-smokers (negative values in both categories), while wanting was much higher and uncorrelated to liking in smokers. Another study (Koranyi et al., 2020) applied the IST to heavy coffee drinkers and compared them to regular/non-drinkers. Using different IATs for wanting and liking as well, they demonstrated that wanting for coffee related cues differed between heavy coffee drinkers and regular/non-drinkers, while liking for coffee related cues did not.

Very little research has been done in this regard outside of addiction. Boredom has been linked to addictive behaviour before (e.g. Lin et al., 2009; Biolcati et al., 2018), and it has been demonstrated that novel, salient stimuli evoke an increased dopamine reaction compared to repeated stimuli that are linked to a fixed reward (Kakade & Dayan, 2002). It is possible that the motivational shifts that have been observed in bored individuals (e.g. Bench & Lench, 2019; Westgate & Wilson, 2018) are caused by shifts in incentive salience that occur due to similar principles as the ones described in the IST. This would mean that boredom sensitizes the neural dopamine system towards cues that are different from the cause of boredom without affecting hedonic pleasure regarding those cues. Following this theoretical and empirical groundwork, the following hypotheses are derived:

H1a: Boredom due to understimulation enhances 'wanting' regarding effort.
H1b: Boredom due to understimulation does not enhance 'liking' regarding effort.

Sensation Seeking

Sensation seeking describes the tendency of a person to seek out new, complex and intense experiences and sensations and is related to individual differences in preferred arousal levels (Patton, 2012). The theoretical conception of the construct is closely tied to the Sensation Seeking Scale (SSS) first created by Zuckerman et al. in 1964; the most commonly used version of it is the Sensation Seeking Scale form V (SSS-V) that consists of four subscales. It is somewhat related to boredom by definition, since one of these subscales measures boredom proneness, which corresponds to trait boredom.

Similarly to boredom, sensation seeking has been linked to several negative behaviour patterns. For example, Wang et al. (2018) found a significant positive connection between sensation seeking and smartphone addiction among adolescents; Arria et al. (2008) showed that sensation seeking predicts nonmedical use of prescription drugs among students and interacts with the perceived danger of this drug use. Other findings point towards, among

other things, correlations between sensation seeking and adolescent alcohol use (Sznitman & Engel-Yeger, 2017), sensation seeking and caffeine addiction (Jones & Lejuez, 2005), as well as sensation seeking and self-harm behaviour (Kentopp et al., 2021). Additionally, Zuckerman (1984) hypothesized that the dopaminergic structures in the brain – together with serotonergic and noradrenergic structures – are at least partly responsible for sensation seeking as a trait, explaining the high heritability of sensation seeking. Studies have since confirmed this link between dopamine and sensation seeking: Dellu Hagedorn et al. (1996) found that rats with high response rates to novel stimuli had higher dopaminergic activity than rats with low response rates. Experiments by Piazza et al. (1993) demonstrated that both rats with high response rates and humans with high sensation seeking scores have increased release from dopaminergic systems in the brain. Derringer et al. (2010) showed that genetic variations of the dopaminergic system are associated with significant variance of sensation seeking behaviour in individuals. These and other findings (e.g. Roberti, 2004; Zald et al., 2008) suggest that higher scores in sensation seeking are generally correlated to stronger dopaminergic responses. These stronger responses might manifest themselves on an affective and motivational level in an increased feeling of wanting (i.e. incentive salience), since wanting is, as discussed before, tied to the dopaminergic system on a neurological level.

To sum up, sensation seeking is connected to boredom on a trait level, to addiction on a behavioural level and to the dopaminergic system on a neurological level. In turn, addiction has been connected via the IST to a dissociation between wanting and liking through hypersensitization of the dopaminergic systems in the brain towards relevant cues. As such, sensation seeking might bridge the gap between the two concepts. Specifically, it might influence the level of sensitization predicted by the IST and thus lead to enhanced wanting, but not enhanced liking in the context of boredom. Based on this, the following hypotheses are derived:

H2a: Sensation seeking enhances the effect of boredom on the 'wanting' of effort.

H2b: Sensation seeking does not affect the relationship between boredom and 'liking' of effort.

