RELATIONSHIPS AMONG HUMAN VAGINAL BLOOD VOLUME, PULSE PRESSURE, AND SELF-REPORT OF AROUSAL AS A FUNCTION OF EROTIC STIMULATION

by

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This thesis is dedicated to the memory of my

former thesis advisor

Dr. Sergio Yulis

ABSTRACT

Using a photoplethysmograph, vaginal blood volume (VBV) and pulse pressure (VPP) responses of 53 women volunteers were compared and related to immediate self-reports of either sexual or genital arousal. The responses were examined across a sequence of experimental phases and, in one of these phases as a function of high or low erotic stimulus intensity. Results indicated that both physiological and subjective responses were specifically affected by the erotic stimuli. After these stimuli VPP and subjective responses returned to prestimulation levels whereas VBV did not. Intensity of erotic stimulus affected subjective responses but not the physiological responses. Correlations between the measures indicated that VBV and VPP were moderately well correlated at all times but became more so during the high intensity erotic stimulus and when physiological responses were strong. The correlation between physiological and subjective responses was also enhanced during the erotic stimulus phase as a function of both erotic stimulus intensity and strength of physiological response. Following the erotic stimuli, subjective reports of declining arousal were still strongly correlated with VPP but not with VBV. Results were discussed in terms of the nature of the haemodynamic system underlying changes in blood flow and the possible mechanism by which women detect such changes. Four factors shown to influence the correlation between physiological response and self-report (ie. response change, physiological response strength, particular physiological response, and erotic stimulus intensity) were discussed in terms of this process, and in terms of cognitive variables which may affect subjective judgments of sexual arousal. Methodological and statistical implications of this research were examined, as well as implications for the clinical assessment of female sexual arousal.

SOMMAIRE

Le volume sanguin vaginal (VSV) et le pouls vaginal (PV) furent enregistrés à l'aide d'un photoplethysmographe auprès de 53 femmes volontaires et furent mis en relation et comparés au niveau d'excitation sexuelle ou génitale tel qu'exprimé par les sujets. Ces mesures furent examinées au cours d'une succession de phases expérimentales dont l'une fut l'objet d'une étude plus spécifique de la relation entre ces mesures et l'intensité, basse ou élevée, du stimulus érotique. Les résultats indiquèrent que les stimuli érotiques affectèrent de façon spécifique aussi bien les mesures physiologiques que les réponses subjectives. Après la présentation des stimuli, PV et les réponses subjectives revinrent à leur niveau initial, ce qui ne fut pas le cas de VSV. L'intensité du stimulus érotique influa sur les réponses subjectives mais non sur les mesures physiologiques. Des analyses de corrélation montrèrent que VSV et PV étaient au moins modérément corrélés dans toutes les phases, mais que cette corrélation s'accroissait lorsque l'intensité du stimulus érotique était élevée et lorsque les réponses physiologiques étaient d'un haut niveau. La corrélation entre les mesures physiologiques et les réponses subjectives augmenta également durant la phase de stimuli érotiques en fonction de l'intensité du stimulus et du niveau de la réponse physiologique. Après la présentation des stimuli érotiques, les réponses subjectives indiquant une diminution d'excitation étaient encore corrélées avec PV mais non avec VSV. Les résultats furent discutés en fonction de la nature du système hémodynamique sous-jacent aux fluctuations de la circulation sanguine et d'un mécanisme qui permettrait à la femme de détecter de telles fluctuations. Quatre facteurs influençant la relation entre les mesures physiologiques et les réponses subjectives

furent identifiés: modification de la réponse, niveau de la réponse physiologique, type de réponse physiologique, intensité du stimulus érotique. Le rôle de ces facteurs fut discuté en fonction du mécanisme proposé ainsi que des variables cognitives qui pourraient influer sur les jugements subjectifs d'excitation sexuelle. Les implications méthodologiques et statistiques de cette recherche sont examinées et la discussion débouche sur les implications de cette étude sur l'évaluation clinique de l'excitation sexuelle féminine.

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INTRODUCTION

Empirical investigation of human sexual behaviour has a relatively short history, beginning with the surveys of Kinsey and his colleagues (Kinsey, Pomeroy, and Martin, 1948; Kinsey, Pomeroy, Martin, and Gebhard, 1953). One of the many aspects of sexual behaviour investigated in these surveys was what stimuli or events men and women reported to be sexually arousing. Men, more often than women, reported that they were likely to be aroused by isolated erotic stimuli (such as naked or partly clothed women, pictures of sexual scenes, and sexually explicit stories). Women and men reported being similarly aroused by continuous stimuli incorporating romantic elements (such as motion pictures, short stories, novels and so forth). Interpretation of these male-female differences is complicated by the methodological problems inherent in data derived by surveys. There is, for instance, no way of knowing whether the respondents were similarly interpreting the questions asked of them. Furthermore, and more important from the standpoint of analysis, there was no way of controlling for the specific types of stimuli to which people reported being aroused, making comparisons most difficult. Restrictions such as these prompted controlled laboratory research to determine which stimuli men and women reported to be sexually arousing.

In most of such laboratory research subjects are presented with erotic materials in one or more forms, including literature, taped narratives, photographic slides, and films. Following this psychosexual stimulation subjects are asked to provide their reactions to the erotica, usually on rating scales. Typically, the reactions assessed have included ratings of experienced sexual arousal, perceived genital sensations, and a variety of

emotional responses (eg. pleasure, anxiety, disgust). The effects of psychosexual stimulation on later sexual behaviour have also been examined. There are two important features being addressed by this kind of research. One concerns determining which stimuli effectively induce sexual arousal, in other words an analysis of stimulus variables. The other issue concerns response components of sexual arousal and how to measure these, in other words, an analysis of response variables.

Research to determine which stimuli differentially arouse men and women address such theoretical issues as, determining to what extent differences reflect sex-related physiological factors or the consequences of social learning. The current indications are that men and women are affected by similar kinds of erotic stimuli, in similar ways, and that this trend reflects changes in social attitudes concerning female sexuality (eg. Schmidt and Sigusch, 1973). Earlier indications were, for instance, that sexually explicit stories would not be particularly arousing for most women whereas stories incorporating romantic elements would be (Kinsey et al., 1953). This general view was not proposed as definitive, and Kinsey et al. pointed out that conclusions reflecting sex differences in response to erotica should be tempered by cognizance of wide individual variations. Furthermore, there was considerable overlapping of the kinds of erotica likely to arouse men and women.

Analysis of response variables is tied to the problems of defining sexual arousal and selecting or developing appropriate measures of it. Whalen (1966), for example, defined sexual arousal as the "current level of sexual excitement" (p. 153) and distinguished it from sexual arousability. Sexual arousability was defined as the rate at which an individual approaches

maximum sexual arousal. To measure sexual arousal one can ask for subjective ratings or one can record objective responses. Whether the measures are subjective or objective, they can be more or less specific. For example, a self-rating of experienced sexual arousal may be prone to more diverse subjective interpretation than is a self-rating of perceived genital sensations. Similarly, heart-rate may be a less specific objective index of sexual arousal than is labial temperature because heart-rate may co-vary with other states of arousal.

If both subjective and objective measures are taken, then the question of how they relate to one another arises. There are two important facets to this question. The first concerns the validity of the respective measures and consequently which to regard as the most accurate measure in cases where they may be discrepant. Here the decisions may include accepting one response while rejecting the other, or accepting both and concluding that they provide complementary yet independent information about sexual arousal. The second facet pertains to whether the objective response measured forms the basis for the subjective experience of sexual arousal. If so, then one can expect to find reliable agreement between subjective and objective responses.

The research described in this thesis is principally concerned with the analysis of sexual arousal responses to effective erotic stimuli. The nature and form of two physiological measures of human female genital response were examined in relation to erotic stimuli, to one another, and to accompanying self-reports of sexual arousal or of genital sensation. At issue are both substantive questions about the nature of the sexual response and methodological questions about the way to measure sexual response in

women under the controlled (and perhaps constraining) conditions of the laboratory. Before describing the relevant findings on subjective self-reports and on objective physiological measures, a brief outline of the stimulus variables examined in these studies is necessary. Following this, a discussion of the relevant research has been divided into studies which used subjective measures of arousal and those which used genital measures.

Stimulus Variables

Since the time of the report by Kinsey et al. (1953) it has been shown that women do become sexually aroused by "hard-core" or explicitly sexual stories (Jakobovits, 1965) and that romantic elements in the story are not necessary for this to occur (Fisher and Byrne, 1978; Schmidt, Sigusch, and Schaffer, 1973). Similar results have been obtained for sexually explicit films (Hatfield, Sprecher, and Traupman, 1978), and for pictorial stimuli although here it has been suggested that romantic elements may add to the effectiveness of the stimuli (Sigusch, Schmidt, Reinfeld, and Wiedmann-Sutor, 1970; Schmidt, 1975). In the main, women have reported somewhat less sexual arousal than men to narrative and pictorial stimuli (Kutschinsky, 1970; Mann, Sidman, and Starr, 1970; Mosher, 1972, b). This is not always the case, however, for there are instances where no sex differences have been found (Byrne and Lamberth, 1970; Schmidt et al., 1973), and at least one instance where women reported higher arousal than did men (Jakobovits, 1965).

Subjective Measures of Sexual Arousal

Two types of subjective responses have generally been measured, namely self-reports of affective reactions and of sexual arousal to erotic

stimuli. The affective reactions of men and women to these situations have been extensively investigated (eg. Fisher and Byrne, 1978; Griffitt, 1975; Jakobovits, 1965; Kutschinsky, 1970; Mosher and Abramson, 1977; Mosher, 1973; Ray and Walker, 1973; Schill, 1972; Schmidt et al., 1973; Schmidt, 1975).

Although these reactions are interesting in their own right, the central point with regard to the present research is that such affective reactions were reported concomitantly with reports of sexual arousal and did not seriously influence them. In some instances reports of sexual arousal may be diminished in the presence of other affect (eg. Galbraith and Mosher, 1968) but these reports still reliably occur and are thus legitimate measurement targets.

Given that erotic stimuli lead to self-reports of sexual arousal, the question of the validity of such reports arises. It seems clear that when subjects have been asked to report on their sexual arousal it has been the level of sexual excitement that they have been asked to estimate (cf. Whalen, 1966). Nevertheless, it is quite possible that different individuals interpret the term 'sexual arousal' differently and may therefore be providing qualitatively different responses from one another. Although quantitative differences, whatever they may be due to, will simply show themselves as individual differences, qualitative differences are problematic. Because the validity of subjects' self-reports are open to question, corroborative measures of arousal have been sought. These have generally been objective physiological measures. Since genital responses also reliably accompany exposure to erotica and most men and women report them (Kutschinsky, 1970; Mann et al., 1970; Sigusch et al., 1970; Schmidt et al.,

1973), some of the objective measures have been designed to detect genital changes.

Physiological Measures of Sexual Arousal

Many attempts have been made to find physiological or psychophysiological measures of sexual arousal that are reliable, valid, and objective measures of sexual arousal. The measures examined have included cardiovascular changes; electrodermal responses, hormonal fluctuations, respiration rate, testicular elevation or frequency and amplitude of uterine contractions, skin temperature, pupillary dilation, evoked cortical responses, and biochemical excretions. Recent reviewers have concluded that there is overwhelming evidence to show that none of these measures specifically discriminates sexual arousal from any other affective state of arousal (Bancroft and Matthews, 1971; Zuckerman, 1971). There are, however, genital changes that are reliable accompaniments of sexual arousal namely penile tumescence and vaginal vascular engorgement (Masters and Johnson, 1966).

Changes in penile tumescence and in penile pulse pressure (i.e. vascular changes related to blood pressure) have been measured by direct volume displacement (eg. Fisher, Gross, and Zuch, 1965; Freund, Sedlacek, and Knob, 1965) or by direct diametric variations (eg. Bancroft, Jones, and Pullan, 1966; Barlow, 1973). The design and application of these phallometric devices have been reviewed elsewhere (Bancroft, 1971; Geer, 1975; Jovanovic, 1971; Yulis, 1976). They have been used extensively to accumulate knowledge of male sexual response, and in clinical applications relating to modification of sexual preferences.

Measurement of female genital response during sexual arousal was, until recently, difficult to obtain. There were several early attempts to develop appropriate instruments. Jovanovic (1971) described a device consisting of an inflatable rubber balloon which transduced vaginal muscle contractions to pressure variations that could be then converted to electrical impulses and recorded. Cohen and Shapiro (1970) measured changes in the pooled blood volume of the vagina by means of a temperature sensing device (thermistor), mounted on a diaphragm, that responded to vasocongestive changes. These early devices were difficult to use and consequently their application was limited. Thermistors have also been used with less difficulty to measure external temperature changes accompanying clitoral vasocongestion during sexual arousal (Fisher et al., 1965) and, more recently, of similar changes in the labia minora (Henson, Rubin, Henson, and Williams, 1977; Henson, Rubin, and Henson, 1978).

The most often used device, designed and described by Sintchak and Geer (1975), is the vaginal photoplethysmograph. This is a small probe, made of clear acrylic material, housing a miniature light source and photocell. When the probe is inserted in the vaginal canal the light source illuminates vaginal wall tissue and reflected light is monitored by the photocell, in amount proportional to vaginal vasocongestion. An indirect measure of the pooled blood in vaginal tissue, referred to as vaginal blood volume (VBV), is thereby obtained. The photoplethysmograph is also sufficiently sensitive to detect small changes in the distension of the vascular tissue as the heart beats. These vaginal pulse pressure changes (VPP) can be monitored at the same time as VBV. Among the advantages of the photoplethysmograph are that it is small, robust, safe to use, easily sterilized, and can be inserted by subjects themselves.

There are numerous possible applications of the vaginal photoplethysmograph in research concerning female sexual response. These include: ascertaining the nature of genital responses during psychosexual stimulation, assessing sexual preferences, determining sexual responsiveness, and use as a clinical outcome measure. These applications are, however, predicated on the assumption that vaginal changes monitored reflect sexual arousal accurately. Two principal approaches have been adopted to test this assumption. One approach has been to demonstrate that the vaginal responses monitored occur during presentation of erotica but not during presentation of neutral or other non-sexual but affective stimuli. The second approach has been to show that vaginal responses are corroborated by self-reports of sexual arousal. Both of these are essentially concerned with the validity of the photoplethysmograph as an objective measure of sexual arousal. However, since it is not always clear which of the two outputs, VBV and VPP, is the most appropriate measure of sexual arousal, each will be considered and evaluated separately.

Vaginal Blood Volume Changes During Psychosexual Stimulation

Geer, Morokoff, and Greenwood (1974) were the first to show that VBV was significantly greater during presentation of an erotic film compared to a control film. Others since then have confirmed this finding (Hoon, Wincze, and Hoon, 1976; 1977a, b; Wincze, Hoon and Hoon, 1976; 1977). Similar results have been obtained comparing VBV responses to audio-taped erotic stories and neutral stimulus stories (Heiman, 1977). Some doubt has been expressed concerning the sensitivity of VBV in these circumstances (Osborn and Pollack, 1977).

It also appears that imagination of sexual events alone (Heiman, 1975, a, b) or in conjunction with a biofeedback procedure (Hoon, Wincze, and Hoon, 1977) induces reliable VBV changes with respect to baseline values.

Direct stimulation of the genitals also produces increases in blood volume as orgasm approaches that diminish thereafter (Geer and Quartararo, 1976). In these cases, the VBV response may be subject to artefacts resulting from vaginal muscular contractions (Gillan and Brindley, 1979).

In summary, the specificity of the VBV measure to psychosexual stimulation has been repeatedly demonstrated by these studies. Such distinct response specificity is unknown for other psychophysiological measures in any context and augurs well for the use of VBV as an index of female sexual response.

Vaginal Pulse Pressure Changes During Psychosexual Stimulation

Results using VPP as the dependent measure have been quite concordant with results using VBV. Geer et al. (1974) found VPP was significantly greater during presentation of an erotic film than during a control film. Responses during the control film were also significantly greater than during the preceding baseline period which is, in a sense, disconcerting because it suggests less specificity of the response to sexual stimuli. Perhaps, in this instance, the increase during the control film occurred because subjects were anticipating an erotic film at some point. At any rate VPP changes were generally larger than VBV changes leading Geer et al. to speculate that VPP might be a more sensitive measure. This opinion has been expressed by others (Gillan and Brindley, 1979; Heiman, 1975; 1977; Osborn and Pollack, 1977). Several studies demonstrated that, compared to control conditions, VPP increased during sexually explicit films (Wilson and Lawson,

1976; 1978), during audio-taped erotic stories and fantasy (Heiman, 1975; 1977), or when subjects read erotic stories (Osborn and Pollack, 1977). Furthermore, direct genital stimulation produced VPP increases above pre-stimulatory levels (Geer and Quartararo, 1976; Gillan and Brindley, 1979). So, there is little doubt that the vaginal photoplethysmograph monitors genital changes that occur specifically during psychosexual or genital stimulation.

To determine whether these indices are valid measures of sexual arousal they should also be related to self-reports of sexual arousal. This issue will now be addressed, first in terms of its general importance and then with particular reference to each physiological measure in turn.

Relation Between VBV and Self-Report Measures

Thus far there have been no reports describing a functional relationship between the photoplethysmograph's measures and self-report. Attempts to show that there is a simple relation between the measures have met with varied success but even these do not demonstrate any interdependence.

Geer et al. (1974) instructed subjects to indicate their degree of sexual arousal, during the presentation of an erotic film, by pressing a button once for low arousal, twice for moderate, and three times for high arousal. Self-reports did not correlate with VBV data recorded in the same interval. Furthermore, the difference between mean VBV values during erotic film and control film presentations did not correlate with self-reports of sexual arousal rated on a 5-point scale after the experimental session. Osborn and Pollack (1977) found no association between maximum deviation of VBV from baseline values, recorded as subjects read erotic stories, and their subsequent retrospective reports on a 7-point scale rating the sexual

stimulation produced by the stories. Similarly, using audio-taped erotic stories, Heiman (1977) found no reliable agreement between maximum deviation of VBV from baseline, and subjects' retrospective reports of sexual arousal on a 5-point rating scale. Henson and Rubin (1978) failed to find a significant correlation between VBV and retrospective reports of genital sensations to two erotic films.

There have been three reported instances of significant association between VBV and self-report. Cerny (1978) found a significant product-moment correlation ($r = 0.72$) between self-report and VBV averaged over intervals and compared to basal values, while subjects viewed an erotic film. In this biofeedback study, however, the significant association held only for the no-feedback group perhaps because the biofeedback signal was disruptive. In a comparison of three genital measures (VBV, VPP, and labial temperature), Henson, Rubin, and Henson (1979) report a somewhat lower significant correlation ($r = 0.42$) between VBV and retrospective report of genital sensations. Labial temperature changes and self-reports were significantly correlated ($r = 0.84$).

Finally, Wincze et al. (1977) recorded self-reports of sexual arousal continuously, by providing subjects with a lever that could be moved between extremes representing no sexual arousal and maximum arousal. Product-moment correlations between VBV and self-report, based on measures taken every 15 seconds, were computed for each individual over the entire experimental session. Correlations for the six subjects ranged from 0.12 to 0.78. Wincze et al. report that five of the six correlations were significantly different from zero; however, four of the six accounted for less than 10% of the variance in the relationship between VBV and self-report.

Relation Between VPP and Self-Report Measures

Correlations between VPP changes and self-reports of sexual arousal have, in general, been little better. In several instances VPP and self-reports have been found not to correlate at all (Cerny, 1978; Geer et al., 1974; Osborn and Pollack, 1977; Wilson and Lawson, 1976). There are, however, some notable exceptions to the set of negative findings.

Heiman (1975a) found significant correlations between VPP and retrospectively given self-report of sexual arousal for sexually functional women listening to audio-taped erotic stories ($r = 0.68$), or viewing erotic films ($r = 0.54$) and similar correlations for a smaller number of sexually dysfunctional women. Correlations ranging from 0.44 to 0.68 were obtained in a later study in which subjects also listened to audio-taped erotic stories (Heiman, 1975b; 1977).

Using retrospective reports of genital sensations to an erotic film, Henson et al. (1979) found that VPP and self-report were quite highly correlated ($r = 0.76$).

