Sexual arousal is an emotional/motivational state that can be triggered by internal and external stimuli and that can be inferred from central (including verbal), peripheral (including genital), and behavioral (including action tendencies and motor preparation) responses. This article, while focusing on sexual arousal in men, provides a conceptual analysis of this construct, reviews models of sexual arousal, and discusses the usefulness of perspectives derived from motivation and emotion research in improving our understanding of its determinants and behavioral correlates. In this, it considers the role of genital feedback in men’s subjective sexual arousal and the connections between sexual arousal and sexual desire. Future research and definitions may increasingly focus on its central integrative functions (as opposed to its input and output characteristics). Yet, the study of sexual arousal can be expected to continue to benefit from the measurement of its genital, verbal, and behavioral components. Instances of discordance between response components suggest that they are, at least in part, under the control of different mechanisms, and it is proposed that a better understanding of sexual arousal will prove contingent on a better understanding of such mechanisms and the conditions under which they converge and diverge.

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Introduction

"Coitus is impossible for man without erection of the penis, and that requires his sexual arousal."
(Squier, 1938, p. 119)

Defining sexual arousal

The use of the term sexual arousal in the English-language medical and scientific literature can be traced back to the 1930s (e.g., Murchison and Harden, 1933; Squier, 1938). Phrases and expressions that refer to arousing the sexual impulse (e.g., Ellis, 1903), arousing erotic sensations (Kelly, 1930), arousing passion (e.g., Gurley, 1909;

References

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Malchow, 1907), and arousing desire (Nascher, 1916) were commonly used around the turn of the century, but gradually disappeared during the 1930s and 1940s. Thus, the history of the term sexual arousal involves a transition from the predominant use of a verb (to arouse) to that of a noun (sexual arousal). However, as was the case for the verb, the noun could refer to psychological processes, physiological processes, or a combination of the two, and it often was left to the reader to infer the specifics from the context in which the term was used.

Although the past century has seen a number of important advances in the study of human sexual response, the current literature is still rife with ambiguity about what exactly is being felt or observed when someone is sexually aroused, and sex researchers have yet to arrive at a consensus on how to best define this state. Most would probably agree that in developing a definition one needs to address questions regarding the importance of peripheral (including genital) and central (including experiential) processes. Yet, definitions tend to be challenged rather than informed by findings from psychophysiological studies that show the relative independence of peripheral and central indicators of sexual arousal. Although correlations in men between genital responses and self-reports of sexual arousal are, on average, substantial (Chivers et al., 2010), large variability can be found between studies, with some finding almost no, or at best weak, associations between the two (e.g., Both et al., 2004; Janssen et al., 2009; van Lankveld and van den Hout, 2004). Indeed, it can be argued that the introduction of psychophysiological methods in the 1960s—allowing for first time the concurrent measurement of genital and subjective reactions—is largely responsible for initiating, or at least invigorating, the continuing debate on what constitutes sexual arousal.

In addition to variations in correlations between subjective and physiological measures, numerous psychophysiological studies have revealed response patterns in men that defy simple, unidimensional conceptualizations of sexual arousal (e.g., Bach et al., 1999; Cranston-Cuebas and Barlow, 1990; Delizonna et al., 2001; George et al., 2006; van Lankveld and van den Hout, 2004). For example, experimentally induced distraction (e.g., by having men engage in mental arithmetic) during erotic film presentations has been found to decrease erections but not subjective sexual arousal (van Lankveld and van den Hout, 2004). Also, providing men with false feedback (e.g., by informing them that their erections do not measure up to those of the other subjects) has been found to decrease genital responses but not subjective arousal during subsequent stimulus presentations (Bach et al., 1999). More divergent patterns have also been reported. For example, Both et al. (2010) found that the repeated exposure to a sexual stimulus resulted in habituation in men’s subjective sexual arousal. Genital responses, in contrast, increased over trials.

In addition to psychological and physiological indicators, or subjective and genital response components, sexual arousal has been described in behavioral terms. Beach (1942), who was one of the first to use the term sexual arousal in the animal literature, mainly referred to it in motivational terms, as something that leads to mating/uniFB01 been described in behavioral terms.

So, what is sexual arousal? In short, we don’t know. Although its main indicators (including, for men, penile erection) may be well recognized, we do not know what is necessary or sufficient to label someone as being sexually aroused. Most men may be capable of having erections. Most men may know what it feels like to be sexually aroused. But despite the generally high correlations between erections and subjective arousal (Chivers et al., 2010), men do not always report feeling sexually aroused when they have an erection, nor do they always experience an erection when they feel aroused. Erections occur during sleep (in particular Rapid-Eye-Movement or REM sleep), and have been studied both during the night and during daytime naps (e.g., Gordon and Carey, 1995). However, generally speaking, sleep-related erections are dissociated from erotic dream content or the experience of subjective sexual arousal (e.g., Karacan, 1982). As another example, men may experience erections in situations that are, at least at face value, devoid of sexual meaning, including accidents (Janssen et al., 2008). Consistent with this, psychophysiological studies have found that men can get erections to, for example, rape films while experiencing little to no subjective arousal (Janssen et al., 2002b). The opposite has been observed as well. For example, some men report experiencing sexual arousal in the absence of erections when they visit a strip club (Janssen et al., 2008). Psychophysiological studies, too, suggest that men can feel subjectively aroused in the absence of a genital response. For example, Janssen et al. (2009) found, in a sexually functional community sample of men, that about one-quarter of the participants met the criteria of a ‘nonresponder’ (penile rigidity of <10%). Cluster analyses confirmed differences in genital response, but low and high genital responders did not differ in subjective sexual arousal. Findings like the ones discussed above underscore the complexities involved in establishing the necessary and sufficient conditions for sexual arousal.

