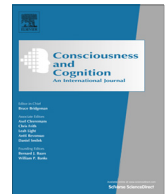




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Relationships between non-pathological dream-enactment and mirror behaviors [☆]

Tore Nielsen ^{a,b,*}, Don Kuiken ^c^a Dept. Psychiatry, Université de Montréal, Montréal, Québec, Canada^b Center for Advanced Research in Sleep Medicine, Hôpital du Sacré-Coeur de Montréal, Montréal, Québec, Canada^c Dept. Psychology, University of Alberta, Edmonton, Alberta, Canada

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ABSTRACT

Dream-enacting behaviors (DEBs) are behavioral expressions of forceful dream images often occurring during sleep-to-wakefulness transitions. We propose that DEBs reflect brain activity underlying social cognition, in particular, motor-affective resonance generated by the mirror neuron system. We developed a Mirror Behavior Questionnaire (MBQ) to assess some dimensions of mirror behaviors and investigated relationships between MBQ scores and DEBs in a large of university undergraduate cohort. MBQ scores were normally distributed and described by a four-factor structure (*Empathy/Emotional Contagion, Behavioral Imitation, Sleepiness/Anger Contagion, Motor Skill Imitation*). DEB scores correlated positively with MBQ total and factor scores even with social desirability, somnambulism and somniloquy controlled. Emotion-specific DEB items correlated with corresponding emotion-specific MBQ items, especially crying and smiling. Results provide preliminary evidence for cross-state relationships between propensities for dream-enacting and mirror behaviors—especially behaviors involving motor-affective resonance—and our suggestion that motor-affective resonance mediates dream-enactment imagery during sleep and emotional empathy during waking.

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1. Introduction

Dream-enacting behaviors (DEBs), or acting out of the fictive movements, speech or emotions of a dream, are prevalent among normal college students (Nielsen, Svob, & Kuiken, 2009). Although most young adults experience them occasionally, frequent and intense DEBs are symptomatic of REM sleep behavior disorder (RBD) (Schenck, Bundlie, Ettinger, & Mahowald, 1986), sleep walking and sleep terrors (Oudiette, Leu, et al., 2009), and other nocturnal anomalies (Ohayon & Schenck, 2010) such as sleep-related eating disorders (Brion et al., 2012) and obstructive sleep apnea (Iranzo & Santamaria, 2005). One hypothesis is that DEBs occur during dreams that are of sufficient perceptual, dramatic, and emotional intensity to over-ride the neuromuscular inhibition of REM sleep. A second (and compatible) hypothesis is that DEBs result from direct disruption

Abbreviations: DEBs, dream-enacting behaviors; MBQ, Mirror Behavior Questionnaire; RBD, REM sleep behavior disorder; ToM, theory-of-mind; IFG, inferior frontal gyrus; REM, rapid eye movement; MRI, magnetic resonance imaging; EEG, electroencephalogram; DEBS, dream-enacting behavior scale; SDS, social desirability scale; EMG, electromyogram.

* The study was conducted at the Department of psychology of the University of Alberta, Edmonton, Alberta, Canada and the Dream & Nightmare Laboratory, Center for Advanced Research in Sleep Medicine, Hôpital du Sacre-Coeur, Montreal, Quebec, Canada.

* Corresponding author. Address: Dream & Nightmare Laboratory, Hôpital du Sacré-Coeur du Montréal, 5400 boul. Gouin Ouest, Montréal, Québec H4J 1C5, Canada. Fax: +1 514 338 2531.

E-mail address: tore.nielsen@umontreal.ca (T. Nielsen).

of the brainstem mechanisms that maintain the atonia of REM sleep. Either dream intensity, atonia disruption, or their combination may explain how the action tendencies embodied in the fictive portrayal of a dreamer's actions result in overt behaviors that are isomorphic with the actions of the dreamed self. Consistent with this model, among RBD patients, violent actions by the dreamed self frequently culminate in overtly aggressive outbursts that may even injure the patient or his/her sleeping partner (Schenck, Lee, Bornemann, & Mahowald, 2009). Similarly, among healthy subjects, DEBs isomorphic with actions of the dreamed self are evident during nightmares but also during very sad, angry or mirthful dreams—and even intensely erotic ones (Nielsen et al., 2009).

