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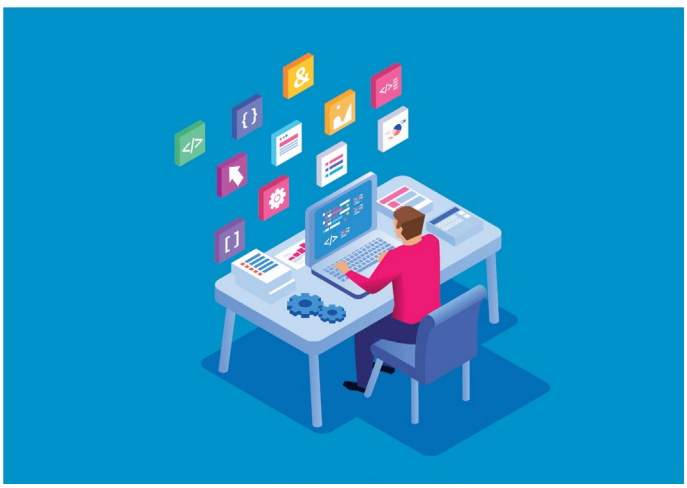
The importance of accounting for off-task behaviours during data collection

Allison C. Drody, Effie J. Pereira & Daniel Smilek

Off-task behaviours, such as media multitasking, are frequent in social science experiments and are especially common during online data collection. Such off-task behaviour can affect the quality of research data, making it crucial to understand the nature of this behaviour and to account for its influences.



Over the past few years, social scientists had to become more creative with their data collection. Since the COVID-19 pandemic temporarily halted almost all laboratory-based testing, experimental researchers have increasingly turned to online crowdsourcing methods (for example, Amazon Mechanical Turk, CrowdFlower, Prolific) for quality data.

In theory, these alternatives to standard, in-person testing serve their function well: many survey-based tasks (for example, questionnaires or personality inventories) have previously been adapted for online settings[1], clearing a path to similarly tailor experimental tasks (for example, sustained attention or go/no-go) to assess various measures of processing in an online format. However, unlike in controlled laboratory settings, one unique behaviour that is available to participants within online environments is the ability to media multitask, that is, engage in media-based activities (for example, checking one's smartphone, listening to a podcast) while completing the experimental task at hand[2]. Recent work has revealed that a large proportion of individuals (about 38% on average) engage in this off-task behaviour during online experiments[3], raising a critical question about the degree to which online off-task behaviours like media multitasking complicate the conclusions that can be drawn from online experimental settings.

The problem with online off-task behaviours

Given that little research has examined the nature and impact of online off-task behaviours, there are many unanswered questions about the problems these behaviours can pose for experimental tasks.

Range of disengagement. Although more than one-third of participants engage in media multitasking during online experimental tasks, meta-analyses reveal that this range varies anywhere from 9% to 85% of participants[3]. This large variability is also not explained by differences in demographic, recruitment or study variables[3], meaning that questions regarding how and when participants engage in this behaviour during online experimental tasks remain largely unanswered.

Types of disengagement. When completing online experimental tasks, there is a wide variety of activities in which participants can engage, various ways that participants can arrange their multitasking sessions (for example, intermittently or for prolonged periods of time), and diverse motivational reasons that drive this behaviour (for example, habit, boredom, a desire to acquire information)[2]. Each of these different multitasking combinations can have different implications for task performance. For example, media multitasking within the same modality (for example, watching TV while completing a visual attention task) is known to lead to worse task performance than media multitasking across different modalities (for example, listening to music while completing a visual attention task)[4]. As the impact of different online off-task behaviours is not widely studied, we lack a clear understanding of how each of these behaviours influences task performance.

Differences in disengagement across individuals. Media multitasking is known to correlate with a variety of individual factors, such as risk taking and sensation seeking[5]. This would mean that certain groups of individuals who have particular characteristics and traits associated with media multitasking might score lower for attention-based measures of processing. This leads to several difficulties for establishing exclusion criteria that can be applied equally across all participants, as online off-task behaviours may result in unintentionally leaving out certain groups of individuals when examining group-based effects or in becoming an important but statistically unaccounted for 'third' variable when examining individual differences.

In sum, the overarching problem is that participants in online settings have the unconstrained ability to engage in off-task behaviours in a myriad of ways that can differ across situations and vary across individuals. For this reason, it is difficult to disentangle off-task behaviour from on-task performance, which poses a particular problem for the assumptions that underlie several of our most common and enduring experimental approaches. More specifically, these approaches infer the inner workings of the mind by assuming that participants are fully

attending to their task. For example, the study of mental chronometry measures the time course of information processing at various stages of the cognitive architecture[6]; the capacity of cognitive resources helps us to determine the maximal limits of cognitive processes[7]; and the examination of between-participants variability allows for the study of individual differences in cognitive abilities[8]. If participants are engaging in unconstrained online off-task behaviours that pull attentional resources away from their experimental task[4], measures for the speed of information processing, maximal limits of cognitive processes, and individual differences among cognitive abilities are all likely to be confounded. In this manner, online off-task behaviours threaten the validity of online experimental conclusions, compromise the replicability of online scientific results and reduce the generalizability of online experimental findings to laboratory environments and potentially even to real-world environments.

