

Information processing approach and the sexual response in human studies

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Introduction

Information processing is the major function of the nervous system. Processing of information has to occur in such a way that appropriate motor responses can occur [1]. In cognitive psychology information is difficult to define precisely. In general it refers to representations derived by a person from environmental stimulation or from processing that influences selections among alternative choices for belief or action. Thus information can be distinguished from data. Information is knowledge in the receiver whereas data are in the environment. Information processing in cognitive psychology is assumed to occur in the nervous system. States of the system are called representations, and operations used to transform the representations are called processes [2].

Models of information processing try to trace the progression of information through several stages from stimuli to responses. The crux of working within this framework is the construction of a theoretical model that postulates certain stages of processing. At least, these models should include stimulus decoding and response selection stages. The construction of a model starts by mapping the necessary sequence of stages. Of course, the cognitive system in humans is highly complex. The complexity of an intended model depends on the need to incorporate one or several characteristics of processing. In addition to the sequence of processing stages one may wish to incorporate feedback and feedforward processes. Processing may be conceptualized as proceeding in discrete steps versus continuous processing. It may be useful to distinguish between conscious / voluntary, and unconscious / involuntary processing. Processing also can proceed in a serial- or in parallel-fashion. Complexity in the model should be restricted by the demand for parsimony. This may be supported by the conviction of those working within the information processing paradigm, that one should attempt to understand complex behavior in terms of the interaction of simpler processes.

Models of sexual function

Recently, there have been several attempts to study sexual function within an information processing framework. Several of these models of sexual function will be discussed in the next section. After that, some processing mechanisms will be described in more detail.

Sexual function has been described as a sequence of physiological and psychological events. DSM-IV proposes a three-phase sequence consisting of desire, excitement, and orgasm [3]. These phases are to some extent independent, although they also occur in a positive feedback fashion. Not only does the initial stimulus evoke a response, under many conditions of sustained attention to that stimulus the response further enhances the magnitude of the response. Sexual desire may increase to the extent that it cascades into, or triggers sexual excitement. However, to trigger orgasm a high level of excitement is necessary. Both discrete and continuous processing have to be considered in a description of the sexual response cycle. Browsing through the literature makes clear that there is no satisfactory model to explain the response cycle as a whole. There are a number of attempts at explaining the separate phases. In addition, the attention for the different phases has not been well balanced. Most attention has been given to the excitement phase. Recently, there has been an increase in studies on sexual desire. Studies on orgasm are sparse. More research-effort has been devoted to male function and dysfunction as compared to female function and dysfunction.

Sexual Desire. Until Moll's interference in 1897 the sexual impulse was seen as the expression of a 'need of evacuation' (of male semen), or as a biologically driven impulse to reproduce. Moll proposed to distinguish between two component drives; first, the impulse of detumescence is aimed at the relieve of tension in the sexual organs, and second, the impulse of contrectation is the instinct to approach, touch, and kiss another person, usually of the opposite sex [4]. The adequacy of such views has been challenged by evidence from several lines of investigation, including phyletic comparisons, effects of castration, and research on the periodicity of sexual desire [5,6]. As Beach concluded: "No genuine tissue or biological needs are generated by sexual abstinence. ... What is commonly confused with a primary drive associated with sexual deprivation is in actuality sexual appetite, and this has little or no relation to biological or physiological needs" (p.4) [7].

While there may not be an innate sexual impulse, conditions most likely exist that are innately pleasurable (e.g. local stimulation of the genitals and the experience of orgasm [5]). According to Hardy, these conditions "form the constitutional base for the elaboration of sexual appetite". In his theory of sexual motivation, Hardy postulates that sexual motives are based upon learned expectations, the learning being a result of actual experiences or imaginal processes. The pleasure that accompanies genital stimulation continues throughout life as an affective base for motivational development; many stimuli may become associated with it and may serve as cues leading to the elicitation of sexual desire [5]. On the other hand, habituation processes can occur in many sexual areas wherein the repetition of a given activity produces a diminished affective response [7]. Sexual motives are not restricted to the learning of positive expectations (the 'approach' type), motives may also be avoidant (as a result of negative expectations). However, most of the motivated behavior is ambivalent, based upon a mixture of positive and negative expectations. Sources of negative affective expectations, for example social sanctions and feelings of guilt, provoke inhibition or concealment of sexual expression. Hardy's distinction between sexual motives squares well with Byrne's conception of erotophilia-erotophobia [8,9]. Byrne also presumes the existence of an innate mechanism of sexual arousal (that is responsive to tactile stimulation), and claims that all human beings are probably born with erotophilic or positive emotional responses to sex. According to Byrne, the acquisition of positive (erotophilic) and negative (erotophobic) emotional responses to sex involves the pairing of sexual cues with emotion-producing punishment or reward [8].