Method

The data for this study was collected via a laboratory experiment. In addition to the data for this thesis, the experiment also collected data for another paper. This additional data consists in cardiovascular measures (pre-ejection period, pulse and blood pressure) during the boredom manipulations as well as a clicking task. These measures will not be described in detail here, since they and their data are not directly pertinent to the thesis at hand.

Sample

The experiment had a sample size of n=111 participants. 74 of those participants were female, 36 were male and 1 was non-binary. 78 participants were in the age group 18-24, 18 participants were between 25 and 34 years old, 3 were between 35 and 44, one was between 45 and 54 and another one was between 55 and 64. The participants were recruited using the LABS system of the university of Vienna, and they could choose either 12€ or, if they were psychology students, 5 LABS credits as compensation for their participation.

Operationalisation

Manipulation of Boredom

Boredom was manipulated in the experiment via a two-part video that was shown to the participants. The control group was shown two parts of a TEDxTalk (Hör! Mir! Zu! Warum wir gute Kommunikation lieben: Bert Helbig at TEDxStuttgart, 2013) about effective communication. The experimental group was shown two parts of a video where the verbal content of the TEDxTalk video is read slowly in front of a white background. Additionally, that video was also slowed down by approximately 10% with video editing software. All the parts have a video length of ca. 215 seconds, respectively. An online pilot study with n=38

participants had been done with these videos in order to ensure that they had the intended effect – i.e. a boring effect for the experimental group compared to the control group. The pilot study showed significant group differences in self reporting questions regarding feelings of boredom during the videos.

Evaluation of Effort

The evaluation of effort of the participants was measured with two computer based Implicit Associations Tests (IAT). One test measured psychological liking (L-IAT), while the other test measured psychological wanting (W-IAT). The L-IAT corresponds to a conventional IAT, where the participants have to correctly assign words that appear at the centre of the screen into one of four categories as fast as possible by pressing either the left or right response key (i.e "E" as the left and "I" as the right response key). These categories were "I like", "I don't like", "effortful", and "non-effortful". They were grouped together alternately on either the left or the right side of the screen in a series of trial blocks. In compatible blocks the categories "positive" and "non-effortful" were on one side of the screen and the categories "negative" and "effortful" were on the other side of the screen; in incompatible blocks the categories "positive" and "effortful" were grouped together on one side and the categories "negative" and "non-effortful" on the other. Differences in response times between blocks were used to measure differences of 'liking' regarding the cues. An error penalty of 600ms was added for failed trials.

For the W-IAT, the principles established and validated by Koranyi et al. (2017) are used: The test generally works the same as the L-IAT, but instead of using the categories "I like" and "I don't like", participants were asked to assign letters (e.g. "E", "L", etc.) to the category "I want" and numbers (e.g. "4", "7", etc.) to the category "I don't want". In order to induce a feeling of want, participants were told that they will get a monetary reward of 5 cents every time they correctly assign a letter to the category "I want" (while they get no reward for

assigning numbers correctly to the category “I don’t want”). When the participants earned the 5 cents, they were also shown an icon of a Euro coin and a sound was played to make sure they were aware of the reward. Again, differences in response times between blocks were used to measures differences of wanting regarding the cues with an error penalty of 600ms for failed trials.

Sensation Seeking

Sensation seeking was measured with the German version of the Brief Sensation Seeking Scale (BSSS). The scale consists of 8 items – two for each of the subscales of the SSS-V (i.e. experience seeking, boredom susceptibility, thrill and adventure seeking, disinhibition). These items are formulated as statements (e.g. “I get restless when I spend too much time at home.”) which the participants were asked to rate on a Likert Scale from 1 (“strongly disagree”) to 5 (“strongly agree”). Higher scores indicate a higher tendency towards sensation seeking behaviour (Hoyle et al., 2002).

Manipulation Check

The emotional state of the participants before and after the experiment was measured using the MDBF (Multidimensionaler Befindlichkeitsfragebogen; Steyrer et al. 1997). This scale consists of 12 items relating to the current emotional state (e.g. “I am feeling good”, “I am feeling relaxed”, “I am feeling tired”, etc.) that participants had to rate on a scale of 1 to 5 (“not at all” to “very”). The MDBF is made up of three subscales corresponding to three emotional dimensions: “Calm – unrest”, “wakefulness – tiredness” and “good – bad”. There are two versions of the MBDF that both operate on these subscales. One version is used at the very beginning of the experiment and the other one at the very end so that changes in the measured emotional states during the experiments can be evaluated. These versions use polar opposite items for the same emotion (e.g. “good” on one version and “bad” on the other) in order to avoid biases due to repetition. Additionally, the participants had to answer eight

questions that asked them to rate statements about how they felt while watching the videos on a 1 to 5 Likert scale (see Appendix A).