The evidence reviewed thus far points to two conclusions. The first of these is that the vaginal photoplethysmograph reliably detects genital changes that occur during the presentation of erotic stimuli but not during the presentation of other stimuli. The second conclusion is that these genital changes sometimes correlate with self-reports of sexual arousal and sometimes do not. There are a number of possible reasons for the unreliable correlation and these will now be considered. The first is that VBV and VPP may be indices that measure different responses. The second is that self-reports may be affected by numerous factors. The third relates to whether genital sensations can be detected and if self-reports are based, in part,

on these sensations. The fourth pertains to context effects that may influence the agreement between genital and self-report measures. The fifth concerns the possibility that the objective and subjective may measure independent aspects of sexual arousal. The sixth concerns techniques for measuring physiological components VBV and VPP.

Factors Affecting Discrepancy Among VBV, VPP and Self-Report

Relation between VBV and VPP. Visual inspection of physiographic records of VBV and VPP obtained during presentation of erotic materials reveals that these indices certainly do seem to increase and decrease, more or less in synchrony. What is also apparent is that there may be considerable individual differences in the initial levels of these variables and in the changes of levels during exposure to erotica, and thereafter. The evidence reviewed above suggested that neither VBV nor VPP consistently relates to self-report. VBV and VPP do, however, seem to be related to one another if one selects one representative score of each from many subjects. Heiman (1975b) reported product moment group correlations ranging from 0.015 to 0.599 between VBV and VPP during audio-taped erotic stories. The correlations were computed by using, as the paired data points for each subject, maximum deviation of VBV from baseline together with the mean peak-to-peak amplitude of VPP in a 12-second interval containing the largest responses. Henson et al. (1979) measured VBV changes from the lowest pre-stimulus level, at 15-second intervals. VPP changes were scored as mean peak-to-peak amplitudes in the equivalent 15-second intervals. Thus VBV and VPP changes could be correlated for each subject during the presentation of an erotic film and thereafter. Correlations between VBV and VPP during the film ranged from -0.015 to 0.892, but most of them were above 0.50. In the post-film

interval, correlations ranged from -0.545 to -0.606 principally because VBV levels did not decrease.

The analyses outlined in the above two studies are quite different in two respects. The first concerns the selection of a reference point for measurement of changes. The second relates to the unit of analysis, ie. computation of inter-individual (group) correlations or intra-individual correlations between the measures.

Measuring changes in VBV and VPP in different ways may have implications for design, analysis, and interpretation of results within and across experiments (see Hatch, 1979, for a recent review). However, if an experimental effect is strong it should not be obliterated by minor differences in the choice of a baseline point.

A more important point to be abstracted is that the different magnitudes of correlations in the two studies cited above may well be due to variability of the VBV and VPP responses within and across subjects. Computation of inter-subject correlations will likely be confounded with individual scalar differences of a particular kind. For example, two subjects having the same maximum magnitudes of VBV levels may have widely different maximum VPP amplitudes. Nevertheless, within-subject VBV and VPP responses may covary monotonically in each case. Inter-subject correlations, based on selecting maximum response values as representative measures, are therefore likely to underestimate the actual association between the responses. However, within-subject correlations between VBV and VPP computed over time, will not be affected by these (or similar) scalar differences. This argument applies with equal force to correlations between the genital measures and self-report, except that additional self-report scalar differences are

involved. However, as long as within-subject correlations across time are computed, these will be independent of scalar differences among the measures. In other words, within-subject correlational analysis may reveal strong agreement between two responses that does not appear in correlations of single representative measures, such as response maxima.

It can be seen that the method of measurement may affect the results and consequent conclusions concerning how responses covary. Thorough exploration of these relationships requires analysis which takes into account such scalar differences between subjects, over a range of experimental conditions. This was attempted in the present research by computing within-subject correlations between responses and thereafter using these correlations as the units of analysis.

Factors affecting self-reports. The strength of association between self-report and VBV or VPP may depend on several factors related to self-report. These include the times at which self-reports are given and the kinds of self-report requested of subjects.

In all but two of the studies reviewed earlier (and this applies equally well to studies not recording physiological measures) self-reports have been obtained retrospectively. Typically, subjects have been asked to rate the maximum degree of sexual arousal that, on looking back at the erotic stimulus period, they felt they had attained. Ratings were generally made on scales that ranged from "not at all" to "maximally" arousing. These ratings were then paired with maximum values of the genital measures recorded to compute inter-subject correlations between these measures and self-report. As detailed in the preceding section, correlations so obtained might not reflect the real strength of the association between the measures because of inter-subject scalar differences. They simply indicate how accurately one

maximum value predicts the other.

On the two occasions when self-report was recorded during the experimental session, only one yielded significant positive correlations between self-report and VBV (Wincze et al., 1977). Subjective reports were made continuously using a lever moveable over a calibrated scale. Assessments took place during baseline, stimulus, and inter-stimulus intervals. Within-subject correlations between VBV and self-report were calculated for the entire experimental session. Most of the correlations, as indicated earlier, were not strong, but were significant because of the large number of data points.

In principle, the continuous recording of subjective arousal is a definite improvement over retrospective reports. It takes into account considerably more information from each subject, it circumvents the scalar problems, is not biased by factors related to memory of a past experience, and it allows for the calculation of within-subject correlations over time, a much finer analysis of the association between physiological and self-report changes. There are, however, two factors that may have restricted subjects' use of the lever. First, it had to be positioned over a calibrated scale which may have distracted subjects' attention from the stimulus. Second, continuous monitoring itself may be a potentially distracting intrusion and a constant reminder of the task. Such distracting influence may have prevented a natural response from occurring (eg. Geer and Fuhr, 1976) and thus contributed to reducing the size of the correlations obtained. An additional feature may have contributed to the relatively weak correlations. One correlation was obtained for each subject, based on data collected throughout the entire experimental session. This method overlooks the possibility that the strength of the association between self-report and VBV might vary as a function of the experimental phase. Baseline correlations, for

example, might be weaker than those obtained during erotic stimulus presentation. Therefore, in the present research, within-subject correlations were analyzed separately for different experimental phases.

The kind of self-report requested of subjects may also influence the measured strength of the relationship with the genital measures. Some of the highest correlations have been reported when subjects were asked to retrospectively report on genital sensations that occurred during erotic film presentation rather than on sexual arousal. This was true when labial temperature was recorded as the dependent variable (Henson, Rubin and Henson, 1978; Henson and Rubin, 1978; Henson, Rubin and Henson, 1979), when VPP was recorded (Henson et al., 1979), but not when VBV was measured (Henson and Rubin, 1978; Henson et al., 1979). However, in all of these studies self-report of genital sensations was assumed to be equivalent to sexual arousal. The 7-point scale used was proposed by Griffitt (1975) and defined sexual arousal according to the strength of genital sensations, presence of vaginal lubrication, and orgasm. Subjects were thus asked to report their specific sensations rather than their sexual arousal as such. By operationalizing sexual arousal in terms of specific sensations there is less likelihood that subjects' self-reports will be based on different interpretations of the meaning of sexual arousal. In another sense, however, the two may not be equivalent; subjective judgments of sexual arousal may not be based entirely on physical sensations. Since there has been no direct comparison of the two forms of self-report and no exploration of their comparative relationships to VBV or VPP, the equivalence of the two measures is open to question. By examining the relation between self-reports of sexual arousal and of genital sensations we may begin to understand other factors that affect the strength of association between self-report of sexual arousal and

genital measures.

Detection of genital sensations. It has been suggested that reports of sexual arousal may, in large part, be based on the detection of physiological events and, in the relevant context, labelling these events as sexual arousal (eg. Geer, 1977; Heiman, 1975a, b; Hoon et al., 1977; Wilson and Lawson, 1978). The most basic consideration is, of course, whether genital sensations can be detected by subjects.

There is some evidence suggesting that subjects are not always aware of their physiological state. For example, subjects sometimes report little or no sexual arousal despite the presence of strong VBV or VPP changes (Heiman, 1975a, b). Similarly, when subjects were asked to rate their "physical responses", some reported physical sensations even though their VBV and VPP responses were modest, whereas others reported no physical sensations despite strong VBV and VPP changes (Heiman, 1977). These collective findings led Heiman to suggest that subjects might be differentially sensitive to genital responses. Furthermore, Heiman found that most disagreements between self-report of sexual arousal and VBV or VPP changes occurred in non-erotic contexts possibly because genital responses were less likely to be labelled as sexual arousal. Such disagreements were also more likely with respect to VBV changes. Heiman (1977) speculated that since VBV seemed to be a slower response, it might be more difficult to detect due to adaptation to the response.

Henson and Rubin (1978) contested the notion that adaptation may account for the poor correspondence between VBV and self-report. Labial temperature increases during erotic film viewing did correlate with retrospective self-report of genital sensation, whereas VBV changes did not. Yet, there were no differences in the latencies of labial temperature and VBV.

If adaptation to VBV occurred, then, it was argued, why not to labial temperature. Henson and Rubin accounted for the difference by supposing that labial changes were more easily detected than VBV because of the greater sensory innervation of the labia. Henson et al. (1979), however, later reported strong correlations between VPP, labial temperature, and self-report of genital sensations and suggested that the innervation hypothesis was not adequate either.

The results of these studies provide indirect evidence suggesting that the ability to detect genital changes may vary with individuals, with the stimulus context, and with the particular genital measure recorded. In all instances, however, reports of genital sensations were obtained retrospectively. Thus it is quite likely that such reports were given in a non-erotic context and at a time when the actual genital sensations were different from those experienced during the erotic stimulation. This, coupled with the limitations of between-subject correlations mentioned above, may well have obscured the correspondence. The simplest way to find out whether subjects can detect genital sensations would be to ask them to report on such sensations throughout an experimental session encompassing different contexts. Such an approach would additionally provide much useful information on individual differences in the ability to detect genital changes measured by (or related to) the photoplethysmograph's output.

Closely related to the issue of detection is the degree of kinaesthetic feedback coming from genital changes. Since a feedback system, regardless of its type, operates by detecting changes in input (or output) levels to the system one must observe its operation at times of changing levels.

Males typically make fewer "detection errors" than do females in similar situations (Heiman, 1975b; 1977). That is to say, there are fewer

discrepancies between self-reports of sexual arousal and penile blood volume or pressure pulse, than between such self-reports and VBV or VPP. This observation has led to the speculation that feedback from a tumescing penis may be more salient making it easier for males to detect genital sensations (Geer, 1977; Heiman, 1975b; Hoon et al., 1977; Wilson and Lawson, 1978). If it is easier for males to detect genital sensations, and if labelling sexual arousal is a function of such feedback, this would explain why males less often make reports of sexual arousal that are discrepant with their penile responses. Males may indeed receive more kinaesthetic feedback from the genitals, than do females, but it is by no means clear that they can or do use it accurately. In fact, when asked to estimate the degree of penile tumescence at intervals throughout an experimental session, males consistently underestimated (Schaefer, Tregerthan, and Colgan, 1976). The degree of underestimation was greatest during non-erotic contexts despite erections of 90% of maximum. Schaefer et al. proposed that psychological cues, not physiological ones were the critical determinants of estimation accuracy. Heiman (1975b), however, found that large changes in penile circumference were consistently associated with reports of sexual arousal regardless of context suggesting that the critical determinants were physiological. Thus, for males there are conflicting results concerning the relative contributions of physiological and psychological cues to reports of sexual arousal. Despite the presence of strong penile responses, context seemed more important in one case (Schaefer et al., 1976) and physiological state in the other (Heiman, 1975b).

It may well be that, for females, context indeed has more of a determining influence on reports of sexual arousal irrespective of the strength of genital response. This would make sense if the supposition were true that

females receive less genital feedback than do males. One way of reconciling these contradictory results would be to test the assumption that context is more important when genital responses are weak and becomes less important as genital responses grow stronger.

What is also possible, however, is that feedback effects were not optimally measured. Schaefer et al. (1976) measured levels of penile tumescence, Heiman (1975b) additionally measured vaginal response levels. If change in the levels is more directly related to detection of kinaesthetic feedback, then self-reports and genital measures should be compared as changes in VBV and VPP occur.

Therefore, in the present research special attention is given to correspondence between self-report and genital measures as levels change. Moreover, to determine whether genital sensations can be detected, some subjects were asked to report the strength of genital sensations experienced in the experimental phases. These reports were compared with other subjects' reports of sexual arousal to ascertain if the two would differ in erotic and non-erotic contexts. Since strength of genital response might be a significant variable, two erotic contexts intended to produce differential strengths of genital response were also included.

Contextual cues. If reports of sexual arousal are, in part, predicated on the labelling of genital sensations, subsequent to detection, then the context may be an important factor. Thus the context in which self-reports are given could affect the strength of association between genital measures and self-report.

The main point to be made here is that retrospective reports are given in a context quite different from that to which the reports are intended to refer. This, together with the changes in physical sensations that are

occurring (or have occurred), might well contribute to a greater discrepancy between self-report and genital measures. Wilson and Lawson (1978), for example, found significant positive correlation between retrospective self-report of sexual arousal and VPP for a homosexual but not for a heterosexual film. They surmised that the lack of correlation in the second case resulted from too great a delay between heterosexual film presentation and the taking of self-report. Ensuring that self-reports are made in the appropriate contexts could reduce such sources of discrepancy.

Independence of responses. Another possible reason for the variable association between self-reports and genital measures is that they represent separate aspects of sexual arousal. The view that physiological, behavioral, and self-report measures sometimes provide independent information is commonly held in the behavioral assessment of anxiety (eg. Lacey, 1967; Lang, 1977).

In such cases the separate indices of arousal are all assumed to be valid; however, they are held to be loosely coupled. To some extent this perspective may reflect the paucity of agreement in defining arousal states such as anxiety, thereby forcing the subdivision of dependent measures into discrete categories that have been determined, in turn, by what have been considered as historically important aspects of arousal (Schwartz, 1978). Or it may reflect the multidimensional nature of emotion (Izard, 1965), certain dimensions contributing more than others in certain individuals. Thus, when the individual measures do not covary the discrepancy is not problematic. It also follows that there will be less emphasis on establishing the validity of one of the indices by reason of its correlation with another. Amoroso and Brown (1973) make a similar argument concerning the assessment of sexual arousal. They assert that it might be more prudent to accept genital responses and self-reports as measuring different facets of sexual

arousal and not to use one to cross-validate the other. Despite these and other such arguments expressed by Heiman (1975b) and Geer (1975), vaginal measures have been regarded as a better index of arousal even when these measures were not corroborated by self-report (eg. Hoon et al., 1975, 1977a, b; Osborn and Pollack, 1977; Wilson and Lawson, 1976, 1978; Wincze et al., 1976; Zingheim and Sandman, 1978). Considering VBV and VPP as the only criterion or reference for sexual arousal may result in the devaluation of self-report as a reliable and valid measure. If a subject shows VBV and VPP responses, but does not report sexual arousal, it is then concluded that she is unable to detect the physiological changes, or is unable to "correctly label" them (for contextual or experiential reasons), or is simply withholding self-report (perhaps because she feels constrained about sexuality). The reverse situation creates no less of a dilemma. If a subject reports sexual arousal but shows little or no vaginal response then it is concluded that the report is the result of pressure to respond and is unrelated to her "true" state.

This is not merely an argumentative issue. The outcome affects the development of theoretical models to explain aspects of sexual arousal and it affects the forms of clinical assessment of sexual functioning and of clinical intervention techniques. For example, Wincze et al. (1976) reported finding that the average VBV response of a small group of sexually dysfunctional women was lower than that of a sexually functional group, although the average report of sexual arousal was the same for the two groups. Winze et al. concluded that the dysfunctional group's self-ratings were probably elevated by demand characteristics. In a later study, this difference in physiological response is referred to as a deficit in physiological responsivity, and is used as evidence for a sexual arousal deficit (Wincze et al., 1978).

There is an alternative, perhaps simpler, explanation for the vaginal response differences between the functional and dysfunctional groups. The functional group had previously participated in a similar study, whereas the dysfunctional group was experimentally naive. Moreover, the functional group viewed neutral, dysphoric, and erotic films whereas the dysfunctional group viewed only the erotic film. Different procedural instructions were conveyed to the two groups, the dysfunctional group being additionally told that the study was part of an initial objective assessment of sexual functioning. All subjects wore blood pressure transducers, skin conductance electrodes on the soles of the feet, a finger blood pulse amplitude transducer, and a temperature device on the forehead. In view of the differences in experimental sophistication, in experimental procedure and in instructional set, the reasons for lower VBV responses cannot be unequivocally attributed to subjects' dysfunctional status.

So, it can be concluded that the absence of reliably occurring correlations between genital responses and self-reported arousal is consistent with the prevailing view that physiological and cognitive indices may tap different aspects of arousal. However, this argument would be considerably weakened if such correlations could be reliably demonstrated, or if the responses could be shown to covary systematically. As such the units of analysis selected to determine the degree of correlation or covariation are potentially crucial.

Techniques for measuring VBV and VPP. Thus far, extensive attention has been given to research in which the vaginal photoplethysmograph has been used to measure sexual arousal. Some measurement issues were raised and given detailed attention but there are still two issues that must be considered for the sake of completeness. Perhaps the most basic of these

concerns exactly what physical changes are being monitored by the photoplethysmograph.

Masters and Johnson (1966) concluded that vaginal vasocongestion was one of the early reliable signs of female sexual arousal. Geer et al. (1974) state that the photoplethysmograph measures two kinds of vascongestive response, vaginal blood volume and vaginal pulse pressure.

The direct-current (DC) output from the vaginal photoplethysmograph is thought to be an analogue of the pooled volume of blood present in the vascular tissue of the vagina. During sexual arousal, this pooled blood volume increases. Recall that the photoplethysmograph illuminates the vascular tissue and detects light (in the infra-red region) reflected from this tissue. As blood volume increases the degree of reflected light decreases (eg. Gillan and Brindley, 1979) and so does the DC output of the photoplethysmograph. With constant DC amplification, the photoplethysmograph output can be used to deflect proportionally the pen of a physiographic recorder.

An alternating current (AC) output from the device is assumed to measure pulse pressure, although this has not been verified. It may well be that pulsations in blood volume are being monitored but, though these are directly related to heartbeat, they may have no simple relation to pulse pressure (Gillan and Brindley, 1979). Nonetheless, during sexual arousal the pulse wave amplitude increases, resulting in greater alternating changes in the reflectance of the vaginal tissue and a corresponding alternating output from the device. This AC output can be transduced, through constant AC amplification, to proportional alternating responses of a physiographic pen.

Despite the fact that the haemodynamic bases of vaginal vascongestion are poorly understood, it is generally agreed that the photoplethysmograph

reliably monitors vaginal circulatory changes. Since it is also one of the most frequently used objective measures it is important to evaluate its relationship to sexual arousal.

A second problem with the technique is that there are no standard units of measurement for either VBV or VPP. The choice of units is an arbitrary one and all measurements are of change relative to some selected reference point or level. There is no "absolute" reference for any subject since even resting levels of the physiological responses are probably affected by, for example, the menstrual cycle (Palti and Bercovici, 1967; Wincze et al., 1976). The absence of an invariant reference may complicate the measurement and interpretation of changes within and across subjects.

In general, changes in VBV and VPP during exposure to erotica have been measured with respect to their resting levels in a non-erotic context. Within this general pattern, however, there has been wide variation among studies, in the choice of reference levels, in the frequency of data sampling, and in measuring changes due to experimental conditions (Hatch, 1979).

Summary of factors affecting discrepancy among self-report and vaginal responses. So, the observed discrepancies in agreements among VBV, VPP, and self-report may have arisen from any combination of several factors that are now summarized.

Even though VBV and VPP tend to correlate with one another, they do not consistently correlate with self-reports of arousal. It was suggested that one possible reason for this was that correlations were based on single representative measures of subjects' responses, typically on maximum values. Correlations thus computed have indicated that one set of maximum response values does not reliable predict another set. For example, maximum VBV levels do not predict maximum self-reported arousal. This suggests that

genital and self-report response magnitudes to the same stimulus are different across subjects. Therefore, it was proposed that within-subject trend analyses of responses would be more likely to reveal the presence of correlations between the responses because such analyses are not prone to the same scalar problems. As long as the responses monotonically covary, the association between them will be accurately reflected.

