



Contents lists available at ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

How pervasive is mind wandering, really?, ☆, ☆ ☆

Paul Seli^{a,*}, Roger E. Beaty^b, James Allan Cheyne^c, Daniel Smilek^c,
Jonathan Oakman^c, Daniel L. Schacter^d

^a Department of Psychology and Neuroscience, Duke University, Durham, NC, USA

^b Department of Psychology, Penn State University, State College, PA, USA

^c Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada

^d Department of Psychology, Harvard University, Cambridge, MA, USA



ARTICLE INFO

Keywords:

Mind wandering
Task-unrelated thought
Frequency
Rate
Daily life

ABSTRACT

Recent claims that people spend 30–50% of their waking lives mind wandering (Killingsworth & Gilbert, 2010; Kane et al., 2007) have become widely accepted and frequently cited. While acknowledging attention to be inconstant and wavering, and mind wandering to be ubiquitous, we argue and present evidence that such simple quantitative estimates are misleading and potentially meaningless without serious qualification. Mind-wandering estimates requiring dichotomous judgments of inner experience rely on questionable assumptions about how such judgments are made, and the resulting data do not permit straightforward interpretation. We present evidence that estimates of daily-life mind wandering vary dramatically depending on the response options provided. Offering participants a range of options in estimating task engagement yielded variable mind-wandering estimates, from approximately 60% to 10%, depending on assumptions made about how observers make introspective judgments about their mind-wandering experiences and how they understand what it means to be on- or off-task.

1. Introduction

Mind wandering¹ is ubiquitous and consequential in human functioning, and so understanding its prevalence in everyday life is a worthwhile endeavour. Estimates of daily-life prevalence have often been obtained via samples of dichotomous “thought probes” asking participants to report whether they are focused on an ongoing task (“on-task”) or mind wandering (Kane et al., 2007; Killingsworth & Gilbert, 2010). Based on these studies, repeated claims have been made (by researchers and the media alike) that people spend almost *half their waking hours* engaged in mind wandering (e.g., Bennike, Wieghorst, & Kirk, 2017; Ergas, 2018; Franklin et al., 2013; Killingsworth & Gilbert, 2010; McCormick, Rosenthal, Miller, & Maguire, 2018). Use of such dichotomous self-report measures assumes that people can and do report binary states (on-task and mind wandering) at an instant in time. Although people might be able to attend to only one stream of thought at each instant, this does not mean that self-reports can reflect this so precisely as researchers have assumed. Perhaps the best people can do is make introspective judgments from memory of their recent mental states (James, 1890/1950) over self-selected and possibly variable time intervals to estimate whether they have recently been more

* Daniel Smilek was supported by a Natural Sciences and Engineering Research Council discovery grant 06459. Daniel L. Schacter was supported by a National Institute on Aging grant R01 AG08441.

** **Open Practices:** All data have been made publicly available via Open Science Framework and can be accessed at <https://osf.io/z7qpg/>.

* Corresponding author at: Department of Psychology and Neuroscience, Duke University, 417 Chapel Dr, Durham, NC 27708, USA.

E-mail address: paul.seli@duke.edu (P. Seli).

¹ Conceptualized and operationalized here as task-unrelated thought.

<https://doi.org/10.1016/j.concog.2018.10.002>

Received 30 May 2018; Received in revised form 21 September 2018; Accepted 16 October 2018

Available online 06 November 2018

1053-8100/ © 2018 Elsevier Inc. All rights reserved.

or less off-task, and then convert this into a dichotomous report.

The foregoing considerations raise the following question: When people endorse mind wandering roughly 50% of the time in response to dichotomous probes, does this mean they were (a) completely absorbed in mind wandering 50% of the time and completely on-task 50% of the time, or (b) forcing experiences of degree (i.e., mixtures of on-task and mind wandering experiences) into dichotomous decisions?² To examine this question, we assessed peoples' responses to a dichotomous (on-task vs. mind wandering) probe, and their responses to a multi-level probe (e.g., Mrazek et al., 2013) that allowed them to report various combinations of being both on-task and mind wandering; to obtain an assessment of probe reports in daily life, thought probes were administered and responded to via participants' smartphones while they engaged in their everyday activities. To enable comparison with prior studies conducted in real-world settings, we followed closely the methods of the earlier studies (Kane et al., 2007; Killingsworth & Gilbert, 2010).