Some have proposed that the most parsimonious approach to defining sexual arousal, at least when it comes to men, is to discount subjective feelings and equate it with penile erection (Agmo, 2008). However, not only is this position unlikely to take our understanding of sexual arousal to new levels—as all, erections can be studied without the need to invoke higher-level constructs such as sexual arousal—it is also based on the empirically unsubstantiated assumption that a man’s subjective state of sexual arousal finds its roots in his genitalia and, thus, that the “crucial component of the term ‘subjective arousal’ is genital blood flow” (Agmo, 2008, p. 313). In a less extreme form, Sachs (2000, 2007) has proposed that penile erection in a sexual context can be considered a reliable and valid indicator of male sexual arousal. Although this position acknowledges that not all erections are sexual, it invites circular reasoning as it transfers definitional challenges to the question of what makes a context “sexual.” In contrast, other researchers (e.g., Rosen and Beck, 1988, cf. Janssen and Everaerd, 1993) have proposed that sexual arousal cannot be defined adequately “without highlighting the critical role of cognitive labeling and subjective experience” (p. 28). However, this position ignores the possibility that sexual arousal can be activated (and even impact behavior) at a level that fails to translate into the conscious experience of “feeling” aroused (e.g., Janssen et al., 2000).

Opinions not only differ in how to best define sexual arousal, scholars also disagree on how important definitions are to scientific progress. Sachs (2007), who presents a comprehensive overview of definitions of sexual arousal, believes that advances in the study of this construct are dependent upon improvements in our terminology and definitions. Yet, the history of related areas of scientific inquiry, including that of human emotion, suggests that explicit definitions often “are a result of scientific investigations, not a prerequisite for them” (Öhman, 1987, p.81). The position taken in this article is consistent with the latter position, in that any definition that assigns more importance to one indicator of sexual arousal over another, at this stage, can be expected to constrain scientific progress.
Consistent with positions held in both emotion theory (e.g., Lang, 1984) and affective neuroscience (e.g., LeDoux, 1996; Panksepp, 1998), sexual arousal may be described as an emotional/motivational state that can be triggered by internal and external stimuli and that can be inferred from central (including verbal), peripheral (including genital), and behavioral (including action tendencies and motor expressions) responses. Although future research – in particular research using brain imaging and EEG techniques – may reveal a need for definitions to incorporate its central integrative functions (as opposed to its input and output characteristics; cf. Lang, 2010; Panksepp, 1998), at present the study of sexual arousal continues to benefit from the measurement of its genital, verbal, and behavioral components. Instances of discordance between the various indicators of sexual arousal suggest that, at least to some degree, they are under the control of different mechanisms (cf. Bancroft, 1989). The position taken in this article is that, ultimately, our efforts to arrive at an empirically informed and conceptually sound definition of sexual arousal will prove contingent on a better understanding of such mechanisms and the conditions under which they converge and diverge.

Models of sexual arousal

Whereas the previous section emphasizes its multifaceted nature, most existing models of human sexual arousal tend to treat it as a unified construct. Early models (e.g., Ellis, 1906; Moll, 1908/1912) described processes relevant to sexual arousal in relatively nonspecific terms, distinguishing two or more phases of increasing levels of sexual tension (e.g., “tumescence” in Ellis’ words) and release (“detumescence”). Masters and Johnson’s (1966) four-stage model of sexual response, while reminiscent of Moll’s (1908/1912) ‘curve of voluptuousness,’ was the first to describe, based on empirical research, the genital and extragenital responses that occur in humans during sexual behavior. However, Masters and Johnson did not specifically address the subjective experience of sexual arousal in their model. Furthermore, Masters and Johnson’s model implies that the sexual response involves some natural sequence of physiological events that is activated automatically as long one is presented with adequate sexual stimulation. However, they did not define adequate sexual stimulation (Janssen and Everaerd, 1993). In fact, their approach to the term is circular: Effective stimulation produces a response and a response is evidence for effective stimulation. Kaplan (1977, 1979), who introduced a modification of Masters and Johnson’s model, replaced their first stage by the more psychological phase of ‘desire,’ dropped their ‘plateau phase,’ but she retained the ‘excitement’ and ‘orgasm’ phases.

Although a number of other models relevant to sexual arousal in men have been proposed over the years (e.g., Bancroft, 1989; Byrne, 1977), only a few are based on empirical research. One of the first of such models was introduced by Barlow (1986). His model was inspired by a series of psychophysiological studies (see Barlow, 1986; Cranston-Cuebas and Barlow, 1990, for review) that revealed a number of factors differentiating men with psychogenic erectile problems from men without such problems. The model proposes that sexual responses form either a positive or a negative feedback loop, which start with the perception of an explicit or implicit demand for sexual performance. This perception triggers positive or negative affective evaluations which both activate autonomic arousal. Increased autonomic arousal enhances attention for those features of the sexual situation that are most salient. Continued processing of sexually relevant cues produces genital response, and ultimately leads to sexual approach behavior. Continued processing of nonsensual cues (e.g., consequences of not responding and a form of self-generated distraction) interferes with sexual arousal and ultimately leads to avoidance behavior.

