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Behavioral and psychophysiological approaches in women

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Introduction

There exists a notable dearth of research examining pharmacological effects on the psychological and physical components of the sexuality of women. This lack is in striking contrast to the relative volume of research on men. Although the reasons for this imbalance are important, the present paper is instead focused on specific methods that have already shown potential to address an important segment of knowledge regarding women, namely the connection among genital response, cognitive subjective states, and reported sexual behavior. The purpose of the following remarks is to examine: (a) pertinent key behavioral and psychophysiological methodological issues; and (b) selective research findings in two promising research areas, aging and sexual dysfunction.

Why might it be important to understand the impact of pharmacological agents on women's sexuality? Women in industrialized countries have access to an increasingly broad array of medicinal and recreational pharmacological agents. It is quite possible for a woman to be on hormonal compounds in order to manage contraception or menopause for the majority of her adult life. Women also make up a larger percentage of the depressed population [1,2] and an equal to slightly greater percentage of the anxiety-disordered population in the U.S. [3,4]. In both categories of disorder, pharmacotherapy is a frequent intervention, involving the prescription medications known to impact sexuality. Finally, women outlive men, and medication usage increases with age.

Above and beyond the quantity and context of pharmacological use is the fact that sexuality can be impacted by any drug or condition that affects the vascular, neural, or hormonal systems, which are commonly the precise targets of a given agent. In short, as one might expect, a significant number of drugs can and do impact sexual response in either an inhibitory or an excitatory way. Methods for studying these impacts, particularly those that attend to effects on both physiological and subjective sexual response, would help to document prevalence and specificity of effects on sexuality. The results would contribute to a more thorough evaluation of a given drug and its potential sexual response risks and benefits, as well as a clearer understanding of sexual desire and response.

Methodological issues

Human sexual research requires attention to biological and psychosocial factors interacting in an often method-defying complex manner. Researchers who focus on just one domain, as is often necessary, are not free of the influence of the other simply because their subjects are not. Behavioral and psychophysiological methods have the advantage of being able to focus on more than one domain.

Behavioral approaches

Behavioral research measures are primarily self-reported frequencies or intensities of sexual feelings, responses, and activities. Physiological measures may be included to confirm, for example, vital signs, drug, or hormone levels, but the direct measure of the genital response during monitored sexual activities is excluded from the behavioral approaches. The behavioral approach is an extremely important methodology and one that is most often relied upon to test pharmacological effects where subjective response is a primary outcome variable of concern (e.g., anxiety, depression, pain). Indeed, self-report is a critically important variable to collect as reliably and validly as possible, since, without it, a pharmacological agent's effect on human sexuality may have little value. A medication designed to facilitate sexual desire is dependent upon a person's reporting this effect with some consistency.

There are several issues which impact the collection of valid and reliable self-reports of sexual response. One is social desirability, where individuals may intentionally or unintentionally give a response that either is self-deceptive or impression-managing to fit their broader sociocultural values of what is desirable and appropriate. Thus, a woman raised to inhibit and not discuss sexual feelings may have trouble acknowledging increased desire and arousal in a research study. Another issue is the possible avoidance or reinterpretation of sexual feelings. For example, some women may identify sexual arousal as anxiety [5]. A third issue is faulty recall of feelings or activities. While there is no flawless solution to these problems, there are choices which can minimize some of their effects. Regarding social desirability in responding, there is reason to believe that this may not be a trait across all situations, but may be situation specific, though this supposition is yet to be convincingly tested. In either case, there are options to evaluate sexual defensiveness with a scale by Jemail and LoPiccolo [6], though this measure was normed on heterosexual men and women in ongoing relationships and, thus, may be less appropriate for single, homosexual, or bisexual men and women. Alternatively, there are several measures of general social desirability constructs, one of the most promising recent examples being that developed by Paulhus [7]. Social desirability is more of an issue in questionnaire research, but may impact experimental work if subjects are unbalanced across groups on this dimension. With regard to the problem of avoiding and reinterpreting sexual feelings, some individuals with these issues will self-select away from studies that obviously involve sexual questions. However, study avoidance may not occur to individuals who are in clinical trials testing blood pressure or psychotropic medications where sexual side effects are only incidentally questioned. In these latter cases, relying on questions of behavior (masturbation, manual or other nonintercourse sexual contact, coitus, orgasm) *rather than feelings (desire, fantasy, satisfaction) would help skirt this issue,* though certainly not solve it. Regarding faulty recall, this may be influenced by measurement strategy (such as providing more frequent behavioral checks) and by collateral reports from partners for those participants who are in relationships. Again, the collateral check works well with partner-related activities, but not private experiences. Although active misrepresentation of reporting of sexual behavior is also possible, it is probably infrequent in volunteers for studies with a known focus on sexuality.

