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Suppressing memories of words and familiar objects results in their affective devaluation: Evidence from Think/No-think tasks

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ABSTRACT

Potentially distracting or otherwise-inappropriate stimuli, thoughts, or actions often must be inhibited to prevent interference with goal-directed behaviour. Growing evidence suggests that the impact of inhibition is not limited to reduced neurocognitive processing, but also includes negative affective consequences for any associated stimuli. The link between inhibition and aversive response has primarily been studied using tasks involving attentional- or response-related inhibition of external sensory stimuli. Here we show that affective devaluation also occurs when inhibition is applied to fully-encoded stimulus representations in memory. We first replicated prior findings of increased forgetting of words whose memories were suppressed in a Think/No-think procedure (Experiment 1). Incorporating a stimulus-evaluation task within this procedure revealed that suppressing memories of words (Experiment 2) and visual objects (Experiment 3) also results in their affective devaluation. Given the critical role of memory for guiding thoughts and actions, these results suggest that the affective consequences of inhibition may occur across a far broader range of situations than previously understood.

1. Introduction

The inhibition of potentially distracting or otherwise-inappropriate stimuli, thoughts and actions is critical for reducing their capacity to interfere with processes of goal-directed behaviour (Anderson & Spellman, 1995; Dagenbach & Carr, 1994; Munakata et al., 2011). Indeed, the important role of inhibition in adaptive cognitive and behavioural functioning has been identified in diverse domains ranging from perceptual detection to the ability to overcome a habitual yet momentarily-inappropriate response (see Bari & Robbins, 2013 for a historical overview). Substantial research has also revealed much about the fundamental characteristics of the neurocognitive mechanisms of inhibition and the corresponding consequences of suppressing goal-irrelevant sensory, perceptual, and response-related representations (see Bari & Robbins, 2013; Munakata et al., 2011 for reviews). The nature of these consequences, which mainly tend to reflect some form of blocked or otherwise reduced activation of the corresponding representations, may explain why definitions of cognitive inhibition often focus on the stopping or overriding of a mental process (e.g., MacLeod, 2007). In addition to well-established effects associated with such reduced processing is the more recent discovery that inhibition appears to have affective consequences. Stimuli that have been ignored or from which a motor-response has been withheld, for example, subsequently receive more negative affective ratings than novel stimuli or prior targets of attention/response (see Fenske & Raymond, 2006; Gollwitzer, Martiny-Huenger, & Oettingen, 2014; Raymond, 2009 for reviews).

The evidence linking inhibition to aversive response has been obtained in a variety of attention- and/or response-related inhibition tasks that require categorical, spatial or temporal discrimination (e.g., Fenske, Raymond, & Kunar, 2004; Kihara, Yagi, Takeda, & Kawahara, 2011; Kiss, Raymond, Westoby, Nobre, & Eimer, 2008; Raymond, Fenske, & Tavassoli, 2003) of stimuli that range from simple abstract patterns and shapes (e.g., Buttacio & Hahn, 2010; Raymond et al., 2003), alphabetic and logographic characters (e.g., Martiny-Huenger, Gollwitzer, & Oettingen, 2014; Veling, Holland, & van Knippenberg, 2007), common objects and entire scenes (e.g., Frischen, Ferrey, Burt, Pistchik, & Fenske, 2012; Griffiths & Mitchell, 2008), to images of real human faces and bodies (e.g., Fenske, Raymond, Kessler, Westoby, & Tipper, 2005; Ferrey, Frischen, & Fenske, 2012; Raymond, Fenske, & Westoby, 2005). The affective devaluation of stimuli revealed by these studies has likewise been found across a variety of subjective emotional judgments (e.g., likeability, preference, cheerfulness, pleasantness, trustworthiness, sexual attractiveness), and in the form of decreases in the motivational incentive to seek and obtain otherwise-appealing stimuli.

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However, while there is growing evidence that stimulus devaluation is associated with inhibition, it has so far been studied almost exclusively using external sensory stimuli in tasks involving attention- or response-related inhibition. Yet many thought processes and goal-directed behaviours are guided by representations in memory that are solely maintained (or retrieved) in the absence of corresponding sensory stimulation. Inhibition is thought to be critical in these internally-focused situations to prevent interference from other competing mental representations by reducing their activation (Anderson & Spellman, 1995; Chun, Golomb, & Turk-Browne, 2011; Jonides, Smith, Marshuetz, Koeppe, & Reuter-Lorenz, 1998). The link between inhibition and negative affect suggests that its impact on stimulus evaluations should not be restricted to situations in which an inhibited stimulus is immediately present in the environment, but should also occur whenever inhibition is applied to stimulus representations in memory, including in the absence of corresponding sensory stimulation.

The two studies that have thus far examined the potential affective consequences of inhibition applied to representations in memory have yielded conflicting results. The results of Janczyk and Wühr's (2012) combination of a retrieval-induced forgetting paradigm with subsequent stimulus evaluations, for example, failed to provide any evidence that memory inhibition impacts the affective status of associated stimuli. Prior to affective evaluation, the word-stimuli in their study had first been committed to memory, then—in a retrieval-practice phase—been the target of retrieval (thought to strengthen memory representations), related to a retrieval target (thought to trigger inhibition of memory representations to reduce associative interference), or neither retrieved nor related to a retrieved memory (control-baseline). Janczyk & Wühr interpreted their failure to obtain any difference in the ratings of stimuli from these retrieval-practice conditions as an indication of one of three possibilities: (1) the inhibition of memories does not have affective consequences, (2) retrieval-induced forgetting is not caused by inhibition, or (3) their specific experimental approach lacked sensitivity to the affective devaluation of stimuli whose memories had been inhibited during retrieval-practice.

