# Bored participants, biased data? How boredom can influence behavioral science research and what we can do about it

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*** This manuscript is a preprint and has not been peer reviewed.***

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When studying affect, cognition, and behavior, scientists often use "artificial tasks in sensory and socially deprived environments" (Shamay-Tsoory & Mendelsohn, 2019). While such settings maximize experimental control, they might introduce confounds that systematically alter participant behavior. In the worst case, such confounds could lead to biased study outcomes and even wrong inferences. Due to the way prototypical research settings are designed, one confound that is very likely to occur is boredom, a sensation whose effect on human affect, cognition, and behavior has been shown in numerous studies (Jangraw et al., 2023; Raffaelli et al., 2018).

In this comment, we draw upon theoretical and empirical evidence to make the case that a) participants tend to be bored while taking part in studies, b) the degree of boredom differs as a function of inter-individual differences in trait boredom, c) boredom can impair participants' attention, can make study participation more effortful, and can increase the urge to do something else (i.e., to disengage from the study). Most importantly, we argue that some participants might adjust their behavior because they are bored, and that this might bias study outcomes.

Our comment is data-supported: Substantiating these theory-driven propositions, we present data that support the claim for the (unintended) role of boredom in behavioral science research. To this end, we surveyed two samples drawn from the population of participants that provide the backbone for many results from behavioral science research: University students ($n$ = 113) and paid online workers ($n$ = 419). Across both samples, boredom was reported as a corollary of study participation, and 53% of the participants think that – based on their personal experiences as participants to studies – study outcomes are altered due to boredom.

Taken together, we provide conceptual and empirical support for the hypothesis that boredom can be an unaccounted confound in behavioral science research. Building on this, we provide a set of recommendations on how to control for (and deal with) the occurrence and effects of boredom in behavioral science research. However, to better understand why boredom might be such a frequent confound, it is crucial to define *what* boredom is and *when* it occurs.

## What is boredom and why does it matter?

Boredom is a ubiquitous human experience (Harris, 2000) that occurs in a plethora of different situations (Chin et al., 2017). Boredom can be understood as a state of inadequate function utilization that occurs when the reward prediction error[i] has been minimized and things seem entirely predictable (Wolff et al.,

[i] Reward prediction error refers to the difference between the predicted reward of a given situation and the actual reward of the situation: It has been suggested that it is more adaptive to maximize reward prediction errors, in other words, to put oneself in situations where the reward is higher than expected (Schultz, 2017; Wolff et al., 2022).

2022). This state is particularly likely to occur when an activity is perceived as meaningless (Pekrun et al., 2010; Westgate & Wilson, 2018), when task demands do not align with one's capabilities (Westgate & Wilson, 2018), and/or when one perceives a lack of agency (Raffaelli et al., 2018).

Crucially, boredom matters. Theoretical and empirical work has shown that boredom is an aversive sensation (Westgate & Steidle, 2020) that acts as an internal signal to change one's ongoing course of action (Wolff & Martarelli, 2020). More specifically, functional accounts of boredom propose that boredom triggers exploration (i.e., it orients our attention off task) and thereby assumes a key role in navigating the trade-off between exploration and exploitation (Bieleke & Wolff, 2021; Danckert, 2019). By acting as a push towards exploration, boredom is understood to increase the urge to do something else (Wolff & Martarelli, 2020), and as a state of heightened sensitivity to rewards (Milyavskaya et al., 2019). Importantly, when one cannot escape the boring situation, boredom is frequently accompanied by an increased feeling of effort that is required to stay concentrated on the task at hand (Eastwood et al., 2012). Possibly as a means to escape a boring task, research has shown that boredom causes participants to rush through it, by prioritizing speed over accuracy (Bieleke et al., 2021). Importantly, this tendency to rush through a boring task varies as a function of inter-individual differences in trait boredom (Bieleke et al., 2021). Thus, by acting as a signal that change is needed, boredom assumes an important role in the regulation of goal-directed behavior.