The domain of sexual motivation also includes the study of sexual arousability, which has been defined as the individual's propensity for arousal given an adequate source of sexual stimulation. In Whalen's view, sexual arousability is a dimension apart from sexual appetite [10]. According to Bancroft, sexual arousability ('central arousability') is, together with cognition (e.g. internal imagery) and affect (mood states), one of the three dimensions of sexual appetite. In his view, sexual arousability points to a neurophysiological mechanism that determines the sensitivity of the sexual response system (its central and genital components) to internal and external stimuli. High arousability might imply a high sensitivity for external cues, revealing itself through an increased likelihood of central and genital responses. These responses could, in turn, lead to an increase in sexual thoughts and the experience of sexual appetite or desire [11].

Both Whalen and Bancroft view hormonal (i.e. androgen) factors as important determinants of sexual arousability. After reviewing the data available in 1966, Whalen concluded that androgens determine the responsiveness to erotic stimuli; they alter 'the threshold for erotic stimulation' [11]. At present, however, the relationship between androgens and the sexual response appears to be much more complex. Recent empirical studies point to the possibility of two distinct sexual response systems; one that is androgen-dependent, and one that is not [10]. For instance, erections during sleep, and erections in response to erotic fantasy, appear to be affected by androgen withdrawal and replacement [12,13]. In contrast, mechanisms leading to erection in response to external erotic stimuli (e.g., erotic films) may remain intact despite androgen deficiency [13]. Furthermore, the androgen-dependent system is believed to be linked with sexual desire, that is, levels of androgen seem to have an effect on sexual interest and sexual activity [10].

What are the implications of these findings for our grip on the determinants of sexual arousability? According to Bancroft, sleep erections give us "a 'window' into the central arousability system" (p.77) [1]. This window allows the assessment of sexual arousability when it is "relatively independent of the effects of the environment or cognitive processes" (p.72). Thus, the information obtained through this window relates primarily to the androgen-dependent response system itself, that is, to the responsiveness of the sexual response system to internal stimuli (e.g., sexual imagery and spontaneous genital responses). The responsiveness of the sexual response system to external stimuli depends, as is implied by Bancroft, on many other (i.e., cognitive and environmental) factors, the exact nature of this mechanism being less clear. We may safely conclude at this point that this aspect of sexual arousability is less dependent on hormonal influences than was once believed.

Sexual motivation, to be a functional mechanism, has to respond both to the concerns of the organism (the energetic aspect) as well as to relevant environmental cues (the situational aspect). This interactive aspect has been highlighted in models of incentive-motivation [6]. The energetic aspect *pushes* the individual towards the situation; the situation *pulls* the individual in its direction. The exploration of the mechanism of sexual motivation in humans has only recently begun. The push of motivation may increase through past experience, possibly in combination with various hormonal or other somatic factors. Motivation is ultimately dependent on the pull factors of the situation. There is no motivation to be found in the organism; it is an emerging property that will come about when all conditions are fulfilled.

Sexual Arousal. Sexual arousal may be produced by a multitude of external (e.g., visual and tactile), and internal (sexual imagery) stimuli. Furthermore, sexual arousal can be indexed with measures from three different response systems: verbal reports, physiological responses, and overt behavior [14]. An adequate model or theory of sexual arousal should help explain how stimuli acquire sexual meaning, and how they

lead to physiological (e.g., genital) responses, affective responses (e.g., conscious subjective experience of sexual arousal), and sexual behavior. Particular instances of discordance between response systems highlight the potential complexity of the mechanisms involved in the activation of sexual arousal. Psychophysiological studies have shown that correlations between self-reported sexual arousal and genital responses are variable over situations, as well as between and within subjects [15,16]. Also, differential response patterns have been found between and within investigations. The phenomenon of discordance has led Bancroft to the conclusion that "we should not assume that, as the theoretical models of arousal have encouraged us to do in the past, central arousal and peripheral arousal are linked manifestations of the same process" [10]. Thus, a comprehensive theory of sexual arousal should not only explain how stimuli derive sexual meaning and bring about sexual responses, but also help to explain the complex interrelationships between and among components of the sexual response.

