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Reference to self, other, and object as levels of processing in recognition memory

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Abstract

Information related to the self tends to be better remembered than other information. Mentalization (i.e., attributing mind to an external entity) is one potential intervening factor in contrasting myself, others "like me", and inanimate objects. Twenty-seven undergraduates (mean age 23.6 years, 16 women) responded to a Remember/Know (R/K) recognition task. In the study phase, 78 words were presented at 3 levels of processing: Self (item applies to myself), Other (applies to the Queen of England) and Object (applies to statues). In test trials, subjects recognized items as Old or New. After an "Old" response, an R/K judgment was prompted. We observed significant differences in recognition reaction times (RTs) between Self/Other and Self/Object conditions. R/K judgment RTs showed significant differences between Self/Object conditions. Results support self-reference at a deeper level of processing, but not in a continuum from self to other and to inanimate object.

Keywords: Episodic memory; levels of processing; theory of mind; self-reference.

Information encoded in relation to the self tends to be better remembered than other information. The self-reference effect has been relatively well documented (Glisky & Marquine, 2009; Magno & Allan, 2007). However, questions remain as to how self-reference compares to other, non-self-referential, cases of information encoding. Self-reference effects are especially relevant for episodic memory. Episodic memory refers to the recall of information about personally experienced past events from specific time and space. It is characterized by a set of specific subjective experiences at retrieval: a sense of "mental time travel"; a belief in the accuracy of the information as it corresponds to the actual event; a qualitative sense of conscious recollection, and a judgment of "actually remembering" as opposed to "merely knowing" the event occurred. We explored this latter feature through the Remember/Know (R/K) paradigm.

The R/K paradigm allows one to explore the role of conscious recollection when an item is recognized. As described by Gardiner, Ramponi and Klavehn (1998), remembering reflects the subjective feeling of having actually experienced an event, whereas knowing indicates events recognized without a phenomenological experience of the subject's reliving the first occurrence. Those judgments apply to the retrieval of several types of information, from the simplest (e.g., items in a study list) to more complex, like significant events in one's life.

The levels of processing (LoP) framework suggests that information is stored in long-term memory with variable depths of processing depending on conditions at encoding (Roediger & Gallo, 2006). Shallow levels include physical and sensory aspects of stimuli and their context; deeper levels, on the other hand, involve articulating stimuli features with varying degrees of meaning, from the lexical to the personal. Items encoded at deeper levels are more likely to be retained and more available for retrieval. Ultimately, greater depth of processing means a stimulus or experience is associated to a deeper level of meaning in a person's cognitive processing at a given time (Roediger & Gallo, 2006).

The self is considered to engage the deepest possible LoP a stimulus might relate to. The self-reference effect consists of more information about an event encoded when it is related to oneself. The self may be conceived as a control function that establishes and maintains goals that regulate encoding, providing a rich set of inner clues with which information can be associated (Magno & Allan, 2007). Moreover, self-reference seems to allow access to a qualitatively different structure, permitting extensive elaboration of stimuli and multiple routes for recollection (Gliski & Marquine, 2009).

A theoretical understanding of the mechanism of self-reference effects demands a clarification of the concept of self. In that respect, a potential contribution comes from studies of the cognitive development of the self/other distinction. Theory of mind and empathy studies have demonstrated that the perception of other people differs not only from that of one's self, but also from that of inanimate objects. Such an effect is hypothesized to result from considering other humans as being "like me", in the sense that they also have beliefs and desires (Meltzoff, 2007). For inanimate objects, actions would be visually processed and

successfully predicted based on physical characteristics and physical laws. Understanding human actions and internal states, however, would rely on the empathic capacities of perceiving other humans as "like me" and simulating the observed actions and internal states of other humans within one's own motor, cognitive, and emotional representations.