How to account for online off-task behaviours

Given the considerations discussed above, we propose that the only realistic way that social scientists can deal with on-task disengagement in online settings is to adopt the assumption that off-task behaviours are going to occur. This means facing issues of inattention head on by placing a greater emphasis on accurately measuring off-task behaviours, statistically accounting for these off-task states, increasing on-task engagement, and crafting robust research questions that are resilient to off-task behaviours.

Measuring off-task behaviours. Online off-task behaviours are currently not widely measured across experimental studies, but fortunately, there are several direct and indirect methods that are easy to implement for these purposes. Direct methods can involve explicitly asking participants to self-report their attentional focus during the task, either specifically at various points in time (for example, using intermittent thought probes[9]) or globally at the end (for example, using overall engagement questions[3]). Indirect methods can infer the presence of off-task states by monitoring participants' behaviour for signs of disengagement. Along these lines, experimental researchers could index the occurrence of media multitasking by assessing changes in the size or focus of the task screen, tracking the number of new browser windows opened, examining movements of the mouse or track pad, or video-recording participants during the online experimental task. These methods may not capture all forms of online off-task behaviour, but they increase the likelihood that researchers will record as many of these instances as possible.

Accounting for off-task states. Once off-task states are suitably measured, researchers can take steps to statistically control for them during various stages of data analysis. During data cleaning, for instance, researchers can set certain threshold levels for off-task performance and then specifically exclude trials (rather than participants) based on whether this threshold is exceeded. During statistical analysis, more complex techniques can be used that allow off-task states to be accounted for as either a covariate or a multilevel random effect when studying group-level and individual-level behaviour. Researchers could also think about accounting for off-task states earlier in their experimental design by intentionally building off-task behaviours as a condition within the study. For example, manipulating task difficulty is known to influence whether participants are likely to media multitask[10], allowing a more thorough assessment of the role of disengagement in experimental tasks. This degree of off-task accounting during online experimental studies would go a long way towards assuaging concerns about the influences of off-task behaviour on primary metrics of interest.

Increasing on-task engagement. Enhancing motivation during experimental tasks is known to successfully reduce off-task behaviours and improve on-task performance[11]. Although financial incentives have proven useful in the past, work has shown that individuals participate in online studies for a variety of reasons, including for enjoyment, to pass time, and to learn about themselves[1], suggesting that intrinsic motivations could prove fruitful in online experimental settings. Another option would be to re-examine the types of tasks we rely on for experimental studies, which typically use simplistic stimuli presented over many repeated trials. Although these parameters have provided high reliability and strong experimental control, they can result in experimental tasks being monotonous and mind-numbingly boring, thereby increasing participants' desire to engage in off-task behaviours. Including experimental stimuli and tasks that have more overlap with the complexity, interestingness and variety found in everyday life could prove beneficial in this regard. It is important to note, though, that these methods of increasing on-task engagement may require researchers to adjust their theoretical questions of interest or their assumptions about the data being collected.

Crafting robust research questions. A final way forward is to reframe research questions so that they do not hinge on the assumption of full on-task attention. At a minimum, relaxing this assumption would allow researchers to formulate questions that overlap with the dominant mode of attention in everyday life, which seems to be characterized by regular off-task states[12]. For example, a modified research question about the limits of cognitive processes might involve asking about the functional limits of a cognitive process in a particular everyday context (for example, how attentive are students during virtual lectures?). This modification acknowledges that in any given situation participants' performance might not reflect their actual maximal abilities, which shifts the focus from what a person can do to what a person actually does in a given context.

Broader ties to laboratory off-task behaviours

It is also worth reflecting on how much of the aforementioned discussion of online off-task behaviours applies to off-task behaviours that occur during traditional in-laboratory studies. In the laboratory, off-task behaviours primarily manifest as mind-wandering, which entails engaging in thoughts that are not tied to a specific task at hand[9] and often occurs 10–60% of the time when participants complete laboratory-based experimental tasks[13]. Critically, these laboratory off-task behaviours seem to mirror online off-task behaviours in the main concerns raised earlier: namely, that both types of disengagement show variation in the range of their occurrences, the manner in which they can occur, and the different ways they manifest across individuals.

Several lines of evidence point to the possibility that both types of off-task behaviours may serve a common objective or goal, but that they may have different presentations depending on the context — presenting as mind-wandering in the laboratory, when a strong degree of experimental control can be applied, and as media multitasking online, when distracting media options are more readily available. First, a wealth of studies have demonstrated an overlap in performance between laboratory and online settings[1,14], suggesting a commonality

in the degree to which these off-task behaviours affect on-task performance even when the former method does not allow participants to media multitask. Second, when participants are given the opportunity to media multitask during an experimental task, mind-wandering is found to decrease as media multitasking increases[15], suggesting that individuals may be substituting one off-task behaviour for another.

Conclusion

Given the overlap and possible trade-off in off-task behaviours between laboratory and online settings, it is all the more important to ensure that researchers carefully consider how off-task behaviours can affect both modes of data collection to ensure that, contrary to our intentions, we as social scientists are not merely studying the disengaged mind.

Allison C. Drody [1,2] ✉, **Effie J. Pereira** [1,2] **& Daniel Smilek** [1]
[1]Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada. [2]These authors contributed equally: Allison C. Drody, Effie J. Pereira.
✉e-mail: acdrody@uwaterloo.ca

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Competing interests

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