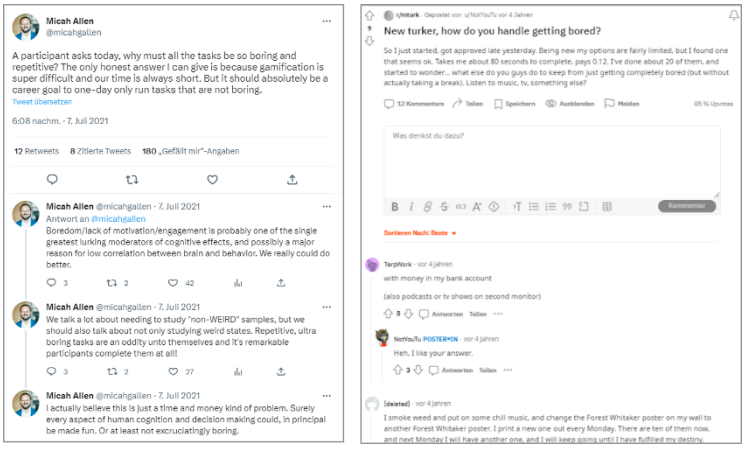
Attesting to the influential role boredom plays for human functioning, a substantial body of research has underscored the effect boredom has on affect, behavior, and cognition across various domains (Raffaelli et al., 2018). To use some of the most drastic examples, boredom has been linked to sadistic aggression (Pfattheicher et al., 2021), self-harming behavior (Wilson et al., 2014), self-induced pain (Nederkoorn et al., 2016), gambling (Blaszczynski et al., 1990), and premature death (Britton & Shipley, 2010). On a mechanistic level, research has shown that boredom begets negative affect (van Hooft & van Hooff, 2018) and is linked to impaired self-regulation (Struk et al., 2016), attention (A. Hunter & Eastwood, 2018), and decision making (Yakobi & Danckert, 2021). Clearly, boredom alters how people feel, think, and act. But *why* would people be bored when they participate in research studies?

## Boredom in behavioral science studies

When studying phenomena of interest, researchers strive to maximally control ancillary factors that might distort findings. For example, researchers may systematize their interaction with participants, keep participants in the dark with respect to the true research question to avoid biased responding, or use highly standardized tasks to maximize experimental control and internal validity. With respect to frequently employed experimental tasks, participants might be asked to passively process a stream of presented stimuli, to categorize a stream of stimuli, or to solve tasks that substantially exceed their capabilities. Furthermore, in order to fully tap into the latent construct of interest and to optimize reliability, researchers often employ lengthy multi-item questionnaires.

Paradoxically, these legitimate efforts of researchers to exclude any external confounding factors and to measure the construct of interest as precisely as possible might be an ideal breeding ground for boredom. Per design, it is likely that many research studies employ protocols during which participants feel that (part of) the tasks have little meaning to them or that their agency is low. Likewise, study demands are often tailored to a very specific research question (e.g., to find out the smallest pitch difference people can discriminate) which might create under-challenging and over-challenging tasks. All these features contribute to being bored (Westgate & Wilson, 2018), and as such, many behavioral science studies are likely to induce some degree of boredom.

The occurrence of boredom among participants has been reported anecdotally by academics, as well as by research participants. For example, researchers are discussing the problem of boring experiments, and study participants exchange ideas on how to cope with boredom during study participation on social media platforms (see *Box 1* for two examples). Attesting to its relevance, the issue of boring participants out during study participation has even been raised as an ethical concern (D'Angiulli & Smith LeBeau, 2002). However, research on the actual occurrence and relevance of boredom in behavioral science studies is scarce. Nevertheless, some evidence suggests that participants do experience boredom during study participation and that this can affect their behavior.




*Box 1. Researchers (left panel; https://tinyurl.com/32h4yxhf) and research participants (right panel; https://tinyurl.com/3yc8jspd) publicly discuss the occurrence and relevance of boredom during studies along with ideas and examples on how to reduce boredom, or cope with it.*

For example, categorization tasks, such as the Stroop task are among the most widely used experimental paradigms to study effects of interference on reaction time, and thereby offering insights into how the human brain processes information (MacLeod, 1991). However, to tap into these processes, participants have to categorize a large number of stimuli that are sequentially presented on a computer screen for a prolonged duration. In light of the conditions under which boredom is likely to occur, such a repetitive computerized task might not only tap into human information processing but might also be boring for participants. Indeed, a recent study found that self-reported boredom increased steadily during a ten-minute Stroop task (Bieleke et al., 2021). Consistent with the conceptual considerations about boredom's function, boredom was associated with a reduced threshold parameter in a drift diffusion model, indicating that bored participants were adjusting their behavior to get the task over with.