Human acts might be represented within a supramodal code that applies to the self as well as to others (Meltzoff, 2007). There is an overlap of neurocognitive systems processing knowledge about self-performed actions, self-conceived thoughts, and self-experienced emotions when it comes to understanding actions, thoughts, and emotions (Lombardo et al, 2010). Those systems seem to be recruited in processing information related to others, when they are human. In that sense, representing self and others share neural substrate where two aspects of empathy interact: higher level mentalizing and lower level simulation and embodiment processes.

Theory of mind studies have explored the hypothesis of a continuum in empathy effects, from self to other humans, and further to artificial and/or inanimate objects. Jackson, Brunet, Meltzoff and Decety (2006) manipulated three different perspectives in a pain simulation task: the subject's own perspective (Self), that of a specific but unfamiliar person (Other), and that of a plastic limb (Artificial). Participants rated higher perceived pain and had lower reaction times (RTs) in response to the Self-condition than both the Other- and Artificial-conditions: Actual human perspectives led to significantly higher ratings than the human- inanimate perspective.

Contrasting between imagining Self and Other in painful situations versus imagining damage to an artificial limb pointed out to neural activity associated with adopting the perspective of a human being. Stronger involvement of the medial prefrontal cortex extending to the frontal poles in imagining Self and Other, compared to an Artificial limb, supports the hypothesis of attribution of mental states (Frith & Frith, 2003). Mental states are not imagined when the stimulus is processed as an artificial object.

In a previous study of self-reference and theory of mind effects on recognition memory (Gauer & DeSouza, 2012), 30 subjects (average 24 years-old, 18 female) responded to a R/K task manipulating three LoPs at encoding: self, other and object. In the study phase, 66 words (adjectives and quality-related nouns) were presented in three conditions, respectively asking if the word applied: to one´s self (Self condition); to the President of Brazil (Other); or to a train (Object). In the test phase subjects responded whether each item was old or new (O/N) and were prompted for a R/K judgment if the item was recognized. There were lower recognition (RTs) for Self, followed by the Other and Object conditions. RTs for R/K judgments were better predicted by a "Remember" response than by the LoP conditions. Results indicate activation of self-related representations facilitating deeper encoding, but not necessarily engaging episodic recollection. Recognition accuracy was significantly greater for items in the Self condition with the lowest rate in the Other condition. The results suggested complex influences of self-related representations in LoP manipulation. Conceptualizations of self-reference effects on LoPs could benefit from a clarification of the specific roles of "self" and "other" categories in cognitive processing. The pattern of results in that study were only partially compatible with a continuum from self to other and to inanimate object. That might have to do with the chosen operationalizations of LoPs. "Applies to the Brazilian President?" and "applies to a train?" were the prompts to address respectively the Other and Object LoPs. The lack of evidence for the continuum hypothesis might have been confounded by the subjects´ not being neutral toward the president, combined with the disproportion of a train when compared to the human form.

In the present study, we refined the experimental procedure by applying the Theory of Mind principle of mentalizing to the encoding conditions. Two predictions are outlined. The first prediction combines the LoP and Theory of Mind frameworks: reference to self leads to more effective recognition (a deeper level of processing at encoding) in comparison to reference to other (human), and in turn, reference to other engages deeper processing than reference to inanimate objects. The second prediction, consonant with previous results on self-reference effects on episodic memory, is that reference to self at encoding results in higher frequency of remember judgments at recognition. Participants answered a computerized R/K recognition task for verbal stimuli manipulating three empathy-related LoP conditions at encoding. The self-reference LoP (Self condition) was operationalized through an "applies to myself?" prompt at encoding. The Other condition asked if the item "applies to the Queen of England". The Object condition asked if the item "applies to statues". The Queen of England was chosen for being a real, well-known, but not personally acquainted person. Statues were chosen as a prototypical object referent, clearly nonhuman and nonliving, although close to the human shape and proportions. Using the plural aimed at avoiding subjects imagining a statue of a specific person, with the risk of referring the item to them and not to the actual inanimate object.

Method

Participants
Twenty-seven undergraduates (mean age 23.6 years, 16 women) from the Federal University of Rio Grande do Sul (Porto Alegre, Brazil) took part in the study voluntarily.

