Neuropsychologia xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Neuropsychologia

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

The ERP correlates of self-knowledge: Are assessments of one's past, present, and future traits closer to semantic or episodic memory?

Annick N. Tanguay[a,c,*], Lauren Benton[b], Lorenza Romio[c], Carolin Sievers[c], Patrick S.R. Davidson[a], Louis Renoult[c]

[a] School of Psychology, University of Ottawa, Ontario, Canada
[b] Department of Neuroscience, Dickinson College, PA, USA
[c] School of Psychology, University of East Anglia, Norfolk, UK

ARTICLE INFO

Keywords:
Personal semantics
Self-knowledge
Episodic memory
Semantic memory
Time perspective
ERPs
N400
LPC

ABSTRACT

Self-knowledge concerns one's own preferences and personality. It pertains to the self (similar to episodic memory), yet does not concern events. It is factual (like semantic memory), but also idiosyncratic. For these reasons, it is unclear where self-knowledge might fall on a continuum in relation to semantic and episodic memory. In this study, we aimed to compare the event-related potential (ERP) correlates of self-knowledge to those of semantic and episodic memory, using N400 and Late Positive Component (LPC) as proxies for semantic and episodic processing, respectively. We considered an additional factor: time perspective. Temporally distant selves have been suggested to be more semantic compared to the present self, but thinking about one's past and future selves may also engage episodic memory. Twenty-eight adults answered whether traits (e.g., *persistent*) were true of most people holding an occupation (e.g., soldiers; semantic memory condition), or true of themselves 5 years ago, in the present, or 5 years from now (past, present, and future self-knowledge conditions). The study ended with an episodic recognition memory task for previously seen traits. Present self-knowledge produced mean LPC amplitudes at posterior parietal sites that fell between semantic and episodic memory. Mean LPC amplitudes for past and future self-knowledge were greater than for semantic memory, and not significantly different from episodic memory. Mean N400 amplitudes for the self-knowledge conditions were smaller than for semantic memory at sagittal sites. However, this N400 effect was not separable from a preceding P200 effect at these same electrode sites. This P200 effect can be interpreted as reflecting the greater emotional salience of self as compared to general knowledge, which may have facilitated semantic processing. Overall, our findings are consistent with a distinction between knowledge of others and self-knowledge, but the closeness of self-knowledge's neural correlates to either semantic or episodic memory appears to depend to some extent on time perspective.

1. Introduction

The ancient Greeks' invitation to "Know thyself" resonates to this day in popular culture. Despite this, self-knowledge is rarely integrated into current models of declarative memory. Declarative memory is usually described as consisting of semantic and episodic memory, which are depicted as two branches of a tree diagram (Squire and Wixted, 2015) or two extremes of a continuum (e.g., Jacoby and Craik, 1979; Cabeza and St Jacques, 2007). At one extreme, semantic memory concerns knowledge of facts that are detached from their context of acquisition and shared with other people in the culture (Binder and Desai, 2011; Lambon Ralph et al., 2017). At the other extreme, episodic memory concerns our ability to remember events from our past and related contextual information (Tulving, 2002). Between these two extremes arguably falls *personal semantics*, which (like semantic memory) are factual and limited in spatial/temporal details, but (like episodic memory) are idiosyncratically personal. Personal semantics were broken down into four types in a recent review and taxonomy (Renoult et al., 2012). Two of the four types were hypothesized to be closer to episodic memory (i.e., memory for repeated events, autobiographically significant concepts), one as being closer to semantic memory (i.e., autobiographical facts), and one as being relatively distinct from both (i.e., self-knowledge; see Fig. 1; Renoult et al., 2012). Recently, we have used ERPs to compare repeated events, autobiographically significant concepts, and autobiographical facts to semantic and episodic memory (Renoult et al., 2015, 2016b). Here we

* Correspondence to: Faculty of Social Sciences, 136 Jean-Jacques Lussier Priv., Room 3021, Ottawa, Ontario, Canada, K1N 6N5.
E-mail address: atang027@uottawa.ca (A.N. Tanguay).

https://doi.org/10.1016/j.neuropsychologia.2017.10.024
Received 1 March 2017; Received in revised form 30 September 2017; Accepted 19 October 2017

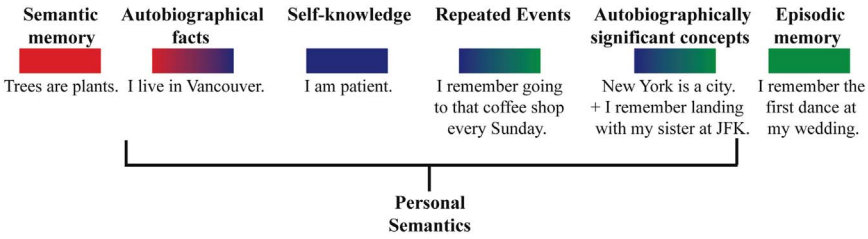

Fig. 1. The 4 types of personal semantics in relation to semantic and episodic memory.

turn to the fourth operationalization of personal semantics: self-knowledge.