Beyond computerized experimental tasks, boredom is also likely in survey research. Especially in personality research, questionnaires can comprise 200 items and more. For example, the NEO Personality Inventory consists of 240 items, the Minnesota Multiphasic Personality Inventory-2 Restructured consists of 338 items, and the California Psychological Inventory even comprises 434 items. While such comprehensive questionnaires are likely to provide a more accurate representation of the construct of interest, to participants, a seemingly endless string of questions might be boring and lead to careless responding (Gibson & Bowling, 2020). Research shows that careless responding increases the further participants have progressed into a questionnaire (Bowling et al., 2021), indicating that data quality deteriorates throughout a survey.

Further indirect evidence on how boredom can alter human affect, cognition, and behavior and how this might have substantial ramifications for study outcomes comes from work on mood decline and media multitasking among research participants. A high-powered study (*N* of nearly 29'000 participants) showed a gradual decline in mood during rest and simple tasks over time (Jangraw et al., 2023). Although this work focused on mood drifts, the researchers highlight how boredom, as a negative affective state, might contribute to declining mood among research participants over the course of a study. Indirect evidence for an impact of boredom on behavior during study participation also comes from a study showing high rates of distraction by media multitasking during online studies (average of 38%, ranging from 9% to 85% across different studies with an *N* of nearly 3'000 participants) (Drody et al., 2023). It is conceivable that media multitasking is a response to boredom in online settings. This interpretation aligns well with the strategies on how to handle boredom during study participation that are discussed by participants in online platforms (*Box 1*). If changes in affect, cognition, and behavior occur as a function of an experimental manipulation but the manipulation also differs in experienced boredom, to what degree can the changes be attributed to the focal construct of interest, and to what degree do they reflect effects of boredom?

Taken together, anecdotal, conceptual, and scattered direct and indirect empirical evidence supports the hypothesis that boredom might be a frequent occurrence among research participants. And, in light of boredom's function and effects, it is highly likely that bored participants behave differently than those who are not bored. However, to better gauge the general applicability of this claim, it is important to ask people who have participated in a variety of studies and who can report how they generally feel during study participation if boredom matters.

## Boredom in behavioral science studies: What do participants say?

To substantiate the theoretical and anecdotal reasoning for boredom's role as a potential confound in behavioral science research, we conducted a brief online self-report study about the occurrence and relevance of boredom when being a study participant during spring and summer 2022. Specifically, we wanted to assess if participants perceive study participation as boring, if boredom exerts the effects it is theorized to have (i.e., urge to do something else and make it more effortful to stay concentrated), and

if perception and effects differ as a function of individual differences in trait boredom. Most importantly, we were interested if participants reported to adjust their behavior because of boredom, and if they think this alters study outcomes. We report more information about the procedure and the samples in Appendix A.

Across a student ($n$ = 113) and a paid online worker ($n$ = 419) sample, we found support for the hypothesis that participants face boredom as a challenge during study participation (*boredom (item)*: "While participating in (online) studies I get very bored" [10-point Likert scale, 1 = strongly disagree to 10 = strongly agree]; mean = 5.32, *SD* = 2.88, minimum = 1, maximum = 10, skewness = -.04). Across both samples, 47.37 % of respondents agreed or strongly agreed that boredom affects their behavior or performance during study participation (*own behavior:* "Boredom affects my behavior and/or performance in (paid online) studies." [5-point Likert scale, 1 = strongly disagree to 10 = strongly agree]), and 53.01 % agreed or strongly agreed to the statement that boredom alters study outcomes (*study outcomes*: "Boredom alters the findings of paid online studies", [5-point Likert scale, 1 = strongly disagree to 10 = strongly agree]). Only 28.2 % rejected or strongly rejected that boredom affects their participation behavior and performance in studies, and 21.8 % rejected or strongly rejected that boredom affects study outcomes.