Stimuli
We selected 128 words (adjectives and nouns) from a concreteness norm list for Portuguese common words (Janczura, Castilho, Rocha, van Erven & Huang, 2007). The words were divided into three study lists of 26 words each. The remaining 50 words were used as distractors in the test phase. Example of items are: disciplina (discipline), difícil (difficult), movimento (movement), and contente (happy).
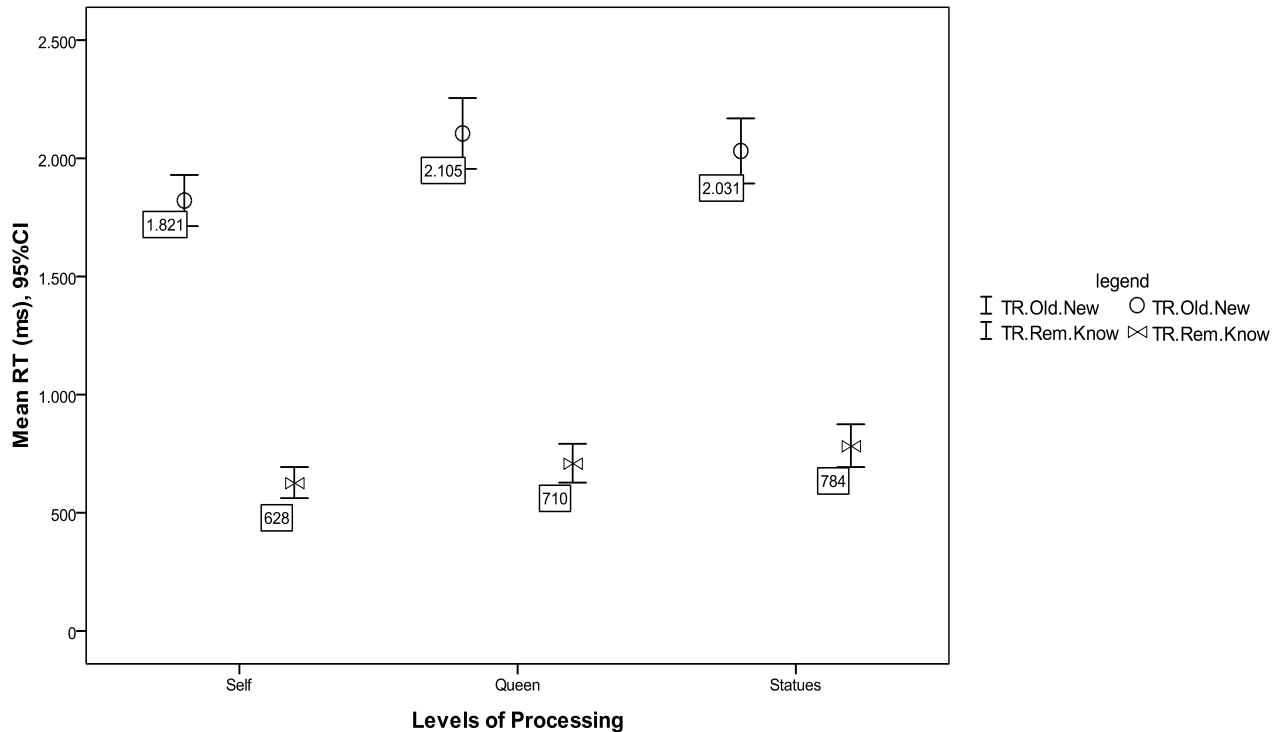
Figure 1: Old/New and R/K mean RTs by LoP

Procedure

The experiment consisted of three stages: study phase, filler task, and test phase. At the study phase, each of the 78 trials started with a 2000ms presentation of one of the LoP prompts, followed by one item, displayed for 2000ms. "Yes" or "No" responses were entered respectively through letters "E" or "I" via computer keyboard. In the four-minute filler task, participants responded to a series of up to 20 simple arithmetic problems. In the test phase, the 78 studied (Old) items were randomly presented along with 50 distractors. In each trial participants responded whether the word was in the study list (Old) or not (New). Recognition responses were entered respectively through letters "E" or "I" in the keyboard. If the response was "Old", a "Remember" or "Know" (R/K) prompt was presented, and responses were entered respectively through keyboard letters "E" or "I". Old/New (O/N) and R/K responses and RTs were recorded. Trials with incorrect O/N responses, and RTs below 200ms or above 6000ms were discarded.