2. Materials and method

In accordance with the recommendations of Simmons, Nelson, and Simonsohn (2012), we report how we determined our sample size, all data exclusions, and all measures in our study. Moreover, in accordance with the recommendations of Seli et al. (2018), we report that, in the present study, we conceptualized mind wandering as task-unrelated thought, and we operationally defined it for our participants in terms of thoughts pertaining to something other than what they were doing when queried about their mental states (see below for more details).

2.1. Participants

Undergraduate students ($n = 239$) were randomly assigned to either the dichotomous ($n = 122$) or multi-level ($n = 117$) probe condition. We determined, in advance, that we could collect as much data as possible before the end of the academic term, with a minimum requirement of 100 participants per condition (which seemed reasonable for our research question). In the dichotomous-probe condition, 14 participants did not respond to at least seven of the 70 probes; in the multi-level-probe condition, 10 participants did not respond to at least 7 of the probes. As in previous research (Cotter & Silvia, 2017; Kane et al., 2017), we excluded these participants' data from all analyses (final n s = 108 and 107, for the dichotomous and multi-level probe conditions, respectively).

2.2. Experience sampling

To assess rates of mind wandering, we presented participants with thought probes via MetricWire, which is a smartphone application for daily-life experience-sampling data collection. The survey system probed participants 10 times per day, for seven days, between 8am and midnight (with at least 50 min between probes; Cotter & Silvia, 2017). Participants were encouraged to respond to as many probes as possible, but not in dangerous or inappropriate contexts (e.g., while driving). Prior to completing the experiment, an experimenter explained the survey system and completed a practice survey with participants in the laboratory. In the dichotomous-probe condition, the probes read, "At the time of the beep, my mind had wandered to something other than what I was doing," and participants could respond by selecting "no" or "yes" (e.g., Kane et al., 2007, 2017; Killingsworth & Gilbert, 2010). In the multi-level-probe condition, the probe read, "At the time of the beep, my mind was..." and was accompanied by the following response options: '(1) Completely focused on what I was doing'; '(2) Mostly focused on what I was doing'; '(3) Both focused on what I was doing and something other than what I was doing'; '(4) Mostly focused on something other than what I was doing'; or '(5) Completely focused on something other than what I was doing' (Mrazek et al., 2012; for more studies employing multi-level probes, see Schad, Nuthmann, & Engbert, 2012; Seli et al., 2014, Study 2). Previous research employing multi-level probes has provided evidence that people are able to make such distinctions in levels of mind wandering and that these distinctions are reliably associated in conceptually meaningful ways with performance on attention-demanding tasks (e.g., Laflamme, Seli, & Smilek, 2018; Seli et al., 2014, Study 2). Both probe conditions included three subsequent survey questions that are not considered in the present report (see supplemental materials for full details).

² When posed in this manner, we imagine that most researchers would argue that participants are likely forcing their graded experiences into a dichotomous decision (option b). However, a survey of the literature reveals that, in numerous cases, researchers have interpreted responses to dichotomous thought probes in terms of reflecting a dichotomous (rather than a graded) experience, whereby states of "mind wandering" and states of "on-task focus" are mutually exclusive (option a). For instance, referencing studies that have assessed mind wandering via dichotomous probes (e.g., Killingsworth & Gilbert, 2010), many researchers have made statements such as, 'people spend roughly 50% of their waking lives engaged in mind wandering' (e.g., Bennike et al., 2017; Ergas, 2018; Franklin et al., 2013; Killingsworth & Gilbert, 2010; McCormick, Rosenthal, Miller, & Maguire, 2018; McVay & Kane, 2012; Mrazek, Phillips, Franklin, Broadway, & Schooler, 2013; Pepin et al., 2018; Smallwood, Fishman, & Schooler, 2007; Welz, Reinhard, Alpers, & Kuehner, 2018). Such statements, however, are inconsistent with the assumption that participants dichotomize their graded experiences as either "on task" or "mind wandering" (option b). Indeed, working under the assumption that mind wandering is a graded experience, it would be imprudent to draw any conclusions about rates of mind wandering when examining responses to dichotomous thought probes, which, as the assumption goes, provide a relatively crude index of a graded experience that encompasses both mind wandering and on-task focus, rather than a discrete measurement of each state, and one that could inform estimates of rates of mind wandering versus on-task moments.