One of the reasons that single response measures have been taken is that self-reports of sexual arousal have almost always been a retrospective statement of maximum arousal experienced during the experimental session. Retrospective self-reports are probably biased by factors related to memory of past experiences, and are given out of context. Recording self report immediately and continuously circumvents these problems, allows for the computation of within-subject correlations over time, and permits a much finer response analysis. Furthermore, separate correlations can be determined for each of several experimental phases to assess the effects of context on the agreement between responses.

The strength of association between genital response and self-report may also be affected by the kind of self-report made. On occasion, self-report of sexual arousal has been operationalized in terms of specific genital sensations possibly to minimize between-subject response variability arising from different interpretations of sexual arousal. However, the two types of report may not be equivalent since subjective judgments of sexual arousal may not be based entirely on physical sensations. So, in the present research, the two types of self-report were compared with one another and with the genital responses.

Comparison of these reports also allowed an examination of the claim that discrepancies between reported sexual arousal and genital response may

stem from an inability to detect genital sensations. This claim is based on the observation that despite the presence of strong physiological responses some subjects report little or no sexual arousal or physical sensations. Males make fewer such "detection errors" than do females and it has been argued that females may receive less genital feedback. The data on this issue, and on the relative contributions of psychological and physiological cues to reports of sexual arousal have been contradictory. Perhaps this has been because self-reports of genital sensation have also been taken retrospectively and consequently are equally prone to memory and context biases, and because attempts to assess the relative amounts of feedback have measured genital response levels not changes in genital response which might be a better method. So, in the present research, special attention was given to the correlation between genital responses and self-reports during such changes, in a variety of experimental contexts, and in conditions likely to lead to different levels of arousal.

The discrepancy between genital responses and self-reports has been attributed to their possible independence. Each measure, it has been asserted, provides separate valid information of arousal. Adopting such a view results in less attention to cross-validation of the responses by correlating them with one another, may pose problems in deciding which is the more accurate measure of arousal, and lead to difficulties in clinical assessment of arousal deficits. Demonstrating that there were reliable correlations between subjective and objective measures would weaken the assertion that they are independent and help resolve the dilemma of which measure to choose.

Finally, it is possible that complex factors affecting the physiological response and the fact that the photoplethysmograph cannot be calibrated may also contribute to the discrepancy between genital and self-report responses.

METHOD

Subjects

A total of 53 female volunteers participated in the research. Ages ranged from 18-32 years (M = 22.32 years, Standard Deviation = 3.76 years).

Most of the participants were undergraduate students although other occupations (such as secretary, guidance counsellor, housewife) were represented.

Subjects were recruited in a variety of ways to encourage volunteers from relatively diverse backgrounds.

1. Presenting details of the research to groups of undergraduate classes. (This was done by a female research assistant.)
2. Posting details of the research around Campus.
3. Posting details of the research in the offices of women's groups.

Potential volunteers telephoned the female research assistant, at a private number, and a brief description of the research was provided. Those wishing to volunteer, or to have more information, made an appointment to see the research assistant. Of the 60 initial volunteers, two declined to continue beyond completing the questionnaire. Five others who completed the questionnaires, made arrangements to continue in the second session but did not. A full description of subsequent aspects of subject selection and participation appears in the Procedure section.

Design

The procedure was divided into two parts, a Questionnaire Session and Experimental Session. All subjects completed the same questionnaires. However, subjects were randomly assigned to only one of four experimental conditions derived from the combination of two factors: intensity of erotic story (low or high); and subjective state being reported (sexual arousal or

genital sensation). Thus the two between-subject factors were erotic story intensity and subjective report.

The experimental session for each subject was made up of five consecutive periods in the following order:

1. Baseline of 10-minutes duration
2. Control story of approximately 6-minutes duration
3. Inter-story interval of 1-minute duration
4. Erotic story of approximately 10-minutes duration
5. Return to Baseline of 10-minutes duration

The five periods of the experimental session served as levels of a within-subject factor, allowing each subject to serve as her own control.

Materials

Questionnaire. The Sexual Arousability Inventory (SAI) developed by Hoon, Hoon and Wincze (1976) was administered to all subjects. The SAI was selected because it measures the degree of sexual arousal individuals say they feel to a wide variety of intimate erotic situations. Subjects rate on a 7-point scale the degree to which they find (or think they would find if they have not experienced a particular activity) each of 28 erotic activities to be sexually arousing. The ratings range from -1 indicating "adversely affects arousal; unthinkable, repulsive, distracting" to 5 indicating "almost always causes sexual arousal; extremely arousing". Scores can range from a minimum of -28 to a maximum of 140, with the total score being the algebraic sum of positive and negative ratings. Hoon et al. (1976) report a test-retest reliability of 0.69, and Spearman-Brown split-half reliability coefficients of 0.92 for both validation and of cross-validation samples. They also report moderate significant correlations between the SAI total

score and such indices as self-rating of satisfaction with sexual responsivity, frequency of intercourse, awareness of physiological changes during sexual arousal, and the Bentler Heterosexual Experience Scale.

In addition to the items referring to erotic activities, the SAI requires subjects to rate the degree to which they are aware of certain physiological changes during sexual arousal. Degree of awareness is rated on a 7-point scale ranging from 1 indicating "never" (aware), to 7 indicating "always" (aware). Ratings are made of the following eleven physiological changes: vaginal lubrication, mild, moderate and strong genital sensations, nipple erection, breast swelling, muscular tension, sex flush, hyperventilation, heart rate increases, and decreasing awareness of the environment.

Additional questions request information about each respondent's age, level of education, occupation, marital status, number of children, frequency of intercourse, frequency of orgasm, preferred method of reaching orgasm, sexual preference, number of sexual partners, method of birth control, present position in the menstrual cycle, and satisfaction with present sexual responsiveness.

Appended to the SAI were 21 items that make up the Bentler Heterosexual Behavior Hierarchy (Bentler, 1968). This hierarchy of behaviours constitutes a check-list of sexual activities, ranging from "one minute continuous lip kissing" to "mutual oral manipulation of genitals to mutual orgasm". Although the original purpose of the scale was to develop an ordinal scale of experience of such activities, the list was used simply as an indication of sexual behaviours experienced by subjects. Bentler (1968) reports the Kuder-Richardson internal consistency reliability of the items as 0.95 on the original scale and 0.95 and 0.95 on the cross-validation samples. Hoon et al. (1976) reported a correlation of 0.42 between SAI score and the

Bentler Heterosexual Scale, suggesting that sexual arousability and sexual experience were positively related but measured somewhat different experiences. The complete questionnaire is contained in Appendix A.

Stimulus tapes. Two audio-tapes each of approximately 40-minutes duration were prepared, one for each level of erotic story intensity. Each audio-tape included the five consecutive periods outlined earlier:

1. Baseline Period. This period was of 10-minutes duration. The beginning of the period was marked by a 400 Hz (sinusoidal) cue-tone, approximately 10 db lower than subsequent speech levels. The level of the cue-tone was informally pre-tested to ensure that, while it was distinctly audible, it would not be distracting during the subsequent narratives. The cue-tone was repeated at 30-second intervals throughout the otherwise silent baseline period. The cue-tone was a signal for subjects to make self-reports.

2. Control Story Period. This period was of 6.25-minutes duration on the tape containing the low intensity erotic story and 5.5 minutes on the tape containing the high intensity erotic story. This minor difference was due to reading speed variation. The story was one of the control stories used by Heiman (1975b): it described a straightforward, non-sexual, social interaction between a woman and a man friend (see Appendix B). This particular story was selected because the interactions therein are primarily initiated by the woman character and are interpreted by her. These two story aspects, female-initiated and female-centred activity, were also incorporated in the erotic stories, as Heiman (1975b) reported these aspects led to higher arousal in females.

The control story was included for two main reasons. First, it controlled for the effects of listening to a male voice and of expecting an erotic story. A comparison of physiological and self-report responses

during this period with the previous baseline level would reflect these two effects. Second, it allowed subjects to become used to the narrator's voice characteristics and to the presence of the cue-tones to which they were to respond by making reports. The story reading was paced so that the cue-tones occurred in natural breaks at 30-second intervals.

3. Inter-Story Interval. This 1-minute interval of silence was broken only by the sound of the recurring cue-tones. Its purpose was to space the two stories.

4. Erotic Story Period. Two different erotic stories were developed for the research. The low intensity story was of 10-minutes duration and the high intensity story was of 10.75-minutes duration (see Appendix C). Both stories incorporated female-initiated activity and female-centred descriptions. That one story was more intense than the other was validated by empirical judgments of sexual arousal made by pretested females. The low intensity story contained more warmth, tenderness, and implicit communication between the partners (elements that Sigusch et al., 1973, refer to as romantic) and fewer explicit sexual references than the high intensity story. The low intensity story describes a slow sequence of progressively more intimate interactions between the couple. The high intensity story describes a more rapid sequence of interactions including caressing, fellatio, cunnilingus, and sexual intercourse. Such differences in content have elsewhere been shown to result in greater self-reports of sexual arousal and in greater vaginal responses monitored by the photoplethysmograph (Heiman, 1975b; Osborn and Pollack, 1977).

5. Return-to-Baseline period. This period was of 10-minutes duration. In all respects it resembled the initial baseline period. The silence of this period was interrupted only by the cue-tone at 30-second

intervals signalling self-reports.

Stimulus tapes were played on a Uher Royal de Luxe tape recorder and presented binaurally over Koss Pro-4A headphones.

Apparatus

Physiological recording equipment. Vaginal blood volume and pulse pressure were monitored by the Geer Gauge vaginal photoplethysmograph manufactured by Farrall Instruments (designed by Sintchak and Geer, 1975).

The photoplethysmograph is a clear acrylic plastic probe 4.45 cm (1.75 in) in length and 1.27 cm (0.5 in) in diameter. It houses a "grain of wheat" light bulb and a resistive type photocell that detects light in the infra-red region (peak response near 7000 Å). The photoplethysmograph was operated from a stable power supply of 5 volts DC with a leakage current of less than 10 microamps in accordance with safety standards. Vascular changes leading to difference in the amount of reflected light are converted to resistive changes by the photo-cell. The photoplethysmograph output was taken to a Farrall Instruments Bridge Plug-In Module PV-1. This unit contains a resistive bridge network that can be balanced by a 10-turn linear potentiometer, and is equipped with a scale multiplier switch that permits linear changes in bridge sensitivity to be made.

The output from the Bridge Plug-In Module was directly coupled to a DC differential pre-amplifier one output from which was used to drive one channel of a 4-channel physiograph (E & M Company Inc., Type PMP-4A). The pen deflected by the channel provided a record of vaginal blood volume. A second output from the differential pre-amplifier was coupled, through a high pass filter network, to another differential pre-amplifier to give vaginal pulse pressure. Pulse pressure variations were recorded on the second physiograph channel.

Since there are no exact units of measurement for VBV or VPP, all pre-amplifier settings were set in advance, as were physiograph pen position controls, to provide optimum working ranges. These settings were then left constant throughout the entire research period, for all participants. Necessary sensitivity adjustments thereafter were made using the scale multiplier switch on the Bridge Plug-In Module. Physiograph paper speed was set to 0.2 cm/sec throughout.

Activated dialdehyde, manufactured by Arbrook Ltd. as Aqueous Cidex, Product CX-250, was used to sterilize the photoplethysmograph.

Self-Report Recording. A moveable lever, mounted on an inverted-U shaped metal rest, was placed on the right arm of the reclining chair. Although firmly fixed, it could be moved back and forth to accommodate different arm lengths. The lever was moveable over 45-degrees of arc, 22½ degrees either side of an unmarked midline. The lever moved the shaft of a linear potentiometer and linear voltage values uniquely corresponding to all possible lever positions were amplified and recorded on the third physiograph channel. The voltage range was constant for all occasions.

Testing room. The testing room was 2.44 m (8 ft) wide, 2.75 m (9 ft) long and 3.36 m (10 ft) high. Room temperature was maintained at 22° ± 1° Celsius (72° F ± 1.8°) throughout. Illumination of the room, provided by recessed fluorescent lamps, was maintained at a constant low level by adjusting a rheostat dimmer control to a pre-determined marker. A reclining armchair was placed with its back diagonal to two corner walls of the testing room. One of the corner walls separated the testing room from the adjacent equipment room. A two-way communication device was mounted on the other wall within easy reach so that the research assistant and participant could speak to one another when necessary.

Great care was taken to create an ambiance in which subjects would feel as much at ease as possible. Thus, the room was furnished with small tables, carpeted, and decorated with plants and artwork. Although the exact effects of room decor cannot be assessed, the aim was to have the room look as little like a research facility as possible. It was assumed that sexual responses are likely to be adversely affected by unfamiliar surroundings especially if these are features that emphasize a testing situation. Extraneous noise was kept to an absolute minimum and the headphones worn by participants further diminished chances of distraction.

Recording equipment was housed in an adjacent room and necessary interconnecting cables passed through a conduit behind the reclining chair out of participants' sight.

Procedure

Participants were seen on two separate occasions, one to complete the questionnaire, the other for the physiological measurement session. To ensure that each participant freely made a fully informed decision to take part, a minimum of 72 hours separated the questionnaire and physiological recording sessions. Both sessions took place in the same testing room. All subjects were seen throughout by the same female assistant, who was an experienced registered nurse and final year undergraduate in honours psychology. The assistant was unaware of the experimental hypotheses. Furthermore, all subjects were informed before attending the first session that the research was concerned with female sexuality and that some physiological measurements would be taken.

Questionnaire Session. The assistant met privately with each participant in the testing room and outlined the general nature of the research.

Each participant was told that the research was designed to gather information about female sexual response. The vaginal photoplethysmograph was shown to each participant, who was told that it measured changes in vaginal blood flow and briefly how it did so. The assistant assured participants that the probe was easy to insert, comfortable to wear, safe to use, and well sterilized. Participants were then taken to the adjacent room containing the recording equipment and were given a brief explanation of the various pieces. They were assured that all information, regardless of type, would be kept strictly confidential. The coding system to safeguard confidentiality was detailed, participants being made aware that the list of codes and corresponding names would be available only to the research director. Furthermore, they were told that this list was to be destroyed at the completion of the research. Any questions not likely to affect the research outcome were answered.

The assistant then explained that there would be two separate sessions, the first for questionnaire completion and the second for the physiological recording. In the second session, participants were told, two stories that might or might not be erotic would be presented to them over headphones. It was explained that the erotic stories depicted ordinary sexual interactions between a woman and man, not involving injurious or out of the ordinary behaviours.

Emphasis was placed on the fact that subjects would insert and remove the vaginal probe themselves, in complete privacy, and would be similarly undisturbed while listening to the stories.

After these preliminary descriptions, those participants expressing a wish to continue read and signed a consent statement. The complete text of this statement appears in Appendix D. The statement summarized what

participants would be required to do, included the assurance of confidentiality of information, and indicated that they were free to discontinue at any time without explanation. The assistant reviewed the contents of the statement with each participant and drew attention to their right to discontinue at any time if they so wished.

Most participants went on at this point to complete the questionnaire. The assistant provided instructions for its completion, stressing that all items should be completed. The rest of the participants made appointments for questionnaire completion on another day.

When participants had completed the questionnaire, an appointment day in the mid-point of the menstrual cycle was set for the second session. Details of, and the reasons for, any medication currently being taken by a participant were recorded at this time.

No attempt was made to script the procedure for the questionnaire session. Instead it was deemed more appropriate to ensure that, although the same sequence was followed and the same information was conveyed, the interaction between assistant and participant was relaxed and somewhat flexible. The development of trust and rapport was considered to be a prerequisite for comfortable and natural adaptation to the second session.

Physiological Measurement Session. Following the questionnaire session subjects were assigned at random, without knowledge of questionnaire responses to one of the four experimental conditions. The assistant did not know to which intensity condition a participant had been assigned.

During this session the assistant read instructions to each subject. The instructions reminded participants that they would hear two stories which might or might not be erotic, and that vaginal measures would be taken. In addition, the instructions briefly described the purposes of the

self-report lever, indicating that a periodically occurring soft-tone would be presented over the headphones as a signal for self-report. This introductory instruction set was identical for all participants.

The assistant then continued with instructions on how to use the lever for self-report. In accord with the experimental conditions, half of the participants were instructed to use the lever to report how sexually aroused they actually felt. The remaining participants were instructed to use the lever to report strength of genital sensations actually felt. The two instruction sets were identical in all respects other than reference to the type of self-report. The left and right extremes of the lever position were described as representing "not sexually aroused at all" ("no genital sensations") and "extremely sexually aroused" ("extremely strong genital sensation") respectively. Moreover, participants were instructed to move the lever proportionally to the right or left, in keeping with their state, each time they heard a cue-tone. If their state had not changed since the last cue-tone participants were instructed not to move the lever. Each participant was then given a few moments to get used to the feel and range of the lever. Participants were asked not to try to become sexually aroused (or to produce genital sensations), but to report whatever sexual arousal (genital sensation) there was. Any questions were answered at this point.

Following the specific instruction set all participants were reminded that the probe had been sterilized and rinsed clean. The assistant then explained how to insert the probe, specifying that its tip should be about 5 cm (2 ins) into the vagina with the photocell at a "10 o'clock position" (12 o'clock represented by the ventral midline). Participants were told that once they had inserted the probe they should sit in the recliner, and

recline to the first position with legs slightly astride and not to move once the session had started. They could close their eyes if they wanted to.

The assistant then indicated that, when she left the room, the participant should insert the probe, sit back, put on the headphones, relax and enjoy the stories. They were to indicate their readiness to begin, by depressing the call button on the intercom system. Following this the assistant described the sequence of taped events that participants would hear, reminding them of the tone and reiterating several times how to use the lever and what they should report. It was emphasized that no one would enter the room at any time during the session. The end of the session, participants were told, would be announced by tape-recorded voice. At this point the probe should be removed. When they were ready for the assistant to re-enter the room they should despress the intercom call-button. A complete text of these instructions is given in Appendix E.

When a participant indicated that she was ready for the session to begin, the tape recorder in the adjacent room was started. The sensitivity of the Bridge Plug-In Module was set at maximum and physiographic recording began. Scale changes in bridge sensitivity were made, as necessary, if responses were about to exceed the working range of the physiograph pen system.

Post Experimental Explanation. Following the physiological measurement session each participant was asked to comment on the research and their comments were noted. Details of the experimental hypotheses were withheld but a general explanation was given. The gist of this explanation was that the possible relationships among all the measures were to be explored.

Participants who were interested in the general results were assured that a summary would be sent to them.

All participants expressed a desire to see their own physiographic record. The assistant indicated what the various tracings represented and explained that changes reflected differences in blood flow patterns in the vaginal tissue, that were possibly related to sexual arousal. It was anticipated that some participants might be curious to know if their responses were "normal" or how they compared to other responses. In answer to questions on these issues participants were told that their responses and all others were considered normal, and that in fact there was no basis for considering them otherwise.

Method of Scoring

The physiographic data were scored with the aid of a Summagraphics ID Digitizer with its associated processor, tablet and sensing stylus, in conjunction with a Multi-Channel Graph Acquisition Programme (XYDGTZ). The first step in scoring was to calibrate the abscissae and ordinates of each of the response channels VBV, VPP, and self-report. All of the abscissae were calibrated such that the data sampling intervals were 2.5 seconds. This permitted 893 data points to be collected from each of the three response channels of each subject. The ordinates of VBV and VPP response channels were calibrated in arbitrarily selected units of physiological response. The self-report channel's ordinate was also calibrated in arbitrary units with limits set by the extremes of the response lever. Following calibration, the responses of each subject were scored and the data simultaneously stored in computer files. The data were smoothed to reduce moment-to-moment fluctuations. The procedures for calibrating, scoring and

smoothing responses are described in more detail below.

To calibrate the axes, the first section of each physiograph record was affixed to the Tablet's surface and horizontally aligned. The Digitizer Tablet encases, below its surface, a cross-wire grid made up of many horizontal and vertical elements. When the hand-held stylus is brought into contact with the Tablet surface, the Digitizer assigns a unique co-ordinate value to the contact point. It does this with a resolution of 0.013 cm (0.005 in) along both the abscissa and ordinate.

With a paper-chart speed of 0.2 cm/sec, each vertical ordinate of the physiograph paper, spaced 0.5 cm apart, denoted a time of 2.5 seconds. The abscissa, or time axis, of each response channel was calibrated so that the data sampling interval was 2.5 seconds.

