ANALYSIS OF THE CONSISTENCY OF OBJECTIVE MEASURES OF SEXUAL AROUSAL IN WOMEN

DONALD E. HENSON, H. B. RUBIN, AND CLAUDIA HENSON

SCHOOL OF MEDICINE AND THE REHABILITATION INSTITUTE
SOUTHERN ILLINOIS UNIVERSITY-CARBONDALE

Eight adult women volunteers viewed the same erotic film in two different sessions. Their resulting genital responses were recorded simultaneously by three different measures: vaginal pressure pulse, vaginal blood volume, and labial temperature change. During the erotic stimulation, the vaginal pressure pulse and labial responses always increased, and the vaginal blood volume response increased on all but two occasions. Although there was considerable intersubject variability in each genital measure, all three measures were found to have some intrasubject consistency over sessions with respect to either their response amplitudes or patterns, with labial temperature being the most consistent on both parameters. The relationship between the response patterns of the three measures during the film was also relatively consistent across sessions, as was the correspondence between subjective ratings of arousal and both vaginal pressure pulse and labial responses but not vaginal blood volume response. To overcome the problem of considerable intrasubject variability of response amplitudes, it was suggested that the inclusion in the data analysis of several parameters of response patterns, which were relatively stable over sessions, might facilitate the evaluation of a treatment.

DESCRIPTORS: genital responses, objective measures, reliability, women

It has been well documented that genital vasocongestion and myotonia are the primary physiological manifestations of sexual arousal for both men and women (Masters and Johnson, 1966). At the present time, however, considerably more is known about how various factors influence the sexual responding of men than women. This has occurred because it has been much easier to objectively measure the genital vasocongestion (penile erection) of men. There is an extensive literature indicating that penile erection, as objectively measured by volumetric changes of the penis by a penile plethysmograph (Freund, Sedlacek, and Knob, 1965) or circumference changes of the penis by either a mercury-in-rubber (Bancroft, Jones, and Pullan, 1966) or mechanical (Barlow, Becker, Leitenberg, and Agras, 1970) strain gauge transducer, is a sensitive, reliable index of the sexual

arousal of men. The genital vasocongestion of women has been much more difficult to measure objectively.

Early attempts to measure objectively female sexual arousal used such physiological reactions as vaginal lubrication and pH (Shapiro, Cohen, DiBianco, and Rosen, 1968, as reported by Zuckerman, 1971), uterine contractions (Bardwick and Behrman, 1967), and vaginal temperature (Fisher and Osofsky, 1968). Unfortunately, none of these studies provided a satisfactory method of measuring women's sexual arousal. However, Shapiro *et al.* (1968) attached an isothermal relative blood flow meter to a vaginal diaphragm and recorded vaginal vasomotor responding during REM sleep (Shapiro *et al.*, 1968) and sexual fantasy (Cohen and Shapiro, 1970; Shapiro *et al.*, 1968). Although the procedure worked, its complexity apparently limited its use (Geer, 1975).

In contrast, the method of vaginal photoplethysmography developed by Sintchak and Geer (1975), which measures changes in blood volume and flow in the vaginal wall, has been

We wish to thank Margaret Koehler for her assistance. Address reprint requests to either Donald E. Henson or Harris B. Rubin, School of Medicine, Southern Illinois University-Carbondale, Carbondale, Illinois 62901.

