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The Influence of Emotion Down-Regulation on the Expectation of Sexual Reward

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Emotion regulation research has shown successful altering of unwanted aversive emotional reactions. Cognitive strategies can also regulate expectations of reward arising from conditioned stimuli. However, less is known about the efficacy of such strategies with expectations elicited by conditioned appetitive sexual stimuli, and possible sex differences therein. In the present study it was examined whether a cognitive strategy (attentional deployment) could successfully down-regulate sexual arousal elicited by sexual reward-conditioned cues in men and women. A differential conditioning paradigm was applied, with genital vibrostimulation as unconditioned stimulus (US) and sexually relevant pictures as conditional stimuli (CSs). Evidence was found for emotion down-regulation to effect extinction of conditioned sexual responding in men. In women, the emotion down-regulatory strategy resulted in attenuated conditioned approach tendencies towards the CSs. The findings support that top-down modulation may indeed influence conditioned sexual responses. This knowledge may have implications for treating disturbances in sexual appetitive responses.

Keywords: emotion regulation; sexual conditioning; sexual response; sexual reward learning; sexual arousal

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RESEARCH IN ANIMALS AND HUMANS supports the notion that reward learning in the form of classical conditioning can contribute to the etiology of both normal and maladaptive sexual behaviors, like paraphilias, or deviant sexual preferences (Brom, Both, Laan, Everaerd, & Spinhoven, 2014; Pfaus, Kippin, & Centeno, 2001). In classical conditioning, through the repeated association with the unconditional stimulus (US), a neutral stimulus (NS) can eventually elicit the same reaction as the US (Bindra, 1974; Pavlov, 1927). The NS is now called

the conditioned stimulus (CS) and the reaction to the CS is called the conditioned response (CR). Several notable studies have demonstrated conditioned sexual arousal responses in humans (for a review see Brom, Both, et al., 2014). Both from a learning theory and neuroscience perspective, disorders in sexual motivation, like hypersexuality, can potentially be characterized as disorders involving disturbed emotional learning and memory processes resulting in enhanced sexual response acquisition and maintenance.

The expectation of a potential sexual reward can elicit positive feelings and sexual arousal and therefore can aid in the learning about environmental cues that predict future sexual rewards. However, this reward expectation signal can also be maladaptive, potentially eliciting sexual urges that may be difficult to control, like in the case of hypersexuality. Therefore, it is important to understand how to regulate or control the positive feelings associated with reward expectation. One promising method for examining this is the utilization of cognitive strategies. The term *emotion regulation* signifies any process that serves to initiate, inhibit, or modulate (e.g., cognitively reevaluate) emotional feelings or behavior (Aldao, 2013; Gross, 2002; Gross & Thompson, 2007). Successful emotion regulation may be dependent on top-down control from the prefrontal cortex over subcortical regions involved in reward and emotion. Failures in this deployment of top-down cognitive control mechanisms or overactive bottom-up processes may contribute to several forms of psychopathology (Heatherton & Wagner, 2011; Ray & Zald, 2012), including sexual disorders with a learned component (Bancroft & Janssen, 2000; Both, Laan & Everaerd, 2011; Klucken et al., 2014; van Lankveld, van den Hout, & Schouten, 2004; Salemink & van Lankveld, 2006). Cognitive strategies can successfully alter unwanted aversive emotional reactions. Emotional down-regulation strategies can influence emotions at the input phases (i.e., antecedent focused like cognitive reappraisal or attentional deployment) and at the output phase (i.e., response focused like suppression; Gross, 1998; Webb, Miles, & Sheeran, 2012). Gross and Thompson (2007) suggest that antecedent-focused strategies (e.g., attentional deployment) are more effective than response-focused strategies. As relatively few studies on negative emotions, and even fewer studies on positive emotions, have investigated the effects of the promising active distraction strategies (where the emphasis is on participants to bring to mind something unrelated to the emotion or emotional stimulus to serve as a distraction), especially on behavioral and physiological measures of emotion, this is an important avenue for future research (Webb et al., 2012). At present, there is growing evidence that cognitive strategies like attentional deployment can also regulate expectations of reward arising from conditioned stimuli (Delgado, Gillis, & Phelps, 2008). However, less is known about the efficacy of such strategies with expectations elicited by conditioned appetitive sexual stimuli. To our knowledge, the present study is the first to investigate whether a cognitive down-regulatory strategy can efficiently regulate sexual arousal elicited by sexual reward-conditioned cues.

At present, it is unclear if men and women are equally prone to conditioning of sexual response and if sex differences do exist in the emotion regulation of positive emotions, like sexual arousal. Given the fact that paraphilia and hypersexuality are predominantly observed in men (Kafka 1994; Kuzma & Black, 2008; Rosen, 2000), it is speculated that men are more receptive to increased CR acquisition (Domjan, 2005; Gutiérrez & Domjan, 1997; Klucken et al., 2009; Pfaus et al., 2001). Nevertheless, few studies have addressed sexual conditioning in both men and women (Brom, Both, et al., 2014), and some results are contradictory to this general assertion (Brom, Laan, Everaerd, Spinhoven, & Both, 2014; Hoffmann, Janssen & Turner, 2004). Second, with respect to emotion regulation, the general assertion is that women use more emotion-focused strategies, while men are thought to use more efficient cognitive (rational) strategies (Whittle et al., 2011). However, most—if not all—of these results relate to the regulation of particularly negative emotions (Gross, 2007; Mak et al., 2009; McRae et al., 2008). Hence, the contradictory results of previous sexual conditioning studies and the lack of studies on sex differences in positive emotion regulation point to the importance for further investigation of possible gender differences in sexual learning and cognitive regulation thereof.

In the present study, a differential conditioning paradigm was applied, with instructions adapted from Delgado et al. (2008). It was predicted that participants in two conditions (the control condition *Attend* and the experimental *Down-Regulate* condition) would show conditioned genital and subjective sexual responding to the CS that was paired with the US (the CS+), which was expected to gradually decrease during extinction trials. When the *Attend* instruction preceded the CSs, the participant was instructed just to pay attention to the stimulus. In contrast, when the instruction *Regulate* appeared onscreen, participants were instructed to conjure a soothing image from nature prompted by the color of the stimulus. Instructions were presented in acquisition and extinction phases. It was