Barlow’s model thus emphasizes the role of affective responses that are triggered by sexual stimuli and attention that is directed by those affective responses and that needs to be maintained in order to obtain higher levels of sexual arousal. While its main strength lies in how it captures the difference between functional and dysfunctional patterns of sexual response, the model does not address the question of how dysfunctional patterns come about, nor does it provide a clear basis for predictions regarding discordance in response patterns. Wiegel et al. (2007) presented an expansion of the model that incorporates roles for schemas, negative/positive expectancies, and a stronger emphasis on the negative effects of self-focused attention. In addition, they discuss a number of biopsychosocial variables that may predispose an individual to develop sexual dysfunctions. An interesting modification involves the proposed partial independency in the effects of positive and negative affect. Positive affect, or its absence, is proposed to be particularly relevant to subjective sexual arousal, whereas negative affect is believed to especially impact attention, increasing a self-evaluating perspective and autonomic arousal and thereby creating a smaller negative feedback loop within the larger one. Although not explicitly stated by the authors, the revised model implies – assuming that sexual stimuli can co-activate positive and negative affect, a possibility that will be discussed in more depth below – that some degree of subjective sexual arousal may be experienced in the absence of a genital response.

Bancroft and Janssen (2000) proposed a model that in various ways was inspired by but also departs from Barlow’s. It could be argued that models like Barlow’s (1986) largely focus on the role of excitatory mechanisms (Janssen and Bancroft, 1996). That is, they underscore the role of attention and how it does (when attention is focused on sexual content) or does not (when attention is not focused on sexual content) result in the activation of sexual arousal. Although the model allows for the “inhibition” of sexual arousal – for example triggered by negative affective responses – the actual mechanism relies largely on processes (e.g., self-focused attention) that seem more relevant to a lack of excitation. The dual control model of sexual response (Bancroft and Janssen, 2000; Janssen and Bancroft, 2007) was the first to explicitly postulate that human sexual arousal involves both excitatory and inhibitory mechanisms. It is a state-trait model: it proposes that the weighing of excitatory and inhibitory processes occurs within individuals in any given situation, and at the same time it assumes individual variability in the propensity for these processes. At the state level, the model implies that the absence of sexual arousal can be the result of the absence of excitation (e.g., due to a stimulus that lacks arousing properties or to attention being focused on nonsensual cues), but it may also reflect the presence of active suppression, or inhibition, of a sexual response (e.g., in response to potent emotional, physical, or other risks or threats, cf. Janssen et al., 2002a,b).

The dual control model was mainly intended to be a conceptual device, a basis for the development of research hypotheses. Over the past decade a substantial amount of data has been collected, mainly focusing on the trait dimension of the model and relying on the use of two questionnaires (SIS/SES, Janssen et al., 2002a,b, SESII-W/M, Milhausen et al., 2010), that support its relevance to our understanding of sexual arousal and sexual functioning (see Bancroft et al., 2009; Janssen and Bancroft, 2007 for reviews). Although the model does not distinguish between genital responses and subjective sexual arousal, or explicitly discuss conditions under which they may converge or diverge, it has been found relevant to the prediction of both genital and subjective sexual responses in the laboratory. Among others, the propensity for sexual excitation is associated with overall sexual responsivity. That is, scores on the sexual excitation scale of the SIS/SES questionnaire are positively correlated with genital and subjective sexual arousal in the laboratory, regardless of the content of the stimuli used (e.g., Janssen et al., 2002b; Janssen et al., 2009).
contrast, sexual inhibition, in particular sexual inhibition due to the 'threat of performance consequences' (SIS2; one of the two types of sexual inhibition assessed by the SIS/SES questionnaire) is not associated with overall responsiveness but is predictive of sexual responses to stimuli relevant to the processing of risk or threat (e.g., depictions of coercive sexual interactions; Janssen et al., 2002b) and to the ability to control one's genital responses (Winters et al., 2009). In addition, sexual excitation and inhibition have been shown to be relevant to the prediction of variables linked to risky sexual behavior, including condom use (see Bancroft et al., 2009; Janssen and Bancroft, 2007, for a review).

One of the first models of sexual arousal to connect specific processes to brain activation patterns and, in doing this, to separately consider mechanisms relevant to subjective and physiological responses, was proposed by Stoleru and Mouras (2007; cf. Stoleru et al., 1999; Redouté et al., 2000). The model integrates findings from a series of brain imaging studies, using Positron Emission Tomography (PET) and functional Magnetic Resonance Imaging (fMRI) techniques, and includes cognitive, motivational, emotional, and autonomic components. The emotional component focuses on the hedonic aspects, or the pleasure associated with sexual arousal, and involves the perception of bodily changes and genital response. The activation of the right insula in response to sexual stimuli is proposed to be a neural correlate of this component. The autonomic component includes genital responses and is proposed to involve the activation of the rostral portion of the anterior cingulate gyrus, the anterior part of the right insula, and the posterior hypothalamus. Stoleru and Mouras (2007) consider the various components to be interrelated and propose that the emotional component is partly based on the perception of bodily changes. This latter interpretation was based on the findings of activation in the right insula. Although this brain area indeed has been associated with interoception and subjective feelings, it, interestingly, has been proposed to be more relevant to negative than positive emotions (Craig, 2010). Furthermore, it remains to be established how specific insular activation in studies using sexual stimuli is to sexual versus other affective (or attentional) processes, to feedback from genital versus other autonomic responses, and even to peripheral versus central-level processes (e.g., the insular receives input from the visual cortex and is not only involved in the perception but possibly also generation of autonomic responses; e.g., Ullsperger et al., 2010). Interestingly, five out of the 10 brain imaging studies reviewed by Stoleru and Mouras (2007) did not show insular activation. Despite these inconsistencies and as yet unresolved questions, imaging studies – especially with the further development of imaging techniques that allow for improved spatial and temporal resolution – clearly will continue to contribute to our understanding of central mechanisms, and Stoleru and Mouras' model is an excellent example of how this research can inform the development of models that describe both unique and shared mechanisms underlying the activation and regulation of the various components of sexual arousal.