Procedure

Firstly, the participants were seated in front of a computer screen and asked to fill out an informed consent form. Afterwards they completed the first part of the MDBF, which measured their current emotional state, as a pen and paper survey. After completing this short survey, electrodes and a blood pressure cuff were put on the participants bodies. A baseline measurement of their cardiovascular markers was done over the next 10 minutes, during which the participants were listening to calm music. Meanwhile they were randomly assigned to either the experimental group or the control group. Next, the participants were shown the first part of the manipulation video (duration: ca. 215 seconds) that was either boring or neutral, depending on what group the participants were assigned to. Following the video, the participants had to do a mouse clicking task. After that they were shown the second part of the video (duration: ca. 215 seconds), which was again either boring or neutral depending on whether the participant was in the experimental group or the control group. Then they had to complete the two IATs (L-IAT and W-IAT) in sequence; the order of the IATs was randomized. Following the IATs the participants were asked questions about the videos they watched in order to make sure that they were paying attention to them, as well as questions about how they felt during the videos as part of a manipulation check. Then they completed the second part of the MDBF and the Brief Sensation Seeking Scale (BSSS; Hoyle et al., 2002). Finally, their demographic data (age group and gender) was collected, and they were debriefed regarding the aim of the experiment and the interventions.

Results

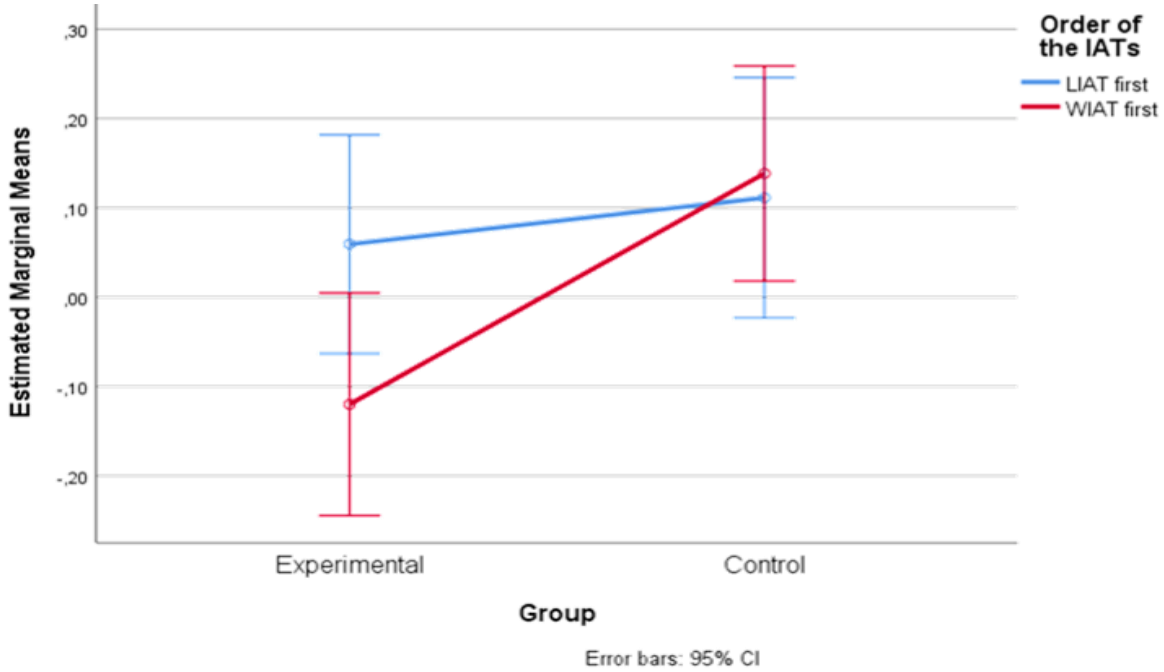
The IAT effects were calculated separately for the W-IAT and the L-IAT following the principles of the D600 measure (Greenwald et al., 2003). For both IATs, the average response