Early models of sexual arousal postulate a pre-programmed sexual mechanism, which is activated by 'adequate sexual stimulation' [17]. Such models have the appealing property that they match with the experience, reported by many sexually functional men and women, that sexual arousal (in particular the genital response) seems to occur in an 'effortless' or 'spontaneous' manner. These models, however, do not fully define the concept of 'adequate sexual stimulation'. Neither do they provide an explanation for the many regulatory processes related to voluntary control of the sexual response, nor can we understand the many variations in subjective experience and the complicated within and between subjects variation in relevant stimulus and response parameters

Bancroft presented a theoretical schema for research on the sexual response, which he named the 'psychosomatic circle of sex'. Sexual appetite, central arousal, peripheral arousal, and genital response, are considered to be the four principal elements in sexual arousal. In the model, a sequential order is introduced by postulating links between: "(1) cognitive processes which influence (2) the limbic system and other parts of the brain, providing the neurophysiological substrate for our sexuality. This system in turn influences the periphery via (3) the spinal cord and reflex centres within it, which, via peripheral somatic and autonomic nerves, control (4) genital responses as well as (5) other peripheral manifestations of sexual excitement. Perception, awareness and cognitive processing of these peripheral and genital changes complete the full circle" (p.12). The second component of sexual arousal, central arousal, refers to central nervous system (CNS) activation and attentional processes that underlie the cognitive processing of stimuli. Bancroft is not very specific, however, on the nature of the cognitive processes that activate the circle in response to sexual stimuli. For example, while tactile stimuli are considered an important source of sexual stimulation, he acknowledges, without further elaboration of the mechanisms involved, that "central processes can influence whether genital stimulation is perceived as erotic" [10]. Furthermore, while Bancroft recognises the complexity of the interrelationships between and among the components of sexual arousal, he does not speculate about possible explanatory mechanisms [18]. In general, psychological processes are considered to play an important role in this model, both because cognitions mediate beliefs and expectations, and because of awareness or perception of genital and somatic changes.

In 1977, Byrne introduced his 'Sexual Behavior Sequence' model which also defines the concepts of arousal, affect, and cognition as being the major determinants of sexual behavior. It suggests that the human sexual response may be contingent upon both unlearned (e.g., tactile) and learned erotic cues. These cues may elicit physiological sexual arousal, affective (and evaluative) responses, and cognitive (i.e.,

informational, expectative, and imaginative) responses. Affect, arousal, and cognition guide and motivate instrumental acts. Such behaviors may have rewarding or punitive consequences that feed back into the system and influence subsequent behavior [8]. According to Byrne, the outcome of the sequence for an individual at a specific time "depends on the relative magnitudes of the various internal and external forces that are operating with respect to this specific individual..." [9].

Byrne's dimension of 'erotophobia-erotophilia', described in an earlier section of this paper, is one of the central concepts in the 'sexual behavior sequence' model. A large number of investigations has suggested the erotophobia-erotophilia dimension to be a fruitful one. For example, this affective response has been shown to influence individuals' willingness to experience erotic stimulation, and the degree of subjective arousal and perception of genital sensation in response to erotic stimuli [19]. Byrne's model may be viewed as the most comprehensive attempt to date which delineates relevant interactive mechanisms of sexual arousal. However, as Rosen and Beck pointed out, given the complex network of feedback loops that it contains, the model has little predictive value [18].

Another recent model concerning interactive mechanisms in sexual arousal has been put forward by Barlow [20]. His 'working model of sexual dysfunction' integrates much of what is known about the role of cognitive processes in sexuality and their consequences for emotional responses. Empirical evidence (reviewed by Barlow) has produced five factors which differentiate sexually functional from dysfunctional men. "First, sexually dysfunctional subjects consistently evidence negative affect in the sexual context, whereas sexually functional subjects display more positive affect. Second, dysfunctional subjects consistently underreport their levels of sexual arousal and generally evidence diminished perceptions of control over their arousal. Third, dysfunctional men are not distracted by non-sexual performance-related stimuli in that they evidence no decrease in erectile response, whereas sexually functional subjects are distracted and show decreases in sexual response. Fourth, dysfunctional men are distracted by performance-related sexual stimuli, whereas sexual arousal of sexually functional men is enhanced. Finally, anxiety inhibits sexual arousal in dysfunctional subjects but facilitates arousal in sexually functional subjects" (p.146).