The ordinates of each response channel was then calibrated separately. Distance along the ordinate was equated with arbitrary units of response for VBV and VPP. Since VBV and VPP have no specific units of measurement, selection of a scale was arbitrary. The ordinate of the self-report channel was also scaled in arbitrary units that had fixed limits set by the extremes of the response lever movement. Once selected, however, the scales were the same for all records with respect to the same reference points of measurement. Measurement on these scales could be automatically made with respect to each channel's reference point anywhere on the scale's ordinate on the Tablet surface.

Each person's data record was scored according to the calibrated scale by placing consecutive sections of the record over the Tablet. The VBV physiographic trace was scored as follows. The stylus was placed exactly on the VBV trace at the ordinate corresponding to the first datum point.

This value, in scaled units, was stored. Subsequent points at 2.5 sec intervals were scored and sequentially stored in like manner. Thus values of the VBV trace which occurred 2.5 sec apart intersected one of these vertical lines and so were digitized.

A slightly different procedure was necessary for digitizing VPP values. There were two reasons for this. First, peak-to-peak amplitude of the VPP trace represented the data values; upper and lower peaks had to be treated as separate channels and digitized accordingly. Secondly, heart-rates are variable and so there could be no assurance that any peak, upper or lower, would coincide exactly with the sampling ordinate. A rule was therefore stipulated, in advance, whereby the peak nearest to each sampling ordinate would be scored. This choice was unequivocal to the naked eye in the great majority of cases. Where doubt arose a second simple rule was invoked. In half of the cases the leftmost peak was selected and in the other half the rightmost peak. To make possible the selection of a datum point that did not fall exactly on the sampling ordinate, the tolerance of the sampling interval was adjusted to allow scoring of points ± 40 percent (1 second) either side of the sampling ordinate. As the upper peaks were scored their scaled values were also stored. The same conditions applied to the separate scoring of the lower peaks of VPP. Although the actual position of the peaks might not coincide with a sampling ordinate, values were automatically scored as if they had so coincided. At a later time lower peak values were subtracted from their chronologically equivalent upper peak counterparts to yield the peak-to-peak VPP amplitude at each point.

Occasionally a participant moved sufficiently to create an artefact

which prevented the target response from being recorded. Such short-duration transient responses were clearly discernable as step-like transitions in the physiograph traces of VBV and VPP. Fortunately, these transients were rare and their brevity, when they did occur, reduced scoring problems. The procedure adopted to fill in the missing datum point or at most two data points was as follows. In the case of VBV, a straight line was drawn on the physiograph record joining the points immediately preceding and following the discontinuity. This line was then treated as the physiograph record and scored accordingly. In the case of VPP straight lines were drawn to connect the upper peaks of the responses immediately preceding and following the discontinuity, and similarly for the lower peaks. These straight lines were then treated as the boundaries of VPP response and were scored accordingly.

To reduce the variance in the data resulting from momentary effects ("shock variations"), while preserving the trends present in the measures, all data were smoothed. Smoothing was effected by taking running means of the responses. Since self-report was collected at 30-second intervals, running means were computed over this interval and were therefore based on 12 data points at a time.

RESULTS

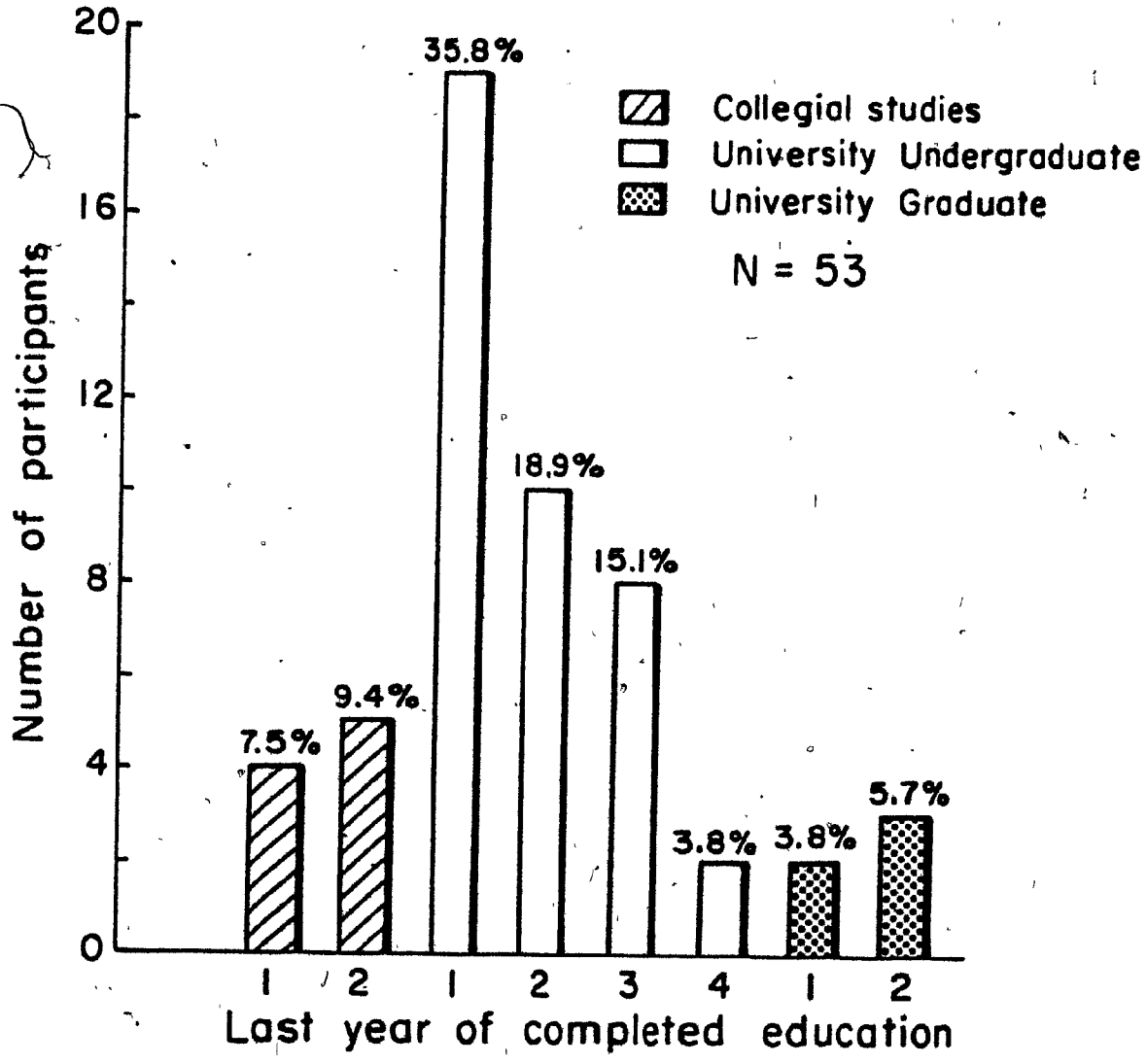
People who volunteer for psychological research may or may not be typical of the more general population from which they come. For this reason, and to provide information pertinent to the limits of generalizability of the research findings, a description of the participating sample is presented together with analysis of the relationships among questionnaire data. Following this the experimental data are analysed. The rates of response change are analysed by examining response slopes and, following this, response levels are examined, in each case by experimental phase. Time differences between the responses are analysed and then the correlations between physiological and subjective responses. Following this, the relationship between physiological and questionnaire data are analysed. Finally, some individual responses are described.

Sample Characteristics

Education and Occupation. As shown in Figure 1, the last year of education completed ranged from one year of (pre-university) collegial instruction to the second year of graduate education. Modal level of completed education was 1 year undergraduate, and 83.1% of the sample had completed one or more years of university education. Over 80% of the participants were presently students; the remainder had clerical (secretary) or professional (nurse, instructor) jobs or were homemakers.

Marital Status and Number of Children. Most of the participants were single (73.6%). The remaining 26.5% were married, separated, divorced or cohabiting with a male partner. Fifty (94.3%) of the participants did not have children. Two participants had one child, and one participant had two children.

FIGURE 1. Number of Participants Completing Stated Year of Education


20
16
12
8
4
0
Number of participants
35.8%
18.9%
15.1%
9.4%
7.5%
3.8%
3.8%
5.7%
Collegial studies
University Undergraduate
University Graduate
N = 53
1
2
1
2
3
4
1
2
Last year of completed education

Frequency of Intercourse and Orgasm. Table 1 shows that 10 (18.9%) of the participants were not currently coitally active and 5 were not coitally experienced. About one half of the participants (50.9%) were currently coitally active at least once a month.

A total of 50 (94.3%) of all participants reported experiencing orgasm, though not necessarily through coitus, as shown in Table 2. A small number, 3 (5.7%) reported never having experienced orgasm. The percentages reported in Table 2 are comparable to those reported by Heiman (1975b) in a U.S. college sample of females where 84% reported that they were orgasmic, 5% said they were not and 10% were unsure.

Table 2 also shows that 27 (45.8%) of the 50 respondents preferred intercourse as the method of attaining orgasm. The next most preferred method was through oral-genital contact, with 17 (28.8%) of the respondents selecting it as their preferred method. Finally, 10 (16.9%) reported masturbation as their preferred method of attaining orgasm.

Sexual Preference. Of the 53 respondents, 49 (92.5%) reported that they preferred sex with a partner of the opposite gender. One (1.9%) reported that her preference was a partner of the same sex and 3 (5.7%) reported equal preference for male and female partners.

Number of Coital Partners. From Table 3 it may be seen that 13 (24.5%) of the participants reported from 3-6 coital partners, 24 (45.3%) reported 7 or more coital partners, and 11 (20.8%) reported 15 or more coital partners. The present sample is somewhat more experienced in this regard than that reported by Heiman (1975b) where around 14% reported 6 or more coital partners.

Birth Control Employed. A total of 40 (75.5%) of the present sample reported that they were presently using some form of birth control. Of

TABLE 1

Current Frequency of Intercourse

Frequency of Intercourse	Number of People	% Total	Cumulative %
Never experienced	5	9.4	9.4
0	10	18.9	28.3
1-10/year	2	3.8	32.1
1-4/month	9	17.0	49.1
2-4/week	19	35.8	84.9
≥ 5/week	8	15.1	100.0
Total	53	100.0	

TABLE 2

Frequency of Orgasm and Preferred Method of Attaining Orgasm

Frequency of Orgasm	Number Reporting	% Reporting
Never	3	5.7
Sometimes	11	20.8
Frequently	30	56.6
Always	9	17.0
Total	53	100.1

Preferred Method of Orgasm	Number Reporting	% Reporting
Masturbation	10	16.9
Intercourse	27	45.8
Vibrator	0	0
Partner's Fingers	5	8.5
Partner's Mouth & Tongue	17	28.8
Total	59*	100

* N = 50 and Nine Participants made double responses

TABLE 3

Number of Coital Partners

Number of Coital Partners	Number Reporting	% Reporting
0	5	9.4
1	6	11.3
2	5	9.4
3 - 6	13	24.5
7 - 10	9	17.0
11 - 14	4	7.5
≥ 15	11	20.8
Total	53	100

these, 19 (47.5%) were taking contraceptive pills, 8 (20%) used a diaphragm, 5 (12.5%) had an intra-uterine device, and the remainder used condoms or the rhythm method.

Sexual Arousability Inventory (SAI) Scores. Scores on the first 28 items of the SAI were tallied as the measure of sexual arousability. SAI scores ranged from 36-127, $\underline{M}$ = 90.1, $\underline{SD}$ = 19.6. A raw score of about 88 was obtained by 55-60% of the normative sample for the SAI (Hoon et al., 1976), a value close to that obtained by the present sample. Furthermore, the obtained data closely resemble those obtained from a sample tested previously by the author where the Range = 46-129, $\underline{M}$ = 88.8, $\underline{SD}$ = 19.8 (Harris, Yulis and LaCoste, 1980).

Responses to items pertaining to Awareness of Physiological Change (APC) during sexual arousal were tallied. APC scores ranged from 39-76 (maximum possible 77), $\underline{M}$ = 56.5 and $\underline{SD}$ = 9.7. There are no reported norms for APC but Hoon et al. (1976) report that SAI and APC scores correlated between 0.50 and 0.57 in their normative sample. A similar result was obtained for the present sample (see below).

The items comprising the measure of sexual experience (modified Bentler Scale, see Q45, Appendix A) were tallied to yield a single score of sexual experience. Experience scores ranged from 3-21 (maximum possible 21), $\underline{M}$ = 17.9, $\underline{SD}$ = 2.7. No normative data on the scale used in this way exist, but Hoon et al. (1976) report a correlation of 0.42 between SAI and the Bentler Scale. A similar result was obtained for the present sample (see below).

Relationships among Descriptive Characteristics. Pearson product-moment correlations were computed among the variables Sexual Arousability (SAI), Awareness of Physiological Changes (APC), Age, and the Bentler Scale

(EXPER). From Table 4 it can be seen that there was a significant tendency for reports of higher sexual arousability and greater awareness of physiological changes during arousal to occur together. This is represented by the positive correlation between SAI and APC ($\underline{r}(51) = 0.52$, $\underline{p} < 0.001$). Similarly, higher scores on the Bentler Scale (EXPER) were accompanied by higher scores on the SAI ($\underline{r}(51) = 0.45$, $\underline{p} < 0.001$). That is, the more sexually experienced tended to report themselves as more sexually arousable (or vice versa). In like manner, APC and EXPER were significantly correlated ($\underline{r}(51) = 0.28$, $\underline{p} < 0.05$) indicating that reports of greater awareness of physiological changes and more sexual experience tended to occur together. None of the other correlations was significant. There was no relationship between age and either SAI or APC scores, or between age and EXPER.

A number of point-biserial correlations were computed among the continuous measures SAI, APC, AGE, and EXPER, and the categorical measures of orgasmic frequency, number of coital partners, and frequency of intercourse. Median splits on the last three variables were created with the following dichotomies. Orgasmic frequency included one category which combined "never" and "sometimes", and another category which included "frequently" and "always". Number of coital partners was categorised as ≤ 6 and >6. Frequency of intercourse was categorised as < 2/week and ≥ 2/week for current frequency.

The point-biserial correlations obtained are shown in Table 5. Inspection of Table 5 reveals that a significant point-biserial correlation was obtained between APC and Orgasmic Frequency ($r_{pb} = 0.27$, $\underline{t}(51) = 2.01$, $\underline{p} < 0.05$). Reports of greater awareness of physiological changes during sexual arousal were significantly related to reports of more frequent experience of orgasm.

TABLE 4

Correlations Among Sexual Arousability, Awareness of Physiological Changes, Age, and Sexual Experience

VARIABLE	SAI	APC	AGE	EXPER
SAI	1.0	0.52***	0.05	0.45***
APC		1.0	-0.06	0.28*
AGE			1.0	0.25
EXPER				1.0

Note: N = 53 for all variables

* $p < 0.05$

*** $p < 0.001$

TABLE 5

Point-Biserial Correlations Between Continuous (Column) and Dichotomous (Row) Variables

VARIABLE	SAI	APC	AGE	EXPER
Orgasmic Frequency	0.20	0.27*	0.21	0.27*
Number of Partners	0.12	0.02	0.36**	0.44***
Current Freq. Intercourse	0.16	0.11	0.28*	0.32*

Note: N = 53, all cases

* $p < 0.05$

** $p < 0.01$

*** $p < 0.005$

Table 5 also shows that older participants reported a greater number of coital partners, in general (AGE vs Number of Partners, $r_{pb} = 0.36$, $t(51) = 2.79$, $p < 0.01$). There was also a significant correlation between AGE and Current Frequency of Intercourse ($r_{pb} = 0.28$, $t(51) = 2.06$, $p < 0.05$), with older participants tending to report higher frequencies.

Significant correlations were also obtained between EXPER and Orgasmic Frequency ($r_{pb} = 0.27$, $t(51) = 2.02$, $p < 0.05$), EXPER and Number of Partners ($r_{pb} = 0.40$, $t(51) = 3.12$, $p < 0.005$), and between EXPER and Current Frequency of Intercourse ($r_{pb} = 0.32$, $t(51) = 2.37$, $p < 0.05$). Therefore, those who reported more sexual experiences on the Bentler Scale, tended to report higher frequency of orgasm, a greater number of coital partners, and more frequent coitus on the SAI.

Prior to analysis of the psychophysiological and self-report data, one-way analyses of variance were computed to ascertain whether the experimental groups differed with respect to a number of descriptive variables. Unless otherwise stated, data for these and subsequent analyses are based on the 48 coitally experienced subjects. The groups were found to be no different with respect to AGE, SAI scores, APC scores, or EXPER scores.

Analysis of Slopes of Psychophysiological Data

Inspection of preliminary graphs of subjects' responses in the experimental session suggested that simple first-order linear regression analyses would provide an accurate summary of overall responding that could be used for subsequent analyses. Thus, separate straight lines were fitted to the data within each of the four experimental phases (baseline, neutral story period, erotic story period, and return to baseline period). The dependent variables for these analyses were smoothed, untransformed values of VBV,

VPP, and Self-report. Time, in single interval units each corresponding to 2.5 seconds, was the independent variable. The interval between neutral and erotic story periods, because of its brevity was omitted from these analyses.

The number of data points included in computing the slopes for each subject, in each of the experimental phases were as follows:

1. Baseline and Return-to-Baseline: N=240 points for High and Low Intensity conditions.
2. Neutral Story: N=132 points in High Intensity Condition, N=150 points in Low Intensity condition
3. Erotic Story: N=258 points in High Intensity, N=240 points in Low Intensity condition.

The slight differences in numbers of points were due to correspondingly slight differences in the reading times of the Neutral and Erotic Stories (see Method section), in the different intensity conditions.

The slopes of the regression (or trend lines) so obtained were treated as subjects' data in a 3-factor ANOVA with repeated measures on one factor. The factors were Erotic Story Intensity (low and high), Type of Self-Report (sexual arousal and genital sensations), and the repeated factor Experimental Phase (Baseline, Neutral Story, Erotic Story, and Return-to-Baseline). To enlarge the scales all slope values were multiplied by 1000.