A related issue in collecting reliable and valid self-report data is the relationship between the research team and the participants. A respectful, collaborative attitude between researcher and participant is likely (though to my knowledge not yet proven) to produce a greater participant commitment to seriously and honestly cooperating with the goals of the study. Survey researchers and those involved with qualitative methodologies have been more explicit about this issue than experimentalists typically have been.

The measures used to assess sexual feelings and behavior need to sample the following domains: *sexual desire*, *sexual arousal* (including lubrication), *orgasm*, *pain*, and *pleasure and/or satisfaction*. Each of these domains could be evaluated by *frequency* and *intensity* across different activities (kissing, sex play, manual stimulation, intercourse). The capacity to evaluate both individual and couple-dependent activities may be important, as relationship distress and partner availability may impact an individual's sexual activities. One reasonably brief measure that can be used as a basis for sexual behavior and feelings variables is the Brief Index of Sexual Functioning for Women by Falotio-Taylor et al. [8]. Additional questions would need to be added to this measure if intensity of experience or latency of responses were central to a study. In addition, the frequency response scales are geared to a monthly reporting frequency, which is probably too long for most experimental behavior studies. The sampling of sexual activities with daily cards may provide an accurate account, especially for high frequency behaviors, but in some cases weekly cards may work as well.

Certain characteristics of research participants are particularly likely to impact sexual functioning and will need to be controlled or matched unless they are used as independent variables: age of participant; marital/relationship status (ongoing, living together v. single); length of relationship; mental and physical health; medication and substance use; partner's age; and, less certainly, menstrual phase and menopausal status. In 436 randomly selected heterosexual women and their partners in Oxford, England, Hawton and colleagues found that sexual intercourse, orgasm, and enjoyment of sex were most closely associated with younger age and more positive marital adjustment [9]. Yet partner's age appeared to be an important negative influence on intercourse frequency, and relationship duration negatively impacted the enjoyment of sex. It appears that age itself has a fairly gradual negative impact on sexuality, with menopause contributing to the decline to a greater or lesser extent than aging, depending upon a given study (e.g., Hallström [10] v. Greene [11]). If women in relationships are selected for a study, partner sexual functioning, partner availability to be sexual, and relationship adjustment will need to be evaluated.

Menstrual cycle-related fluctuations in sexuality are inconsistent across women except for a clustering of sexual activity before and after menstrual flow [12,13], while menopause appears to impact sexual response through specific vaginal lubrication declines and nonspecific and variable changes in well-being [14,15].

Psychophysiological approaches

Psychophysiology as a methodology offers an opportunity to examine both physiological and psychological components of response to a sexual stimulus in a relatively standardized laboratory setting. Typically in sex research, a psychophysiological approach assumes a physical measure of genital response

is included in the design, though technically this is not required. For our purposes here, a direct genital measure is critical. Serious use of psychophysiological methods with women dates back only as recently as 1975, when Sintchak and Geer [16] developed a reliable and practical genital device, the vaginal photoplethysmograph. Subsequently, modifications and additional measures became available [17]. The genital measure was quickly found to have more discriminant validity for sexual response than had earlier measures of EMG, heart rate, and skin conductance. The availability of the vaginal photoplethysmograph allowed a door to be opened for female sex research, which some 20 years earlier had been available to research with men using strain gauges and volumetric measures.

The psychophysiological approach can be appropriate to test the effect of drugs on subjective and genital changes. A variation of this approach is to measure genital changes during self-stimulation in the laboratory, with or without medications, in a repeated measures within subjects design. The genital area of the greatest interest for measurement has been the vagina, given its early vasocongestive response and the fact that the clitoris presents more measurement problems because of its size, sensitivity, and movement during sexual arousal. It should be noted that a number of vaginal measures have been attempted, including the measurement of lubrication, but most were found to be impractical or imprecise.

Although there are several approaches currently available to measure genital response in women, a brief review of the two more frequently used measures reveals different advantages and disadvantages and indications for use. For a review of other measures see Rosen and Beck [17] and Levin [18].