time in compatible blocks is subtracted from the average response time in incompatible blocks, and this difference score is furthermore divided by the standard deviation of both blocks, resulting in the so-called D-score. This score can be interpreted as the difference in response time between compatible and incompatible blocks measured in units of standard deviation. Compatible blocks were defined as blocks where participants had to use the same response key for the categories “high effort” and “I like” (in the L-IAT)/ “I want” (in the W-IAT). Consequently, incompatible blocks are blocks where participants had to use the same response key for the categories “low effort” and “I like” (in the L-IAT)/ “I want” (in the W-IAT). When participants made an error, the latency measure on that trial was replaced with that participant’s mean latency for the block plus an additional 600ms.

The D-scores of both the W-IAT and the L-IAT were analyzed for differences between the control group and the experimental group using an ANOVA. In order to control for possible sequence effects, the order of the IATs during the experiment was also included in the analysis, resulting in a 2 (experimental group vs. control group) x2 (W-IAT first vs. L-IAT first) ANOVA. The analysis showed no interaction between the order the IATs were presented in and the D-scores of either IAT (L-IAT: $F=1.050$, $p=.308$; W-IAT: $F=1.440$, $p=.233$). For the L-IAT, it also showed no difference in the D-scores of the experimental group and the control group ($F=.16$, $p=.901$), as predicted by the hypothesis H1b. For the W-IAT, the analysis revealed a significant effect of group on the D-scores ($F=6.000$, $p=.016$). However, this effect acts in the opposite direction as the one supposed in the hypothesis H1a, meaning that participants in the experimental group had a slower reaction time in compatible trials compared to participants in the control group. This suggests that the boring intervention caused a decreased feeling of wanting towards the cue-words related to effort in the participants.

Figure 1.

Estimated Marginal Means of the D-Score of the W-IAT



In order to check for a possible moderating effect of sensation seeking on wanting and liking according to the hypotheses H2a and H2b, the results of the Brief Sensation Seeking Scale (BSSS) and the respective D-scores of both the W-IAT and the L-IAT were subjected to a moderator analysis. To that end, the group variable (experimental vs. control group), the BSSS score, and the D-score were z-standardized and an interaction term was calculated by multiplying the standardized values of the group variable and the BSSS-score variable. Subsequently, a linear regression was calculated with the D-score as the dependent variable and the BSSS score, the group, and the interaction term as independent variables. The analysis did not show a significant effect of the interaction term on neither the D-scores of the W-IAT ($p=.753$) nor the D-scores of the L-IAT ($p=.602$).

Two manipulation checks were done to quantify the effect of the intervention videos. Firstly, an analysis of possible effects on emotions other than boredom was done using the score of the MDBF. For all three subscales of the MDBF (i.e. “good-bad”, “wakefulness-tiredness”, and “calmness-unrest”), the scores of the measurement at the end of the experiment was

subtracted from the scores of the measurement at the beginning. Subsequently, these score differences were subjected to an independent samples t-test in order to check if these emotional states changed differently between the control group and the experimental group. This analysis yielded no significant results for any of the three subscales ("good – bad" subscale: $p=.382$; "wakefulness-tiredness" subscale: $p=.145$; "calmness-unrest" subscale: $p=.693$). Secondly, the eight questions created to quantify the effects of the intervention videos (see Appendix A) were subjected to an independent samples t-test to analyze differences between the experimental group and the control group as well. This analysis showed significant group differences for seven out of the eight questions, signifying that participants in the control group were more bored ($p<.001$), less interested in the content ($p<.001$), more frustrated ($p=.016$), struggled more to stay serious ($p<.001$), cared less about what happened next ($p=.007$), had their thoughts wander more ($p=.003$), and struggled more to concentrate ($p<.001$) during the videos.

Discussion

Neither of the hypotheses of this paper could be confirmed. However, evidence for a connection between boredom and the feeling of wanting towards stimuli associated with effort was found, albeit in the opposite direction than what was predicted in the hypotheses. These findings suggest that the differentiation between wanting and liking can be feasibly applied in a context other than addiction and the hypersensitization connected to it. Additionally, they suggest that implicit association tests are a useful and effective tool to explore and measure this differentiation.