Average VPP Slopes. The summary of the ANOVA for the trends shown by VPP in the four experimental phases is presented in Table 6. Inspection of Table 6 shows that there was a significant effect due to experimental phases, $F(1,44) = 27.58$, $p < 0.001$ (conservative degrees of freedom were used because assumptions of homogeneity of variance and covariance, and of compound symmetry underlying the ANOVA were violated). As may be seen in Figure 2, the mean slopes of VPP in the baseline and neutral story periods

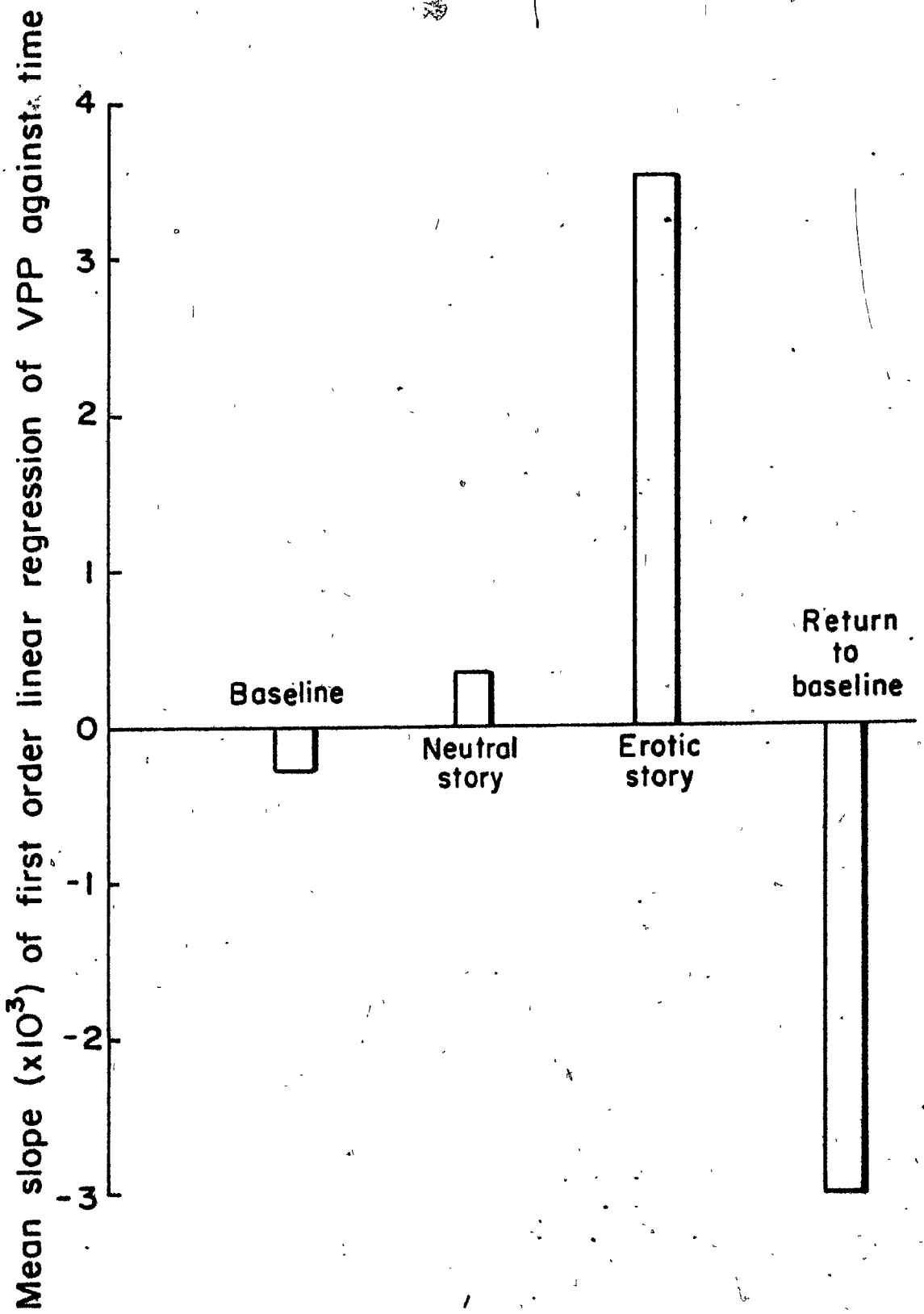
TABLE 6

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type and Experimental Phase on First-Order Linear Regression Slopes of Vaginal Pulse Pressure Against Time

SOURCE	SS	dF	MS	F
Total	2979.0497	191		
Erotic Story Intensity (I)	1.0660	1	1.0660	< 1
Self-Report Type (R)	15.5592	1	15.5592	3.67
IR	0.1053	1	0.1053	< 1
S(IR)	186.5444	44	4.2396	
Experimental Phase	1043.9876	3	347.9959	27.58***
PI	28.8991	3	9.6330	< 1
PR	21.8540	3	7.2847	< 1
PIR	15.6150	3	5.2050	< 1
PS(IR)	1665.4191	132	12.6168	

*** $p < 0.0001$ $F(1,44)$

FIGURE 2. Mean Slopes of First Order Linear Regressions of Vaginal Pulse Pressure Against Time by Experimental Phase


Mean slope (x10³) of first order linear regression of VPP against time
4
3
2
1
0
-1
-2
-3
Baseline
Neutral story
Erotic story
Return to baseline

were close to zero. There was a pronounced positive mean slope during the erotic story period reflecting increases in VPP amplitude with respect to preceding periods. A similar pronounced negative mean slope in the return-to-baseline period reflected decreases in VPP amplitude following erotic stimulation. There were no effects due to erotic story intensity, or to type of self-report requested or any interactions among these factors.

Newman-Keuls post-hoc multiple comparisons among the mean slopes were conducted, also using conservative degrees of freedom. These comparisons revealed that there was no difference between mean slopes during Baseline and Neutral Story periods, and Erotic Story and Return-to-Baseline period slopes were significantly different from one another, and from Baseline and Neutral period slopes (each $p < 0.01$).

In view of the violations of homogeneity of variances, homogeneity of covariance, and of compound symmetry, Hotelling's T^2 was used to contrast a number of the means obtained. Hotelling's T^2 provides an exact multivariate contrast without the assumptions of homogeneity of covariance and compound symmetry of the pooled variance-covariance matrix (Winer, 1971). The vector of mean slopes selected for comparison were the following: Baseline vs Return-to-Baseline, Neutral Story vs Return-to-Baseline, and Erotic Story vs Return-to-Baseline. This vector of means was selected since it allowed those differences found to be significant in the Newman-Keuls comparison to be checked. Hotelling's T^2 indicated that the null hypothesis of no difference between the pairs of simultaneously contrasted means should be rejected ($F(3,9) = 6.99$, $p < 0.01$). Thus differences found with Newman-Keuls were confirmed.

Examination of the variance-covariance and correlation matrices revealed an additional point of interest. There were high negative correlations between the mean slopes during the Erotic Story and Return-to-Baseline Periods. The average correlation was -0.74, indicating that there was a strong tendency for VPP amplitude to decrease at a rate closely related to that with which it increased.

Average VBV Slopes. Trends in VBV changes during experimental phases were similarly examined. However, baseline data were not included for analysis and so the repeated measures factor, Experimental Phase, had 3 levels corresponding to Neutral Story, Erotic Story, and Return-to-Baseline periods. The baseline data were excluded because inspection of preliminary graphs indicated that there were marked positive trends in the VBV response during the baseline period. The presence of these trends will be considered in detail later.

Table 7, the Summary of the ANOVA for VBV trends, shows that there were significant effects due to Erotic Story Intensity, $F(1,44) = 5.52$, $p < 0.025$, and due to Experimental Phase, $F(1,44) = 4.62$, $p < 0.05$ (using conservative degrees of freedom).

Figure 3 shows that VBV showed a positive slope in all three experimental phases examined. There was a slight increase in this slope from the Neutral Story period to the Erotic Story period and a marked deceleration of the slope during the Return-to-Baseline period. Nevertheless, the mean slope of VBV during the Return-to-Baseline phase was still slightly positive indicating that VBV levels were not falling.

The significant main effect due to Erotic Story intensity, in the absence of interactions with other factors, suggests that the positive slope of VBV changes was steeper in the High Intensity Condition than in the Low

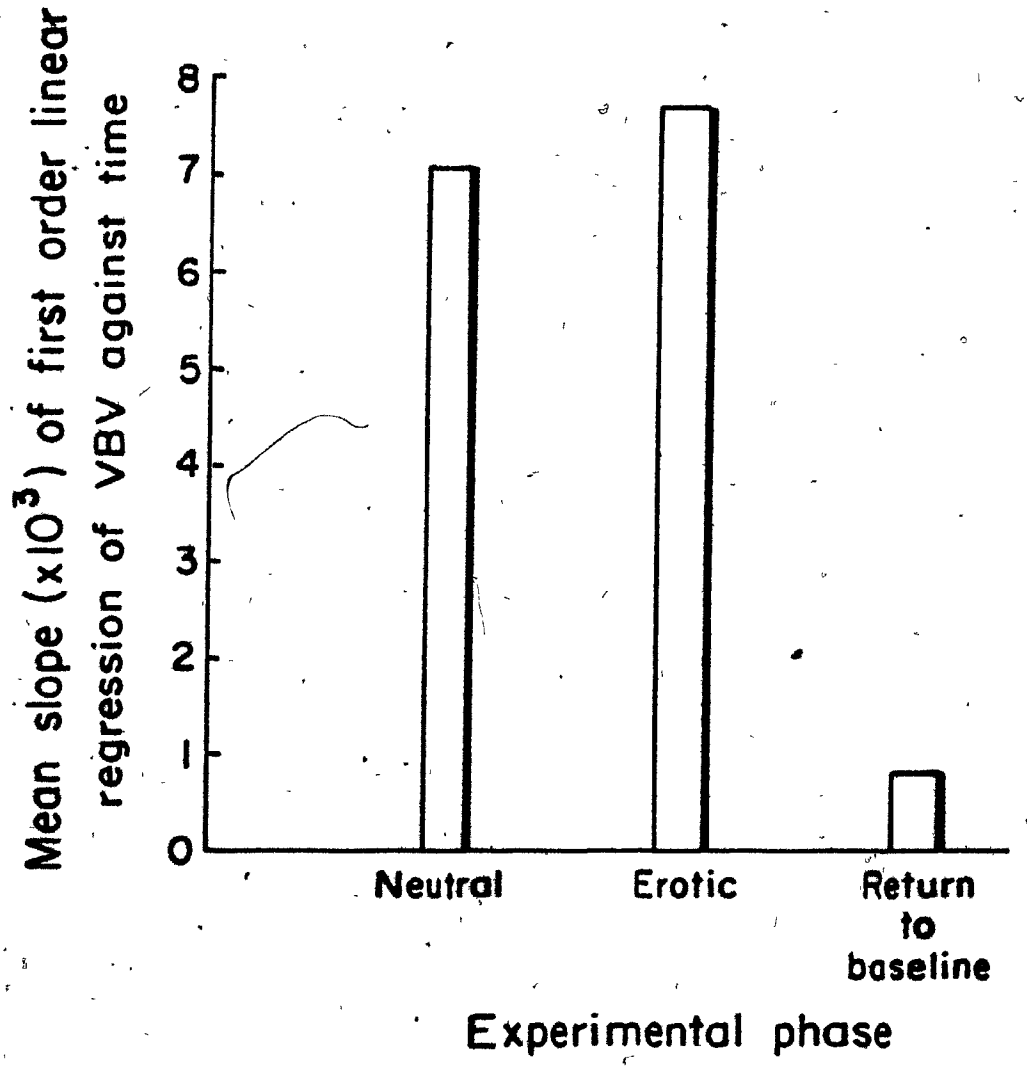
TABLE 7

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on First-Order Linear Regression Slopes of Vaginal Blood Volume Against Time

SOURCE	SS	dF	MS	F
Total	19949.0869	143		
Erotic Story Intensity (I)	520.1270	1	520.1270	5.52*
Self-Report Type (R)	297.5121	1	297.5121	3.16
IR	140.9205	1	140.9205	1.49
S(IR)	4147.0624	44	94.2514	
Experimental Phase (P)	1392.1045	2	696.0522	4.62*
PI	153.9785	2	76.9892	< 1
PR	19.6155	2	9.8077	< 1
PRI	9.3062	2	4.6531	< 1
PS(IR)	13268.4603	88	150.7779	

* $p < 0.05$ $F(1,44)$

FIGURE 3. Mean Slopes of First Order Linear Regression of Vaginal Blood Volume Against Time by Experimental Phase


Mean slope (x10³) of first order linear regression of VBV against time
8
7
6
5
4
3
2
1
0
Neutral
Erotic
Return to baseline
Experimental phase

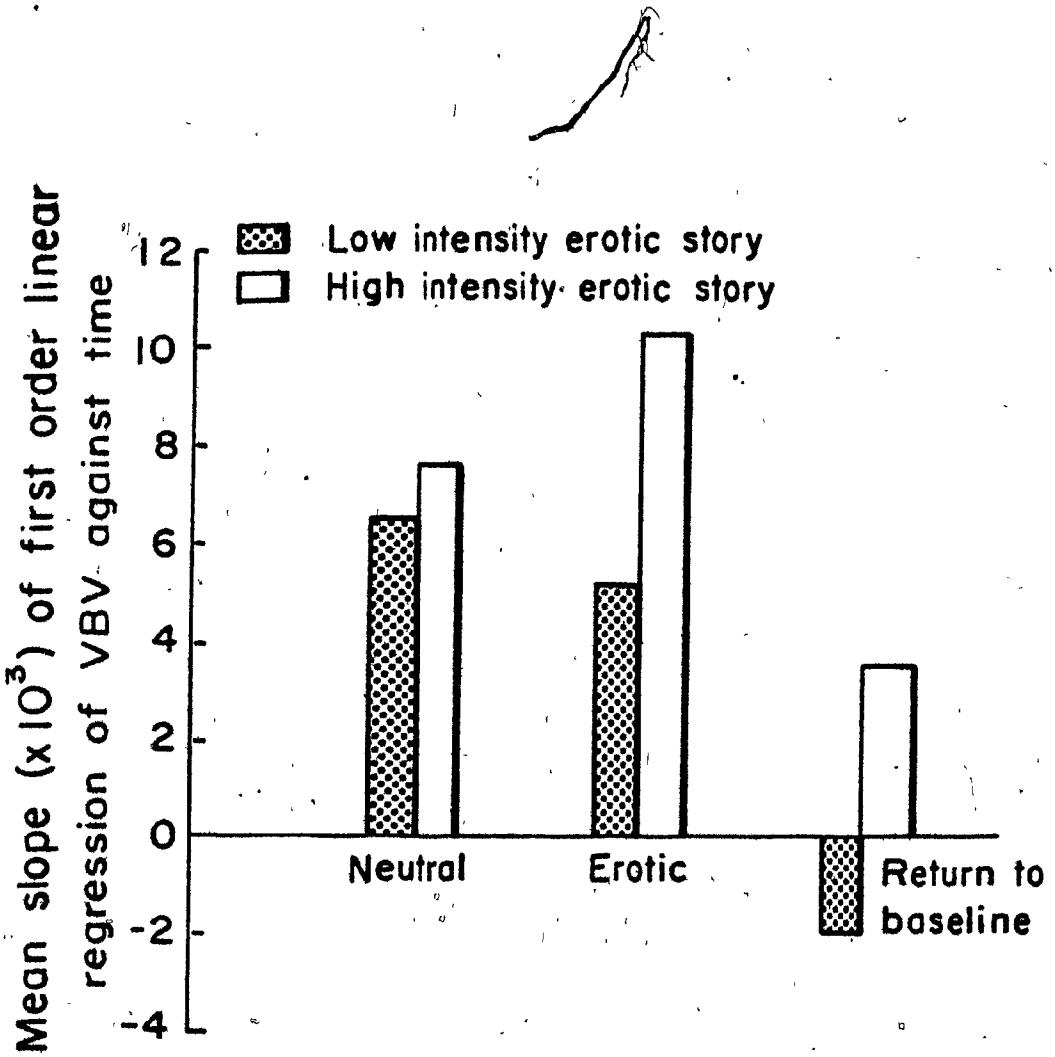
intensity condition.. Figure 4, which shows the mean slopes of VBV during the experimental phases in relation to Erotic Story Intensity depicts this result. The effect of the High Intensity Story is to accelerate the VBV increase, and although this effect is diminished in the Return-to-Baseline period the trend is still positive. The effect of the Low Intensity Story is to produce a decelerating positive slope compared with the Neutral Story slope, followed by a drop in the Return-to-Baseline period.

A Newman-Keuls post-hoc multiple comparison revealed that there was no difference between VBV mean slopes during Neutral Story and Erotic Story periods; and, Return-to-Baseline VBV mean slope was significantly different from Neutral Story ($p < 0.05$), and Erotic Story ($p < 0.05$) VBV mean slopes.

Hotelling's T^2 was also used as a multivariate test of the hypothesis that there was no difference between the vector of VBV mean slopes comprising: Neutral Story period vs Return-to-Baseline period and of Erotic Story Period vs Return-to-Baseline period. The null hypothesis was rejected ($F(2,10) = 9.73$, $p < 0.025$), thus confirming the findings of the Newman-Keuls without specific distribution assumptions being necessary.

The average correlation between the slopes of VBV during Erotic Story and Return-to-Baseline periods, derived from the pooled variance-covariance matrix, was -0.63. Since the overall trend of VBV was increasing, though more slowly during the Return-to-Baseline period, the correlation indicates that deceleration of the trend during Return-to-Baseline was strongly related to acceleration of the trend during the Erotic Story period. This finding is similar in certain respects to that for VPP in that the Return-to-Baseline rate depends on prior changes.

FIGURE 4. Mean Slopes of First Order Linear Regression of VBV Against Time by Erotic Story Intensity and Experimental Phase


Low intensity erotic story
High intensity erotic story
Mean slope (x10³) of first order linear regression of VBV against time
12
10
8
6
4
2
0
-2
-4
Neutral
Erotic
Return to baseline

Average Self-Report Slopes. The results of examining Self-Report trends during the experimental periods are summarized in Table 8. There was a significant effect due to Experimental Phase $F(1,44) = 67.44$, $p < 0.0001$. Figure 5 shows that Self-Report did not change during Baseline and Neutral Story Periods increased during the Erotic Story period, and decreased during the Return-to-Baseline Period. The strongly negative slope in Return-to-Baseline indicates that Self-Report levels decreased below those attained in the Erotic Story period.

The lack of any difference in the two kinds of self-report indicates that the results apply to both reports of sexual arousal and of genital sensation.

A Newman-Keuls post-hoc multiple comparison of means, using conservative degrees of freedom, revealed that mean slope of Self-Report during Neutral Story period was not different from that during Baseline; that mean slope of Self-Report during Erotic Story was significantly different from that during Return-to-Baseline period ($p < 0.01$); and, mean slopes during Erotic and Return-to-Baseline periods both differed significantly from those during Baseline and Neutral Story periods ($p < 0.01$).

The following vector of mean slopes of Self-Report were simultaneously contrasted as being no different from one another, using Hotelling's T^2 test: Baseline vs Return-to-Baseline, Neutral Story vs Return-to-Baseline, and Erotic Story vs Return-to-Baseline. The null hypothesis was rejected ($F(3,9) = 5.41$, $p < 0.025$) indicating that these simultaneously contrasted pairs of means were not equivalent, confirming the Newman-Keuls findings.

The average correlation between slope of Self-Report during Erotic Story and Return-to-Baseline period was -0.83. This indicates a very strong tendency for Self-Report to decrease during the Return-to-Baseline period

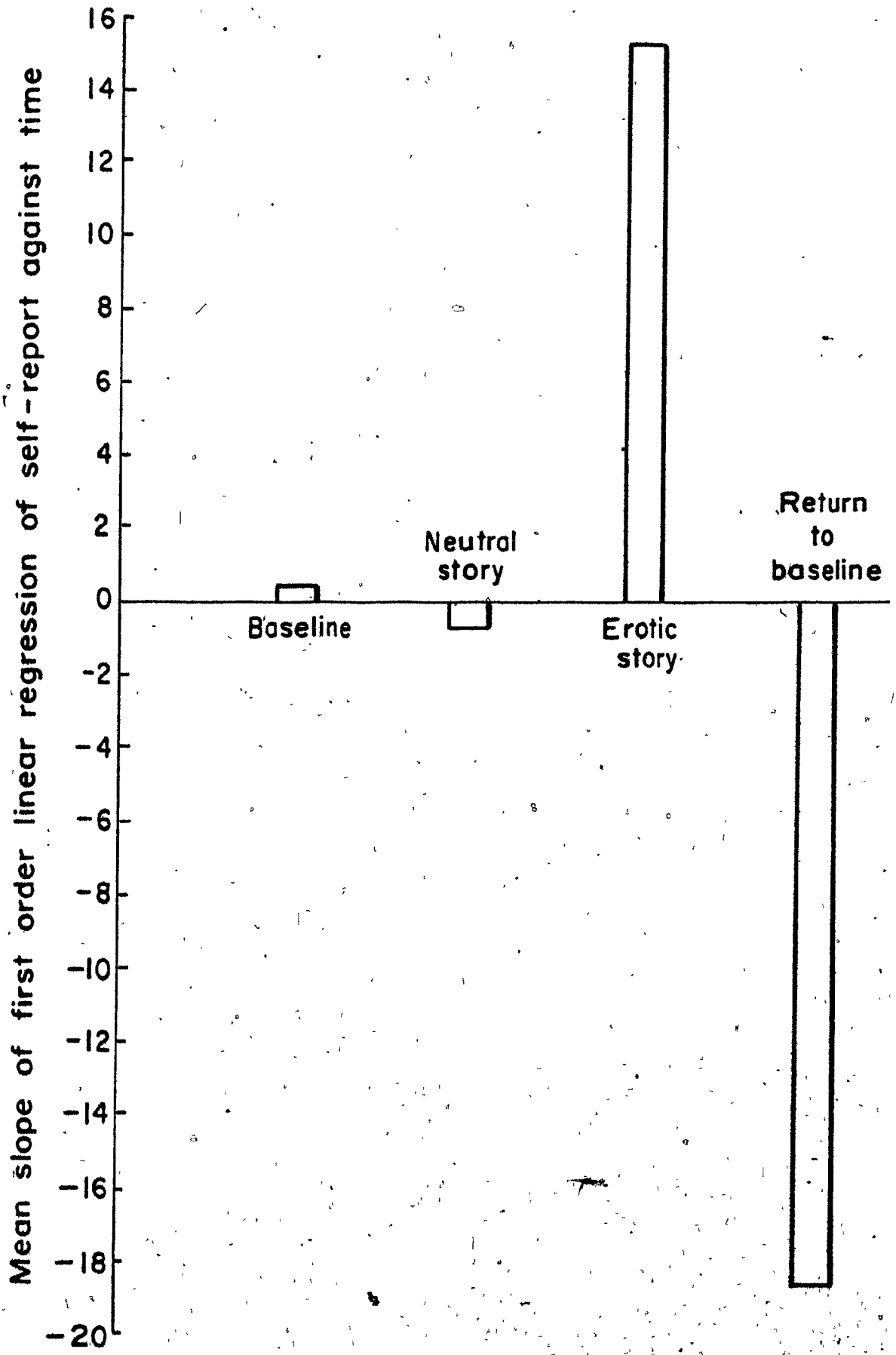
TABLE 8

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on First-Order Linear Regression Slopes of Self-Report Against Time

SOURCE	SS	dF	MS	F
Total	48354.7728	191		
Erotic Story Intensity (I)	54.5300	1	54.5300	1.40
Self-Report Type (R)	23.8948	1	23.8948	< 1
IR	91.7987	1	91.7987	2.36
S(IR)	1708.3674	44	38.8265	
Experimental Phase (P)	27650.5009	3	9216.8336	67.44***
PI	302.0277	3	100.6759	1
PR	45.8756	3	15.2919	1
PIR	437.4296	3	145.8099	1.07
PS(IR)	18040.2982	132	136.6689	

*** $p < 0.001$ $F(1,44)$

FIGURE 5. Mean Slopes of First Order Linear Regressions of Self-Report Against Time by Experimental Phase


Mean slope of first order linear regression of self-report against time
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
Baseline
Neutral story
Erotic story
Return to baseline

at a rate related to that at which it increased during the Erotic Story period. This result is very similar to that reported for VPP trends.