widely adopted. The procedure is relatively easy to use, and it can provide two simultaneous measures (vaginal pressure pulse from AC amplification of the signal from the photosensor, and vaginal blood volume from DC amplification) that consistently increase during sexual stimulation. For example, increases in vaginal blood volume have been recorded during erotic films (Geer, Morokof, and Greenwood, 1974; Henson and Rubin, 1978; Henson, Rubin, and Henson, 1979; Hoon, Wincze, and Hoon, 1976, 1977; van Dam, Honnebler, van Zalinge, and Barendregt, 1976; Wincze, Hoon, and Hoon, 1976, 1977, 1978), during erotic audio-recordings and sexual fantasy (Heiman, 1976, 1977), and during masturbation (Geer and Quartararo, 1976; van Dam *et al.*, 1976). Similarly, vaginal pressure pulse has been demonstrated to increase during erotic films (Geer *et al.*, 1974; Henson *et al.*, 1979; Wilson and Lawson, 1976, 1978), during audio-recordings and sexual fantasy (Gillan, 1976; Heiman, 1976, 1977) and during masturbation (Geer and Quartararo, 1976; Gillan, 1976; Sarrel, Foddy, and McKinnon, 1977). Although erotic film-induced changes in vaginal pressure pulse and vaginal blood volume correlated significantly in most subjects, the vaginal pressure pulse response appeared to reflect women's subjective estimates of arousal more accurately (Heiman, 1976, 1977; Henson *et al.*, 1979).

Recently, another method of directly assessing women's genital vasocongestive reactions, which measures changes in temperature of the minor labia, has been developed (Henson, Rubin, Henson, and Williams, 1977). Labial temperature changes elicited by erotic films were reported to correlate significantly with concurrently recorded changes in both vaginal blood volume (Henson and Rubin, 1978; Henson *et al.*, 1979) and vaginal pressure pulse (Henson *et al.*, 1979) in most subjects. Labial temperature changes were also reported to be correlated with subjective estimates of sexual arousal at a similar level as vaginal pressure pulse (Henson *et al.*, 1979) and much higher than

vaginal blood volume (Henson and Rubin, 1978; Henson *et al.*, *in press*).

The literature cited provides ample evidence that all three currently used measures are indicators of sexual arousal. However, within each measure there is considerable intersubject variability with the same stimulus evoking considerably greater responses in some subjects than in others (Henson *et al.*, *in press*). This variability would cause little problem in any research or therapeutic design where the subject served as her own control. However, in such research or therapy there must be consistency of response within subjects in order to have a baseline against which to measure the effects of the therapy or independent variable. There are very little data to indicate how consistent within subjects are any of the measures either in magnitude or pattern of response. Heiman (1977) reported that vaginal pressure pulse responses to erotic audio-recordings were significantly lower during the second of two sessions. But Henson *et al.* (1978) reported that the labial temperature changes recorded from subjects during two erotic film presentations were significantly correlated. Also, there are no data that compare the consistency of a subject's response across the three measures of arousal. The purposes of this study, therefore, were to determine the intrasubject consistency across two recording sessions of the magnitude and pattern of each measure and to compare the consistencies of the three measures when they were simultaneously recorded from the same subject.

METHOD

Subjects

Eight adult female volunteers (ages 21 to 26 yrs) served as subjects for no remuneration. One was married and seven were single; all were nulliparous. All reported to have previous voluntary exposure to explicit sexual materials, and seven of the eight were reportedly orgasmic. The remaining woman indicated that she was not orgasmic because of physical reasons (*i.e.*,

an attached clitoral hood and a tipped uterus) but experienced considerable enjoyment from sexual stimulation. All were fully informed of the nature of the experiment prior to their participation, all signed statements of informed consent, and all were apprised that they could terminate their participation at any time without prejudice.

Chamber

The experimental chamber was a private, sound-attenuated room (approximately 2.3 m $\times$ 1.5 m $\times$ 2.4 m) in which ambient temperature was maintained at about 27°C and did not vary by more than $\pm 0.10^\circ\text{C}$ during the session. An intercom system permitted communication without compromising the woman's privacy.