Together, these preliminary findings provided the basis for Barlow's model. The model is strongly characterised by the emphasis which it places on the interaction of autonomic activation and cognitive processes in determining functional and dysfunctional responding. The response patterns are conceptualized as forming either a positive or a negative feedback system. Both loops start with the perception of explicit or implicit demands for sexual performance. This perception results in either positive or negative affective evaluations, both triggering autonomic arousal. This increase in autonomic arousal enhances attention for those (i.e., positive/erotic or negative/threatening) features of the sexual situation that are most salient. Continued processing of erotic cues produces genital response, and ultimately leads to sexual approach behavior. Continued processing of non-erotic issues (e.g., social consequences of not responding) produces a dysfunctional arousal pattern and ultimately leads to avoidance behavior.

A noticeable similarity between the models of Byrne and Barlow concerns the focus on affective and cognitive processes in the activation of functional and dysfunctional patterns of sexual arousal. Both models place a special emphasis on the processing of erotic cues and the perception of physiological activation as mediators of male sexual response. The perception of physiological activation ('awareness of peripheral and genital changes') is also considered to be a prominent determinant of sexual arousal in Bancroft's model. Thus, in each of the models described, psychological (affective and cognitive) processes are perceived as an important window for our comprehension of the mechanism of sexual arousal.

Orgasm. It is generally agreed that we know very little about the neuro-physiological mechanism of orgasm and the experience of orgasm [21-23]. From the literature it appears that there is a spinal mechanism which leads to muscle spasms, ejaculation in men and cardiovascular responses. The experience of orgasm seems to require input from the spinal mechanism to higher spinal and brain levels. Sensory information from the contracting muscles seems to contribute to the intensity of the experience. The existence of a separate central mechanism for orgasm is uncertain. In the few psychological studies that have been conducted, there has been some interest in orgasm as an altered state of consciousness, and in the effects of focused and divided attention as determinants of the experience of orgasm [23].

Some elements of processing

In the section on models of sexual function some useful mappings of the necessary stages of information processing have been described. We will now consider some elements, or elementary aspects, of processing.

Attentional processes. The function of attention is selection among the multitude of stimuli in our environment. One of the principal points of the information processing window on human functioning is that an organism needs to actively manage information to survive. Rescorla has put this in the following way: "...the organism (does not) willy nilly form associations between any two stimuli that happen to co-occur. Rather, the organism is better seen as an information seeker using logical and perceptual relations among events, along with its own preconceptions, to form a sophisticated representation of the world" (p.154) [24]. Thus, attention is not only relevant in the initial stage of processing; it is relevant to all aspects of processing that a subject can control. In other words, attention is related to aspects of cognition having to do with limited resources or capacities, and methods of dealing with such constraints. *Strategic processes*, although often involving attention, are distinguished from attentional processes to point at a particular aspect of control: maximizing performance [2].

Several tasks have been used in studies on sexual function to distract or to focus attention on sexual stimuli. Other tasks were designed to divide attention between sexual and non-sexual stimuli [20, 25]. In a very early study Geer and Fuhr had male subjects perform cognitive operations on digits presented to one ear via headphones; during this task an erotic story was presented to the non-attended ear. The results showed an inverse relationship between distraction and genital response; as distraction increased genital responses decreased [26]. When comparing subjects with and without sexual dysfunctions, some interesting differences appeared. It has been shown that dysfunctional subjects show a stronger genital response to visual stimuli when under conditions of distraction or divided attention. When attentional capacities are restricted by performing non-sexual tasks, distracting worries and negative thoughts are precluded. The residual attention seems to provide sustained processing of sexually arousing information [20,25]. Inhibition through attentional effects in men with psychogenic dysfunctions, as compared with functional men, seems to play a role in the reduced response to tactile stimuli. When vibrotactile stimulation is combined with the presentation of an erotic film, the probability of this inhibition decreases drastically. The combination of vibration and film has been found to result in significantly higher response than film or vibration alone [27]. The results

of the men with psychogenic dysfunction suggest that the reflexogenic erectile mechanism is highly susceptible to (central) inhibitory processes.