Summary of slope analysis. Self-Report and VPP show similar changes across experimental phases. There is an average tendency for these measures to remain constant during the Baseline and Neutral Story periods. In the Erotic Story period the slopes of VPP and Self-Report increase significantly with respect to those of the preceding periods, indicating that VPP amplitude is increasing and so is Self-Report. The increase in slopes is not different for the two intensities of erotic story (low vs high), nor with respect to the type of Self-Report given (sexual arousal vs genital sensations). During the Return-to-Baseline period VPP amplitudes diminished and so did Self-Reports.

Analysis of VBV trends in the consecutive phases gave a somewhat different picture. The mean slope of VBV was always positive, indicating increasing levels of VBV throughout the experimental session. The rate of this increase accelerated on average during the Erotic Story period and decelerated during the Return-to-Baseline period. In the Low Intensity condition, VBV values increased at a lower rate than in the High Intensity condition.

Finally, it was observed that there was a particularly strong tendency for VPP and Self-Report measures to decrease during Return-to-Baseline, at the rate related to that at which they increased during the Erotic Story period. This relation, although present for VBV, was in terms of an acceleration and deceleration of a generally positive trend.

Analysis of Levels of Psychophysiological and Self-Report Responses

In order to examine differences in absolute levels of VPP, VBV, and Self-Report, these measures were subjected to analysis of variance. The

dependent measure used was the absolute mean level of response for each subject in each particular experimental phase.

When changes in physiological response levels are measured there is the possibility that the level of change is inversely related to prestimulatory levels. Wilder (1956) termed this the law of initial values. Benjamin (1963) suggested that the strength of this relationship could be assessed by correlating level changes with prestimulatory levels. A significant negative correlation would indicate that the law applied and that analysis of covariance, using prestimulatory levels as the covariate, should be used to undo the effect.

To test the possibility that psychophysiological responses were related to their initial levels, the maximum values (MAXVAL) of VPP and VBV attained during the Erotic Story period were determined for each subject. The mean values ($\underline{M}_N$ of VPP and VBV during the Neutral Story period were also determined for each subject. Product-moment correlations were computed between (MAXVAL-$\underline{M}_N$) and $\underline{M}_N$ values for both VPP and VBV. The correlations for VPP, $\underline{r}(46) = 0.16$, $\underline{p} > 0.1$, and for VBV, $\underline{r}(46) = -0.037$, $\underline{p} > 0.1$, indicated that changes were not related to prior levels. So analysis of covariance was not necessary.

Psychophysiological and self-report changes across the several experimental phases was assessed by comparing absolute mean values. This method avoided data transformations (such as differencing or taking ratios) that might complicate interpretation of the results. The number of data points used to calculate a mean value for each subject during each phase was the same as outlined for the slope analysis.

Mean VPP responses. VPP responses were analyzed in a 3-factor ANOVA including the factors Erotic Story Intensity (low and high), Self-Report (sexual arousal and genital sensation), and Experimental Phase (4 levels), with repeated measures on the last factor. Table 9 summarizes the ANOVA, and shows that there was a significant effect due to Experimental Phase, $F(1,44) = 37.73$, $p < 0.0001$, using conservative degrees of freedom. Figure 6 shows that mean VPP levels during Baseline and Neutral Story periods were very similar. (Straight lines are used to connect the values solely for enhancing the visibility of results. They are not intended to imply that there is a linear function across phases. The same is true for subsequent figures unless otherwise stated.) Mean VPP amplitude increased during the Erotic Story period and decreased slightly during the Return-to-Baseline period.

A Newman-Keuls post-hoc analysis revealed that Baseline and Neutral Story mean VPP were not different; Erotic Story and Return-to-Baseline mean VPP were not different; and, both Erotic Story and Return-to-Baseline mean VPP were significantly greater than mean VPP during the preceding phases, $p < 0.01$ in each case. Since there was no effect due to Self-Report type, these results apply equally to reports of sexual arousal and of genital sensation.

There was no significant effect due to Erotic Story Intensity, indicating that mean VPP responses were not affected by this variable, although mean VPP was slightly greater during the high intensity Erotic Story and thereafter.

Mean VBV responses. A similar analysis of VBV means is summarized in Table 10. There was a significant Intensity x Report interaction; $F(1,44) = 4.24$, $p < 0.05$. Analysis of the interaction, using a single

TABLE 9

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on Mean Vaginal Pulse Pressure

SOURCE	SS	dF	MS	F
Total	267.8056	191		
Erotic Story Intensity (I)	0.1703	1	0.1703	< 1
Self-Report Type (R)	8.6873	1	8.6873	1.93
IR	5.2832	1	5.2832	1.18
S(IR)	197.6599	44	4.4923	
Experimental Phase (P)	24.3464	3	8.1155	37.73***
PI	0.7319	3	0.2440	1.13
PR	2.5227	3	0.8409	3.91
PIR	0.0084	3	0.0028	< 1
PS(IR)	28.3954	132	0.2151	

*** $p < 0.0001$ $F(1,44)$

FIGURE 6. Mean VPP During Experimental Phases by Erotic Story Intensity (and Mean Minval in Return-to-Baseline Phase)

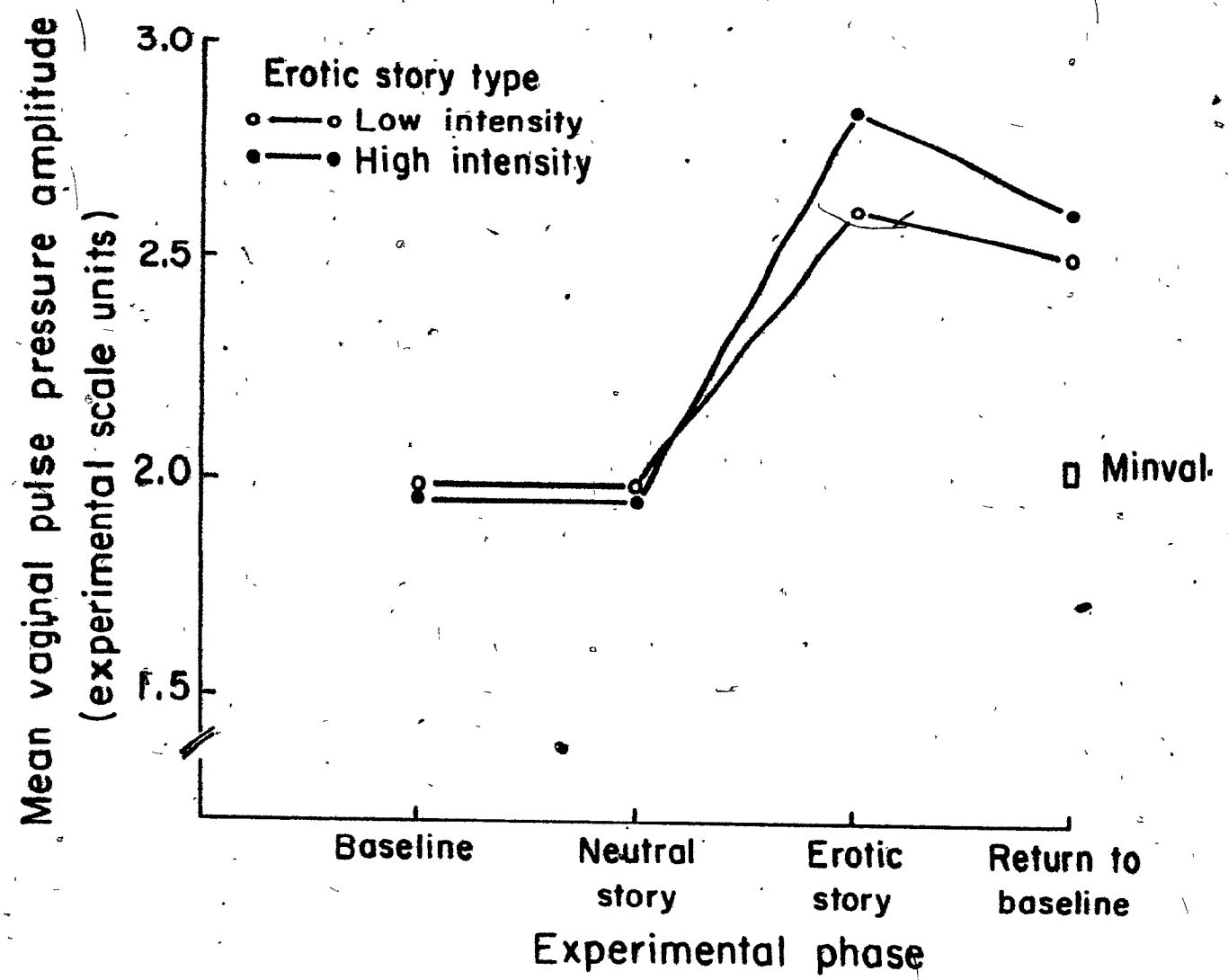

Mean vaginal pulse pressure amplitude
(experimental scale units)
3.0
2.5
2.0
1.5
Erotic story type
Low intensity
High intensity
Minval.
Baseline
Neutral story
Erotic story
Return to baseline
Experimental phase

TABLE 10

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on Mean Vaginal Blood Volume

SOURCE	SS	dF	MS	F
Total	46208.0784	143		
Erotic Story Intensity (I)	0.04650	1	0.04650	< 1
Self-Report Type (R)	110.1403	1	110.1403	1.29
IR	362.6578	1	326.6578	4.24*
S(IR)	3765.7004	44	85.5841	
Experimental Phase (P)	167.2832	2	83.6416	38.39***
PI	9.3732	2	4.6866	2.15
PR	20.1279	2	10.0639	4.62*
PIR	1.0200	2	0.5100	< 1
PS(IR)	191.7292	88	2.1787	

* $p < 0.05$ $F(1, 44)$

*** $p < 0.0001$ $F(1, 44)$

degree of freedom comparison, revealed that the VBV means in the low intensity condition differed as a function of self-report type. Thus the mean VBV for report of genital sensation ($\underline{M}$ = 13.32) was significantly lower than that for report of sexual arousal ($\underline{M}$ = 18.25), $\underline{F}(1,44) = 5.1$, $\underline{p} < 0.05$. Analysis of between-groups simple effects due to Intensity were not significant. Since the significant Intensity x Report interaction combines VBV means across experimental phases between groups, it is not particularly informative.

There was also a significant effect due to Experimental Phase, $\underline{F}(1,44) = 38.39$, $\underline{p} < 0.0001$, and a significant Phase x Report interaction, $\underline{F}(1,44) = 4.62$, $\underline{p} < 0.05$. (Both were evaluated using conservative degrees of freedom because assumptions underlying the ANOVA were violated.)

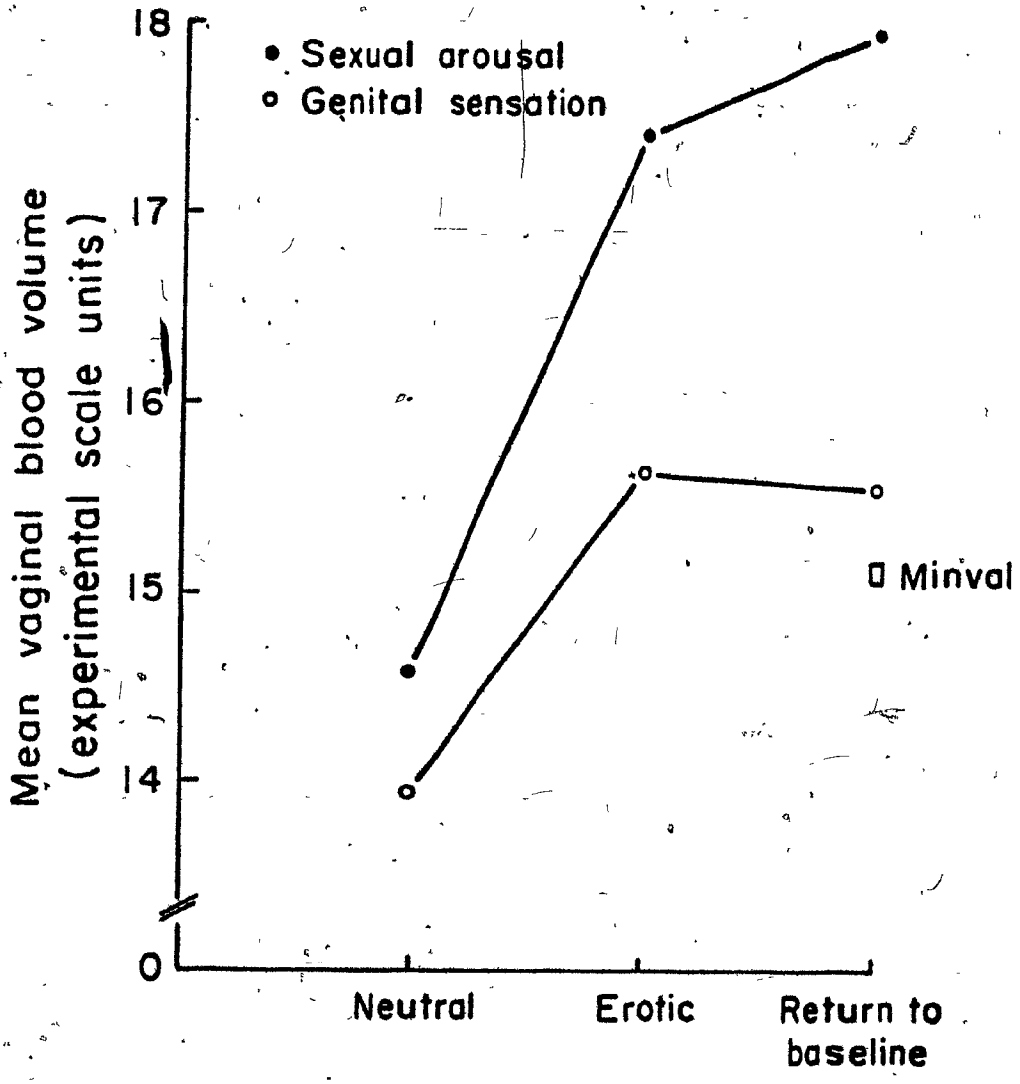
Analysis of the interaction, using a single degree of freedom comparison, did not reveal its source probably because of the pooled error term. However, simple effects analysis revealed that the Experimental Phase effect was significant both for reports of genital sensation, $\underline{F}(1,44) = 9.54$, $\underline{p} < 0.005$, and for report of sexual arousal $\underline{F}(1,44) = 33.47$, $\underline{p} < 0.0001$. Post-hoc Newman-Keuls comparisons were used to determine the differences across experimental phases within each Self-Report type.

The comparisons revealed that, for each report type, Mean VBV in Erotic and Return-to-Baseline periods were not different from one another; but both were significantly greater than VBV during the Neutral Story period ($\underline{p} < 0.01$, in each case).

Figure 7 shows the pattern of VBV levels for each type of Self-Report across experimental phases. The lack of a Phase x Intensity interaction indicated that the patterns shown in Figure 7 were the same at each intensity level. Mean VBV levels significantly increased during the Erotic Story

FIGURE 7. Mean VBV During Experimental Phases by Self-Report Type

(and Mean MINVAL in Return-to-Baseline Phase)


Mean vaginal blood volume
(experimental scale units)
18
17
16
15
14
0
Sexual arousal
Genital sensation
Minval
Neutral
Erotic
Return to
baseline

period compared with the Neutral Story Period and remained significantly elevated thereafter. VBV levels of those reporting sexual arousal were at all times higher than those reporting genital sensations, but especially in the Erotic Story and Return-to-Baseline periods.

Mean self-report responses. Self-Report means were also analysed in a similar 3-factor ANOVA. The summary of results in Table 11 shows that there was a significant effect due to Experimental Phase, $F(3,132) = 30.03$, $p < 0.0001$, and a significant Experimental Phase x Intensity interaction, $F(3,132) = 3.01$, $p < 0.05$. Figure 8 shows mean Self-Reports by Experimental Phases and Erotic Story intensity. Analysis of simple effects revealed that the Experimental Phase effect was significant both for low intensity, $F(3,132) = 7.30$, $p < 0.005$, and for high intensity conditions, $F(3,132) = 25.74$, $p < 0.0001$.

Post-hoc Newman-Keuls comparisons were used to determine the differences across experimental phases within each intensity level. Since self-reports were equivalent the results hold for sexual arousal and genital sensations. The results of these comparisons (using total scores) are summarized in Appendix G. For the low intensity condition Baseline and Neutral Story mean Self-Reports were not different. The Erotic Story produced significantly more sexual arousal and stronger genital sensations than either of the preceding phases. Return-to-Baseline self-reports were significantly greater than they were for Baseline and Neutral Story periods, but not different from mean self-reports during the Erotic Story. For the high intensity condition, Baseline and Neutral Story self-reports were not significantly different from one another. The Erotic Story produced self-reports of significantly greater sexual arousal and stronger genital sensations than during Baseline, Neutral Story and, in this case, Return-to-Baseline periods.