Apparatus

Vaginal photoplethysmograph. Both vaginal blood volume and vaginal pressure pulse were measured by the method of vaginal photoplethysmography first reported by Sintchak and Geer (1975). The modifications suggested by Hoon, Wincze, and Hoon (1976) were incorporated into the system for measurement of vaginal blood volume (see Henson and Rubin, 1978), that is, a light-emitting diode (LED) (Motorola, MLED 60) served as the light source and a transistorized photosensor (Motorola, 2N 5777) as the light detector. The LED was embedded in the tip of a transparent acrylic cylinder (4.8 cm long, 1.9 cm O.D., 1.3 cm I.D.) and the photosensor was located at the midpoint on one wall of the cylinder. Both the LED and photosensor were replaced following the first session for the first four women because of the failure of one or both of the components. With the new components, the device proved to be more sensitive and the recorder sensitivity was lowered from 20 mv/cm to 200 mv/cm to maintain the same range of recording.

Since the electronic circuitry of Henson and Rubin (1978) completely filtered the AC signal, a commercially available photoelectric pulse transducer designed to measure the cardiovascu-

lar pulse wave (Narco, Type 323), was also embedded in the acrylic cylinder at a position 180° from the blood volume photosensor. An amplification of 100 mv/cm was used for the resulting AC signal which provided a measure of vaginal pressure pulse reactions.

Labial thermistor-clip. This device, which was similar to that of Henson *et al.* (1977), was constructed by gluing a small surface thermistor (Yellow Springs Instruments, Model 709) to one leg of a small clip. The clip could be secured to one of the minor labia by adjusting the position of a small bead that encircled both its legs. Temperature changes of the minor labium were amplified (2 mv/cm) and were accurate to within 0.02°C. Sterilization of both genital measuring devices was accomplished by means of either zephiran chloride (1:750 concentration) or a 2% solution of glutaraldehyde (Cidex).

Stimuli

The erotic stimulus was an 11-min, color videotape recording of an erotic film which depicted a variety of explicit sexual behaviors. It was simultaneously presented onto two video receivers, one in the experimental chamber so that the woman could view the film in privacy, and one in the control room so that it could be monitored by the experimenter.

Procedure

Each woman participated in two similarly conducted sessions that were separated by a minimum of seven days. Instructions to each woman at the beginning of both sessions were similar to those provided by Henson and Rubin (1978) and Henson *et al.* (1979). A female experimenter identified anatomical structures of the female external genitalia using a drawing by Netter (1961, Section VI-Plate 2), and demonstrated proper attachment of the thermistor-clip to the minor labium by using a clay model. After the experimenter left the chamber, the thermistor-clip was to be positioned on the widest part of the right minor labium, with

the thermistor on the distal side, securely enough that a gentle tug would not displace it but not so tightly as to cause discomfort. The vaginal probe was to be inserted a distance of 1.5 in. (3.8 cm) with the photoelectric pulse transducer directed laterally toward the inner thigh. Each woman was advised that she should attempt to replicate the attachment of both devices during each session. She was also requested not to touch her genitalia or otherwise stimulate herself or readjust either of the devices once they were judged to be appropriately in place. However, if an unavoidable need to adjust a device arose, she was instructed to inform the experimenter; this was never necessary.

Each woman was also informed that periodically she would be requested, via the intercom, to subjectively rate her level of sexual arousal according to a 7-point scale that she was provided: 1—no genital sensations, 2—mild genital sensations, 3—moderate genital sensations, 4—slightly strong genital sensations, 5—strong genital sensations, 6—vaginal lubrication, and 7—orgasm (Griffitt, 1975). She was asked to give ratings immediately prior to the film, immediately after the film (when she was asked to rate her arousal at that point in time, as well as to retrospectively rate her highest level of arousal during the film), and at 2-min intervals during a 10-min period following the film.

After the instructions were delivered, the experimenter left the chamber and all further communication was via the intercom. When the woman indicated that sufficient clothing had been removed to allow attachment and insertion of the devices, she was instructed to insert the vaginal probe and, approximately 5 min later, to attach the labial thermistor-clip, thereby allowing for thermal adaptation of the vaginal probe to internal body temperature and of the labia minora to ambient temperature. Once the labial response had stabilized to within an arbitrary level of 0.06°C for at least 2 min following attachment of the thermistor-clip (which ranged from about 4 to 16 min), instructions

were given to relax and enjoy the erotic stimulus film which was then presented. The same film was presented during both sessions. Each session was terminated 10 min after the film ended; the duration of individual sessions ranged from about 30 to 45 min. None of the women removed either device or left the experimental chamber until the session ended.

