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Forgetting May be Useful, and Exercise May Help Accentuate Forgetting

Paul D. LOPRİNZİ

Exercise & Memory Laboratory, Department of Health, Exercise Science and Recreation Management, The University of Mississippi, University, MS 38677, USA

Abstract

Memory function plays an important role in daily life. As such, efforts, such as employing select learning strategies, are often utilized to minimize forgetting. However, intentional forgetting, in certain situations (e.g., outdated or irrelevant information), may be a desirable and adaptive memory outcome, as it may help to minimize proactive memory interference for future encoded events or information. Previous research demonstrates that exercise may help to improve memory function. This paper uniquely discusses the potential role that exercise may play in facilitating intentional forgetting. Future work is needed to empirically evaluate this model.

Keywords: Exercise, memory, forgetting

Öz

Unutmak Faydalı Olabilir ve Egzersiz Unutmanın Kolaylaştırılmasına Yardımcı Olabilir

Bellek işlevi günlük yaşamda önemli bir rol oynar. Bu nedenle, unutmayı en aza indirmek için belirli öğrenme stratejileri kullanmak gibi çabalar sıklıkla kullanılır. Bununla birlikte, belirli durumlarda (örneğin, eski veya ilgisiz bilgiler gibi) kasıtlı olarak unutmak, gelecekteki kodlanmış olaylar veya bilgiler için proaktif hatırlama girişimini en aza indirmeye yardımcı olabileceğinden, arzu edilebilir ve uyarlanabilir bir bellek sonucu olabilir. Önceki araştırmalar, egzersizin bellek işlevini iyileştirmeye yardımcı olabileceğini göstermektedir. Bu makale, egzersizin kasıtlı unutmayı kolaylaştırmakta oynayabileceği potansiyel rolü tartışmaktadır. Bu modeli ampirik olarak değerlendirmek için gelecekteki çalışmalara ihtiyaç vardır.

Keywords: Egzersiz, bellek, unutma

INTRODUCTION

Undeniably, memory is critical for optimal daily functioning. For example, remembering how to dress oneself properly, remembering how to get to work, and remembering social relationships may be perceived as prerequisites for a functional day. On the other hand, forgetting information may result from ineffective encoding, passive decay, interference (proactive or retroactive), interrupted consolidation, or employing inadequate retrieval cues. In contrast to unintentional forgetting, intentional forgetting, in certain situations, may prove to be useful, and thus, are not considered a memory failure. For example, intentionally forgetting outdated or irrelevant information, such as where in the parking lot the car was parked during a past visit to the grocery store, may be very useful to prevent a proactive interference effect for remembering where the car is currently parked. Thus, distinguishable from unintentional forgetting, intentional forgetting is a desirable and adaptive memory outcome. As a result, identifying ways to optimize intentional forgetting may be an important adaptive quality, particularly during the aging years.

Correspondence / *Yazışma:*
Paul D. LOPRINZI
Exercise & Memory Laboratory, Department of Health, Exercise Science, and Recreation Management, The University of Mississippi, 229 Turner Center University, MS 38677
Tel: 662-915-5561
E-mail: pdloprin@olemiss.edu

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Research by Anderson and Green (2001) convincingly shows that utilizing executive control can help facilitate the suppression of unwanted memories. That is, executive control may reduce the activation of unwanted memories, assuming that the memory was already committed to long-term memory. That is, if the unwanted memory is already consolidated and stored in a long-term memory system, then inducing intentional forgetting may cause the reactivation of the representation of that memory to be suppressed or inhibited. However, if the memory has yet to be consolidated, then intentional forgetting does not operate on the stored memory representation, but rather, may facilitate passive or active decay of the memory trace (i. e., it operates on the process involved in consolidating the memory) (Wylie, Foxe, & Taylor, 2008).

Other work also supports executive control as a likely mechanism facilitating motivated forgetting (Aguirre, Gomez-Ariza, Andres, Mazzoni, & Bajo, 2017). Attention-driven mechanisms subserving memory suppression likely relies on goal-oriented executive control mechanisms, with this inhibitory mechanism associated with activity in the prefrontal cortex. Specifically, EEG data suggests that the prefrontal cortex may make episodic memories temporary less accessible by decreasing the synchrony of cortical neural networks that are involved in memory retention (Bauml, Hanslmayr, Pastotter, & Klimesch, 2008; Hanslmayr et al., 2012; Silas & Brandt, 2016). Further, fMRI data suggests that intentional forgetting depends on neural structures distinct from those involved in unintentional forgetting. Compared to unintentional forgetting, intentional forgetting is associated with increased activity in the hippocampus and superior frontal gyrus, and when compared to intentional remembering, intentional forgetting is associated with activity in the medial frontal gyrus, middle temporal gyrus, parahippocampal gyrus, and cingulate gyrus (Wylie, Foxe, & Taylor, 2008).