TABLE 11

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on Mean Self-Report

SOURCE	SS	dF	MS	F
Total	727.3644	191		
Erotic Story Intensity (I)	6.6124	1	6.6124	< 1
Self-Report Type (R)	13.5208	1	13.5208	1.32
IR	1.0845	1	1.0845	< 1
S(IR)	452.3247	44	10.2801	
Experimental Phase (P)	95.6407	3	31.8802	30.03***
PI	9.5770	3	3.1923	3.01*
PR	1.8034	3	0.6011	< 1
PIR	6.6913	3	2.2304	2.10
PS(IR)	140.1097	132	1.0614	

* $p < 0.05$ $F(3,132)$

*** $p < 0.0001$ $F(3,132)$

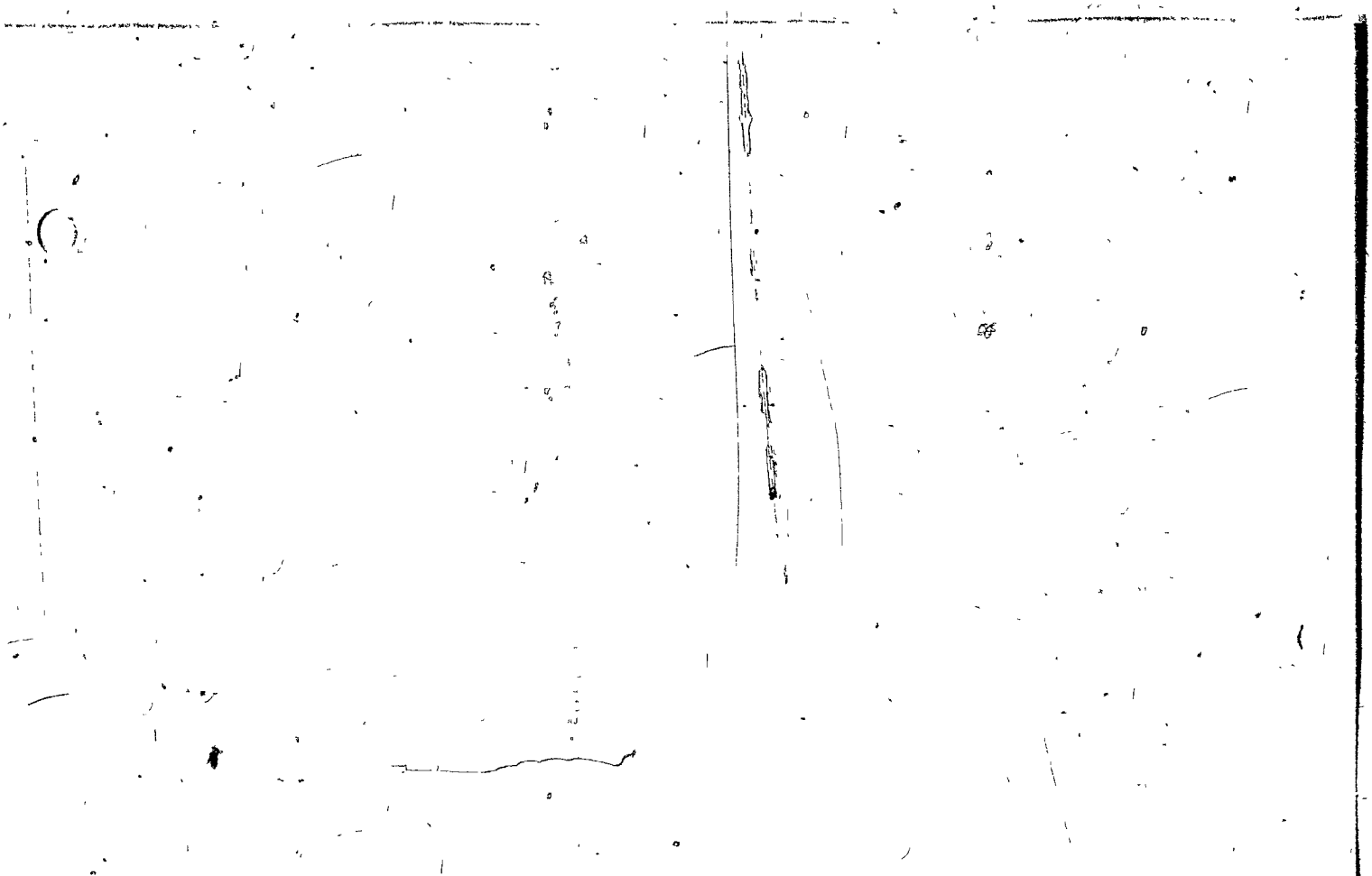
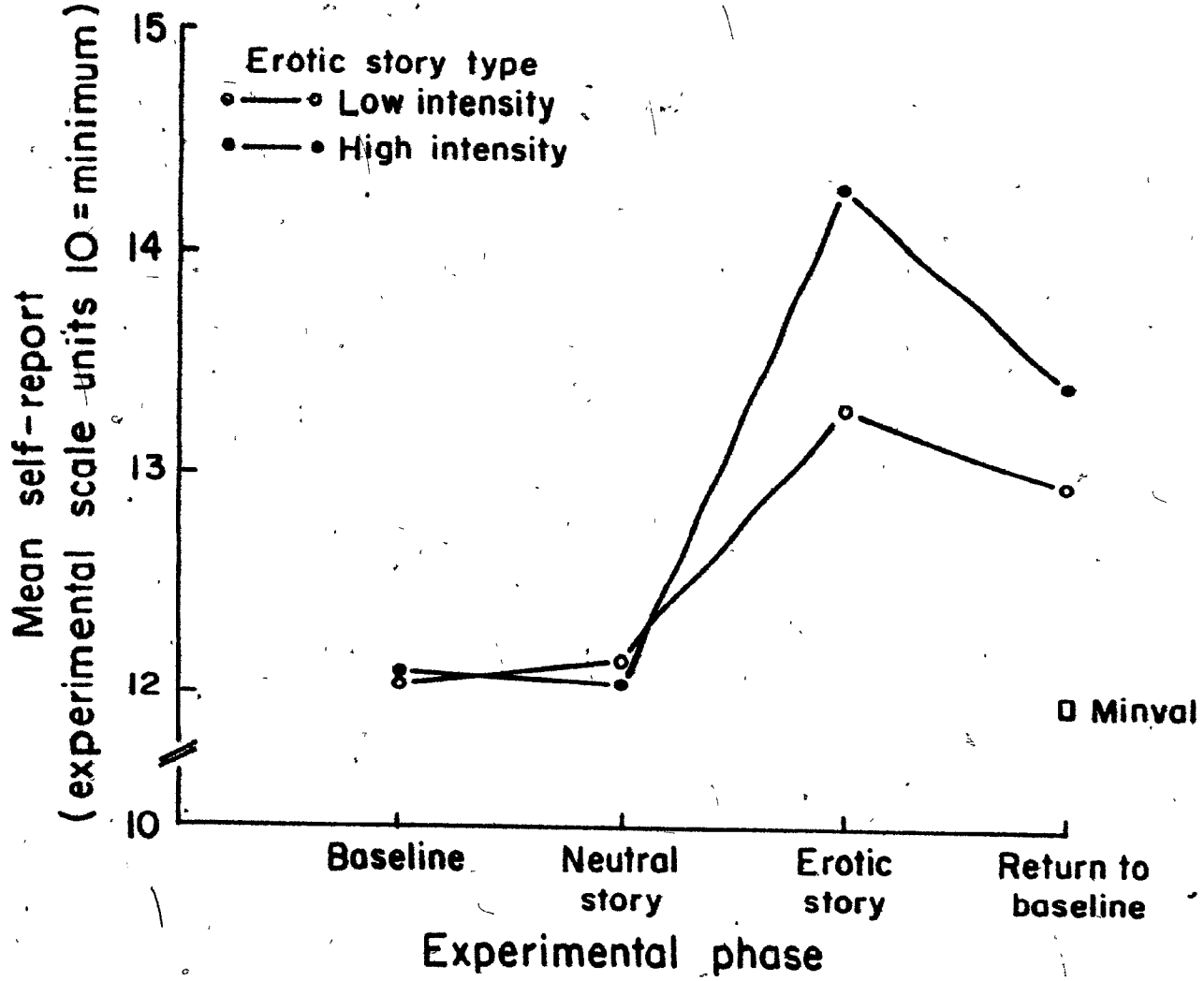


FIGURE 8. Mean Self-Report During Experimental Phases by Erotic Story Intensity (with Mean MINVAL in Return-to-Baseline Phase)


Erotic story type
Low intensity
High intensity
Mean self-report
(experimental scale units 10 = minimum)
15
14
13
12
10
8
Minval
Baseline
Neutral story
Erotic story
Return to baseline
Experimental phase

Similarly, Return-to-Baseline self-reports were significantly greater than Baseline and Neutral Story self-reports.

Breakdown of the significant interaction, by means of a single degree of freedom comparison between means, revealed that Self-Reports were significantly higher during the high intensity Erotic Story period than during the low intensity story ($F(1,44) = 4.11$, $p < 0.05$).

All assumptions underlying the analysis of variance i.e., homogeneity of covariance, of within- and between-group variances and of compound symmetry were met, so full degrees of freedom were used to evaluate within-group effects.

Summary of analysis of mean responses. Mean VPP and Self-Report scores for the four experimental phases are very similar. The presentation of the erotic story resulted in significant increases in mean VPP amplitude and in mean Self-Report relative to their respective levels during the Neutral Story and Baseline periods. Erotic Story intensity significantly increased Self-Report ratings, but did not significantly affect VPP amplitudes. Return-to-Baseline mean levels of Self-Report and VPP amplitude remained significantly higher than their respective levels during Baseline and Neutral Story Periods.

Mean VBV levels showed a similar trend, being significantly higher in the Erotic Story and Return-to-Baseline periods than during the Neutral Story period. In addition, VBV levels of those reporting sexual arousal were consistently higher than of those reporting genital sensation.

Analysis of Response Latencies

To determine the time relationships among VBV, VPP, and Self-Report analyses of response times to maximum values in the Erotic Story period

were done. Times were expressed as a proportion of erotic story length. The untransformed mean times were: VBV = 0.68, VPP = 0.66, Self-Report = 0.87. The proportions were subjected to an inverse sine transformation (Winer, 1971) and related-measures t-tests computed to determine which means were different. VPP was found to reach maximum values significantly sooner than Self-Report, $t(47) = 4.95$, $p < 0.0001$. Similarly, VBV reached maximum values significantly sooner than Self-Report, $t(47) = 4.07$, $p < 0.0002$. VPP and VBV reached maximum values at not significantly different times from one another, $t(47) = 0.32$, $p > 0.7$.

The times to reach minimum values in the Return-to-Baseline period were similarly examined. The untransformed mean times were: VBV = 0.35, VPP = 0.52, Self-Report = 0.59. T-tests, using an inverse sine, data transformation, showed that VPP and Self-Report reached minimum values at not significantly different times from one another, $t(47) = 1.47$, $p > 0.1$. VBV reached minimum values significantly sooner than both VPP, $t(47) = 3.49$, $p < 0.002$, and Self-Report, $t(47) = 4.76$, $p < 0.0001$.

The minimum values (MINVAL) for each of the measures in the Return-to-Baseline were also computed for each subject. The means were as follows: VPP = 2.07, VBV = 15.1, SR = 11.86. An inspection of these values in Figures 6 and 8 indicates that the minimum values of VPP and Self-Report were close to mean values during baseline. On the other hand, subjects' VBV levels reached minimum values significantly sooner than did the other two measures, but the minimum values remained elevated with respect to the control period values (Figure 7).

In addition, separate two-way analyses of variance were conducted to determine whether the times responses took to reach maximum values in the Erotic Story period depended on erotic story intensity or type of self-report.

Similar analyses were conducted on response times to minimum value in the Return-to-Baseline period. All times were expressed as a proportion of the appropriate experimental period and the proportions subjected to an inverse sine transformation. There was only one significant result, which was that VBV levels reached their maximum values in the high intensity Erotic Story period significantly later than those in the low intensity Erotic Story period, $F(1,44) = 4.18$, $p < 0.05$. In other words, VPP latencies to maximum values were the same for all groups, and so were VPP latencies to minimum values. This was also the case for Self-Report latencies to maxima and minima, and for VBV latencies to minima.

Relation Between Physiological and Self-Report Measures

The degree of association among the psychophysiological and self-report measures was assessed for each separate experimental phase by computing Pearson Product-Moment Correlations between the data points. Chronologically equivalent pairs of data points from say, VPP and Self-Report responses were correlated, for each separate experimental phase for each subject. The correlations so obtained were an index of the degree of agreement between responses for one subject. In addition, correlations were computed for each experimental phase by lagging or leading one response with respect to the other. The lag/lead intervals were chosen to be 30-seconds, because this coincided with the interval in which subjects were requested to give self-reports. Since the data were scored every 2.5 seconds, there were 12 data points (30/2.5) in a lag/lead interval.

To illustrate, let the datum point for VPP at time t be represented by V_t and the corresponding datum point for Self-Report at the same time be represented by S_t. Then point-for-point correlations (no lead or lag)

are computed between V_t and S_t, where the number of observations t equals the number of data points in each separate experimental phase.

When Self-Report is lagged by one interval with respect to VPP, then the datum point V_t is paired with the datum point S_{t+12}. In similar fashion, lagging Self-Report by two intervals with respect to VPP produces a correlation between V_t and S_{t+24}, and so on. If Self-Report is advanced by one lead unit with respect to VPP then V_t is paired with S_{t-12}. The effect of this is to pair VPP data points with sooner occurring Self-Report data points.

Correlations were computed for a total of 3 lead and 3 lag intervals, corresponding to a total time lag of ±90 seconds between responses. This lead/lag procedure required an adjustment to the boundaries of the Baseline and Return-to-Baseline periods. Thus, the beginning of the Baseline period was advanced by 36 time sampling units (ie., data points) and the end of the Return-to-Baseline period was retarded by 60 such units. The data before and after these modified boundaries were used to compute the lead/lag correlations.

The number of data points included in Baseline and Return-to-Baseline correlations were therefore 180 (instead of the original 240). The number of data points included in correlations for all other experimental phases remained the same as that for previous analyses. The point-for-point and lead/lag correlations were examined, and the largest single positive correlation was selected from each of the experimental phases according to the following rules:

1. If all lead/lag correlations were negative, the point-for-point correlation was selected, regardless of its value or sign.
2. If two large positive correlations were separated by a smaller positive

or by a negative correlation, the first positive value was selected. Thus if lead/lag 0 correlation was 0.60, lead 1 was 0.70, lead 2 was 0.65, and lead 3 was 0.80, the selected correlation was 0.70.

In this way, one correlation for each experimental phase for each subject was obtained. All correlations were transformed to Fisher's Z scores, where $Z = \frac{1}{2}[\ln(1+r) - \ln(1-r)]$. Each subject therefore had four Z scores representing each experimental phase.

The data were analysed in a 3-factor ANOVA with repeated measures on one factor. As before, the factors were Erotic Story Intensity (2), Type of Self-Report (2), and Experimental Phase (4 levels for VPP correlations, 3 levels for VBV correlations). Two separate sets of analyses were conducted, one based on lead/lag, the other based on no lead/lag. For convenience these analyses will be referred to as LEAD/LAG OPT(imized) and LEAD/LAG 0 (Zero) analyses respectively.

Analysis of LEAD/LAG OPT Correlations between VPP and Self-report. The summary of the ANOVA of LEAD/LAG OPT correlations between VPP and Self-Reports are shown in Table 12 which shows that there was a significant effect due to Experimental Phase, $F(3,132) = 20.37$, $p < 0.0001$, and a significant Phase x Intensity interaction, $F(3,132) = 3.74$, $p < 0.025$. Full degrees of freedom were used to evaluate within-group effects since assumptions underlying the ANOVA were met. Analysis of simple main effects within each intensity level revealed that the Experimental Phase effect was significant for Low Intensity, $F(3,132) = 10.34$, $p < 0.0001$, and High Intensity, $F(3,132) = 13.77$, $p < 0.0001$ conditions. Figure 9 shows the strength of association between VPP and Self-Report by intensity of erotic story for each experimental phase. Fisher's Z scores and their corresponding product-moment correlation values are shown on the left and right ordinates,

TABLE 12

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on LEAD/LAG OPT Correlations Between Vaginal Pulse Pressure and Self-Report

SOURCE	SS	dF	MS	F
Total	61.3718	191		
Erotic Story Intensity (I)	0.3725	1	0.3725	<1
Self-Report Type (R)	0.0274	1	0.0274	<1
IR	0.0666	1	0.0666	<1
S(IR)	16.6347	44	0.3781	
Experimental Phase (P)	12.6967	3	4.2322	20.37***
PI	2.3293	3	0.7764	3.74*
PR	0.6289	3	0.2096	1.01
PIR	1.1958	3	0.3986	1.92
PS(IR)	27.4198	132	0.2077	

* $p < 0.025$ $F(3,132)$

*** $p < 0.0001$ $F(3,132)$

respectively. Inspection of Figure 9 reveals that the strength of the agreement between VPP and Self-Report was greater during Erotic Story and Return-to-Baseline periods than in the preceding phases. A post-hoc Newman-Keuls multiple comparison of the totals within each intensity level is summarized in Appendix H. This summary shows that, within each intensity condition, agreements between VPP and Self-Report during Baseline and Neutral Story periods were not significantly different. For the Low Intensity condition, agreement between VPP and Self-Reports were significantly greater in both the Erotic Story and Return-to-Baseline periods than during other periods but were not different from one another. A similar pattern held for the High Intensity condition except that Erotic Story correlations were significantly higher than Return-to-Baseline correlations. Analysis of the significant interaction, using a single degree of freedom comparison, showed that High Intensity associations between VPP and Self-Report were greater than Low Intensity associations, $F(1,161) = 6.27$, $p < 0.025$, during the Erotic Story period.

None of the interactions involving Self-Report was significant suggesting that the two report types were equivalent. However, inspection of Figure 10, which depicts associations between VPP and Self-Report by intensity and type of self-report, shows that the mean correlation ($\bar{r} = 0.40$) for the low intensity/sexual arousal condition during the Erotic Story period is considerably lower than all others in the period. Since such differences were anticipated in advance, planned comparisons were conducted on these correlations. During the Erotic Story period, the correlation for the low intensity/sexual arousal condition was significantly lower than the average of the three other correlations in this period, $F(1,161) = 10.35$, $p < 0.005$.