RESULTS

Physiograph recordings for each genital measure were time-sampled at 15-sec intervals by hand, beginning 2 min prior to the onset of the film and continuing through the 10-min post-film period. For each genital measure, all responses during each session were calculated from the lowest level recorded during the period of data sampling, which occasionally occurred during the film presentation. The units of measurement for both the vaginal pressure pulse and vaginal blood volume measures were mm of pen deflection, and for the labial response, temperature change in $^{\circ}\text{C}$. Values for the vaginal pressure pulse measure were based on the mean number of mm spanned from the negative peak to the positive peak for each pulse that occurred during each 15-sec interval, except for highly aberrant recordings that were judged to be artifactual.

Because of an apparatus failure that caused a change in the device used to measure vaginal blood volume responses in the second session of subjects 1 through 4, analyses of group data across subjects for the vaginal blood volume measure are only based on reactions of the four subjects (S-5, S-6, S-7, and S-8) who used the same device during both sessions. To facilitate comparison with vaginal blood volume, group analyses for the vaginal pressure pulse and labial temperature measures are performed on the data of those same four subjects, as well as on the data of all eight subjects. Within-subject analyses are all performed on the data of all eight.

Consistency of Response Amplitude

During the film presentations, there was an increase in responding, indicated by each of the three measures for almost every subject. However, there was considerable intersubject variability in the amount of increase in all three measures. For example, increases in vaginal pressure pulse ranged from 2 mm (S-1, session 2) to 10 mm (S-1, session 1), in vaginal blood volume from 6 mm (S-8) to 33 mm (S-5), and in labial temperature from 0.24°C (S-6) to 1.58°C (S-5).

To determine the degree of concordance in the amplitude of responding during the two film presentations, Pearson product-moment correlation analyses were performed across subjects on their absolute levels of responding. For vaginal pressure pulse, the analyses indicated that the response levels during the two presentations were related in a nonsignificant, negative manner for both peak and mean responding, regardless of whether the analyses were performed with subjects 5 through 8 (peak: $r = -0.491$, $df = 2$, $p > .05$; mean: $r = -0.730$, $df = 2$, $p > .05$) or all eight subjects (peak: $r = -0.552$, $df = 6$, $p > .05$; mean: $r = -0.300$, $df = 6$, $p > .05$). For vaginal blood volume, there also was no significant correlation between the response levels during the two presentations for either the peak ($r = 0.700$, $df = 2$, $p > .05$) or mean ($r = 0.826$, $df = 2$, $p < .05 < p < .20$) responses of subjects 5 through 8. In contrast, there was a comparatively high degree of concordance in a subject's labial responses during the two sessions, both for subjects 5 through 8 (peak: $r = 0.928$, $df = 2$, $.05 < p < .10$; mean: $r = 0.970$, $df = 2$, $p < .05$) and for all eight subjects (peak: $r = 0.878$, $df = 6$, $p < .01$; mean: $r = 0.909$, $df = 6$, $p < .01$).

To facilitate comparisons across subjects and across genital measures, and to provide a uniform scale for all responses regardless of the absolute amplitude, the data from each measure were standardized by transforming the responses

of each subject to a percentage of her maximum recorded response for that measure during the experiment. Figure 1 presents each subject's vaginal pressure pulse responding, as a percentage of her maximum response during the experiment. As can be seen, five of the eight subjects developed relatively similar levels of responding during both sessions, but S-1, S-2,

Fig. 1. The amount of vaginal pressure pulse responding for each subject (based on 15-sec time samples), as a percentage of her maximum peak response during the experiment, during each session. The horizontal line above each graph indicates the period of the film presentation.