Consistent with theoretical propositions, being bored during studies was reported to require a higher level of concentration (*concentration*: "Because I am bored, I find it harder to concentrate" [5-point Likert scale, 1 = strongly disagree to 5 = strongly agree]; mean = 3.17, SD = 0.81, minimum = 2, maximum = 4, skewness = -.31). Also, boredom was reported to evoke thoughts of doing something else (*disengage*: "Because I am bored, I would prefer to do something else" [5-point Likert scale, 1 = strongly disagree to 5 = strongly agree]; mean = 3.33, SD = 1.24, minimum = 1, maximum = 5, skewness = -.31) and the need

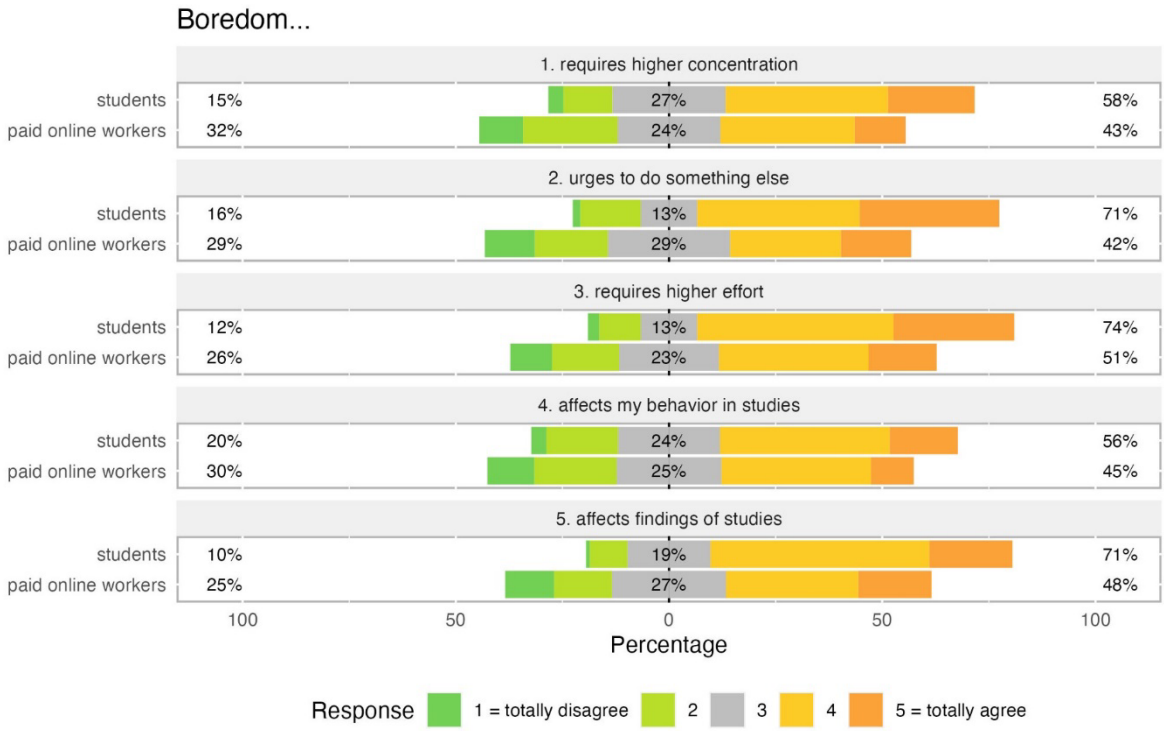



*Figure 1. Ratings of student (n = 113) and paid online worker (n = 419) samples on the perceived effects of boredom on one's own behavior and performance, as well as in the findings of scientific studies. The numbers on the left reflect the proportion of the horizontal bar that is green or light green, representing the percentage of answers we deem unproblematic (i.e., where boredom does not matter); the numbers in center reflect the grey proportion of the bar and refer to the percentage of answers that are neither decidedly unproblematic, nor problematic (i.e., boredom could matter but not very much); the numbers on the right reflect the orange or red proportion of the bar and refer to problematic answers (i.e., indicating that boredom alters behavior and study outcomes).*

to mount more willpower to complete the study (*effort*: "Because I am bored, I have to apply more effort to participate appropriately" [5-point Likert scale, 1 = strongly disagree, 5 = strongly agree]; mean = 3.44, SD = 1.19, minimum = 1, maximum = 5, skewness = -.52).