The vaginal photoplethysmograph consists of a tampon-shaped and -sized device, typically 2cm and 5cm. An infrared LED light source and a phototransistor detector (modified by Hoon et al. [19] from the original device) are encased in the acrylic probe and allow measurement of the amount of back scattered light to the phototransistor. Due to the differences in transparency between engorged an unengorged tissues, this probe provides an indirect measure of vaginal vasocongestion. The measure provides both AC, vaginal pulse amplitude (VPA), and DC, vaginal blood volume (VBV), signals. VPA appears to reflect short-term changes in vasocongestion, with larger amplitudes of the pulse wave of the cardiac cycle signalling greater vasocongestion. VBV appears to measure slower changes of pooled blood in the vaginal tissues. The advantages of the vaginal photoplethysmograph include the following: (a) it is comfortable and easy to place; (b) subjects can be instructed and place it themselves; (c) it is easily sterilized; (d) its placement can be somewhat controlled using a sterilizable acrylic plate attached to the cable [20]; (e) it has been found to be a sensitive and valid indicator of sexual arousal [19,21,22]; (f) it can be used for experiments of over 1 hour without harm to the subject [23]; and (g) it has been validated to discriminate sexual from nonsexual stimuli [21,22].

Disadvantages of the vaginal probe are that: (a) there is no absolute calibration of blood flow in ml/min, thus data must be reported in relative units; (b) the AC and DC signals are not completely understood in their relationship to vaginal vasocongestion; (c) there is considerable evidence suggesting that VPA is a more

sensitive indicator of sexual arousal, while VBV is less reliable and more unstable across time [21,22,24,25], thus using both measures may be informative until more is understood about each signal; and (d) the probe is subject to movement artifact if masturbation is part of a particular methodology [26].

Another device, less frequently used, is called the heated oxygen electrode, which measures oxygen partial pressure (pO_2) and heat dissipation. This measure was developed for vaginal use by Levin and Wagner in 1978 [27]. The device consists of a 2cm x 0.5cm round oxygen electrode, made of a platinum cathode and silver anode and covered with an oxygen permeable hydrophobic membrane. Applying a polarizing voltage to the cathode results in pO_2 levels, calibrated in mm Hg, which are the result of the current generated by the reduction of oxygen at the cathode. The electrode is attached to the vaginal wall using water suction. The energy required to keep the probe set at a constant 43°C is related to the thermal conductivity of tissue under the electrode and provides a reading in milliwatts. This device has been used to measure vaginal blood flow (electrode power consumption) and vaginal surface pO_2 under several conditions, including self-stimulation to orgasm, where power consumption increased above baseline until orgasm, then fell slightly and only gradually decreased and was still quite elevated 20 minutes following orgasm. A similar but less dramatic pattern was found for the pO_2 measure [28].

Advantages of the heated oxygen electrode include: (a) the capability to calibrate if in absolute units; (b) it is not influenced by movement artifacts; and (c) it appears to be a stable measure, though there has been essentially no data on within-subject reliability of basal arousal states. In terms of disadvantages: (a) it cannot be used over 1-1.5 hours with the electrode at the same skin site due to possible local tissue damage; (b) it must be placed by an experimenter; (c) it is somewhat more cumbersome and expensive as a measure; and (d) almost no work has been done using it in combination with self-reported arousal and pleasure, or validly discriminating erotic from nonerotic psychological stimuli.

Overall, the heated oxygen electrode and the vaginal photoplethysmograph offer good opportunities to monitor different aspects of vaginal hemodynamics. Yet we know perilously little about underlying physiological mechanisms (as much of this work essentially halted by the mid-1980s) as well as corresponding subjective intensity and pleasure measures. Similarly, test-retest reliability and patterns of response of self-stimulation in comparison to erotic materials are unknown and deserving of serious attention. What we do know about both measures is that they appear to detect very early arousal and that sexual arousal itself begins almost instantaneously (as measured by these two vaginal devices) with clitoral or effective psychological stimulation.

While genital measures have attracted researcher attention as the more accurate or "true" markers of sexual experience, the majority of psychophysiological studies have found revealing and perplexing differences between genital and subjective measures of arousal [17]. Examples will be described in the next section. The typical approach to subjective measuring is to ask subjects, using a Likert scale, how sexually aroused they were during a specific experience in the laboratory [5,21,29]. Questions about genital response such as warmth, pulsing, or lubrication may also be relevant for women, but are in fact different from a global subjective sense of "sexually aroused." In some

designs, it is useful to measure subjective arousal using a continuous measure, such as a lever, with which a subject indicates arousal level. While this technique does not appear to impair genital response, it does not necessarily produce higher correlations between self-reported sexual arousal and genital vasocongestion [30]. Other emotions such as disgust, attraction, sensuality, guilt, anger, and pleasure can be important to tap in certain design conditions. Both "negative" emotions (including guilt and disgust or dislike) as well as "positive" feelings (such as pleasure, enjoyment, and interest) have been found to correlate with vaginal response, depending upon other factors of a particular study [31]. Overall, it is important to gather subjective measures of arousal as well as affective context in which the arousal occurred since both may be important factors interacting with genital patterns of response.

Promising research areas

It is not possible to carefully review each of the behavioral and psychophysiological studies of women in these brief remarks. Thus, I will make some selective comments with regard to two areas which address common problems for women and where behavioral and psychophysiological approaches have already begun to illustrate their advantages and limitations.