Fig. 2. The amount of vaginal blood volume responding for each subject (based on 15-sec time samples), as a percentage of her maximum peak response during the experiment, during each session. The horizontal line above each graph indicates the period of the film presentation.

and S-6 exhibited much lower levels of responding during the second session than the first.

Figure 2 presents each subject's vaginal blood volume responses for each session as a percentage of her maximum amount of change for that measure. For subjects 1 through 4, the quantitative relationship between the response levels during the two sessions is not particularly meaningful because the measuring device had

Fig. 3. The amount of labial responding for each subject (based on 15-sec time samples), as a percentage of her maximum peak response during the experiment, during each session. The horizontal line above each graph indicates the period of the film presentation.

a different sensitivity during the second session. For the four subjects who used the same device in both sessions, one (S-6) had a very similar response level during both sessions but the response levels of the other three differed considerably in one session compared to the other.

Similarly, Figure 3 presents each subject's labial responses as a percentage of her maximum amount of change for the experiment. As can

be seen, seven of the eight subjects developed similar levels of responding during the two sessions, but one subject (S-6) responded at a higher level in the second session than in the first.

Consistency of Response Pattern

Within measures. As can be seen from the figures, each of the measures typically increased during both film presentations. The most obvious exception occurred in the vaginal blood volume responses (see Figure 2) of S-3 during the second film presentation, when her response level decreased precipitously to its lowest point of the session. As soon as the presentations ended, each of the measures generally started a decrease that continued until the session ended. The decrease was almost always slower than the increase, and response levels rarely reached the pre-stimulatory baseline by the end of the 10-min period following the film. It can also be seen from the figures that for each of the measures the pattern of responding in the two sessions was usually very similar. Table 1 presents the within-subject correlations of response levels, taken from 15-sec time samples during the two film presentations for each measure. As can be seen, for vaginal pressure pulse response patterns, there were significant positive correlations for six of the eight subjects, and a significant negative correlation for one subject (S-5). Vaginal blood volume response patterns were significantly correlated in a positive manner over the film presentations for seven of the subjects and in a negative manner for one subject (S-2). Labial response patterns were significantly and almost perfectly correlated across film presentations in every subject.

Between measures. As can be seen in Table 2, there also appeared to be a relatively consistent relationship between measures with respect to the response patterns from individual subjects. Of the 16 comparisons between vaginal pressure pulse and vaginal blood volume, four were non-significant or negative. Similarly, there were three nonsignificant or negative correlations be-

tween labial temperature and each of vaginal pressure pulse and vaginal blood volume. Three subjects (S-2, S-3, and S-5) accounted for all the discrepancies.

Consistency of Relationship to Subjective Arousal

Table 3 shows the Pearson product-moment correlation coefficients for the relationship between each genital measure (in absolute units of measurement), and the subjects' subjective estimates of their sexual arousal given immediately before, during (reported retrospectively immediately after), and immediately after the erotic film. As can be seen, subjective estimates of arousal were significantly correlated with both vaginal pressure pulse and labial responding at generally similar levels during both sessions. However, vaginal blood volume responses were significantly correlated with subjective arousal during the first session but not the second.

DISCUSSION

The consistency of any response measured over sessions is evaluated by two factors that do not necessarily have to be in accord with each other. The first is the pattern of the re-

Table 1
Within-subject analyses^a of each genital measure over film presentations.

	Vaginal Pressure Pulse	Vaginal Blood Volume	Labial Temperature
S-1	0.363*	0.737***	0.827***
S-2	0.076	-0.333*	0.961***
S-3	0.305*	0.440**	0.960***
S-4	0.523*	0.948***	0.936***
S-5	-0.332*	0.955***	0.928***
S-6	0.326*	0.846***	0.689***
S-7	0.764***	0.909***	0.989***
S-8	0.671***	0.708***	0.962***

^aPearson product-moment correlation, $df = 42$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2
Within-Subject Analyses^a Between Each Genital Measure