However, the isomorphism between DEBs and fictive actions of the dreamed self may be the most salient aspect of an even more inclusive isomorphism. Some evidence suggests not only isomorphism between DEBs and actions of the dreamed self but also between DEBs and actions of other dream figures. For example, although the DEBs of RBD patients are consistently isomorphic with the aggressive actions of the dreamed self, they are regularly isomorphic with the actions of other dream figures as well. That is, their defensive—and enacted—aggression mirrors the aggression perpetrated by other dream figures (Iranzo & Santamaria, 2005; Nielsen, 2011; Schenck & Mahowald, 2002). Similarly, the DEBs of healthy subjects are regularly isomorphic with the actions of the dreamed self, but they are also occasionally isomorphic with the actions of other dream figures. For example, one laboratory subject reported that her dream enactive utterance coincided with the verbalizations of another dream character struggling aggressively to control a horse (Nielsen, McGregor, Zadra, Ilnicki, & Ouellet, 1993).

The preceding examples involve the aggression that is especially common in REM dreams (McNamara, McLaren, Smith, Brown, & Stickgold, 2005), but DEBs do not only involve aggression. RBD patients regularly report violent behaviors but also some nonviolent behaviors that are isomorphic with their own dreamed actions, such as digging up dreamed treasure or giving bossy commands (Oudiette, de Cock, et al., 2009). Similarly, NREM somnambulism and sleep terrors involve not only isomorphic aggressive actions (e.g., fighting in self-defence), but also isomorphic avoidant behaviors (e.g., screaming in fear) and expressions of emotion that are independent of fight or flight (e.g., singing dirty or childish songs) (Oudiette, Leu, et al., 2009). In these cases, too, isomorphism between DEBs and the actions of a dreamed self are complemented by occasional isomorphism between DEBs and the actions of other dream characters. For example, the dreamer may enact the growling of a feline dream figure (Eiser & Schenck, 2005); the dreamer's gestures (pointing fingers, flailing arms) may be synchronized with another character's speech (Oudiette, de Cock, et al., 2009); or the dreamer may enact another's physical assault while dreaming about actively protecting the victim (Schenck & Mahowald, 2002). Thus, dreams with DEBs are regularly isomorphic with the actions of the dreamed self, but they are also sometimes isomorphic with the actions of other dream characters.

Extension of the DEB isomorphism to include the actions of figures other than the dreamed self is consistent with evidence that sometimes the fictive actions of a dreamed other correspond with the site of somatosensory stimulation administered during REM sleep. For example, Koulack (1969) found that electrical stimulation applied to the wrist during REM sleep influenced not only the actions of the dreamed self but sometimes also the actions of other dreamed characters. Similarly, Nielsen et al. (1993) found that application of pressure stimulation to the legs during REM sleep sometimes influenced the leg sensations and actions of other characters (see dream reports in Table 2). These experimental findings suggest that covert action tendencies resulting from bodily stimulation, like overt DEBs, are isomorphic not only with actions of the dreamed self but also with the actions of other dreamed figures.

This more broadly construed isomorphism is reminiscent of the now compelling evidence that similar cortical areas (the *mirror neuron system*) are activated when a specific action (e.g., grasping something) is executed, when that action is observed, when that action is imagined for oneself (Filimon, Nelson, Hagler, & Sereno, 2007), and when it is imagined for another (Saygin, McCullough, Alac, & Emmorey, 2010; Zwaan, Taylor, & de Boer, 2010). Perhaps the isomorphism between DEBs, the actions of the dreamed self, and the actions of dreamed others depends upon the same motor-affective resonance that mediates personal and interpersonal perception and imagination during waking. The present study examines the correlation between the isomorphism that shapes DEBs and the isomorphism that shapes waking mirror behaviors (e.g., motor mimicry, empathy).

Neurophysiological factors responsible for an individual's propensity to resonate with the emotions and actions of other characters during dreaming remain unclear, but they may depend upon neural networks that underlie basic social cognition. Two anatomically distinct networks subserving social cognition include the *mentalizing network* and the *mirror neuron system*. The mentalizing network supports theory-of-mind (ToM) functions, i.e., the generic ability to recognize and explain mental states (emotions, beliefs, motives) of others (Premack & Woodruff, 1978), including the mental states of fictional others, such as characters in literary texts (Mar & Oatley, 2008). Brain imaging has revealed a consistent ensemble of regions that comprise the mentalizing network: the medial prefrontal cortex, posterior cingulate/precuneus, and bilateral temporal junction. Functioning of the mentalizing network has been explored in dream content, specifically, in the mental features that are attributed to other dreamed characters (Kahn & Hobson, 2005; Kahn, Pace-Schott, & Hobson, 2002; Schweickert & Xi, 2010). An early general assessment of dream character attributes (Kahn et al., 2002), as well as a more focused study of ToM (Kahn & Hobson, 2005), found that participants are frequently aware of what they and other dream characters are feeling in the dream. The dreamer is also frequently interested in other characters' feelings about him/herself. One study found ToM attributions to be stable in dreams, tending to be maintained once characters are introduced into the narrative—even in the face of character metamorphoses (Schweickert & Xi, 2010).

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