1.1. Self-knowledge

Self-knowledge entails evaluative judgments of oneself, and includes knowledge of one's own traits and preferences (Renoult et al., 2012). Self-knowledge is arguably a highly abstract form of knowledge (Grilli and Verfaellie, 2014; Renoult et al., 2012), which in part could explain its apparent independence from episodic and semantic memory impairment (Klein and Gangi, 2010). For example, amnesic patients can describe their post-morbid personality, indicating that self-knowledge can be updated despite episodic memory impairment (Craver et al., 2014; Grilli and Verfaellie, 2015). In addition, self-knowledge can remain intact when another kind of personal semantics is impaired [i.e., autobiographical facts: knowledge of facts about oneself that resemble an autobiographical "CV", including jobs, hobbies, diplomas; etc. (Klein et al., 2003, 2002; Renoult et al., 2012; Warrington and McCarthy, 1988)]. The reverse pattern has also been found: A patient with damage to medial prefrontal cortex (mPFC) showed impaired insight into his own traits (i.e., self-knowledge) in the face of accurate knowledge of an acquaintance's traits (Marquine et al., 2016).

1.2. Knowledge of past, present and future selves

Conceptualizations of self-knowledge usually focus on the present self, but knowledge can extend to past selves and future "possible selves" (Markus and Nurius, 1986) or the "temporally extended self" (Prebble et al., 2013). Two perspectives have been taken on the relative contribution of semantic and episodic memory to self-knowledge across time. From the first perspective, several have posited that episodic memory shapes self-knowledge through the elaboration of self-defining events in one's past and future, and contributes to a sense of continuity of one's identity in time (Demblon and D'Argembeau, 2016; Prebble et al., 2013). In these respects, traits are concepts that can acquire a personal significance through events, particularly when considering the past or the future (Demblon and D'Argembeau, 2016; Renoult et al., 2015). Semantic memory is usually argued to be associated with a subjective awareness based in the present, whereas episodic memory is associated with a subjective awareness oriented towards the past and possibly also the future (Tulving, 2001, 2002). This difference in temporal orientation might suggest that present self-knowledge is more similar to semantic memory, whereas past and future self-knowledge are more similar to episodic memory. However, the relationship between temporal orientation and episodic memory lends itself to potential confusion. A case study of amnesic patient KC found that he understood time as a concept, and he could orient to his past, present, and future (that is, he was not "stuck in the present"; Craver et al., 2014). To nuance this perspective, one might consider episodic memory as associated with awareness of oneself in a specific temporal context, including the ever-changing present. If so, the neural correlates of present self-knowledge may be intermediate between semantic and episodic memory (Prebble et al., 2013). Present self-knowledge shares the personal and introspective characteristics of episodic memory that are absent from semantic memory. The (re)construction of self-defining events and the maintenance of a sense of continuity of one's identity may additionally engage episodic memory in the past and the future. Although neuropsychological studies indicate that self-knowledge is independent of episodic memory (Klein and Gangi, 2010), it may become less so when the self-knowledge is accompanied by a spatial or temporal context (for example, the distant past or the future; see Grilli and Verfaellie, 2016).

From the second perspective, however, some have suggested that semantic memory is essential for thinking about the past and future, particularly when events are novel (Irish et al., 2012; Irish and Piguet, 2013; Wang et al., 2016; Weiler et al., 2011) . Semantic memory encompasses a variety of knowledge about the world, including knowledge of one's culture's typical "life periods" or "life chapters" and what novel experiences might involve (Thomsen, 2015). For example, young adults could muse about or appraise their future identity in relation to the prototypical life narrative: (*I will graduate from university, obtain a fulfilling job, buy a house, get married, have children*, et cetera). As the case of KC has shown, semantic memory includes knowledge of time as a concept, and we note that he could order his autobiographical facts mostly correctly (Craver et al., 2014). The construal-level theory of psychological distance of Trope and Liberman (2010) stipulates that temporal distance makes us think more abstractly and thus in a more meaning-based (i.e., semantic) than experience-based (i.e., episodic) manner. In a similar logic, La Corte and Piolino (2016) have suggested that thinking about a distant future increases the use of general or semanticized memories (including personal semantics) relative to a closer time. Concordant neuroimaging findings indicate that the neural correlates of thinking about temporally distant selves may be more similar to thinking about other people compared to the present self (D'Argembeau et al., 2008, 2010; see also Palombo et al., in press). Taken together, this second perspective suggests that past and particularly future self-knowledge may rely more on semantic memory than present self-knowledge does.

1.3. The present study

Personal semantics are often compared to either semantic or episodic memory alone, but rarely to both. Yet, as seen in the review above, both semantic and episodic memory could be significantly related to self-knowledge. In the present study, we designed a novel task to compare the behavioral and electrophysiological correlates of self-knowledge to semantic and episodic memory in a within-subject design, and tested whether the temporal orientation of the self-knowledge influences the relationship to semantic versus episodic memory. Thus, the study included five closely matched memory conditions: semantic and episodic memory, and past, present, and future self-knowledge. We operationalized self-knowledge as knowledge of one's own personality traits, as this has been the most frequently studied operationalization (Renoult et al., 2012). In the self-knowledge tasks, participants decided whether target words (e.g., *generous*) reflected their past traits, present traits, or future traits. In the semantic memory task, participants indicated whether the words reflected the traits of most people holding a certain occupation. The episodic memory task also involved being shown traits, but deciding whether each trait had been seen previously during the study or not. We used positive (e.g., *generous*) and negative