	Vaginal Blood Volume		Labial Temperature	
	Session 1	Session 2	Session 1	Session 2
VAGINAL PRESSURE PULSE				
S-1	0.515***	0.653***	0.544***	0.495***
S-2	0.826***	0.173	0.771***	0.043
S-3	0.029	-0.048	0.303*	0.576***
S-4	0.892***	0.628***	0.882***	0.757***
S-5	0.402**	-0.118	0.241	-0.240
S-6	0.737***	0.819***	0.621***	0.832***
S-7	0.886***	0.803***	0.800***	0.597***
S-8	0.762***	0.874***	0.847***	0.888***
VAGINAL BLOOD VOLUME				
S-1			0.682***	0.706***
S-2			0.986***	-0.313*
S-3			-0.174	-0.325*
S-4			0.936***	0.887***
S-5			0.904***	0.960***
S-6			0.636***	0.857***
S-7			0.910***	0.936***
S-8			0.929***	0.912***

^aPearson product-moment correlation, $df = 42$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

sponse and the second is its amplitude. In this study most subjects had a relatively consistent response pattern for each of the three genital measures during the two sessions. In most subjects, the most consistent pattern of responding was for the labial temperature measure. This was followed closely by the vaginal blood volume measure. The vaginal pressure pulse response patterns during the two sessions were less closely related in all subjects.

With respect to response amplitudes, most subjects were relatively consistent in the amount that their labial responses changed during the film presentations of the two sessions, a finding in accord with Henson *et al.* (1978). Although both the vaginal pressure pulse and vaginal blood volume responses were as consistent as the labial response for some subjects, each was very much more inconsistent for others.

The measured inconsistencies in response amplitudes during the two sessions for each of

the three measures may have been related to any of a variety of factors. The most obvious of these would be changes in the amount of arousal elicited by the film during the two sessions. But, if elicited arousal varied, the variation was either relatively small or it did not affect the three measures in the same way because large intersession differences in one of the measures was not necessarily accompanied by large recorded differences in the others. This is

Table 3
Correlation coefficients between subjective arousal and each genital measure.

	Session 1	Session 2
Vaginal Pressure Pulse	0.648*** ^a	0.570*** ^a
Vaginal Blood Volume	0.888*** ^b	0.386 ^b
Labial Temperature	0.639*** ^a	0.816*** ^a

^a $n = 8$, $df = 22$.

^b $n = 4$, $df = 10$.

*** $p < .001$.

perhaps most clearly illustrated by the reactions of S-6 who developed a much higher level of vaginal pressure pulse responding during the first session than the second, much lower levels of labial responding during the first session than the second, and very similar levels of vaginal blood volume responding during both sessions with the levels being slightly higher during the first session. Interestingly, the two genital measures which had the most reproducible amplitudes across sessions (*i.e.*, vaginal pressure pulse and labial temperature) were also the most reliably related to subjective arousal. This suggests that women are utilizing similar criteria over time to evaluate their subjective arousal.

It is also possible that the incongruencies in the response amplitudes of the genital measures over sessions resulted from improper or different emplacement of the measuring devices during the two sessions. (The guarantee of privacy, of course, precluded any determination of the correctness of the placement of the devices.) For example, Gillan (1976) reported that vaginal pressure pulse responses recorded from the outer one-third of the vagina were significantly higher than responses recorded from a deeper position during tactile stimulation of the clitoris or sexual fantasy. The effects of more subtle changes in the position of the vaginal probe (either in depth or direction of the photo-sensor) on vaginal pressure pulse or blood volume reactions during sexual stimulation are not known. However, Wilson and Lawson (1978) reported that, at least during asexual conditions, vaginal pressure pulse responses appear not to be influenced very much by subtle changes in position of the vaginal device because vaginal pressure pulse responses recorded during two non-erotic films (one presented before and the other after the removal and reinsertion of the device) were significantly correlated. Nor is it known to what extent changes in position or force of attachment of the labial thermistor-clip affect measured labial responding.