Of the models discussed above, only the revised and expanded model of Wiegel et al. (2007) suggests predictions about when subjective and genital responses may diverge, in that positive affect is believed to be particularly relevant to subjective sexual arousal, while not necessarily always impacting genital response. Janssen et al. (2000) presented a model that, consistent with Wiegel et al.'s observations, is relevant to the connections between sexual and nonsexual affect, the meaning or valence of sexual stimuli, and subjective and physiological indicators of sexual arousal. The model focuses on the interaction between automatic (unconscious or implicit) and controlled (conscious or explicit) cognitive processes and proposes that different levels of processing can differentially impact subjective and physiological sexual arousal. Thus, Janssen et al.'s (2000) model states that unconscious processes are relevant to explaining the automaticity of the genital response, whereas subjective feelings of sexual arousal are believed to be under control of higher-level, conscious cognitive processing (see also Janssen and Everaerd, 1993; Laan and Everaerd, 1995; Laan and Janssen, 2007). Support for the model is provided by studies exploring the role of unconscious processes in the activation of genital responses and sexual meaning (e.g., Gillath et al., 2007; Janssen et al., 2000; Ponseti and Bosinski, 2010; Spiering et al., 2003, 2006). For example, subliminal presentations of sexual stimuli have been found to impact genital responses in both men (Janssen et al., 2000) and women (Ponseti and Bosinski, 2010). However, subliminal sexual stimuli, in contrast to superliminal ones, do not induce subjective feelings of sexual arousal, which indicates that the subjective experience of sexual arousal requires the involvement of conscious processes (Spiering et al., 2003). A basic assumption of Janssen et al.'s (2000) model is that sexual stimuli may convey more than one meaning. Thus automatic and controlled cognitive processes may help explain differences in outcome in situations that convey sexual meaning while simultaneously activating negative meanings. Janssen et al. (2000) proposed that in these situations, automatic processing of sexual meaning initiates genital response, whereas controlled processing of negative meaning may result in decreased or nonsexual subjective experience.

The notion that sexual stimuli or situations may have multiple meanings is supported by a number of studies on the connection between emotions, or more generally, affect, and sexual arousal. For example, Everaerd and Kirst (1989) measured the possible overlap of sexual arousal with profiles of other emotions using a computer program that was based on Frijda’s (1986) emotion theory. They found that sexual arousal overlaps with the profiles of positive but also negative emotions. Similarly, a substantial number of studies show that sexual arousal can occur in the presence of both positive and negative affect, when stimuli are negatively evaluated (e.g., Heiman and Hatch, 1980; Janssen et al., 1994; Janssen et al., 2002b; Laan et al., 1994), and when an individual experiences anxiety or anger (Barlow, 1986; Janssen and Everaerd, 1993). The following two sections discuss the connections among sexual arousal, emotion, and motivation in more depth.

**Sexual arousal and motivation**

Although some contemporary scholars (e.g., Ariely and Loewenstein, 2006; Nordgren et al., 2009) still consider sexual arousal to be a drive, or visceral impulse, the application of drive theories to sexual arousal is generally considered problematic, if not erroneous (e.g., Beach, 1956; Janssen and Everaerd, 1993; Plass, 2007; Singer and Toates, 1987). Especially 'hydric' drive notions have been criticized. Indeed, the proposition that sexual arousal is initiated independent of the presence of (internal or external) stimuli, that it grows over time, and that it requires release or otherwise will result in some kind of discomfort, perhaps even tissue damage, lacks empirical support. As pointed out by Beach, in contrast to hunger and thirst, "no one ever died from the lack of sex" (Beach, 1956, p. 3). More recent theories of motivation, in particular incentive-motivation theories, emphasize the interaction between internal (e.g., hormones) and external (sexual stimuli or 'incentives') variables (e.g., Bindra, 1978; Singer and Toates, 1987). From this perspective, not ‘drive reduction’ – based on built-in mechanisms designed to maintain homeostasis – but the rewards associated with sex, or its incentive salience (Berridge, 2004), ultimately provide the ‘fuel’ for sexual action.