Several studies showed that the strategic use of attentional resources has dramatic effects on sexual response. In men it was found that functional men can produce erections promptly when required to do so. Men with psychogenic dysfunctions responded to this same requirement not with sexual responses but often with severe negative emotional reactions [20,25]. Functional women were as prompt as men in producing considerable genital arousal [28].

Encoding and Identification. Which stimuli are suitable for 'sexual' processing? The simplest model proposes a pre-programmed sexual mechanism that is activated by an 'adequate' sexual stimulus [17]. This involuntary, reflexogenic, or conditioned mechanism accounts for the effortless and spontaneous sexual experience of many functional subjects. However, this model does not provide an explanation of the many regulatory processes related to voluntary facilitation and inhibition of the response. Nor, as was pointed out earlier, can we understand from that simple model the many variations in subjective experience and the complicated within and between subjects variation in relevant stimulus and response parameters. To accommodate regulatory processes, most researchers adhere to a cognitive model. The central role of cognition in these theoretical approaches has several consequences. It is implied in the model that stimuli are (cognitively) transformed into messages that eventually result in a sexual response, subjective sexual experience in particular. Thus, a stimulus is *not* intrinsically sexual; it becomes sexual by its transformation. We have no certainty about the existence of so-called unlearned sexual stimuli. There is ample evidence that there are stimuli (e.g., tactile) that activate arousal in the physiological component of sexual response. However, this arousal alone is not sufficient to produce subjective sexual experience. This experience ultimately depends on the individual's awareness and definition of the response as sexual [29].

A second important point is that a stimulus may convey several meanings depending on the circumstances or the individual's history. Different messages, in the same or in different individuals, may thus be accessed by the same stimulus. Sexual meaning and other meanings relevant for different emotions like anxiety, anger, or elation, may be present at the same time. The different meanings will be processed as different messages which, by further processing, may develop divergent physiological and behavioral responses and subjective experiences.

A simple application of this theoretical notion is to be found in the assessment of erectile disorders. One would predict that a patient with erectile disorder, when confronted with a 'sexual' situation, will report meaning (cognitions) resulting in negative emotions, erectile failure, and avoidance of the 'sexual' situation. An interesting point is that functional males, as compared with females, seem to be limited in the conscious emotional experience of 'sexual' situations. Whereas women, concurrent with sexual excitement, report many other positive and negative emotions, reports of men are almost exclusively limited to sexual excitement [30].

Encoding and identification processes assist the processing system to recognize sexual information, by comparing incoming data with the knowledge base in memory. Thus, the answer to the question about the suitability of stimuli for sexual processing may be twofold: (i) the recognition of sexual stimuli is pre-programmed and is independent of learning from interactions with the environment; and (ii) a knowledge base is built in the course of individual development and growth. It is very difficult to decide between these options. Many skills may be mastered to an extent that for their execution, among other aspects, not much effort is needed, as such requiring little of our attentional resources. For the individual they may appear as spontaneous; and thus may seem to be pre-programmed. Therefore, information

processing may be distinguished in an automatic and a controlled mode, and there is no simple way to empirically distinguish between pre-programmed and automatic origin of processing.

There is some evidence that we encode and identify sexual information very quickly, even before we are aware of doing this. We were able to show that subliminal or unconscious priming of pictorial sexual stimuli has effects on the development of the genital response to visual stimuli. It was also established that sexual pictorial subliminal primes have considerable effects on the decision (sexual or non-sexual) about a sexual pictorial subliminal target. After completion of the decision task, subjects were subjected to a recognition test. They had to discriminate between sexual pictures that were used in the decision task (old pictures), and new sexual pictures (distractors). Interestingly, a negative correlation was found for the sexual trials between the effect of priming and recognition accuracy, indicating that priming of sexual targets was more successful at lower levels of stimulus accessibility [31].

Another aspect of encoding and identification, more specifically 'memory in sexuality', has been studied by Geer and his co-workers [32]. This research is guided by the idea that the memory structure that exists following encoding reflects both previous structures and changes brought about by the newly encoded material. Priming tasks and other tasks have been used to study relationships between words in memory and to access representations of sexuality in memory. The authors identified a general response tendency for subjects to delay or hesitate when identifying or dealing with sexual words. They argued that this hesitation may point to a strategic aspect of processing; a tendency of subjects of wanting to be certain about their decision. Alternatively, it may reflect emotional reactions to sexual material. Another interesting finding is the sex-specific differences in memories for sexual sentences. In men explicit sexual material is easily accessed, and activation is readily enhanced, whereas in women this enhancement is observed for relationship-oriented material only [33].