It is also possible that changes in the physio-

logic condition of women's reproductive organs or tissue that were produced by alterations in sex hormone levels over the menstrual cycle (whether occurring naturally or controlled by anovulatory drugs) could have differentially affected the genital measures. For example, the cyclic variations in women's body temperature that are correlated with phases of the menstrual cycle (Botella-Llusia, 1973; Turner and Bagnara, 1971) could have confounded the labial temperature measure. Similarly, fluctuations in ovarian hormones that accompany the menstrual cycle produce both quantitative and structural cytologic effects in the vagina that change the thickness of the vaginal epithelium over the woman's cycle (Botella-Llusia, 1973; Eskin, 1970; Turner and Bagnara, 1971); it is possible that such changes differentially affected the vaginal measures.

Whatever the reasons for the inconsistencies in response amplitude, the fact that they exist for some subjects creates a potential problem for the sex therapist or researcher wanting to use an objective measure of sexual arousal to determine the efficacy of a treatment procedure. Changes in response amplitude or frequency are the most commonly used indicators of the effect of a treatment. But for an accurate determination to be made, the effect must be considerably greater than the variations of the baseline.

In the present study the smallest variations in amplitude of responding were found to be in the labial temperature measure. But the requirement of strict ambient temperature control that is assumed to be necessary for this procedure probably precludes its use by most researcher/therapists. Both vaginal blood volume and vaginal pressure pulse measures require a less restrictive environment, but the variations in amplitude of both of them over time were relatively large, perhaps large enough to mask treatment effects. On the other hand, patterns of responding were quite consistent, especially in the vaginal blood volume and labial tempera-

ture measures. Such parameters of a response pattern as latency and duration of response as well as rate of amplitude change, therefore, could be analyzed along with response amplitude to enhance the evaluation of a treatment.