Beyond descriptive statistics, positive associations emerged between a trait measure of boredom (*boredom trait*, measured via the Short Boredom Scale of Boredom, SBPS) (Struk et al., 2017), boredom during study participation (*boredom (AEQ)*, measured via the Boredom Scale of the Achievement of Emotions Questionnaire, Pekrun et al., 2011, and the single item measure *boredom (item)* described above), reported consequences of boredom (single item measures *concentration, effort, disengage*), and the estimated effects boredom has on participant behavior and study outcomes (single item measures *own behavior, study outcomes*). Descriptively, the associations in the paid online worker sample were stronger when compared to the student sample. As an example, we found significant, medium to strong positive associations between trait boredom and boredom in studies (AEQ) both in the student ($r$ = .34) and in the paid online worker ($r$ = .81) samples, thus suggesting that individual differences in trait-like boredom proneness might differentially impact the experience of boredom during research studies and

in turn differentially impact research outcomes. Another association that turned out to range from medium to strong was the significant positive relationship between boredom in research studies and the urge to disengage from the task at hand, both in the student ($r$ = .31) and in the paid online worker ($r$ = .63) sample. Notably, paid online workers ($r$ = .62) believed that study outcomes are altered due to boredom (this association was not significant in the student sample). The associated correlation matrix for both samples is depicted in *Figure 2*.


*Figure 2. Combined correlation matrix of Pearson's correlation coefficients between trait boredom as well as estimated effects of state boredom during studies on behavior and performance, as well as on study outcomes in the student (n = 113; upper right) and in the paid online workers (n = 419, lower left) samples. Blue circles indicate the strength of the correlation.*

Taken together these results support the notion of boredom as a confounding variable in behavioral science studies. This can be particularly problematic when studying subpopulations that differ in their boredom proneness, when comparing experimental conditions that systematically vary in their perceived average "boringness", or when perceived boredom substantially coincides with changes in variables of interest (e.g., decreases in attention and increases in boredom).

## What can be done about boredom as a potential study confound?

In the previous sections, we have made the conceptual and empirical case for the notion that boredom is prevalent among research participants and that this might bias research findings. As concluding remarks,

we would like to highlight three implications that we deem critical considering the arguments presented above.

First, in between-subjects designs there is a risk that inter-individual differences in trait boredom might confound experimental results. As an example, in our data, the extent of trait boredom in the student sample (*n* = 113) was relatively low (*mean* = 1.98, *SD* = 0.72, minimum = 1 of 1, maximum = 4.25 of 5, skewness = 1.06), in contrast, the paid online workers (*n* = 419) exhibited higher trait boredom scores (*mean* = 3.18, *SD* = 0.98, minimum = 1 of 1, maximum = 5 of 5, skewness = -.57). Another example are studies that compare younger and older adults; indeed, age-related differences in the experience of boredom exist. It seems that boredom peaks in younger adults and diminishes with age (Spaeth et al., 2015). If within-subjects designs are not possible, we suggest that it is worthwhile to assess trait boredom (see *Box 2* for further illustrations and possible solutions).

Not only trait boredom might differ between conditions, but also state boredom, due to the differences between experimental conditions that might elicit boredom in different degrees, e.g., when comparing the performance in a challenging task vs. an easy task. Various self-report measures to assess state boredom have been developed and validated, that could be used to assess inter-condition differences in boredom (see *Box 2*). Retrospective state scales that assess boredom at the end of a task have successfully been used in boredom research (e.g., Chan et al., 2018), as well as probe-caught methods, that interrupt a task with questions such as "how bored are you right now?" (e.g., Merrifield & Danckert, 2014). A methodology to our knowledge not yet used to assess state boredom are self-caught methods, in which participants voluntarily indicate whether they are bored (Martarelli & Jost, 2023). More research is needed to investigate which of the above presented options poses an optimal solution, as well as whether asking about boredom influences the experience of boredom itself (cf. discussion on measurement reactivity, e.g., in French & Sutton, 2010; König et al., 2022).