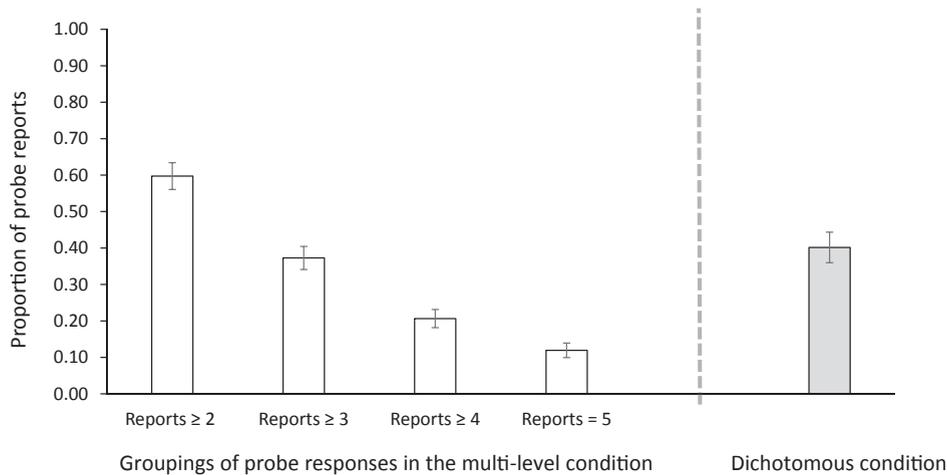


Fig. 1. In the left-hand panel (white bars) are data from the multi-level-probe condition, showing the proportions of mind-wandering reports passing different thresholds: “> 1” = The proportion of probe reports that were greater than 1 on the 1–5 mind-wandering scale; “> 2” = The proportion of probe reports that were greater than 2 on the 1–5 mind-wandering scale; and so forth. In the right-hand panel (gray bar) is the proportion of mind wandering based on data from the dichotomous-probe condition. Bars are 95% between-subjects confidence intervals.

2.3. Rates of mind wandering

In the dichotomous probe condition, rates of mind wandering were calculated as the proportion of thought probes to which participants indicated that they were mind wandering (i.e., the proportion of probes to which participants responded “yes”). In the multi-level probe condition, we calculated rates of mind wandering in four different ways: in terms of the proportion of thought probes to which participants reported (a) any response greater than ‘(1) Completely focused on what I was doing’, (b) any response greater than ‘(2) Mostly focused on what I was doing’, (c) any response greater than ‘(3) Both focused on what I was doing and something other than what I was doing’, and finally, (d) any response greater than ‘(4) Mostly focused on something other than what I was doing’.

3. Results

First, we examined the average number of probes that participants responded to in both conditions. Importantly, response rates across the dichotomous-probe condition ($M = 32.15$, $SD = 15.73$, Range = 7–63) and the multi-level probe condition ($M = 29.91$, $SD = 14.65$, Range = 7–55) were not statistically different, $t(213) = 1.08$, $SE = 2.07$, $p = .28$, $d = 0.15$, indicating that participants in both conditions had similar rates of compliance.

Next, we examined rates of mind wandering, yielded by our thought-probes, for both the dichotomous-probe condition and the multi-level probe condition. As can be seen in Fig. 1, when calculating rates of mind wandering in the dichotomous-probe condition (gray bar), we find that participants reported that they were engaged in mind wandering 40% of the time, which is consistent with other work examining mind wandering in daily life (e.g., Killingsworth & Gilbert, 2010; Kane et al., 2007). In the multi-level probe condition (white bars), however, when classifying any responses greater than ‘(1) Completely focused on what I was doing’ as mind wandering, we found that participants engaged in mind wandering 60% of the time, or conversely, that they were completely focused on their ongoing activities a mere 40% of the time. That said, when classifying any responses greater than ‘(2) Mostly focused on what I was doing’ as mind wandering, we find that rates of mind wandering drop to 37%. Continuing with this pattern, we find that, when classifying any responses greater than ‘(3) Both focused on what I was doing and something other than what I was doing’ as mind wandering, rates of mind wandering again drop, this time to 21%. Finally, when classifying any responses greater than ‘(4) Mostly focused on something other than what I was doing’ as mind wandering, we find that participants mind-wandered only 12% of the time. Put differently, participants reported at least some degree of on-task focus 88% of the time.