Response Selection and Response Production. In this stage of processing the leading question is how knowledge turns into action. A solution to this problem for anxiety has been suggested by Lang. We translated his proposal for anxiety into a model for sexual response [34]. Imagery about sexual response is based on the activation of an associative network of propositions in memory. Propositions are logical relationships between concepts. There are at least two categories of propositions: (i) stimulus propositions, which describe external stimuli and the context in which a sexual response occurs ('I see a naked man'); and (ii) response propositions, which describe the sexual response (including verbal behavior, visceral and somatic changes, and overt behavior; 'I feel excited').

Lang's model is based on the following sequence of events: Activation of response propositions starts an associated motor program, which in turn elicits the sexual and, possibly related, emotional responses. However, the activation of stimulus propositions only has an indirect effect on the sexual response. This is so because stimulus propositions are associated with response propositions, which may together increase the probability of activating response probabilities. But stimulus propositions have no direct link with motor programs which elicit the sexual response. In the context of brain-behavior studies there is an on-going debate about the relationship between motor imagery and motor representations that are related to intending and preparing movements. Arguments on how imagery turns into action seem to be far from settled [35].

In an empirical test of Lang's model as applied to sexual arousal, subjects were instructed to attend to images of sexual stimuli, or to images of sexual stimuli plus responses. During imagery the genital response and the experience of sexual arousal

were more intense when subjects focused on stimuli plus responses than when they focused on stimuli only. This effect was found in both men and women [34].

One drawback of the information processing approach in cognitive psychology is the relative neglect of motivational and emotional processes. Lang's work and that of several other emotion theorists are examples of a rapprochement between cognitive psychology and the domains of motivation and emotion. One particularly interesting point, raised by emotion theory, is the specificity of physiological aspects of sexual response as compared with patterns of physiological response in other emotions. For most of the emotions it is very difficult or impossible to specify the physiological pattern that accompanies the expression of the emotion. In contrast, the physiological pattern in sexual response, genital vasocongestion, is highly specific. After puberty, many men consider their genital vasocongestive response as a sure sign of being sexually aroused, even in the absence of any sexual feeling. Women also show a very specific genital vasocongestive response to sexual stimuli. In addition, empirical data show that women's responses to a sexual, an anxiety inducing, a sexually threatening, and a neutral film excerpt could be differentiated on the basis of self reports and physiological measures (vaginal pulse amplitude, vaginal blood volume, heart rate, and skin conductance). In terms of convergent and divergent validity, vaginal pulse amplitude was the superior genital measure. During the sex stimulus and sexual threat stimulus subjective sexual excitement and genital arousal were significantly correlated [36]. Thus, peripheral physiological response possibly informs subjective sexual excitement. It remains to be established if and to what extent these specific response patterns are helpful in generating a positive feedback or feedforward cycle, which is typical for the increasing intensity of sexual response. This issue of response specificity is of great theoretical importance, because since William James it has been assumed that physiological response patterns inform us about which emotion we actually experience [16].

Conclusion

The history of the application of the information processing approach to sexual function is a very short one. The construction of theoretical models is the crucial requirement of this approach. It will certainly help to elaborate and refine hypotheses about the mechanisms of sexual function. The published results already show the relevance of this approach. For example, having an understanding of the role of attention in sexual response makes clear that without this kind of data our sexual knowledge really would be impoverished. Another advantage of this approach to the study of sexual function is the improved quality of interdisciplinary cooperation. Psychological data often have been considered too soft or unreliable to be useful in connection with the hard data from physiology, endocrinology, and pharmacology. Recently this situation has begun to change, and is already showing exciting perspectives.

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Discussion - INFORMATION PROCESSING APPROACH AND THE SEXUAL
RESPONSE IN HUMAN STUDIES

J.R. Heiman

Could you please connect the motivational idea to the last study? And, do you see any connection between your attempt to define motivation and some of the animal researchers' attempts to define sexual motivation?

