Consciousness and Cognition 21 (2012) 1097–1108

Contents lists available at SciVerse ScienceDirect

Consciousness and Cognition

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

Individual differences and state effects on mind-wandering: Hypnotizability, dissociation, and sensory homogenization

David Marcusson-Clavertz [a], Devin B. Terhune [b], Etzel Cardeña [a,*]

[a] Center for Research on Consciousness and Anomalous Psychology (CERCAP), Department of Psychology, Lund University, Sweden
[b] Department of Experimental Psychology, University of Oxford, United Kingdom

ARTICLE INFO

Article history:
Received 6 July 2011
Available online 3 May 2012

Keywords:
Mind-wandering
Ganzfeld
Hypnotizability
Dissociation
Altered states of consciousness
SART
Executive control

ABSTRACT

Consciousness alterations can be experienced during unstructured, monotonous stimuli. These effects have not been linked to particular cognitive operations; individual differences in response to such stimulation remain poorly understood. We examined the role of hypnotizability and dissociative tendencies in mind-wandering (MW) during a sensory homogenization procedure (ganzfeld). We expected that the influence of ganzfeld on MW would be more pronounced among highly hypnotizable individuals (highs), particularly those high in dissociative tendencies. High and low hypnotizables, also stratified by dissociation, completed the sustained attention to response task during ganzfeld and control conditions. High dissociative highs made more commission errors during ganzfeld, suggesting increased MW, whereas the other groups displayed the opposite pattern. Increases in commission errors from the control condition to ganzfeld were associated with more alterations in consciousness and negative affect, but only among highs. Sensory homogenization had opposite effects on MW depending on the interaction of hypnotizability and dissociation.

1. Introduction

The human sensory systems continuously receive input from various sources of diverse intensities and structures and are primarily geared for salient and changing stimuli (Ornstein, 1986). In the normal population, a vast amount of mentation concerns matters unrelated to the activities at hand; this activity of engaging in task-unrelated thought has come to be termed *mind-wandering* (MW; Smallwood & Schooler, 2006). Although a considerable amount of research has investigated its characteristics in recent years, much more needs to be known on how trait differences modulate MW (Schooler et al., 2011) and how it may vary across states of consciousness. In this paper, we report on a study that investigated these issues.

1.1. Sensory homogenization (ganzfeld)

Individuals report a wide variety of alterations in consciousness when exposed to monotonous, unchanging (i.e., homogeneous) stimuli. One example of sensory homogenization is *ganzfeld*, which originally referred to an unstructured visual field (Avant, 1965) but is now used to also include a homogeneous auditory field (for a review, see Wackermann, Pütz, & Allefeld, 2008). This multi-modal setup involves fitting participants with translucent goggles and exposing them to a red homogeneous light and white or pink noise. Elementary perceptual changes such as in figure-ground discriminations

* Corresponding author. Address: Department of Psychology, Center for Research on Consciousness and Anomalous Psychology (CERCAP), Lund University, P.O. Box 213, SE-221 00, Lund, Sweden. Fax: +46 46 222 4209.
E-mail address: Etzel.Cardena@psychology.lu.se (E. Cardeña).

1053-8100/$ - see front matter
http://dx.doi.org/10.1016/j.concog.2012.04.002

(Cohen, 1958) are commonly reported after only a few minutes of this stimulation. In addition, more complex changes in perception such as vivid, dreamlike imagery often occur after approximately 10–30 min of exposure (Pütz, Braeunig, & Wackermann, 2006). Other effects include alterations in time perception (Wackermann, Pütz, Büchi, Strauch, & Lehmann, 2002), affect, somatosensory, vestibular, and bodily perception (Tsuji, Hayashibe, Hara, & Kato, 2004), and arousal (Stanford, Frank, Kass, & Skoll, 1989).

As exposure to ganzfeld can induce various perceptual alterations, it has been widely used as a technique for inducing *altered states of consciousness* (ASC, Vaitl et al., 2005). An ASC refers to a mental state that differs qualitatively from typical waking consciousness in terms of the overall pattern of experiences or psychological functioning (Ludwig, 1966). However, this fuzzy concept often hides marked individual differences in response to an induction of an ASC and even differences within the ensuing state (Cardeña, 2011). For example, not all participants experience marked consciousness alterations during ganzfeld. Wackermann et al. (2008) observed that the number of imagery reports was spread across individuals like a U-shaped curve, which suggests that only a moderate proportion of the general population experiences increases in imagery during ganzfeld. Very little is known about the variables that contribute to individual differences in response to ganzfeld.