How useful are theories of motivation to our understanding of sexual arousal? Of the various components of sexual arousal, genital response, subjective experience, and behavior, theories of motivation are most relevant to the latter. After all, theories of motivation, at least traditionally, deal with the determinants of behavior, not feelings. In fact, they have been described as not being very useful in helping us understand "sexual experience and more generally sexual response" (Everaerd, 1989, p. 4). Indeed, motivation theories, especially older ones such as hydric and ‘opponent process’ drive theories, are
limited in their explanatory power when it comes to human sexual response and behavior. Incentive-motivation theory was a major step forward, by emphasizing the importance of incentives, or the “pull” of an appetizing stimulus (Singer and Toates, 1987). Yet, earlier versions of this theory were still largely developed on the basis of research in nonhumans and therefore provisional in their assumptions about human sexual behavior, and somewhat restricted in scope. For example, the original application of incentive-motivation theory to human sexual behavior (Singer and Toates, 1987), includes the proposition that internal states such as hormone levels and abstinence increase sexual motivation — although the theory differs from drive theories in that this “push” effect was not proposed to be direct but mediated by an increased sensitivity to sexual stimuli (Singer and Toates, 1987). Yet, research has failed to find any consistent association between hormone levels (i.e. variations in testosterone within the normal range) and sexual behavior in men (see Bancroft, 2005, for a review). Also, to the knowledge of this author, researchers have yet to conduct experimentally controlled tests of the effects of abstinence on sexual motivation and behavior in men and women. Moreover, original descriptions of incentive-motivation seem to fall short in their ability to explain increased sensitivity to sexual stimuli in some cases of sexual compulsivity or ‘sex addiction,’ where ‘abstinence’ can be considered a particularly relative term (although the incorporation of another concept from motivation theory, settling point — which can be defined as a stable state caused by a balance of opposing forces, but without any setpoint — may be of use here; cf. Berridge, 2004; Wirtshafter and Davis, 1975). Another characteristic of the original version of incentive-motivation theory is that it is mainly concerned with those processes or forces that make us move towards incentives. Motivation is about goal-directed behavior. Goals are incentives (Bindra, 1999). They devote less attention to the role of counter-forces, or processes relevant to avoidance or restraint.

Recently, Toates (2009) presented a revision and expansion of the incentive motivation model of sex that overcomes several of these shortcomings. The model, explicitly presented as being relevant to our understanding of both sexual motivation and sexual arousal, somewhat de-emphasizes the role of factors such as abstinence and hormones and instead emphasizes the hierarchically organized interaction between stimulus-based (“online”) and cognition-based (“offline”) processes. In this, the revised model gives a role to automatic and controlled cognitive processes, sexual inhibition and excitation, and the impact of positive and negative affect. The model allows for conflict in goals (ambivalence) and indicates that regulatory processes can occur both with and without conscious intent. Although the revised model is said to be relevant to our understanding of sexual arousal, the relationship between sexual motivation and sexual arousal remains somewhat elusive. Sexual arousal is described in terms of activity within a particular circuit of neurons that is “functionally tied to both sexual motivation and controlling the state of the genitals” (p. 170), but the conditions under which the connection between motivation and genital response may – or may not – become manifest (if they are not to be considered indistinguishable) are not described. Genital arousal can be triggered by incentives, and the motivational value of incentives can be increased by genital arousal. It does not become clear, however, exactly when or how that happens, nor is it explained why genital response should be considered a more important player in the intricacies of behavioral control than the subjective experience of sexual arousal. Genital responses are considered the outcome of activation of the autonomous nervous system, and in that sense can be considered relevant to the ‘fueling’ of behavior. However, anxiety, which can both facilitate and decrease genital response (Cranston-Cuebas and Barlow, 1990), also is associated with activation of autonomous nervous system activity, yet may lead to avoidance of sexual behavior (Barlow, 1986). Thus, the specifics of the importance of autonomous nervous system activation associated with genital response are not entirely clear. Nevertheless, the revised model is broad in scope and offers a rich framework from which many hypotheses can be extracted.

Sexual arousal and emotion

The terms motivation and emotion are often found in close proximity to each other. Although they are different constructs, with different scientific histories and track records, they indeed have much in common. According to some, they have so much in common that it is unproductive to distinguish between them. For example, Bindra (1969) proposed that both can be studied from a “common set of neuropsychological concepts” (p. 1071). In this, he suggests that both motivation and emotion are “central motive states” and that both emotion and motivation impact behavior. Others (e.g., Buck, 1999) consider emotions the “readouts” of motivation. Yet, according to others, motivation and emotion deserve to keep their own, unique place in the literature. For example, Frijda (2010), while acknowledging their connections, makes the point that while all emotions involve motivation, not all motivation is emotional. This is not inconsistent with modern motivation theories (e.g., Berridge, 1996), where “wanting”, a motivational process, is not always accompanied by “liking,” an affective process. Also, while both motivation and emotion are indeed relevant to behavior, the links between emotion and behavior are less strong and most commonly described as a predisposition towards action (“action tendencies,” Frijda, 1986), instead of necessarily leading to actual behavior (cf. Bradley and Lang, 2007). Thus, emotions often are about behaviors that are not expressed. The most important distinction, however, is related to the fact that whereas behavior is the primary topic of motivation, feelings are the primary area of emotion. That is, where feelings, or more generally speaking, affect, in modern motivation theories (e.g., Berridge, 2004; Toates, 2009) is mainly understood as something that is relevant to the creation of rewards (or for establishing “incentive salience”), emotion theorists for many years have tried to understand how feelings come about.

It has been argued (Everaerd, 1989) that sexual arousal fits the definition of an emotion. It involves bodily reactions, feelings, and it prepares for action. Like other emotions, the activation of sexual arousal is dependent on the processing of relevant, or ‘competent’ (Damasio, 2003) stimuli. This process, called ‘appraisal’ in emotion theory (e.g., Frijda, 1986; Frijda, 2005), relies on various cognitive mechanisms and resources, including memory, attention, automatic and controlled processes (Janssen and Everaerd, 1993). Also, like other emotions, sexual arousal can be defined as an ‘action tendency’ (Arnold, 1960; Frijda, 1986). The distinction from actual, overt behavior is relevant, as the presence of a genital response or the experience of subjective sexual arousal, while indicative of the preparedness to engage in sexual activity, are not always (perhaps most often not) translated into action.