Next, we examined the mean proportions of times each of the 5 response options was endorsed across participants in the multi-level probe condition (Fig. 2). The shape of the distribution is informative in that it provides a *profile of attentional engagement* during everyday activities. In Fig. 2, the values decline linearly over the first four levels and either stabilize or perhaps recover at the highest levels of mind wandering. Thus, whereas participants reported frequent mildly off-task mentation, they were notably less likely to report more severe levels of off-task mentation during their everyday activities, which will almost certainly vary in their importance and attention-demanding character. Repeated-measures analysis across levels of mind wandering revealed significant linear, $F(1,106) = 249.95$, $p < .001$, $\eta_p^2 = 0.70$, and quadratic, $F(1, 106) = 30.82$, $p < .001$, $\eta_p^2 = 0.23$, components. The linear and quadratic components jointly yield an $R = 0.97$, suggesting a rather systematic decline over levels of task engagement. (In Fig. 2, we fit a 2nd order quadratic function to the data for illustrative purposes.) We do not suggest that such a profile will be obtained under all contexts and conditions, but note that participants do appear to be using the scale in a systematic fashion at the group level.

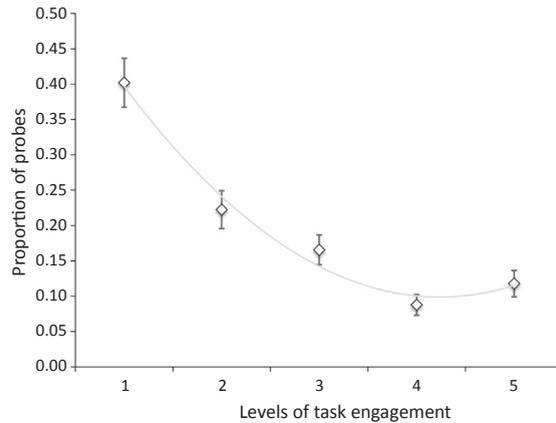


Fig. 2. The proportion of probe reports (1–5) from the multi-level-probe condition, fitted to a second order polynomial. Error bars are 95% within-subjects confidence intervals.

4. Discussion

The mind-wandering rates yielded by our dichotomous probe were comparable to those from previous studies (40%), yet our interpretation of this result is qualified by the multi-level probe results revealing that participants were clearly not completely disengaged from their everyday tasks 40% of the time. Indeed, rates of complete disengagement were far less frequent (occurring only 12% of the time). On the other hand, the dichotomous-probe results cannot be taken to mean that people were completely on-task roughly 60% of the time since the multi-level-probe data revealed that participants were completely on-task only 40% of the time. Thus, the critical point that emerges is that the rates of mind wandering yielded by dichotomous probes are difficult to interpret in the absence of the multi-level probe.

The present results raise broader questions about what people mean when they retrospectively judge that they have been completely or incompletely off-task. One possibility is that such judgments are based on the recent memory of the changing contents of awareness, and hence, indirectly, recent memory of the frequency of channel switching between task focus and non-task thoughts. On this view, apparently ubiquitous mind wandering merely reveals that we are rarely and briefly committed fully to any one processing channel (Schad et al., 2012). Given frequent and rapid changes of the contents of consciousness, deciding on a single value of how much someone is mind wandering becomes highly arbitrary and the attempt to discover a single specific value becomes misleading. Perhaps, when responding to the dichotomous probe, people are coping by making a breaking point in reporting their responses as off-task when, for example, they feel they are devoting insufficient attentional resources to a focal task. The present results seem consistent with this hypothesis. The midpoint of the five-point scale might reasonably be interpreted as representing something close to participants' impressions that their attention was approximately equally divided between some ongoing focal task and mind wandering. That the proportion of reports of '3' or greater (Fig. 1) is very close to the dichotomous mind-wandering value suggests that the people respond to the dichotomous question as if asked if they were mind wandering as much or more than they were attending to the task. It does not mean that they are reporting being completely off-task 40% of the time. Indeed, according to the present results, people are completely off-task only 12% of the time.

An alternative, but compatible, interpretation of the present results is that there are really three types of decisions that one can reliably make about task engagement: adequately on-task (level 1), somewhat equivocal (levels 2–3), or mostly off-task (4–5), in approximate ratios of 2:2:1 (see Fig. 2). On this interpretation, participants were mostly, if not completely, off-task about 20% of the time. In any case, the present results suggest that seeking a single value for mind wandering is not very psychologically informative (see also Weinstein, de Lima, & van der Zee, 2018).

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.concog.2018.10.002>.