Previous research suggests that restricted environmental stimulation generally augments attention to sensory stimulation, particularly novel stimuli (i.e., "stimulus hunger," see Farthing, 1992, p. 192). Rosenzweig and Gardner (1966) argued that it is not the absence of stimuli *per se*, but rather the absence of *meaningful* stimuli that is responsible for many of the effects of restricted environmental stimulation. In support of the stimulus-hunger view, a number of studies observed improved performance in signal-detection tasks when those tasks were administered during restricted environmental stimulation (Gibby, Gibby, & Townsend, 1970; Smith, Myers, & Murphy, 1967). Opposite effects have been found when the signal-detection tasks were administered after the complete termination of restricted environment conditions (Barabasz, 1980; Zubek et al., 1962), possibly because transitioning from restricted to ordinary environmental stimulation may result in a temporary "sensory overload," characterized by an excess of meaningful stimuli to which one's attention is drawn (Smith et al., 1967). Although it has also been suggested that restricted environmental stimulation may generally impair cognitive abilities, this tends to happen with relatively complex rather than with simple tasks (Suedfeld, 1980).

1.2. Ganzfeld, hypnosis, and hypnotizability

As a procedure purported to induce an ASC, ganzfeld shares several features with hypnosis. A hypnotic induction typically consists of instructions and suggestions to facilitate focused attention on hypnotic suggestions and often has the concomitant effect of producing a variety of spontaneous alterations in awareness and perception. In ganzfeld, a similar internally-directed focus of attention is facilitated by the homogeneous audio-visual stimulation (Pütz et al., 2006). Ganzfeld protocols also often include relaxation-based instructions that share similarities with many hypnotic inductions. Spontaneous phenomenological effects reported by those who are very responsive to a hypnotic induction (Cardeña, 2005; Pekala & Kumar, 2007) are similar to those reported in ganzfeld (cf. Rock, Abbott, Childargushi, & Kiehne, 2008; Wackermann et al., 2008). For instance, responsive participants frequently report increased visual imagery and changes in body image during both procedures. The procedures also share electrophysiological signatures, as both ganzfeld (Wackermann et al., 2002; Wackermann et al., 2008) and hypnosis have been associated with increased activity in the α-band relative to baseline. However, in the case of hypnosis, the increased α-band activity has been only observed in high hypnotizables in posterior regions (Williams & Gruzelier, 2001), and in relation to hypnotic depth (which is related to hypnotizability), in the right posterior area (Cardeña, et al., 2012). Given these similarities, we may conjecture that there is substantial overlap in the individual differences variables that contribute to responsiveness to the two procedures.

Individual responsiveness to hypnosis, termed *hypnotizability*, refers to the ability to respond to suggestions following a hypnotic induction. High hypnotizables (highs) have been shown to be a relatively heterogeneous population (McConkey & Barnier, 2004), and whether or not they are also highly dissociative has been posited to account for some of this variance (e.g., Barber, 1999; Barrett, 1992; Cardeña, 1996). Dissociation is typically divided into two subcategories (Cardeña, 1994; Holmes et al., 2005): *compartmentalization* refers to a failure to deliberately access or control psychological processes or actions that are ordinarily expected to be amenable to such control (e.g., dissociative amnesia), whereas *experiential detachment* refers to alterations in consciousness characterized by a detachment from one's body or identity (e.g., out-of body experiences) or the environment (e.g., perceiving the environment as through a foggy lens). Although some authors have posited that hypnotizability does not have a clear relationship with dissociation (Dienes et al., 2009; but see Butler & Bryant, 1997), multiple studies have presented evidence for a dissociative subtype among highs (e.g., Barrett, 1992; King & Council, 1998; Terhune, Cardeña, & Lindgren, 2011b). For instance, Terhune et al. (2011b) found that a hypnotic induction disrupted executive control in high dissociative highs but marginally improved control in low dissociative highs and low hypnotizables (lows). The response pattern of the high dissociative highs is consistent with dissociated control theory, which proposes that a hypnotic induction selectively disrupts executive control processes in highs (Jamieson & Woody, 2007; Woody & Bowers, 1994). Terhune, Cardeña, and Lindgren (2011a) found that highs displayed lower functional connectivity than lows following a hypnotic induction, but not at baseline, in the frontal-parietal network within the α2-band. Insofar as α oscillations may relate to top-down modulation (executive control; Palva & Palva, 2007), it is plausible that Terhune et al.'s (2011a) results may relate to decreases in the executive control observed among high dissociative highs (Terhune et al., 2011b). However, there is a discrepancy between these two studies in that differences in executive control were found between high and low dissociative highs, whereas the two groups exhibited similar differences relative to lows in frontal-parietal phase-synchrony