Sexual arousal interacts with other emotions and affective states, positive and negative, in complicated ways (Peterson and Janssen, 2007). Positive emotions and affect may facilitate sexual arousal in men; however, the relationship seems to be clearer and more consistent for subjective sexual arousal than for genital response (Koukounas and McCabe, 2001; Mitchell et al., 1998; Nobre et al., 2004; Rowland et al., 1996). Research shows a more complicated relationship between negative states and sexual arousal in men. In one study (Mitchell et al., 1998), a negative mood induction resulted in a reduced genital response in men, although it did not impact subjective sexual arousal. Others have found support for a positive relationship between negative emotions and sexual arousal. For example, several studies have shown that anxiety can facilitate genital arousal, at least in sexually functional men (for a review, see Cranston-Cuebas and Barlow, 1990). A number of factors need to be considered in explaining the complex relationships between sexual
arousal and nonsexual emotions and affect. One involves the role of individual differences in the effects of affect on sexual arousal. For example, Bancroft et al. (2003) and Lykins et al. (2006) found substantial variability in the self-reported effects of negative states such as depression and stress on sexual arousal in men, with some reporting negative and some reporting positive effects. Another possibility is that effects have been inconsistent because most researchers tend to analyze the effects of positive and negative affect separately, ignoring the possibility that different combinations of positive and negative affect were experienced (Peterson and Janssen, 2007). A third factor involves the possibility that effects vary depending on whether a specific emotion (e.g., ‘anxiety’) or a more general mood state (‘negative mood’) is induced. This possibility is consistent with discussions in the contemporary emotion literature on how emotions and affect are best conceptualized to begin with.

Although sexual arousal may indeed fit the definition of an emotion (Everaerd, 1989), it remains to be established if the feelings and experiences that are part of sexual arousal are specific to sex or reflect non-sexual affect or emotions associated with general arousal and genital response (Janssen et al., 2007). Related to this, it remains to be determined whether sexual arousal is best approached from a discrete (as suggested above) or dimensional emotion perspective. Dimensional theories, although existing in different forms, generally state that affect and emotions can be captured using two dimensions: valence (indexing hedonic value in terms of positivity and negativity) and arousal (Osgood et al., 1957). More recent versions of this approach (e.g., Watson et al., 1999) allow for valence to reflect two unipolar rather than one single bipolar scale. In this view, any given stimulus potentially can activate positive affect, negative affect, or both (Cacioppo et al., 1999). In contrast, theories of basic, or discrete emotions propose that emotions are categorically distinct (cf. Darwin, 1872), although they, too, at least in the views of some, can be combined to form more complex, or blended, emotional responses (Ekman, 1999).

In what may be the first attempt to test whether sexual emotions are best accounted for by a dimensional or discrete emotion perspective, Stevenson et al. (2011) conducted a study in which participants rated close to 1500 sexual and nonsexual words using, from a dimensional perspective, scales of valence and arousal and, from a discrete emotion perspective, scales of happiness, anger, sadness, fear, and disgust. In addition, ratings were provided for sexual valence, arousal, and energy. A factor analysis produced four factors and regression analyses revealed that the “sexual” factor was best predicted by sexual arousal and energy scales. Dimensional ratings were not predictive of any of the four categories. These results, although preliminary in nature, support the idea that sexual arousal might be best approached from a discrete emotion perspective.

**Sexual arousal and genital feedback**

Emotion theorists for many decades have struggled with the question of how the body (specifically peripheral physiology) and mind (specifically feelings) interact. The same question is relevant to sexual arousal as well. For example, the finding that correlations between genital responses and subjective sexual arousal in general are higher in men than in women (see Chivers et al., 2010, for a meta-analysis) has led researchers to speculate that in men subjective sexual arousal is informed by feedback from their genitals (e.g., Chivers et al., 2010; Laan and Everaerd, 1995). This notion is consistent with the James–Lange theory of emotion (James, 1894; cf. Lang, 1994), as well as with modern versions of this theory (e.g., Damasio, 2003), stating that feelings are influenced by peripheral physiology and consist, in part, of “the perception of a certain state of the body” (Damasio, 2003, p. 86). In comparison, subjective sexual arousal in women has been suggested to be more strongly determined by the conscious evaluation of contextual factors and characteristics of stimuli beyond their sexual explicitness (e.g., Laan and Janssen, 2007), a notion more consistent the Schachter-Singer (1962) theory of emotion, which emphasizes the role of situational factors in the interpretation of the meaning (or appraisal) of one’s emotional reactions. Although this proposed gender difference may have face validity, the role of feedback from the genitals in men has, as yet, not been tested directly. In fact, the psychophysiological literature shows a substantial range of correlations between peripheral and central indicators in men, which suggests that genital feedback, even in men, is not equally important at all times, and this raises the question of under what conditions it may and under what conditions it may not impact men’s subjective sexual arousal. In addition, some psychological findings challenge the importance of genital feedback in men in a more fundamental way. As was discussed above, a number of studies have found that experimental manipulations may modify men’s degree of erection while not affecting their subjective sexual arousal1 (e.g., Bach et al., 1999; Cranston-Cuebas and Barlow, 1990; Delizonna et al., 2001; George et al., 2006; Janssen and Everaerd, 1993; van Lankveld and van den Hout, 2004; Mitchell et al., 1998). Such findings defy the notion that subjective sexual arousal in men is determined by feedback from (changes in) their genitals. Also, some studies have found that not just men with erectile problems but also sexually functional men sometimes underestimate their erections (Nobre et al., 2004), and studies have found that sexually functional men who fail to show genital responses in the lab are not necessarily different from other male participants in terms of their subjective sexual arousal (Janssen and Bancroft, 2007; Janssen et al., 2009). Thus, while researchers are largely focusing on the possible explanation of gender differences in correlations between response levels, discordant response patterns occur in both women and men, and are not well understood.