Perhaps most interestingly, the connection between boredom and the evaluation of effort is indeed only present for psychological wanting, and not psychological liking, suggesting that boredom might influence attention – and thusly behavior – through dopaminergic processes in the brain that are disconnected from the neurological systems

responsible for hedonistic pleasure. As mentioned above, the connection found in this study is to the contrary of the one proposed in the hypotheses. This means that participants who watched the boring video showed a lower feeling of wanting towards stimuli associated with effort than participants who watched the neutral video, while there was no difference regarding the feeling of liking between the two groups.

There are a few possible explanations for this: It is possible that having to focus on the boring video does in fact exhaust mental resources. This would mean that watching the boring video is in effect more effortful than watching the neutral video. Consequently, the emotion evoked in the participants who watch the boring video is not attentional boredom due to understimulation. Antithetically to the original intent of the experimental intervention, the boring video might even evoke boredom due to overstimulation, which would mean that the participants who watch that video will seek out activities that demand fewer cognitive resources when compared to participants who watch the neutral video. This could possibly explain the rift between the prediction of the hypotheses and the observed effects of the video.

Another possible explanation is the fact that it remains unclear in what way boredom that is experienced during the experimental manipulation affects the mental and emotional state of the participants for tasks that are done afterwards. Specifically, it may be possible that the affective state of being bored does not carry over into the completion of the two IATs since they already constitute a switch to an activity that is different from the cause of boredom. This might lead to a seemingly paradoxical effect where participants who were bored due to understimulation during the manipulation experience the completion of the IATs as more stimulating compared to participants who were engaged during the manipulation. If that were the case, it would mean that the participants who watched the neutral video would actually perceive the IATs as more boring and would therefore ‘want’ to seek out more effortful activities.

A third factor that could feasibly explain the observed effects is the possibility that the boring video might cause a state of lower arousal that is not aversive, or not aversive enough for a motivational pull to carry over into the following activities, i.e. the two IATs. This might lead to the video having more of a calming effect than a boring one. The lower level of arousal could in turn have a priming effect which causes the participants to 'want' effortful stimuli less at that moment, while their evaluation of liking of these stimuli stays the same.

As for the influence of Sensation Seeking on the relationship between boredom and the feeling of wanting or liking towards effort, no evidence of an effect of Sensation Seeking on the relationship of these variables was found. This does not necessarily mean that there is no merit for future research to further investigate the relationship between boredom and sensation seeking or similar trait-based concepts (e.g. boredom proneness, impulsivity). A post hoc exploratory analysis revealed significant positive correlations between the BSSS score and three of the manipulation check questions, namely the statements "I felt bored", "My thoughts wandered", and "I struggled to concentrate", as well as a significant negative correlation with "I wanted to know what happens next" (see Appendix C). Notably, these correlations are only found in the experimental group, while there are none in the control group. This might be an indication that people with high scores in sensation seeking did indeed get bored more easily during the boredom manipulation. But if that was the case, why was there no effect of sensation seeking on the d-scores of the W-IAT? One conceivable explanation is that sensation seekers are also able to better cope with boredom: Netter et al. (1996) found that smokers with high sensation seeking are more resistant to nicotine deprivation and have a higher threshold for aversive stimulation. It is also possible, however, that the amount of boredom during the video influenced the answers to the BSSS, which was filled out near the end of the experiment, instead.

To sum up, even though neither of the hypotheses of this study could be confirmed, there is still evidence that boredom influences psychological wanting in the form of incentive

salience while having no influence on psychological liking in the form of hedonistic pleasure. The results also support the notion that IATs can be used to differentiate between wanting and liking in contexts other than addiction, which is where this specific form of IAT has mainly been applied in the past. There are a couple of possible explanations for the results of this study which could be used as a vantage point for future studies. Firstly, having to focus on the boring video might in fact be effortful and as a result the participants would 'want' seek out a situation that requires less effort. Secondly, being bored during the manipulation might have led the participants to experience the IATs themselves as more engaging, leading to less boredom during the IATs. Thirdly, it is possible that the manipulation had more of a calming effect than a boring one, resulting in a priming effect that lowered incentive salience for cues related to high effort. Even though the analyses showed no moderation effect of sensation seeking on wanting, an exploratory analysis suggests that there still might be a connection to the amount of boredom that was experienced by the participants.