Aging

One aspect of aging in women is menopause. Experimental research interest thus far has concentrated on menopausal changes more or less to the exclusion of other topics in research on women's aging. This is simply where the field is at this time. Certainly menopause is an important topic. It affects all women, it has known physiological and psychological effects, though the latter are less consistent across women, and it impacts sexuality.

The behavioral research on menopause, including surgical menopause, has produced important and interesting findings. As a background, correlational studies such as Lieblum et al. [32] have documented that postmenopausal women who were sexually active (sexual intercourse at least three times per month in the year prior) had less vaginal atrophy than women who were defined as sexually inactive (intercourse less than ten times per year). In addition, women with less vaginal atrophy had higher mean levels of androgens (androstenedione and testosterone) and gonadotrophins. Retrospectively, these groups claimed comparable frequencies of sexual activity premenopausally, although the less active sexual cohort reported nonsignificantly lower activity scores. Given the correlational and nonprospective nature of this study and the fact that the authors found that the androgens accounted for more of the vaginal atrophy variance than did current intercourse frequency, the results may have reflected higher behavior was driven by androgen levels, and sexual intercourse frequency thus was an artifact of this relationship. Conversely, later research by this team found that free testosterone levels failed to discriminate between a sexually inactive and sexually active sexagenarian (60-70 years old) sample, though these hormone levels were associated with reports of increased sexual desire [33]. This latter study is a helpful reminder that interpersonal sexual

factors can be important determinants in sexual frequency, as nearly 50% of the women in the study reported that their partners had difficulty achieving and maintaining an erection.

To sort out some of the confounds in this area, the hormone-sexual behavior work by Sherwin and colleagues [15,34,35,36] on surgically menopausal women has been quite helpful, though one must keep in mind differences between surgically menopausal (younger, more sudden and absolute loss of hormones, experience of a major surgery) and naturally menopausal women. Controlled and prospective, these studies randomly assigned women postsurgically to a variety of estrogen or androgen combinations. Their findings have shown that: (a) all women treated with hormones have more positive moods than those given placebo; (b) the women who took an estrogen-androgen combination or androgen alone had greater energy and sense of well-being than women with estrogen alone or placebo; and (c) women receiving androgen compounds reported enhanced sexual desire, arousal, and increased frequency of sexual fantasies (these variables being at a similar level to a control group who underwent hysterectomy without oophorectomy). Coitus and orgasm frequencies did not differ in response to various hormone treatments, except during the 2 weeks following the injection of an estrogen-androgen preparation when androgen levels were supraphysiological. This is an example of the importance of assessing individual as well as partner-dependent sexual activities (interestingly, reports of masturbation were not gathered). These results have been upheld in research on women who had been maintained on hormones for at least 2 years. This work tells us a good deal about the importance of testosterone for some aspects of women's sexuality and some of the differential effects of different hormone preparations. Certainly many further questions remain regarding clarifying menopausal changes when hysterectomy is not involved.

Psychophysiology has been used with interesting, conflicting, and incomplete results. Semmens and Wagner [37] demonstrated, using the heated oxygen electrode, a decrease in vaginal blood flow with decreased estrogen presence, comparing estrogen-treated and -untreated women. No elicitation of sexual arousal via self-stimulation or by erotic materials was used in this study.

Myers and Morokoff [38] compared premenopausal women, postmenopausal women without estrogen replacement therapy (ERT), and postmenopausal women with ERT. The design included an exposure to erotic and neutral videotapes while recording vaginal pulse amplitudes, self-reports of sexual arousal, and other affective responses. Serum was collected and analyzed for luteinizing hormone, testosterone, estrone, and estradiol. VPA to the erotic stimulus did not differ across these groups. However, postmenopausal women not taking ERT reported significantly less vaginal lubrication to the erotic videotape than did the ERT or premenopausal group. Estradiol was correlated with reported lubrication, but not VPA. Testosterone was modestly correlated with reported vaginal lubrication and breast sensation, and LH was negatively correlated with reported lubrication. This study has been criticized for combining naturally and surgically menopausal women in the ERT group (but not the non-ERT group) which could affect sexual response [14]. However, a later report by Myers et al. [39] reported only two of the 14 ERT women has undergone hysterectomy, suggesting little impact on the study's conclusions. The stimulus

material may also have been a problem since the erotic videotape was rated more negatively than the neutral videotape, potentially dampening genital and subjective responses. On the other hand, the suggestion that estrogen may be related to perceived increases in vaginal lubrication during an erotic tape, but not necessarily determine vaginal vasocongestion responses to an erotic stimulus, may be important.