W. Everaerd

The last one is relevant. We attempt to create a paradigm to look into human sexual motivation. Starting from an incentive model, we will use abstinence as a manipulation to create motivation during experimental sessions. This is not very different from what animal researches usually do. Although I believe rats do not think, or cognitively rehearse sex, as much as humans do. Concerning your first question, we did not connect genital physiological arousal and motivation in this study. We tried to answer questions about the contribution of physiological reactions to subjective sexual experience. In addition, I can say that Lang's emotion theory is a variant of theories that try to explain the connection between emotion and motivation. Emotions, according to these theories, are supposed to activate action tendencies and may thus provide a window on emerging sexual motivation.

K. Demyttenaere

I would like to have your comment on the distraction theory because we just finished a study in dysfunctional men in which we evaluated response to intracavernosal injections and before that we were assessing their coping style. What came out of the study is that if you look at several coping mechanisms, and at the variance in erectile responses, such as maximum rigidity, tumescence and duration (the latency before response) there are always the same two coping mechanisms, a high palliative coping and a high avoiding coping, that are predictive of a bad response. Could you say that palliative coping and avoiding are distractive mechanisms? And that leads to the question of whether an external distraction such as that provided by a video could be a way of distracting them from internal distractions.

W. Everaerd

How was your setting? Did you have them look at a film?

K. Demyttenaere

No, not at all. We were just giving them the coping test and then the injection as a diagnostic intervention. We had just the Rigiscan measurements, there were no subjective measures of how they felt about it. The procedure was meant to them to be a diagnostic one using a facilitating drug.

W. Everaerd

It is very difficult to answer your question because I do not know what the men did whilst having an erection. Their expectations are important. It is important whether they consider the reaction in their penis as a sexual response and then it is very important if they were prepared to elaborate on that in a sexual way. If they did not I would not expect much of a subjective response.

B.J. Everitt

I would like to comment that there is a high correlation between states of anxiety and increased indices in noradrenergic transmission and I wonder, therefore, about the increased response to sexual stimuli that you presented; might this also be an explanation of the effects you saw?

C. Carani

Dr. Everitt, what is your expectation about the use of alpha-2-antagonists in hypogonadal men?

B.J. Everitt

I was hoping that clinicians might respond to this. I can make some predictions about the experiment I suggested which is that responses to sexual stimuli would be enhanced in the presence of drugs like alpha-2-antagonists that increase noradrenergic transmission and that there would also be reduced distractibility in the kind of procedure that Everaerd was describing. In a variety of procedures and paradigms in animals you

can demonstrate such effects but it that has never been studied in a sexual context. Selectivity in the response would most likely be an artefact of measuring it in a sexual context. A very general process may have rather specific sexual related consequences because of the situation in which you study it, which would be sexual in this case.

A.J. Riley

We have studied five hypogonadal men treated with yohimbine, in doses between 2 mg and 30 mg over the course of a month, and there was no change at all in their sexual function. All but one of them responded to testosterone at the end of the month. The patient who did not respond, responded to testosterone plus trazodone.

B.J. Everitt

I wonder if I can make an extra comment. There is a high correlation between states of anxiety and increased indices in noradrenergic transmission and I wonder whether the increased response to sexual stimuli that you presented might have that kind of an explanation.

B.J. Everitt

I wonder if I can try to make a link between cognition and psychopharmacology and address something Everaerd was saying today and some of the things we were hearing about yesterday and I think will hear about tomorrow in terms of noradrenaline. Everaerd was talking about selective attention as a process that needs addressing in the context of studies of sexuality. One of the most robust findings in the animal, and indeed to some extent human, psychopharmacological literature is that increasing noradrenergic transmission in the brain enhances selective attention. This is true in rats, in monkeys and in man. The alpha 2 antagonists enhance selective attention in rats and monkeys (by turning on the locus ceruleus) and in man this might be one of the ways in which alpha-2-antagonists can increase sexual responsiveness. So, I would like to ask a question of the clinicians working with the alpha-2-antagonists. Do they think that kind of explanation would be valid for some of the alpha-2-antagonists-induced changes they see in sexual response? I would also like to ask Everaerd whether he might be prepared to do an experiment where he looks at the effects of

alpha-2-antagonists on attention to sexual stimuli with and without distraction and also in a subliminal cue exposure experiment? My firm prediction is that those responses will be enhanced in the presence of drugs that activate the noradrenergic system.

J.R. Heiman

I think it would be important to do that in both men and women. The reason why I am saying that is because of this whole issue of the focus on erection as being so much of its own selective attention device in humans. You cannot remove that effect, but it would be interesting to see if there were any differences in terms of selective attention using alpha-2-antagonists in men and women.