Limitations

IATs are not very established yet as a method to distinguish between psychological wanting and psychological liking. Despite existing research, which has mainly focused on the context of addiction (e.g. Koranyi et al., 2020; Grigutsch et al., 2019), indicating that the methodology is valid and reproduces the differences in incentive salience and hedonistic pleasure, this validation has only happened on a relatively small scale and only in the context of addiction. While the results of this study also suggest that IATs with this paradigm can be used to differentiate between wanting and liking, it is still possible that the observed effects do not correspond – or at least do not 100% correspond – to the concepts of incentive salience and hedonistic pleasure on a neurological or affective level.

The meaning component of activities and goals, which – according to the MAC model of boredom (Westgate & Wilson, 2018) – can cause boredom independently from the attentional component which was manipulated in the experiment, is difficult to control within

the context of a laboratory experiment. Therefore, it is possible that the meaning component influenced the amount of boredom the participants experienced and thus distorted the effect of the intervention in some way or another. Additionally, the participants might have also experienced other affective states that are tangential to, but not synonymous with boredom, such as for example fatigue or frustration due to the interventions and/or the conducted tests, which might confound the results regarding the evaluation of effort as well.

The boredom manipulation itself was relatively short – ca. 215 seconds for each part of the respective videos. Even though this length was based on previous research related to this type of boredom manipulation (Merrifield & Danckert, 2014), the duration of the whole experiment clocked in at ca. 70 minutes, meaning that the difference between the duration of the tasks and duration of the manipulation was quite drastic. It is possible that the affective state of the participants would change when they are exposed to the boredom manipulation for a longer period of time. If that would lead to a difference beyond the intensity of the boredom, there is a question to be raised about the ecological validity of such short manipulations of boredom, since in everyday experiences boring situations are often characterized by taking up a lot of time.

The effect of the boredom manipulation might not have persisted through the tests that were done afterwards, especially due to the length of the tasks following the manipulation. A form of regression toward the mean regarding the state of boredom of the participants might have happened as time went on, since the participants who received the boring manipulation might have "recovered" from it, while the participants who received the neutral intervention might have gotten bored by the tests. Thus, the observed effects might have been diminished and the external validity of the experiment might be compromised, because in reality the altering of the affective state due to boredom and the proposed attentional and motivational shifts would happen simultaneously and not sequentially.

Future Research

This study set out to shed light on the relationship of boredom due to understimulation and the evaluation of effort, it seems, however, to have raised more questions about this relationship than it answered. In turn, this also means that some of these questions might provide fruitful starting points for future research. Logically, the limitations of this study as well as the possible explanations for its results described in the discussion would lend themselves to be explored and examined by subsequent studies and experiments.

In order to further validate IATs as a method to differentiate between wanting and liking, future studies could use alternative ways to measure incentive salience and hedonistic pleasure – for example by measuring facial electromyographic reactivity to assess hedonistic pleasure (e.g. Soussignan et al., 2011), or by directly manipulating the neurological systems responsible for incentive salience (e.g. Berridge & Robinson, 2003) – in addition to the W-IAT and the L-IAT in order to confirm the results regarding the methodology of this study and of previous research in the context of addiction.

The found connection between boredom and a lower feeling of wanting towards effort could merit further investigation in future studies as well. Since it is not clear if the boredom manipulation in this study caused understimulation in the sense of the MAC model of boredom (Westgate & Wilson, 2018) or if it actually exhausted mental resources, a promising prospect for further research could be to use different types of boredom manipulation. One conceivable type of manipulation could be, for example, tasks with varying difficulty, ranging from understimulating to overstimulating, which would enable a more precise assessment of the relationships between the resulting types of boredom and feelings of wanting and liking towards effort. Other factors to consider regarding the manipulation of boredom are further measures to control for possible emotional consequences that could confound the results such as calming or frustrating effects, as well as – especially if done via video – the length of the manipulation, since in real life situation causes of boredom are mostly characterized by a

duration that is way longer than that of the videos used in this study. A longer duration could also increase the experienced aversion towards the boring situation and in consequence lead to stronger and clearer reactions.