Myers and colleagues [39] repeated some of the measures in the Myers and Morokoff study, but instead used a double-blind, prospective design comparing Premarin, Premarin and medroxyprogesterone acetate, Premarin and methyltestosterone, and placebo. Again, there were no significant differences between women on the different preparations on VPA or VBV. In addition, there were essentially no significant mood or sexual behavior differences except for reports of significantly increased pleasure during masturbation in the group taking the Premarin with testosterone.

If we try to summarize the findings thus far combining the behavioral and psychophysiological methodologies, it appears that androgens are important for the desire, fantasy, masturbation, and related self-dependent sexual activities; estrogens impact lubrication and may impact resting levels of vasocongestion [37] but to date there is insubstantial evidence that exogenous estrogens in postmenopausal women facilitate vaginal vasocongestion in response to an erotic tape. Given that I could only locate a total of five psychophysiological studies on menopause, few conclusions can be stated. The most obvious and helpful next step would be a prospective study on menopausal women examining responses to both self-stimulation and erotica under estrogen, androgen-estrogen, androgen, or placebo compounds, but using the heated oxygen electrode measure. The reason for the measure choice is that it is possible, given Semmens and Wagner's [37] results, that vaginal vasocongestion baselines shift in postmenopausal women, which in turn may influence relative change measures during erotic stimulation. Movement artifact would be an additional reason for measure choice. Another interesting direction would be to study groups of women who were 10-12 years beyond their last menstrual cycle, as this group may have had more time for menopausal effects to become established. A number of research challenges present themselves within this topic, including sample selection bias, the difficulty of finding age-appropriate erotic stimuli, and the problems of matching older groups due to complex health issues and partner availability. Nevertheless, there are potentially valuable contributions to be made from a behavioral and psychophysiological approach to understanding this life transition and some of the psychoneuroendocrine contributions to women's sexuality.

Sexual dysfunction

In spite of the fact that sexual complaints are common in women, perhaps more common than in men, there have been few experimental studies examining differences between those who do or do not suffer from a sexual dysfunction such as low desire, low arousal, or lack of orgasm.

One area that has begun to be explored is that of the effect of performance anxiety and anxiety on sexual response. "Performance anxiety" was coined by Masters and Johnson [40], who appeared to focus on the psychological consequences of performance fears, primarily viewing them as distracting and

interfering with an individual's sexual response by "blocking the reception of sexual stimuli" [p. 13]. Kaplan [41] and others not only recognized the psychological component of performance anxiety but also saw the possibility of a more generalized sexual anxiety with the accompanying physiological arousal as a problem for sexual response.

After a significant body of work on this concept in men [42], suggesting that anxiety was not in fact inhibiting sexual response, similar ideas have begun to be explored with women. This work was started by Hoon et al. [43] who found that sexual arousal was enhanced in sexually functional women by exposure to an anxiety-evoking film rather than a relaxation film prior to viewing an erotic stimulus. Palace and Gorzalka [44] took this idea a step further by comparing sexually functional and dysfunctional women who experienced a pre-exposure neutral or anxiety-producing film followed by an erotic video. In both groups, anxiety pre-exposure significantly increased VBV response to the erotic material. Also, dysfunctional subjects showed significant increases only after the anxiety pre-exposure, while functional subjects showed significant increases after both anxiety and neutral pre-exposure. Increased VBV after anxiety was true for 100% of clinical subjects. Subjective sexual arousal was significantly less for both groups following in the anxiety/erotic condition than the neutral-erotic condition. No significant between-group subjective sexual arousal effects were found for either condition. The authors argue for a more significant role for the sympathetic nervous system than previously assumed in sexual response, and their data encourage further work in this direction. Still, the design of the present study does not preclude the possibility of a rebound effect from the anxiety stimulus, the withdrawal of or relief from anxiety being the critical ingredient.

A different approach to the anxiety issue is a focus on the more classical performance anxiety already discussed. Laan et al. [29] have examined this issue in sexually functional women. They compared demand instructions ("Try to become as sexually aroused as possible within the 2 minutes and then maintain it") to nondemand instructions ("Focus on sexual enjoyment and pleasure . . . your arousal level is unimportant") during an erotic film and self-generated fantasy. Demand instructions resulted in higher VPA during the fantasy. For subjective sexual arousal, there was greater response during the demand condition, unless the film and demand condition occurred first. The continuous lever measure of subject arousal yielded lower correlations with vasocongestion and appeared to be more sensitive to order effects than discrete ratings of sexual arousal.

