



Language facilitates introspection: Verbal mind-wandering has privileged access to consciousness

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ABSTRACT

Introspection and language are the cognitive prides of humankind, but their interactions in healthy cognition remain unclear. Episodes of mind-wandering, where personal thoughts often go unnoticed for some time before being introspected, offer a unique opportunity to study the role of language in introspection. In this paper, we show that inner speech facilitates awareness of mind-wandering. In two experiments, we either interfered with verbal working memory, via articulatory suppression (Exp. 1), or entrained it, via presentation of verbal material (Exp. 2), and measured the resulting awareness of mind-wandering. Articulatory suppression decreased the likelihood to spontaneously notice mind-wandering, whereas verbal material increased retrospective awareness of mind-wandering. In addition, an ecological study using smartphones confirmed that inner speech vividness positively predicted mind-wandering awareness (Exp. 3). Together, these findings support the view that inner speech facilitates introspection of one's thoughts, and therefore provides empirical evidence for a positive relation between language and consciousness.

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1. Introduction

Two of the most important human cognitive functions, consciousness and language, interact to produce internalized “inner” speech, which is conscious thought with a verbal structure (Alderson-Day & Fernyhough, 2015). Inner speech is reported in 20–30% of daily thoughts (Heavey & Hurlburt, 2008) and has been shown to serve numerous functions related to cognitive control (Cragg & Nation, 2010; Vygotsky, 1962), such as task-monitoring (Tullett & Inzlicht, 2010), task-switching (Emerson & Miyake, 2003) and planning (Lidstone, Meins, & Fernyhough, 2010). Theoretical proposals have suggested that inner speech could also be involved in reflective- and self-awareness (Baumeister & Masicampo, 2010; Morin, 2005; Morin & Everett, 1990). Indeed, task-monitoring, task-switching and planning already rely on the awareness of one's goals. However, empirical evidence for a role for inner speech in awareness is scarce and indirect (Morin & Hamper, 2012).

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Various theories of consciousness (Dehaene, Changeux, Naccache, Sackur, & Sergent, 2006; Lamme, 2006; Lau & Rosenthal, 2011) and meta-cognition (Fleming, Weil, Nagy, Dolan, & Rees, 2010; Kornell, 2009; McCurdy et al., 2013) have recently emerged in parallel to the studies of inner speech. Yet, these theories do not assign any specific role of language in conscious access or metacognitive representations. Whether inner speech increases the salience or awareness of one's own thoughts therefore remains to be tested and integrated to more general models of human consciousness.

The phenomenon of mind-wandering offers a unique opportunity to test how language interacts with consciousness. People often experience thoughts that are not related to the task at hand (Schooler, Reichle, & Halpern, 2004), some of these thoughts having a verbal nature – e.g. wondering, in English, whether a person will show up to an appointment later in the day – and some other thoughts having a imaginal nature – e.g. picturing, with visual mental imagery, that the person will show up or not (Stawarczyk, Cassol, & D'Argembeau, 2013). Moreover, mind-wandering is often unnoticed and people eventually discover that they were zoning out a few seconds after (Schooler et al., 2011). This lack of reflective awareness, or “meta-awareness” (Schooler, 2002; Winkielman & Schooler, 2011), of one's own thoughts is a common failure of introspection: these thoughts are consciously *experienced* – and reportable – yet the ability to take stock of them (i.e. spontaneously noticing them) is temporarily impaired. Two distinct paradigms have been developed to measure mind-wandering awareness. First, the self-caught/probe-caught paradigm (Schooler et al., 2004) holds that episodes of mind-wandering that are reported spontaneously by participants (“self-caught”) reflect greater awareness than episodes of mind-wandering that are caught by randomly distributed thought-probes (“probe-caught”). Second, the experience sampling paradigm can include a retrospective assessment by participants of how aware they were of the past mind-wandering episode (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009).

Many factors, such as alcohol intoxication (Sayette, Reichle, & Schooler, 2009), cigarette craving (Sayette, Schooler, & Reichle, 2010), or attention deficit (Franklin et al., 2014) have been shown to impair awareness of mind-wandering. Thus mind-wandering episodes can serve as a test bed for the hypothesis that verbal representations and processing facilitate awareness: we can ask whether participants are more or less aware of their mind-wandering when verbal processing is favored or impaired. We can also ask whether the verbal phenomenology of one's mind-wandering thought is associated with increased awareness.

In this paper, we present three studies showing that verbal processing contributes to the awareness of mind-wandering, as measured either by the self-caught/probe caught (Exp. 1) or the experience sampling paradigms (Exp. 2 & 3). First, in two laboratory experiments, we tested whether the amount of verbal material in mind-wandering episodes predicted whether participants were aware of them. We used articulatory suppression (Repovš & Baddeley, 2006) to decrease the verbal content of working memory (Exp. 1), and we presented verbal material (Abramson & Goldinger, 1997; Pintner, 1913) so as to entrain the verbal component of working memory (Exp. 2). In addition, a crowd-sourced study running on Android smartphones was designed to test whether more vivid verbal thoughts were positively associated with heightened awareness.

2. Experiment 1

Experiment 1 tested whether the impairment of verbal working memory decreases awareness of mind-wandering. Articulatory suppression was used to impair verbal working memory, and mind-wandering awareness was measured using the self-caught/probe-caught paradigm.

2.1. Material and methods

2.1.1. Participants

29 students (15 females, 21.5 y.o., SD = 4.4, range = [18–39]) from the Department of Psychology of the University of California, Santa Barbara (UCSB) participated in the study. All participants had normal or corrected-to-normal vision and spoke fluent English.

2.1.2. Materials

2.1.2.1. *Primary task.* A version of the SART (Sustained Attention to Response Task, Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) was used as the base task, with thought-probes (Hurlburt & Heavey, 2004; Klinger, 1978) to measure mind-wandering and meta-awareness. Digits were presented sequentially in white “courier new” font (30 points) at the center of a black computer screen (refresh rate of 60 Hz) for 500 ms, every 2 s. Participants were required to press the space bar as fast as possible in response to each digit except when presented with the digit “3” (the target no-go stimulus). No-go targets were rare (7%: 8 out of 108 trials per block).

2.1.2.2. *Secondary task.* The SART was performed under three conditions in a within participant design: (1) single-task (hereafter ST) (2) articulatory suppression dual-task (hereafter AS), and (3) foot tapping control dual-task (hereafter FT). In the articulatory suppression condition, participants repeated “a-b-c” out loud, while in the foot tapping condition they tapped on a stapler fixed on the floor. The rhythm for both articulatory suppression and foot tapping conditions was one beat every 750 ms, as set by a metronome at the beginning of each block. The disruptive effects of both foot tapping and articulatory suppression have been shown to be comparable (Emerson & Miyake, 2003; Gaillard, Destrebecqz, & Cleeremans, 2012; Miyake, Emerson, Padilla, & Ahn, 2004).

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