Using a different approach, Vivas, Marful, Panagiotidou, and Bajo (2016) combined a directed forgetting task with an affective evaluation task to assess the potential affective consequences of inhibition applied to a stimulus representation during memory encoding. They used the item-method of directed forgetting, whereby participants were presented with individual words followed by an instruction to either continue encoding (i.e., remember) or terminate encoding (i.e., forget) the word. They obtained more negative ratings for words that participants had been instructed to forget compared to those that participants had been instructed to remember, and interpreted these results as evidence that inhibition applied to a representation during memory encoding results in its affective devaluation.

There are several differences between the paradigms used by Vivas et al. (2016) and Janczyk and Wühr (2012) that may be relevant to the differences in their corresponding results, including whether the inhibition of the pertinent memory representations is intentional (item-based directed forgetting) or is incidental to the primary goal of remembering (retrieval-induced forgetting). Having just seen an item immediately before the instruction to forget in item-based directed forgetting also means that the relative salience of the pertinent stimulus representations in such situations may be much greater than those involved in retrieval-induced forgetting that have not been explicitly encountered for a much longer period, and are only indirectly activated through the retrieval of other associated items. This is relevant because inhibition is thought to be a reactive process that is applied in direct proportion to the salience of the stimulus/response representations that might otherwise elicit interference (Houghton & Tipper, 1994). Prior affective-rating results are consistent with this view to the extent that the level of stimulus devaluation increases with the salience of items that must be ignored (e.g., those closer to a response target: Martiny-Huenger et al., 2014; Raymond et al., 2005) or otherwise inhibited (e.g., Frischen et al., 2012). Thus, the affective consequences of intentionally inhibiting highly-salient stimulus representations may be greater and more readily detected for stimuli used in an item-based directed forgetting procedure (Vivas et al., 2016) than any affective consequences of incidentally inhibiting less salient stimulus representations during the retrieval of other stimuli (Janczyk & Wühr, 2012).

Another potentially important difference between the paradigms used by Vivas et al. (2016) and Janczyk and Wühr (2012) concerns the point at which inhibition is thought to be applied to stimulus representations during the respective memory-related tasks. Whereas the putative function of inhibition in a directed-forgetting task is to prevent a stimulus from being fully encoded into memory (e.g., Bjork, 1989), its putative function during retrieval practice is to reduce associative interference from a stimulus that has already been fully encoded into memory (e.g., Anderson, 2003). Vivas et al.'s finding that inhibition leads to affective devaluation when applied to stimulus representations not yet fully encoded into memory converges well with the growing list of studies showing that attentional inhibition leads to affective devaluation when applied to perceptual representations of stimuli not yet fully encoded into memory (Duff & Faber, 2011; Fenske et al., 2004, 2005; Goolsby, Shapiro, & Raymond, 2009; Goolsby, Shapiro, Silvert, et al., 2009; Griffiths & Mitchell, 2008; Kihara et al., 2011; Kiss et al., 2007; Martiny-Huenger et al., 2014; Raymond et al., 2003, 2005; Veling et al., 2007). Considering this, Janczyk and Wühr's (2012) failure to obtain similar stimulus-evaluation differences across the different conditions in their experiment could mean that inhibition does not have affective consequences when applied to fully-encoded stimulus representations, or that inhibition does not operate on long-term memories as it does on less durable stimulus representations.

However, there is substantial evidence beyond the retrieval-induced-forgetting phenomenon that inhibition's influence on memory representations is not restricted to stopping encoding and that it continues to play a crucial role in the domain of long-term memory (Anderson, 2003; Anderson & Spellman, 1995; Johnson & Anderson, 2004). Consider, for example, the results of studies using the Think/No-think paradigm in which participants memorize pairs of stimuli, and are then presented with only one member of each pair along with the instruction to either retrieve (i.e., Think) or suppress retrieval (i.e., No-think) of the associated item (Anderson & Green, 2001). Consistent impairments in the subsequent ability to retrieve No-think items in later tests of memory have been attributed to intentional memory suppression and taken as evidence that inhibition may be crucial for preventing the retrieval of unwanted memories of objects (e.g., Gagnepain, Henson, & Anderson, 2014; Kim & Yi, 2013) and words (e.g., Anderson & Green, 2001; Anderson et al., 2004; but see Tomlinson, Huber, Rieth, & Davelaar, 2009 for an alternate interpretation). As a further test of the hypothesis that inhibition leads to stimulus devaluation when applied to fully-encoded memories of the corresponding items, we therefore integrated a stimulus-evaluation component within modified versions of two separate Think/No-think tasks. If inhibition is indeed critical for modulating the selection of information from long-term memory, as it is during selection of information from the external environment and during memory encoding, then inhibition applied to fully-encoded memories should result in the affective devaluation of the corresponding items, just as it does when applied to less durable stimulus representations.