A final example is used with permission from the authors, as the paper is in submission at this writing. Meston and Gorzalka [45] showed a facilitary role for sympathetic activation in female sexual arousal. They exposed 35 women to two experimental sessions in which they were exposed to two conditions in counterbalanced order. The "no-exercise condition" viewed a 3-minute neutral film and 3-minute erotic film in counterbalanced order. The "exercise condition" was identical to the no-exercise condition except it was immediately preceded by 20 minutes of cycling on a stationary bicycle at a constant 70% of their estimated VO_2 max (pretested and determined in an earlier session). The results indicated that vaginal vasocongestion measured by VPA and VBV was higher in the exercise condition. Evidence that sympathetic activation occurred was that

heart rate was higher through the film conditions of the exercise group, an important, and in prior studies undetermined, validity check on sympathetic response. There were no differences in subjective arousal between the exercise and no-exercise conditions.

The above studies suggest that conceptual hypotheses can be tested in clinical and nonclinical samples, and that genital response and subjective response may be tapping overlapping but independent domains in women. This is an important methodological point, suggesting both measurement categories are important descriptors of women's sexuality. Additional contributions have come from Dekker et al. [46]. Using Lang's [47] information processing ideas, they found that male and female subjects encouraged to focus on sexual stimuli as well as sexual responses during a semi-structured fantasy showed stronger subjective and genital sexual arousal than subjects asked to focus on sexual stimuli only. In addition, there were stronger genital-subjective correlations during stimulus plus sexual response focus.

Because it relates to these issues and because it is the only one of two (the first being Wincze et al. [48]) psychophysiological studies to date of women before and after therapy for sexual arousal and orgasm problems, I will speak briefly of a study by Morokoff and Heiman [5]. Clinical (n = 11) and nonclinical (n = 11) subjects were compared in their responses to erotic tape and film and fantasy over two sessions four months apart, which was before and after 14 sessions of modified Masters and Johnson's style sex therapy with partners for the clinical group. VPA responses were equivalent between groups, though with nonsignificant differences in greater clinical response to the tape and fantasy posttherapy. Subjective sexual arousal was rated as higher for the nonclinical than the clinical group before therapy in Session 1; there were no differences on subjective measures in Session 2 (posttherapy). All eight of the nonorgasmic subjects became orgasmic in treatment and improved 1 standard deviation on a sexual rating scale. Three clinical subjects increased their orgasm frequency and stimulation. For clinical subjects, VPA was correlated with self-reported "anxiety" (r = .72) during the first session. For nonclinical subjects, VPA during the tape negatively correlated with bored (r = -.68) and offended (r = -.70) in the first session, and with liked (r = -.69) and enjoyed (r = -.67) in the second session. Small sample sizes may have precluded further findings, but this study does suggest that significant clinical improvements may be related only modestly to laboratory measures, except those which fit more closely with the subject's treatment experience. For example, the nonsignificantly improved VPA response during fantasy and tape for the clinical subjects may reflect that there was considerable therapy attention devoted to fantasy and developing arousing images and experiences. In addition, the labelling of arousal was an important component of treatment, and the two groups labelled their arousal as equivalent at Session 2. An added issue is the variability of VPA in response to erotic stimuli; the greater the potential erotic response to the stimuli, as one moves from fantasy to tape to film, the greater the variability of VPA response.

A prior study by Wincze and colleagues [48] found that five women with arousal problems demonstrated no posttherapy changes in behavioral or physiological (VBV) measures of sexual arousal. In this study, it was somewhat unclear whether significant clinical changes had occurred on the target

symptoms, as opposed to the reported increase in overall satisfaction as a result of therapy. It is also possible that the levels of vasocongestion measured in both of these studies are not relevant for the diagnoses reported in that the physiological problem actually happens at a later point in the sexual arousal pattern. Hoon et al. [49] propose this idea based on three case studies using the heated oxygen electrode.

Recommendations

As becomes evident from the preceding sections, both behavioral and psychophysiological approaches to understanding women's sexuality contribute important perspectives, but are also unsettling because of data inconsistencies across studies and the fact that there are so few studies overall. Where does the work particularly need to develop?

Methodological issues remain troubling. Genital measurement currently has the problem of either restricted interpretability (vaginal photoplethysmograph) or restricted time use (heated electrode probe), and questions about use for repeated measure designs and the capacity to return to baseline (perhaps all but the AC measure of the vaginal photoplethysmograph). Certainly other measures deserve attention that might be able to mitigate some of the disadvantages, and one would hope for increasing attempts at multiple measures from a single probe or electrode, and eventual access to transistorized instrumentation. Technical problems have also plagued the development of a good direct measure of lubrication, which would be quite useful in studying older or posthysterectomy women. In all of the current measures, the field would also benefit from more reliability data regarding individual baselines and response patterns across repeated exposures and throughout the menstrual cycle, as Schreiner-Engel et al. [13] and Laan and Everaerd [50] have suggested. To help evaluate the photoplethysmograph's baseline measure, concurrent or sequential (in the same sessions) measurement with the heated oxygen electrode would be useful, this comparison repeated weekly across 2 months. Direct comparison of a variety of genital measures simultaneously in response to stimulation is of interest and has been at least partially attempted by Henson et al. [51].