Finally, we suggest controlling for the occurrence of boredom because the experience of boredom has been shown to change not only between persons, but also within persons over the course of a task (see *Box 2*).

Taken together, we believe that boredom is a frequently neglected factor in behavioral science studies. To put it in an exaggerated way: As excited as researchers are when their design employs a well-controlled protocol, as bored might the participants be who have to complete this protocol. We believe it is paramount to be aware of boredom as a potentially biasing factor in studies. The facts that (A) study participants are exposed to highly artificial situations (Shamay-Tsoory & Mendelsohn, 2019) and (B) these situations likely evoke boredom during participation are important factors that researchers might want to consider when designing studies in the future.

Box 2. *Boredom in research and how to tame it.*

1. Trait boredom may differ between different populations, as well as within the same population.

***Exemplary illustration of potential problem.*** If one were to design a physical exercise intervention to get people to exercise more and the control group displays a priori differences in sport-specific boredom, then this might lead to an overestimation of the intervention effect.

***Possible solutions.*** Assess trait boredom to test whether different populations that are to be compared in the experiment differ regarding this feature, and control for it if necessary. Different domain-general trait boredom scales exist. A widely used boredom proneness questionnaire is the Boredom Proneness Scale [BPS] (Farmer & Sundberg, 1986). This questionnaire was shortened in the BPS-SF (Vodanovich et al., 2005) as well as in the SBPS (Struk et al., 2017). More recently, other domain general measures have been developed, such as the Harthous Boredom Proclivity Scale [HBP] (van Tilburg et al., 2019) and the Boredom Avoidance and Escape Scale [BAE] as well as the Dealing with Boredom Scale [DWB] (Bieleke et al., 2022). In addition, domain-specific trait boredom scales have been developed, such as for academic boredom or sport-specific boredom (Vodanovich & Watt, 2016). Those might for example be useful in intervention studies, to control for pre-existing differences in the generalized disposition towards the construct of interest.

2. State boredom may differ between experimental conditions.

***Exemplary illustration of potential problem.*** One might want to measure if, compared to an easy non-demanding task, a self-control demanding task would impair subsequent performance. A possible effect might be offset if the non-demanding task would be more boring than the self-control demanding task and participants would perform worse because they are bored (Wolff & Martarelli, 2020).

***Possible solutions.*** Design experimental conditions in a way that ensures they are "equally boring". This would assure high internal validity. If external validity matters, construct experimental conditions that resemble everyday life in their degree of boringness. A further option is to assess state boredom, and control for it if necessary. Different options to assess state boredom exist. Widely used scales are the State Boredom Measure [SBM] of Todman (2013) and the Multidimensional State Boredom Scale Short-Form [MSBS-SF] (J. A. Hunter et al., 2016) and its variations (e.g., the MSBS-15 by Baratta & Spence, 2015). Further options are probe-caught methods that stop participants throughout a task by asking them to report their experience of boredom in a particular moment (e.g., Blondé et al., 2022). In order to limit the length of questionnaires participants need to fill in and thus counteract potential boredom, single item scales may be a good choice if test criteria are met.

3. State boredom may change over the course of the study.

***Exemplary illustration of potential problem.*** When conducting a survey study with an extensive questionnaire battery, then boredom-induced gradual response degradation might yield systematically less valid answers in the latter part of the study.

***Possible solutions.*** Construct studies ensuring that participants do not get bored easily. One possible approach is to consider gamification techniques, which may lead to more engagement and interest in various contexts (Feyisetan et al., 2015). Other options might be to use rewards and incentives, or to avoid repetitive tasks and to insert breaks in the study. While these methods might temporarily alleviate boredom, boredom is likely to return over time. Another possible approach is to highlight the meaning and relevance of research studies, as meaning has been shown to be inversely related to boredom (van Tilburg & Igou, 2012). Finally, also here, an option is to assess boredom over time to control for its effects.