REFERENCES

- Bancroft, J. H. J., Jones, H. G., and Pullan, B. R. A simple transducer for measuring penile erection, with comments on its use in the treatment of sexual disorders. *Behaviour Research and Therapy*, 1966, 4, 239-241.
- Bardwick, J. M. and Behrman, S. J. Investigation into the effects of anxiety, sexual arousal, and menstrual cycle on uterine contractions. *Psychosomatic Medicine*, 1967, 29, 468-482.
- Barlow, D. H., Becker, R., Leitenberg, H., and Agras, W. S. A mechanical strain gauge for recording penile circumference change. *Journal of Applied Behavior Analysis*, 1970, 3, 73-76.
- Botella-Llusia, J. *Endocrinology of woman*. (Trans. by E. A. Moscovici.) Philadelphia: Saunders, 1973.
- Cohen, H. D. and Shapiro, A. A method for measuring sexual arousal in the female. *Psychophysiology*, 1970, 8, 251 (Abstract).
- Eskin, B. A. Female endocrinology—The ovary and menstrual disorders. In N. G. Schneeborg (Ed), *Essentials of clinical endocrinology*. St. Louis: Mosby, 1970. Pp. 359-383.
- Fisher, S. and Osofsky, H. Sexual responsiveness in women: Physiological correlates. *Psychological Reports*, 1968, 22, 215-226.
- Freund, K., Sedlacek, F., and Knob, K. A simple transducer for mechanical plethysmography of the male genital. *Journal of the Experimental Analysis of Behavior*, 1965, 8, 169-170.
- Geer, J. H. Direct measurement of genital responding. *American Psychologist*, 1975, 30, 415-418.
- Geer, J. H., Morokoff, P., and Greenwood, P. Sexual arousal in women: The development of a measurement device for vaginal blood volume. *Archives of Sexual Behavior*, 1974, 3, 559-564.
- Geer, J. H. and Quartararo, J. D. Vaginal blood volume responses during masturbation. *Archives of Sexual Behavior*, 1976, 5, 403-413.
- Gillan, P. Objective measures of female sexual arousal. *Journal of Physiology*, 1976, 260, 64P-65P.
- Griffitt, W. Sexual experience and sexual responsiveness: Sex differences. *Archives of Sexual Behavior*, 1975, 4, 529-540.
- Heiman, J. R. Issues in the use of psychophysiology to assess female sexual dysfunction. *Journal of Sex and Marital Therapy*, 1976, 2, 197-204.
- Heiman, J. R. A psychophysiological exploration of sexual arousal patterns in females and males. *Psychophysiology*, 1977, 14, 266-274.
- Henson, C., Rubin, H. B., and Henson, D. E. Women's sexual arousal concurrently assessed by three genital measures. *Archives of Sexual Behavior*, 1979, 8, 459-469.
- Henson, D. E. and Rubin, H. B. A comparison of two objective measures of sexual arousal in women. *Behaviour Research and Therapy*, 1978, 16, 143-151.
- Henson, D. E., Rubin, H. B., and Henson, C. Consistency of the labial temperature change measure of human female eroticism. *Behaviour Research and Therapy*, 1978, 16, 125-129.
- Henson, D. E., Rubin, H. B., Henson, C., and Williams, J. R. Temperature change of the labia minora as an objective measure of human female eroticism. *Journal of Behavior Therapy and Experimental Psychiatry*, 1977, 8, 401-410.
- Hoon, P. W., Wincze, J. P., and Hoon, E. F. Physiological assessment of sexual arousal in women. *Psychophysiology*, 1976, 13, 196-204.
- Hoon, P. W., Wincze, J. P., and Hoon, E. F. A test of reciprocal inhibition: Are anxiety and sexual arousal in women mutually inhibitory? *Journal of Abnormal Psychology*, 1977, 86, 65-74.
- Masters, W. H. and Johnson, V. E. *Human sexual response*. Boston: Little-Brown, 1966.
- Netter, F. H. *Reproductive system, The CIBA collection of medical illustrations*. Summit, N.J.: CIBA, 1961.
- Sarrel, P. M., Foddy, J., and McKinnon, J. B. Investigation of human sexual response using a cassette recorder. *Archives of Sexual Behavior*, 1977, 6, 341-348.
- Shapiro, A., Cohen, H. D., DiBianco, P., and Rosen, G. Vaginal blood flow changes during sleep and sexual arousal. *Psychophysiology*, 1968, 4, 394 (Abstract).
- Sintchak, G. and Geer, J. H. A vaginal photoplethysmograph system. *Psychophysiology*, 1975, 12, 113-115.
- Turner, C. D. and Bagnara, J. T. *General endocrinology* (5th ed.). Philadelphia: Saunders, 1971.
- van Dam, F. S. A. M., Honnebler, W. J., van Zalinge, E. A., and Barendregt, J. T. Sexual arousal measured by photoplethysmography. *Behavioral Engineering*, 1976, 3, 97-101.
- Wilson, G. T. and Lawson, D. M. Effects of alcohol on sexual arousal in women. *Journal of Abnormal Psychology*, 1976, 85, 489-497.
- Wilson, G. T. and Lawson, D. M. Expectancies, alcohol and sexual arousal in women. *Journal of Abnormal Psychology*, 1978, 87, 358-367.
- Wincze, J. P., Hoon, E. F., and Hoon, P. W. Physiological responsivity of normal and sexually dysfunctional women during erotic stimulus exposure. *Journal of Psychosomatic Research*, 1976, 20, 445-457.
- Wincze, J. P., Hoon, P., and Hoon, E. F. Sexual arousal in women: A comparison of cognitive and physiological responses by continuous measure-

- ment. *Archives of Sexual Behavior*, 1977, **6**, 121-133.
- Wincze, J. P., Hoon, E. F., and Hoon, P. W. Multiple measure analysis of women experiencing low sexual arousal. *Behaviour Research and Therapy*, 1978, **16**, 43-49.
- Zuckerman, M. Physiological measures of sexual arousal in the human. *Psychological Bulletin*, 1971, **75**, 297-329.

Received 4 October 1978.

(Final Acceptance 24 July 1979.)