Subjective measurement of sexual arousal remains a very overlooked issue. Our fascination and more obvious difficulties with the genital measures may have distracted and lulled us into complacency about the self-reporting of arousal. This is in spite of discordance between subjective and genital measures, which appears to be determined by a variety of factors. The scientific issues with the subjective measure are: (a) what does the construct of sexual arousal mean to an individual women (what psychological and physical signs might she take into account); and (b) how consistent is that construct across different erotic situations (watching a film, hearing a story, being touched by a partner, masturbation)? Cognitive information processing approaches and qualitative methods may be helpful in addressing this issue [52,53]. Currently, methodologies need to be careful to ask about overall sexual arousal, maximum arousal, and perceived genital response, and possibly include self-reported emotional and psychological sexual arousal as distinct from physical sexual

arousal. For those studying orgasm intensity, the same considerations may apply as the physical recordings of the orgasm experience do not seem to be necessarily correlated with the subjective ratings of intensity (Bohlen et al. [54]; Levin and Wagner [55]) with the possible exception of increased heart rate being correlated with increased subjective orgasmic intensity (Levin and Wagner [55]).

Basic research on women's physiology during sexual response could be very valuable. As Levin [18] has reviewed, we have tentative but interesting leads from research thus far about vaginal circulation, the role of neuropeptides in genital tissue, neural control of vaginal response and its smooth muscle functioning, and cervical functioning. Still we have remarkably little understanding of the physiological processes which may facilitate or inhibit sexual arousal. In addition, developments in these areas interact with new genital measurement possibilities.

Another area of consideration is *erotic stimulus* development. As mentioned, videotapes appear to be the most arousing, followed by audio tapes and fantasy. A recent study found slides of too low an erotic value to use with women [50]. Consideration needs to be given to the development of individualized stimuli in conjunction with standardized materials. Content factors thus far have been rarely analyzed, and may change with a given generation or subculture. We do know that a number of subjects report negative feelings to erotic stimuli. The extent to which this is a problem, or in some cases may contribute to a tension that facilitates arousal, is unknown. A final issue with erotic stimuli is that the sexual response to them has not been compared to masturbation-induced arousal patterns, a potentially useful analysis in attempting to understand connections between some aspects of women's sexual response patterns.

Within the current methodological constraints and imperfections, it is still possible to explore several important topics, including the impact of medications, disease, and sex therapy on sexual response patterns. An extremely relevant topic, for example, is the effect of antidepressants on women's sexual response and behavior. A prospective psychophysiological-behavior study would be very appropriate to address this fairly obvious and surprising omission. If the vaginal photoplethysmograph is used, one would need to consider using two samples before and after medication adjustment in comparing neutral to erotic stimuli and fantasy. If there were questions about the medication affecting baseline vasocongestion levels, the heated oxygen electrode might be the better choice. Behavioral data from outside the laboratory would also be important. A variety of other medications or experimental substances believed to impact sexuality, such as yohimbine [56] and alcohol [57], deserve further attention from a psychophysiological perspective. Given its ease of use and return to baseline, the vaginal probe may be most valuable when short-term drug effects are studied, such as the rapid infusion of a stimulants or depressants in responses to erotic material.

Using the psychophysiological approach to understand the impact of disease on sexuality has been underexplored, with the exception of two studies on diabetes [58,59]. This is in spite of many diseases occurring during years when a woman would be expected to be more sexually active. With the diabetes studies, the labial thermistor was found to be a measurement problem [58], and

the photoplethysmograph discriminated matched diabetic and nondiabetic women on VPA but not subjective responses [59]. An additional strength would be to use the heated oxygen electrode, given that Slob [58] found an unexplained higher baseline temperature in the diabetic sample. Other diseases could be examined, with measurement choice depending upon the importance of the different advantages and limitations already listed.

Within the sexual dysfunction/sex therapy area, the current direction to tease out conceptual elements believed to be related to dysfunction, such as anxiety or distraction, or to test specific elements of treatment, such as masturbation or sensate focus, may be more productive than broad scale outcome studies. This is not to discourage the latter, but to encourage research to more closely match what we know clinically about dysfunction and treatment with the advantages and limitations of testing moderate levels of sexual arousal in a laboratory setting.