## Acknowledgements

We thank Anna Lena Majovski for her help in programming the online survey and recruiting the student sample, and Maik Bieleke for sharing his ideas on earlier versions of the manuscript.

## Supplemental material

Supplemental material such as the questionnaires used in the two online surveys, the associated data as well as the RMarkdown analysis script can be found via the following link: https://osf.io/syj23/.

## Conflict of Interest

None.

## CRediT author statement

Maria Meier, Corinna Martarelli & Wanja Wolff: Writing - Original Draft. Writing - Review & Editing. Formal analysis. Conceptualization.

Corinna Martarelli & Wanja Wolff: Funding acquisition. Resources.

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# Appendix A

We surveyed two samples of populations that a substantial proportion of behavioral science research relies on: University students and paid online workers (Buhrmester et al., 2018; Roulin, 2015; Shen et al., 2011). The student sample ($n$ = 113) was mainly recruited at the University of Konstanz, Germany, whereas the paid online workers ($n$ = 419) were recruited via Amazon's website Mechanical Turk (MTurk; requirements: ≥ 50 HITs, approval rate ≥ 90%, US citizenship). The study lasted approximately 5 minutes and was approved by our local ethics committee. Participants gave informed consent and the students received course credit, whereas the paid online workers received a fixed payment on MTurk upon completion of the study.

## Procedure

The online study consisted of demographic questions and two measures of trait boredom, namely the Short Boredom Proneness Scale (SBPS) (Struk et al., 2017), and the Boredom Scale of the Achievement of Emotions Questionnaire (AEQ) (Pekrun et al., 2011). We used the SBPS (a one dimensional 8-item scale, e.g., "I don't feel motivated by most things I do") to assess domain-general boredom proneness, and the AEQ (a one dimensional 8-item scale, e.g., "participating in a study is so boring that I find myself daydreaming") to assess the generalized domain-specific experience of boredom during research studies ( referred to as *boredom (AEQ)* in the manuscript). Given online paid workers take part to online studies, we added "online" to all boredom relevant items in the MTurk sample. The SBPS and AEQ scales are well validated scales (Pekrun et al., 2011; Struk et al., 2016), which is reflected in the Cronbach's alphas we found in our study (.930 for SBPS and .931 for boredom (AEQ)). Lastly, we asked participants if and how they felt boredom affected their own behavior and performance in scientific studies, and whether they thought it affected study outcomes with six self-created items (e.g., "Because I am bored, I would prefer to do something else."). We used 5-point Likert scales for all items (1 = strongly disagree to 5 = strongly agree) except for the single boredom item ("While participating in online studies I get very bored"), which was to be answered on a 10-point Likert scale. The student questionnaire also included other items that are not further considered in this paper. The full questionnaires are available on OSF (https://osf.io/syj23/).

## Samples

Participants' experience in study participation varied from novice to expert test taker. 76.99% of the student sample ($n$ = 113, age mean = 21.59 years, $SD$ = 3.2, female 88.50 %, diverse 0.88%), and 70.88 % of the paid online workers ($n$ = 419, age mean = 37.16, $SD$ = 11.08, female 40.33%, diverse 0.24%) reported that they had participated in five or more studies in the past (student sample: mean = 9.09, $SD$ = 6.1, minimum = 1, maximum = 35; paid online workers: mean = 68.63, SD = 114.4, minimum = 1, maximum > 300). In the sample of paid online workers, 22.67% reported to have participated in 100 or more studies. The majority of students studied psychology (88.50%) and were enrolled in the second or a higher semester (56.64%). Most of the paid online workers worked full time (73.75%) and earned up

to $60,000 a year (73.98%). We did not exclude any data from the student sample, whereas we excluded 85 participants from the paid online workers sample (the original sample size was of 503 participants, 85 failed the instructional manipulation check and were thus excluded). While the student sample can be considered as rather small, the paid online workers sample is sufficiently powered (Schönbrodt & Perugini, 2013).