In addition to executive control-induced inhibition, other mechanisms may also be contributory. Creating diversionary thoughts/associations with the unwanted stimuli may facilitate interference when subsequently trying to recall the memory, and resultantly, weakens the cue-target connection. Thus, a controllable process exits to suppress the retention of memories when the stimuli is deliberately kept out of consciousness. This process may involve the regulation of consciousness via an inhibitory control mechanism and/or filling of working memory via diversionary thoughts. Contextually, these strategies can be used to prevent awareness of the memory when a stimulus that is thought to cue an unwanted memory.

In addition to executive control and diversionary-related mechanisms, intentional forgetting may be precipitated via a mismatch between contextual factors related to encoding and retrieval (Aguirre, Gomez-Ariza, Andres, Mazzoni, & Bajo, 2017). Per the encoding specificity paradigm (Tulving & Thomson, 1973), retrieval is enhanced with there is congruence in the context between encoding and retrieval. In intentional forgetting, encoding occurs without any desire to suppress the memory. However, during retrieval, there is a mismatch in the contextual state as now the individual has attempted to suppress the memory prior to retrieval. Similar to retrieved-induced forgetting (Anderson & Spellman, 1995), intentional suppression of unwanted memories can also be enduring. If retrieving diversionary thoughts and associations becomes habitual, inhibition may become subconscious, ultimately evolving the intentional suppression process to an unintentional process.

Taken together, various factors, such as executive control, cognitive awareness, diversionary associations, and contextual congruence, may play an important role in influencing intentional forgetting. Although speculative, it is conceivable that exercise may help to facilitate intentional forgetting through some of these postulated mechanisms. Candidate mechanisms include exercise-induced alterations diversionary associations and executive control.

In the context of diversionary associations, research demonstrates that acute exercise is favorably associated with divergent-based cognitive-creativity (Oppezzo & Schwartz, 2014). This suggests that acute exercise may help increase an individual's ability to generate multiple solutions to a given task or problem. This increased fluency and originality may help foster the cultivation of diversionary thoughts/associations, which in turn, may precipitate intentional forgetting.

A more likely candidate through which exercise may subserve intentional forgetting is through its effects on executive control, which involves the ability to carry out goal-directed behavior via complex cognitive processes, such as impulse inhibition. This is thought to be mediated via neuronal activity in the prefrontal cortex (Sakagami, Pan, & Uttl, 2006). Notably, exercise has been shown to increase neuronal activity in the prefrontal cortex and favorably influence executive-control-based inhibitory mechanisms

(Hillman, Snook, & Jerome, 2003; Ludyga, Gerber, Brand, Holsboer-Trachsler, & Puhse, 2016; Tsujii, Komatsu, & Sakatani, 2013). Importantly, this effect is likely to be intensity-dependent. That is, light and moderate-intensity acute exercise, but not high-intensity exercise, has been shown to increase P3 amplitude in cognitive tasks related to information processing and executive function, whereas only moderate-intensity acute exercise is associated with shortened P3 in tasks involving executive control (Chang, 2016; Kamijo et al., 2004; Kamijo, Nishihira, Higashiura, & Kuroiwa, 2007). On the other hand, high-intensity exercise will increase levels of norepinephrine (NE) and dopamine (DA) in the prefrontal cortex, and in turn, activate β-adrenoceptors and D_1-receptors, respectively, ultimately activating cAMP, which may dampen neuronal activity. This dampened neuronal activity is thought to occur via cAMP activation, which may facilitate the opening of nearby K+ channels and, in turn, weaken the effectiveness of nearby synaptic inputs in the prefrontal cortex (Arnsten, Wang, & Paspalas, 2012), and potentially impair prefrontal cortex function (Arnsten, 2011).

In conclusion, this brief commentary contrasts unintentional and intentional forgetting and highlights the importance of inducing intentional forgetting. Various factors may influence intentional forgetting, such as executive control. Unique to this commentary is the potential role through which exercise may help to subserve intentional forgetting. This is an exciting area and future empirical work is needed to evaluate the extent to which exercise may influence intentional forgetting.

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