Stimuli presentation, responses and RTs recording were performed using the PxLab platform (Irtel, 2007). The study was approved by the local ethical committee. All participants signed an informed consent form to take part in the experiment.

Results

Crosstabulation of response types by encoding condition yielded an association between R/K judgment and LoPs (χ^2 = 25.36, p < .01). Although Remember responses were more frequent than Know responses in all conditions, the frequency of Remember responses was significantly higher for the Self condition (77.2%) than Other (58.3%) and Object (64.3%).

Correct recognition RTs and R/K judgment RTs were submitted to a repeated measures ANOVA with LoP condition as factor. Results for both dependent variables are depicted in Figure 1. A main effect of LoP on recognition RTs was observed (F = 4.83, p < .05). Mean recognition RTs were lowest for items encoded in the self condition (1821.07ms, SD = 1007.46), whereas Other showed higher RTs (2105.20ms; SD = 1210.20) than Object (2030.96ms; SD = 1134.54). Differences in pairwise comparisons were significant between Self and Other (p < .05) and marginally significant between Self and Object (p = .058), but not significant between Other and Object conditions.

Mean recognition RTs for Remembered items were significantly lower than for Known items (t = 5.3; p < .01), regardless of LoP condition. A multivariate test with LoP condition as fixed factor and the R/K judgment as random factor maintained a main effect of R/K judgment, but yielded no interaction between LoP and R/K judgment. Nevertheless, visual inspection of panels (a) and (b) in Figure 2 demonstrates that recognition was slower for Remembered items in the Object condition compared to Other, but the pattern was reversed for Known items. R/K judgment RTs showed a main effect of LoP (F = 4.06; p < .05). RTs for the Self condition were lower than for Other,
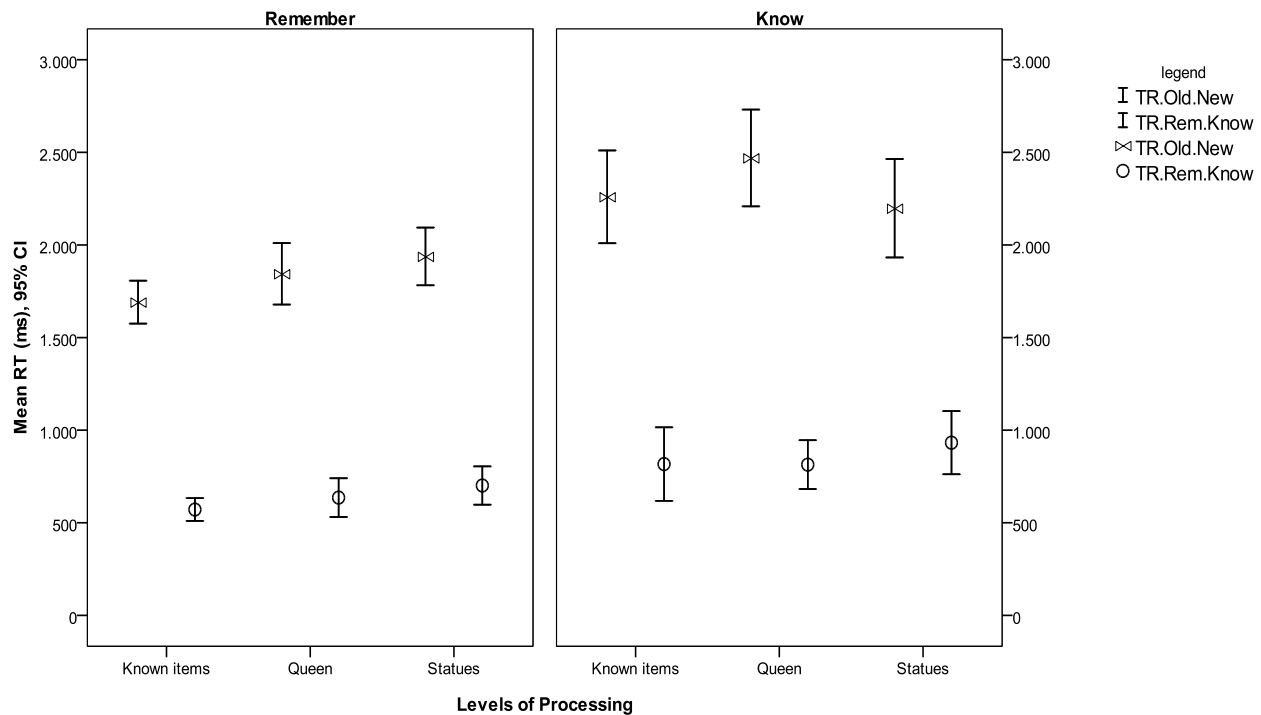
Figure 2: Old/New and R/K RTs by LoP in items judged as Remembered versus Known