**Sexual arousal and desire**

Another aspect of sexual arousal that is understudied and both a source of confusion and debate involves the connection between subjective sexual arousal and sexual desire (cf. Graham, 2009). Traditionally, sexual desire has been described as a motivational state. It directs behavior. And sexual arousal has been mainly approached as an emotional state, an embodied affective state. Yet, as the discussion of motivation and emotion above may have made clear, there is considerable overlap in these approaches and the past few decades have shown a convergence in developments in motivation and emotion research. Emotions are most commonly defined as action tendencies (Frijda, 1986; Bradley and Lang, 2007). From this perspective, both sexual arousal and sexual desire can be considered emotional states, and both prepare for action. Regulation at various levels (e.g., involving inhibitory, automatic, and controlled processes, cf. Toates, 2009) ultimately determines whether or not they are translated into behavior. Thus, this is true not only for sexual arousal but also for sexual desire, as the latter, too, can be experienced without resulting in action.

So, how different or similar are the subjective experiences of arousal and desire? From a phenomenological perspective, it has been found (Janssen et al., 2008) that men do not as consistently, or easily, separate desire from arousal as perhaps once was assumed. Desire can be experienced without genital response, as is true for subjective sexual arousal, and erections may be experienced in the absence of desire. However, such observations are largely based on qualitative research (e.g., Janssen et al., 2008), as desire measures are not systematically included in psychophysiological studies on sexual arousal. Yet, some exceptions exist and suggest that subjective arousal and desire may not always follow identical patterns. For example,

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1 This would not be reflected in reported correlations, as shifting the intercept of one of two variables does not change their correlation.
Peterson and Janssen (2007) found that men, when presented with a rape film, reported higher levels of sexual arousal than women. However, levels of desire in response to the film were low and not different between men and women.

The analysis of possible difference between the subjective experience of sexual arousal and desire is complicated by the fact that the assessment of the two depends on people's self-report, and there is limited research on how men and women interpret and define the two constructs. The reliance on people's self-report and self-knowledge in the study of complex mental and social processes has long been recognized as being potentially problematic (Nisbett and Wilson, 1977; Wilson and Dunn, 2004). This seems especially the case when the questions involve feelings and require retrospective report (e.g., Robinson et al., 1998). In the study by Janssen et al. (2008), many subjects not only acknowledged the difficulties they experienced in distinguishing between desire and arousal, but also in how to recognize one of the two states, in terms of subjective experience, to begin with. Janssen et al. (2008) speculated that some of the subjects' responses might have reflected the conditions that need to be met for them to take initiative or (continue to) engage in sexual behavior, rather than the actual experience of "feeling" sexual desire or arousal.

From a discrete emotion perspective, the subjective experience of sexual arousal and desire could both be described as positive in valence. After all, they are both relevant to appetitive processes. To approach. This is consistent with findings from studies like Rowland et al. (1996), who used a factor analysis and found that positive emotion items (e.g., pleasant and interested) loaded with items that had a positive sexual connotation (e.g., sensual and passionate) and sexual response items (e.g., general sexual arousal and wanting to make love). Thus, the factor structure was suggestive of a relationship between positive affect and both subjective sexual arousal and desire. Yet, as was discussed above, sexual arousal can occur in the presence of other emotional and affective states. More research on this is needed, but it might be the case that sexual arousal is more likely than sexual desire to be compatible with, and experienced in the presence of, negative affect (e.g., Mitchell et al., 1998; Peterson et al., 2010). It is important to recognize, however, that, if this indeed is the case, it may still be partly confounded by people's interpretation of what the two constructs represent. That is, it is possible that people use the term 'desire' in particular in reference to situations of positive affect, or where valence, as consciously experienced, is mostly positive (Janssen, 2007). As such, desire could be described as the conscious endorsement of arousal. This notion is consistent with the idea that desire is an experience that follows, instead of precedes, the activation of sexual arousal (e.g., Both et al., 2004) — although, in this context, sexual arousal refers to central processes that have not necessarily reached the level of subjectively 'felt' arousal. This notion is also consistent with the distinction between 'wanting' and 'liking' (Berridge, 2004), in that the positively valenced experience of 'liking' is independent from and, in fact, may not always or in everyone be experienced in the presence of motivational activation — or in emotion terms, action tendencies. Thus, the possibility should be considered that sexual desire (as 'liking') might not be experienced, even in the presence of relevant action tendencies and motivation ("wanting") that are associated with the state of "sexual arousal."

Conclusion

Sexual arousal is a multifaceted construct, involving multiple components, and is connected with, even overlaps with, constructs like sexual motivation and desire. Fig. 1 presents a simplified illustration of some of its main components and connections.