References

- Bennike, I. H., Wieghorst, A., & Kirk, U. (2017). Online-based mindfulness training reduces behavioral markers of mind wandering. *Journal of Cognitive Enhancement*, 1(2), 172–181.
- Cotter, K. N., & Silvia, P. J. (2017). Measuring mental music: Comparing retrospective and experience sampling methods for assessing musical imagery. *Psychology of Aesthetics, Creativity, and the Arts*, 11, 335.
- Ergas, O. (2018). Schooled in our own minds: Mind-wandering and mindfulness in the makings of the curriculum. *Journal of Curriculum Studies*, 50(1), 77–95.
- Franklin, M. S., Mrazek, M. D., Anderson, C. L., Smallwood, J., Kingstone, A., & Schooler, J. (2013). The silver lining of a mind in the clouds: Interesting musings are associated with positive mood while mind-wandering. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2013.00583>.
- James, W. (1890/1950). *Principles of psychology*. New York, NY: Dover.
- Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R. (2007). For whom the mind wanders, and when: An experience-sampling study

- of working memory and executive control in daily life. *Psychological Science*, 18(7), 614–621.
- Kane, M. J., Gross, G. M., Chun, C. A., Smeekens, B. A., Meier, M. E., Silvia, P. J., & Kwapil, T. R. (2017). For whom the mind wanders, and when, varies across laboratory and daily-life settings. *Psychological Science*, 28(9), 1271–1289.
- Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science*, 330, 932.
- Laflamme, P., Seli, P., & Smilek, D. (2018). Validating a visual version of the metronome response task. *Behavior Research Methods*. <https://doi.org/10.3758/s13428-018-1020-0>.
- McCormick, C., Rosenthal, C. R., Miller, T. D., & Maguire, E. A. (2018). Mind-wandering in people with hippocampal damage. *Journal of Neuroscience*, 1812–1817.
- McVay, J. C., & Kane, M. J. (2012). Why does working memory capacity predict variation in reading comprehension? On the influence of mind wandering and executive attention. *Journal of experimental psychology: general*, 141(2), 302–320.
- Mrazek, M. D., Phillips, D. T., Franklin, M. S., Broadway, J. M., & Schooler, J. W. (2013). Young and restless: Validation of the Mind-Wandering Questionnaire (MWQ) reveals disruptive impact of mind-wandering for youth. *Frontiers in psychology*, 4, 560.
- Mrazek, M. D., Smallwood, J., Franklin, M. S., Chin, J. M., Baird, B., & Schooler, J. W. (2012). The role of mind-wandering in measurements of general aptitude. *Journal of Experimental Psychology: General*, 141, 788–798.
- Pepin, G., Malin, S., Jallais, C., Moreau, F., Fort, A., Navarro, J., ... Gabaude, C. (2018). Do distinct mind wandering differently disrupt drivers? Interpretation of physiological and behavioral pattern with a data triangulation method. *Consciousness and cognition*, 62, 69–81.
- Schad, D. J., Nuthmann, A., & Engbert, R. (2012). Your mind wanders weakly, your mind wanders deeply: Objective measures reveal mindless reading at different levels. *Cognition*, 125, 179–194.
- Seli, P., Carriere, J. S., Thomson, D. R., Cheyne, J. A., Martens, K. A. E., & Smilek, D. (2014). Restless mind, restless body. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40, 660.
- Seli, P., Kane, M. J., Smallwood, J., Schacter, D. L., Maillet, D., Schooler, J. W., & Smilek, D. (2018). Mind wandering as a natural kind: A family-resemblances view. *Trends in Cognitive Sciences*, 22, 479–490.
- Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2012). A 21-word solution. *Dialogue: The Official Newsletter of the Society for Personality and Social Psychology*, 26, 4–7.
- Smallwood, J., Fishman, D. J., & Schooler, J. W. (2007). Counting the cost of an absent mind: Mind wandering as an underrecognized influence on educational performance. *Psychonomic Bulletin & Review*, 14(2), 230–236.
- Weinstein, Y., De Lima, H. J., & van der Zee, T. (2018). Are you mind-wandering, or is your mind on task? The effect of probe framing on mind-wandering reports. *Psychonomic Bulletin & Review*, 25, 754–760.
- Welz, A., Reinhard, I., Alpers, G. W., & Kuehner, C. (2018). Happy thoughts: Mind wandering affects mood in daily life. *Mindfulness*, 9(1), 332–343.