which in turn were lower than those in the Object condition. The only pairwise significant difference was found between Self and Object conditions (p < .05).

Discussion

The present study attempted to contribute to understanding a relevant aspect of remembering in ecological situations, namely self-reference. Specifically, the experimental paradigm sought to investigate combined effects on recognition memory of two distinct, perhaps complementary, theoretical accounts of meaning structures for cognitive representations: Levels of Processing and Theory of Mind. Even when we accept the evidence that the self stands as reference to deeper levels of processing, the exact way in which it compares to other entities remains a relevant issue of theoretical and empirical inquiry.

In the recognition experiment here presented, items encoded at the Self condition were consistently more swiftly recognized than stimuli encoded in reference to another person or objects. Those results confirm a self-reference effect at encoding. Moreover, the association between the Self condition and Remember judgments corroborates a close relationship between self-reference and episodic memory. Interpreted through the Levels of Processing framework, that pattern indicates that reference to self at encoding favors deep processing and results in stronger memory signals. Nevertheless, that effect seems to encompass more than strength of signal once we consider the association with Remember judgments. Relating an item

to the self also results in a difference in the mode of representation, favoring recollection processes (episodic memory) at recognition. On the other hand, Other- and Object-relatedness showed a less clear pattern in terms of recognition. At least in a recognition task, our data did not find effects according to a hypothesized empathy continuum from self, to "like me" human other, to human-resembling inanimate object.

Nevertheless, a relationship between the Theory of Mind constructs, LoPs and episodic memory is suggested if we compare the patterns of recognition by R/K judgments. Items processed at the shallower level of Other-reference were more rapidly recognized than Object-reference items, but only when participants reported remembering them, not when the item was judged as known. That suggests that a "self-other-object" effect might operate linearly in episodic memory (remembered items), but not in semantic memory (known items). That pattern of results is congruent to the one found by Jackson et al (2006) for empathy in pain judgments.

Finally, we stress that the approach here adopted can contribute to integrate social cognition models and meaning structure models into the explanation of cognitive processes. Despite the present data not corroborating depth of processing effects distributed along a hypothesized one-dimensional account self-other-object continuum, further studies to test possible relationships among memory systems and the reference of stimuli to social-cognitive representational content are encouraged. Evidence for

different memory systems functioning in relation to the meaning contexts elicited by different entities might generate new hypotheses regarding the cognitive and neural relevancy of Theory of Mind distinctions such as self-other, animate-inanimate, and human-nonhuman.

Acknowledgments

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