As Fig. 1 shows, sexual motivation and behavior only partly overlap. That is because sexual behavior can be considered to have many determinants and sexual motivation is only one of them. In other words, not all sexual behavior is sexually motivated. A multitude of nonsexual reasons, or motives, can lead people to engage in sexual behavior (Meston and Buss, 2007), varying from the wish to please one's partner, to a sense of duty or, in the case of coerced behaviors, the objective of preventing further violence or harm. As the figure further indicates, sexual arousal implies sexual motivation. And sexual motivation implies — at least some central state of — sexual arousal. However, to allow for a margin of error in this reasoning, they do not, in Fig. 1, occupy completely identical spaces. Sexual arousal may include genital responses (including erection) and subjective sexual arousal. Although the relationship between these two components is generally stronger in men, they still explain at most about 50% of each other's variance (Chivers et al., 2010), and the processes involved in explaining (variations in) their relationship are, as yet, not well understood. The area of sexual arousal, in Fig. 1, is not completely occupied by subjective sexual arousal and genital responses because it may involve other components, including behavioral ones — that are not depicted to not complicate the figure further and that are not necessarily accompanied by conscious feelings or by an easily detected genital response. From this perspective, sexual arousal may include neither genital responses nor the subjective experience of sexual arousal, in particular in cases where its activation is limited to a central (and, in terms of awareness, implicit) level, although it may still impact behavior and behavioral responses (Janssen et al., 2000; cf. "unconscious emotion", Winkielman and Berridge, 2004). When it comes to genital responses, in a sexual context (cf. Sachs, 2007) they may indeed imply sexual arousal, but they may or may not be associated with the conscious experience of sexual desire or subjective sexual arousal. The area of genital response in the figure extends beyond the boundaries of sexual arousal, as not all genital responses are "sexual" in nature (e.g., erections during REM sleep). Finally, sexual desire may imply subjective sexual arousal (and the other way around) but, in some cases, sexual desire may be experienced independently from sexual arousal (and the other way around), yet, they both reflect aspects of sexual motivation, which is why they are presented, in Fig. 1, inside the corresponding area for sexual motivation.

As Fig. 1 serves to illustrate, and as this article hopes to point out more thoroughly, the study of sexual arousal in men, while having provided us with many interesting findings and insights, still has a long way to go. This article focused on only a small subset of relevant research areas and questions. It did not have as its primary aim to discuss the neurophysiology of sexual response, or the role of hormones, nor did it focus in much depth on the role of sexual arousal, both at the central level and as indexed through genital and

**Fig. 1.** A graphical representation of possible relationships between and overlap among constructs of sexual arousal, sexual desire, sexual motivation, and sexual behavior.
subjective responses, in risky sexual behavior and decision making, in paraphilias and associated behaviors, or, even, sexual orientation. Many questions remain, for example, regarding the role of the stimulus. Both biological predispositions and learning processes (including conditioning) probably play a role, but, still, little is known about what exactly makes some stimuli more likely than others to effectively induce sexual arousal in men. The circularity surrounding the conceptualization of “competent” stimuli (it is competent if it leads to a response), is reminiscent of Masters and Johnson’s (1966) ideas about “effective stimulation” and, essentially, remains to be resolved.

When it comes to sexual stimuli and men, the literature shows remarkable specificity in their genital responses in the laboratory, in that the strongest erections are found to stimuli that are consistent with their sexual orientation (e.g., McConaghy and Blaszcynski, 1991; Rieger et al., 2005; Sakheim et al., 1985). Yet, not all men will respond with exactly the same degree of erection or subjective sexual arousal to the same stimulus, nor is the same man likely to respond equally to all stimuli at all times. Moreover, some studies have found relatively high proportions of “nonresponders,” or sexually functional men who do not respond to relevant (e.g., preferred) stimuli in the laboratory (over 20% in some cases; e.g., Janssen et al., 2009). Thus, what makes an effective stimulus and what makes a stimulus effective should perhaps be considered to involve two different questions. More research is needed to help explore, among others, the role of automatic and controlled (or implicit and explicit) processes, of excitatory and inhibitory processes, of variations in internal state (not limited to hormones and abstinence, but also to energy level, perhaps), and even on the importance of conscious intent, or the ‘willingness’ to process potentially effective stimuli in certain ways.

As was alluded to in earlier sections, the future of research on sexual arousal is likely to increasingly involve the use of brain imaging and related (e.g., EEG/ERP) techniques and this may result in a stronger focus on its “central integrative functions” (cf. Lang, 2010; Panksepp, 1998), as opposed to its input and output characteristics. Yet, the position taken here is that research on sexual arousal will continue to benefit from the measurement of its genital, verbal, and behavioral components. To reiterate an earlier point, discordance between response components is not uncommon in men, and this suggests that these components are, at least in part, under the control of different mechanisms. Current models of sexual arousal devote insufficient attention to different response components and provide little basis for hypotheses regarding their relationship. The literature review presented in this article suggests that a stronger focus on the role of affective processes may be indicated and useful (cf. Janssen et al., 2009). Indeed, affective processes appear to play a role at all levels and to influence all aspects of the relationships among sexual arousal, motivation, and behavior. They are central to the creation, and possibly also modification, of “incentive salience” of sexual stimuli and may strengthen as well as weaken individual response components. It therefore seems reasonable to propose that they will also have the potential to help improve our understanding of the variable relationships among the different components of sexual arousal in men.

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