Another thing to take into account for future research is the possibility of the measurement, in this case the IATs, being perceived as a switch in tasks that satisfies the attentional shift generated by boredom. This could be done by doing the experimental manipulation and the measurement of boredom at the same time instead of sequentially. For example, tasks of varying difficulty could be used to fluctuate the cognitive demands and thus manipulate as how boring these tasks are perceived, while boredom is measured via physiological measures in tandem with self-reporting questionnaires at the end of the experiment. Another possibility would be to design the manipulation and the measurement in such a way that there is no obvious break. Experimental designs like these could be used to ensure that the measurement cannot be perceived as a relief of the induced boredom by the participants, and, subsequently, the possibility of such an order effect confounding the results could be precluded.

Regarding sensation seeking and other similar traits like impulsivity or boredom proneness that are linked to boredom, a promising approach for future studies might be to look at these traits in relation with the ability to manage boredom and the associated affective reactions. The variance among the biometric and behavioural consequences of boredom can be quite large – responses include high arousal states as well as low arousal states (Danckert & Merrifield, 2018), and constructive adaptive behaviours like pro-social tendencies as well as maladaptive behaviours like snacking or the infliction of pain (Havermans et al., 2015). Future explorations of traits that are associated with boredom could shed light on the big variety of different outcomes boredom reportedly has.

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Appendix A

Manipulation Check Questionnaire

Please think about the videos you just watched.

I felt bored. (Ich fühlte mich gelangweilt).

I found the content interesting. (Ich fand die Inhalte interessant).

I felt amused. (Ich fühlte mich belustigt).

I felt frustrated. (Ich fühlte mich frustriert.)

I struggled to stay serious. (Es fiel mir schwer ernst zu bleiben).

I wanted to know what happens next. (Ich wollte wissen, wie es weiter geht).

My thoughts wandered. (Meine Gedanken sind abgeschweift).

I struggled to concentrate. (Es fiel mir schwer mich zu konzentrieren).

Answers on a 1-5 (1 = not true at all; 5 = completely true) Likert scale.

Appendix B

Attention Check Questionnaire

1) Was schaffen Superkommunikatoren?
    a. Sie setzen Ideen durch.*
    b. Sie gewinnen Verhandlungen.
    c. Sie können sehr gut zuhören.
    d. Sie diskutieren ohne Streit.
2) Was ist die ideale Antwort bei der Vorstellung einer Idee?
    a. Ja, aber
    b. Ja, gut
    c. Ja, wann*
    d. Ja, klar
3) Was setzen Superkommunikatoren in den Mittelpunkt der Kommunikation?
    a. Den Mensch*
    b. Die Message
    c. Die Idee
    d. Das Ideal
4) Welches Produkt wird im Video als Beispiel verwendet, um die Vorgehensweise von Superkommunikatoren zu veranschaulichen?
    a. Müllverarbeitungsanlage
    b. Klimaneutrales Baumaterial
    c. Regenwasserwiederaufbereitungsanlage*
    d. Geothermisches Heizsystem

*denotes the correct answer.

Appendix C

Table 1

Correlations of BSSS scores with manipulation check questions for the experimental group.

	I felt bored	I found the content interesting	I felt amused	I felt frustrated	I struggled to stay serious	I wanted to know what happens next	My thoughts wandered	I struggled to concentrate
Correlation	.306*	-.218	.043	.159	.111	-.329*	.467**	.326*
Significance (two tailed)	.021	.104	.750	.238	.410	.012	.000	.013

*the correlation is significant at a .05 (two tailed) level.

**the correlation is significant at a .01 (two tailed) level.

Table 2

Correlations of BSSS scores with manipulation check questions for the control group.

	I felt bored	I found the content interesting	I felt amused	I felt frustrated	I struggled to stay serious	I wanted to know what happens next	My thoughts wandered	I struggled to concentrate
Correlation	.042	.086	.084	.149	-.209	.168	-.073	-.164
Significance (two tailed)	.764	.536	.544	.282	.129	.224	.598	.237

*the correlation is significant at a .05 (two tailed) level.

**the correlation is significant at a .01 (two tailed) level.