Given what we know so far about psychophysiology, it has the most to contribute to understanding processes of sexual arousal and the impact of specific physical or psychological stimuli on sexual response. It is hampered by measurement issues that still need further development, as well as the somewhat intrusive though not invasive nature of the genital measure which appears, as part of the whole laboratory context, to select subjects who are more experienced or more easily responsive, at least among nonclinical samples [60]. In addition, the time and expense of looking at psychophysiology before and after various types of treatment is an important factor. On the other hand, psychophysiology offers opportunities to clarify sexual response patterns that have not begun to be examined, and that may be important if we are to understand more precisely how drugs, treatments, and change in health and mood might precisely impact sexuality. Behavioral and psychophysiological studies thus offer an additional approach to clarify the processes and the agents that impact women's sexuality.

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Discussion - BEHAVIORAL AND PSYCHOPHYSIOLOGICAL APPROACHES IN WOMEN

R.C. Rosen

The fundamental issue that you raise about why pharmacology of sexual behaviour has been so underexplored in women is a very fundamental issue. One thought that comes to my mind is that in the last few years most of the sexual pharmacology studies in men have focused on erectile disorders whereas the sexual arousal disorders in women are not as prevalent. What we see clinically are anorgasmias and low sexual desire and both of those areas have been much less accessible to pharmacology studies. But that is a relatively technical explanation, while you may have some thoughts also about socio-cultural reasons about why we have seen so little work on sexual pharmacology in women. The other observation is that listening to your presentation I am struck with the discordance issue in women. One of the most persistent and interesting questions in human sexual psychophysiology has been that among males with, some exceptions, generally one gets a fairly close concordance between physiological measures, particularly penile tumescence, and subjective reports, while in women that relationship has been much more variable. Some studies have been able to achieve a fairly high concordance rate but many other studies, including the most recent research that you presented, report a discordance in the sense that vaginal photoplethysmography measures move in one direction and the self-report measures move in another direction.

J.R. Heiman

I think we do not know all the reasons why there is a discordance. It could be a measurement problem, it could be a focusing problem or it could be a stimulation problem. In other words, the stimuli we use may be of a certain type, and I do not just mean intensity. Women frequently have a negative affective reaction to erotic stimuli in a number of psychophysiological studies, and I think that may change how they rate their arousal to that material. Another issue is that I do not think we understand the construct of sexual arousal, how women really define their sexual arousal, what they use to define it. Do they use genital responses or an overall feeling or something else?

What types of physical experiences are translated into psychological perceptions of arousal? I think that this would be a good basic research focus, though it is very hard to get funded. I think also that subjective and physiologic reports are independent but overlapping domains that sometimes are concordant and sometimes not. It has been shown that even with orgasm intensity, when people are masturbating in the laboratory and they rate their orgasm, the ratings do not necessarily correlate with the strength of the number of genital contractions. In one of these studies it was found that heartbeat was the only measure that seemed to be related to the intensity of the orgasm.

G. Wagner

If I first may continue on that so called discordance between subjective and objective observations in females. I think it is very simple because there is no physical sign of slight stimulation. Any man who has a minor change in the volume of the penis is able to see that and to feel that very clearly, but a woman is not able to feel, say, a 10 or 15 % increase in the circulatory system of the vagina. In our study about the subjective and objective correlates of orgasm in women we found that the duration of orgasm, which is similar to that in men (22 $\pm$ 3 seconds) was evaluated subjectively to be much shorter. This was in accordance with data in the literature but there was also a new finding: when they signalled, they did signal a longer feeling of orgasm. We could not identify any parameter (respiration, heart rate and a series of other things) as predictor of the subjective intensity of the orgasm.

W. Everaerd

In my group we studied this problem with a psychophysical approach. From the point of view of psychophysics, changes in a physiological variable need to be large enough to allow discrimination between two intensities of that variable. We compared trials with sexual stimuli of increasing intensity, stimuli of equal intensity and repeated exposure to the same stimulus. Stimuli of increasing intensity produced significant changes in genital vasocongestion. As predicted correlations between genital arousal and subjective sexual excitement were highest for this 'increasing intensity' trials as compared with the 'equal intensity' and 'same stimulus' trials.

H. Heiman

Well you also have your work showing that if people focus on both the responses that they are experiencing as well as the stimulus, using an information processing model, you get higher correlations. But to come back to the need for further studies in women, I think that we do simply do not know enough and that one of the reasons why psychopharmacology of women's sexual response has been ignored may have to do with the greater attention to impotence. Certainly psychosocial factors interacting with scientific agendas have contributed to this imbalance: We have only a handful of studies on neurophysiological responses in women, not enough, with almost no replications. More technical people could help improve our instrumentation for genital responses. Subjective measures also deserve more development. In general, we need indeed a lot more basic research and information on womens's sexuality.