FIGURE 9. Mean Association Between VPP- & Self-Report By Intensity and Experimental Phase (LEAD/LAG OPT)

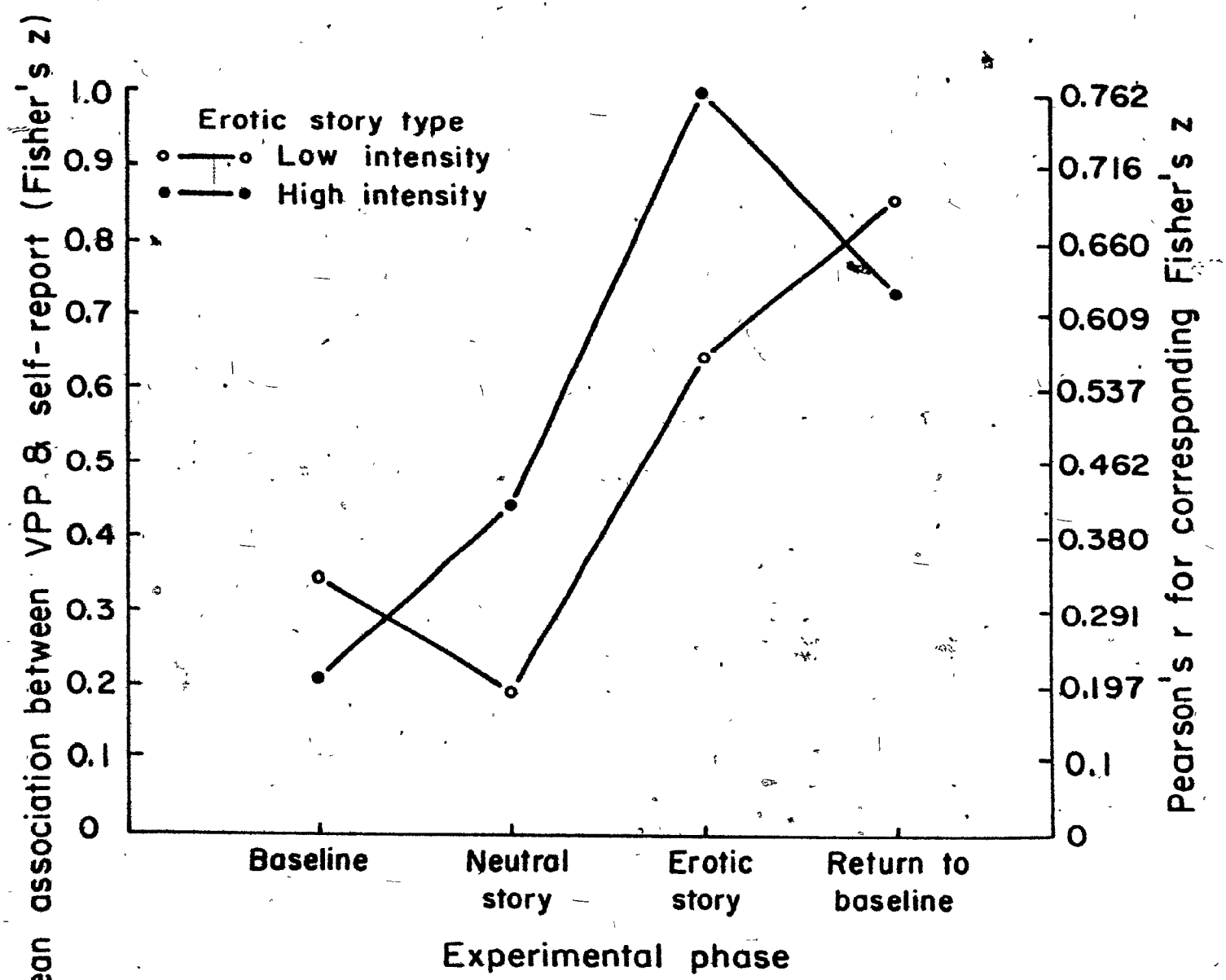
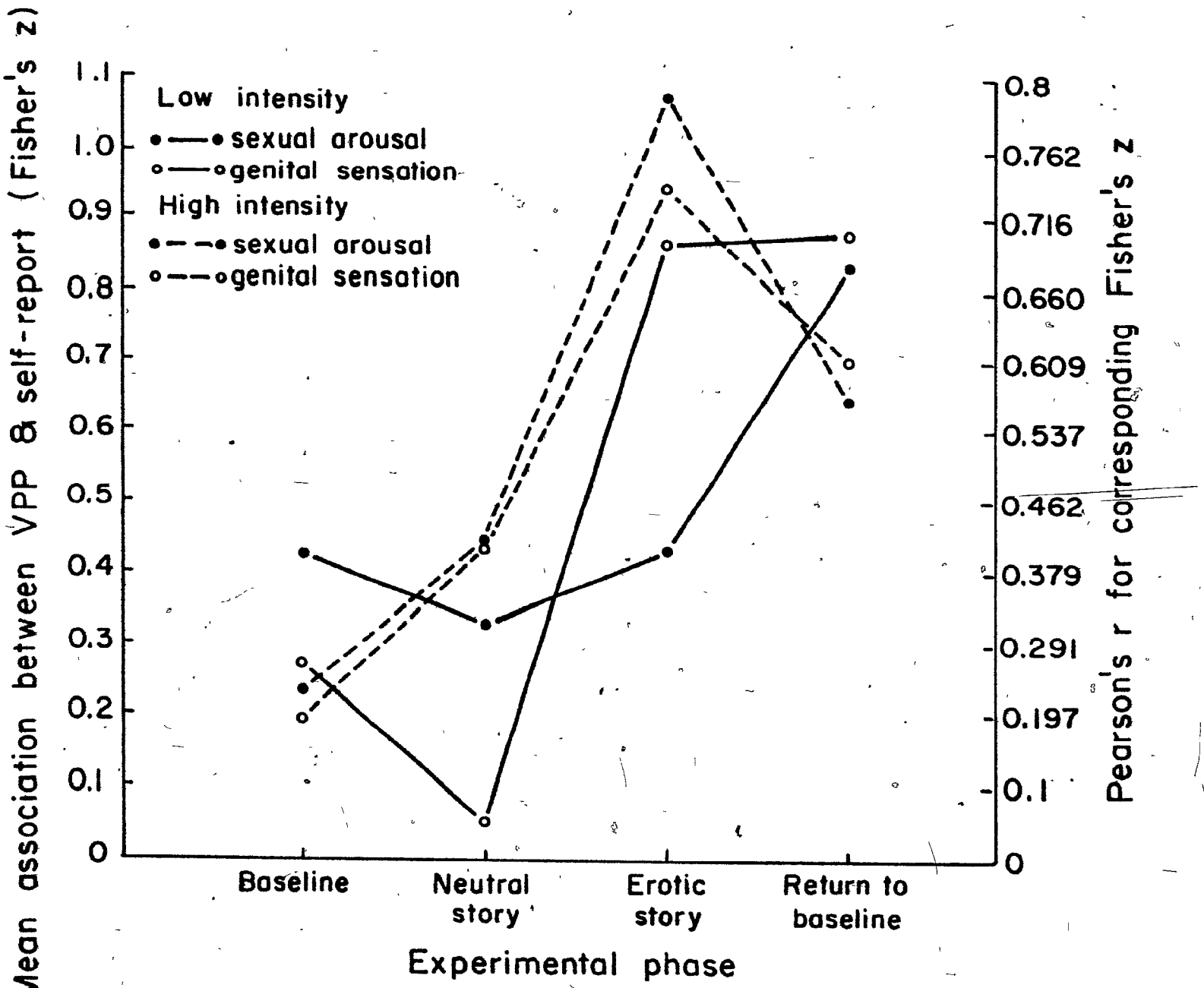

Erotic story type
Low intensity
High intensity
Mean association between VPP & self-report (Fisher's z)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.762
0.716
0.660
0.609
0.537
0.462
0.380
0.291
0.197
0.1
0
Pearson's r for corresponding Fisher's z
Baseline
Neutral story
Erotic story
Return to baseline
Experimental phase

FIGURE 10. Mean Association Between VPP & Self-Report By Intensity, Type of Report, and Experimental Phase (LEAD/LAG OPT)


Mean association between VPP & self-report (Fisher's z)
Pearson's r for corresponding Fisher's z
Low intensity
sexual arousal
genital sensation
High intensity
sexual arousal
genital sensation
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.8
0.762
0.716
0.660
0.609
0.537
0.462
0.379
0.291
0.197
0.1
0
Baseline
Neutral story
Erotic story
Return to baseline
Experimental phase

Likewise, the low intensity/sexual arousal correlation was significantly lower than that for the low intensity/genital sensation condition in the Erotic Story period, $F(1,161) = 4.71$, $p < 0.05$. This indicates that there was significantly less agreement between VPP changes and reports of sexual arousal was compared with all other conditions during the Erotic Story period. Moreover, there was significantly greater agreement in the low intensity Erotic Story between VPP and reported genital sensations than between VPP and reported sexual arousal. The remaining mean correlations in the Erotic Story period are high (Low Intensity / Genital Sensation $\bar{r} = 0.70$, High Intensity/Genital Sensation $\bar{r} = 0.74$, High Intensity/Sexual Arousal $\bar{r} = 0.79$). This indicates that, on average, there is a large amount of agreement between VPP and Self-Report measures during the Erotic Story period.

Analysis of LEAD/LAG 0 correlations between VPP and Self-report.

The summary of ANOVA for LEAD/LAG 0 correlations between VPP and Self-Report is given in Table 13. All assumptions underlying the analysis were satisfied. Only the main effect due to Experimental Phase was significant, $F(3,132) = 32.54$, $p < 0.0001$. Figure 11 shows the mean Fisher's Z scores and Pearson correlations for each experimental phase. Mean correlations during the Erotic Story and Return-to-Baseline periods were considerably higher than during either of the preceding phases. A post-hoc Newman-Keuls comparison of the experimental phase means revealed that Erotic Story and Return-to-Baseline mean correlations were significantly higher than preceding means ($p < 0.01$ in each case), but were not different from each other; and that Baseline and Neutral Story mean correlations were not different from each other.

TABLE 13

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on LEAD/LAG 0 Correlations Between Vaginal Pulse Pressure and Self-Report

SOURCE	SS	dF	MS	F
Total	59.4760	191		
Erotic Story Intensity (I)	0.2886	1	0.2886	<1
Self-Report Type (R)	0.3017	1	0.3017	<1
IR	0.0716	1	0.0716	<1
S(IR)	14.2720	44	0.3244	
Experimental Phase (P)	17.7671	3	5.9224	32.54***
PI	0.6900	3	0.2300	1.26
PR	1.2845	3	0.4282	2.35
PIR	0.7798	3	0.2599	1.43
PS(IR)	24.0207	132	0.1820	

*** $p < 0.0001$ $F(3,132)$

FIGURE 11. Mean Association Between VPP and Self-Report by Experimental Phase (LEAD/LAG 0)

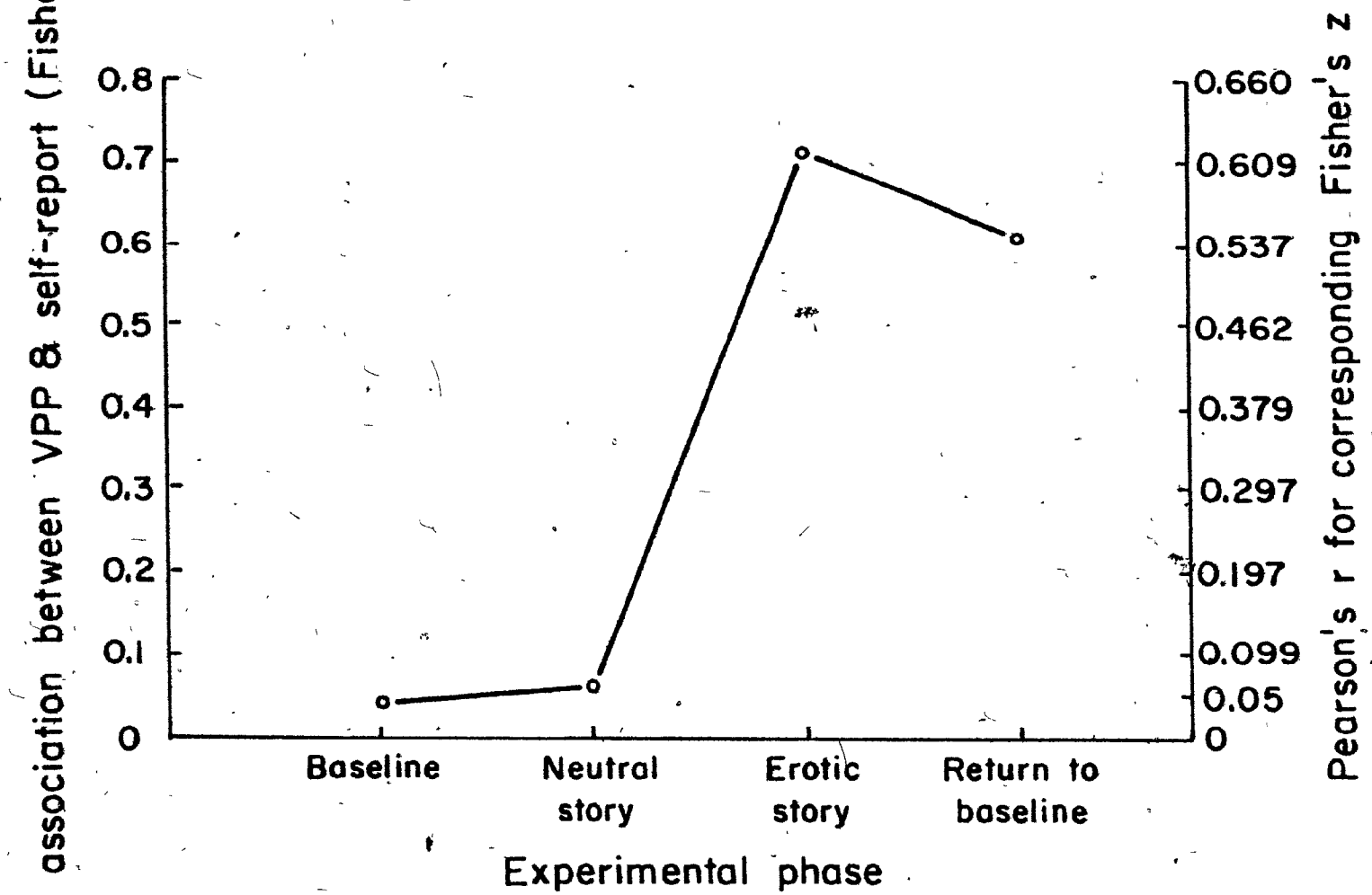

Mean association between VPP & self-report (Fisher's z)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.660
0.609
0.537
0.462
0.379
0.297
0.197
0.099
0.05
0
Pearson's r for corresponding Fisher's z
Baseline
Neutral story
Erotic story
Return to baseline
Experimental phase

Figure 12 shows the mean correlations by Experimental Phase and Erotic Story intensity for purposes of comparison with Figure 9 which shows the results for LEAD/LAG OPT correlations. The general pattern of results is remarkably similar, but in general the LAG OPT correlations are higher because, as their name suggests, they were selected to represent the maximum positive correlation found across various degrees of lead and lag for each experimental phase.

There were no differences in mean correlations between VPP and Self-Report as a function of Erotic Story intensity unlike what was found in the LEAD/LAG OPT results. As Figure 12 shows, mean correlations between VPP and Self-Report in the High Intensity condition were not significantly greater than for the Low Intensity condition during the Erotic Story period, though the pattern of results are similar. Since the LEAD/LAG 0 analysis does not take into account the potential time delay between VPP and Self-Report measures whereas the LEAD/LAG OPT results do, this may be the critical variable necessary for demonstration of intensity differences.

Although the interactions with Self-Report type were not significant, a planned comparison of the correlations between VPP and Self-Report revealed that the correlation for the low intensity/sexual arousal condition was significantly lower than the equivalent correlations for the other three conditions, $F(1,163) = 5.73$, $p < 0.02$. Thus, as in the LEAD/LAG OPT analysis, reports of sexual arousal did not covary as closely with VPP changes in the low intensity Erotic Story as did self-reports in the other conditions.

Analysis of LEAD/LAG OPT correlations between VBV and Self-report. Table 14 summarizes the results of a similar analysis of the correlations between VBV and Self-Report in the experimental phases. Full degrees of freedom were used since assumptions underlying the ANOVA were met. Baseline

FIGURE 12. Mean Association Between VPP and Self-Report By Experimental Phase and Erotic Story Intensity (LEAD/LAG 0)

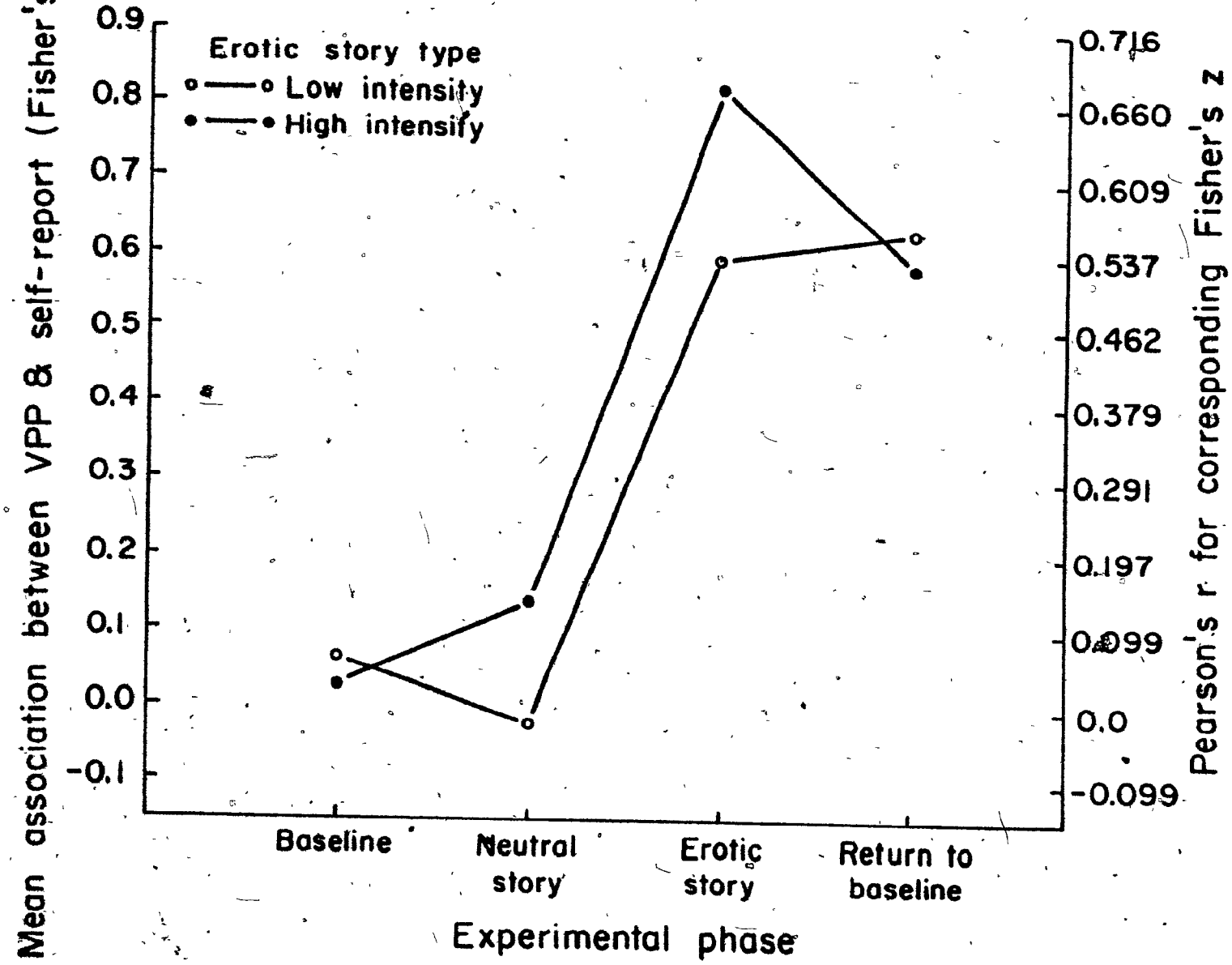

Mean association between VPP & self-report (Fisher's z)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
Erotic story type
Low intensity
High intensity
0.716
0.660
0.609
0.537
0.462
0.379
0.291
0.197
0.099
0.0
-0.099
Pearson's r for corresponding Fisher's z
Baseline
Neutral story
Erotic story
Return to baseline
Experimental phase

TABLE 14

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on LEAD/LAG OPT Correlations Between Vaginal Blood Volume and Self-Report

SOURCE	SS	dF	MS	F
Total	80.3520	143		
Erotic Story Intensity (I)	0.0630	1	0.0630	<1
Self-Report Type (R)	1.6063	1	1.6063	3.37
IR	0.0494	1	0.0494	<1
S(IR)	20.9590	44	0.4763	
Experimental Phase (P)	5.4458	2	2.7229	5.05**
PI	1.8320	2	0.9160	1.70
PR	2.1695	2	1.0847	2.01
PIR	0.7316	2	0.3658	<1
PS(IR)	47.4954	88	0.5397	

** $p < 0.01$, $F(2,88)$

period correlations were excluded from the analysis because of the marked increase in VBV response during this phase. There was a significant Experimental Phase effect, $F(2,88) = 5.05$, $p < 0.01$. No other effects were significant. Figure 13 shows the mean Fisher's Z scores and equivalent correlations between VBV and Self-Report. A post-hoc Newman-Keuls comparison of the totals for each experimental phase revealed that mean correlations between VBV and Self-Report were significantly greater in the Erotic Story period than in Neutral Story ($p < 0.05$) and Return-to-Baseline ($p < 0.05$) periods; and that mean correlations in Neutral Story and Return-to-Baseline periods were not different. Mean correlation during the Erotic Story period was greater for the High Intensity Story ($r = 0.66$) than for the Low Intensity Story ($r = 0.47$). Although this difference was non-significant it was in the same direction as that for associations between VPP and Self-Report.

The significantly lower mean correlation between VBV and Self-Report during the Return-to-Baseline phase can be attributed to the fact that VBV levels in this phase did not drop whereas Self-Report levels did (see Analyses of Slopes and of Means).

Associations between VBV and Self-Report were not different for reports of sexual arousal or of strength of genital sensation.

Analysis of LEAD/LAG 0 correlations between VBV and Self-report. Table 15 summarizes the results of the LEAD/LAG 0 ANOVA of correlations between VBV and Self-Report. Full degrees of freedom were used since assumptions underlying the ANOVA were met. The main effect due to Experimental Phase was significant, $F(2,88) = 10.26$, $p < 0.0001$, as was the Phase x Intensity interaction, $F(2,88) = 3.50$, $p < 0.05$. Analysis of simple main effects revealed that there was a significant Experimental Phase effect

FIGURE 13. Mean Association Between VBV and Self-Report by Experimental Phase (LEAD/LAG OPT)

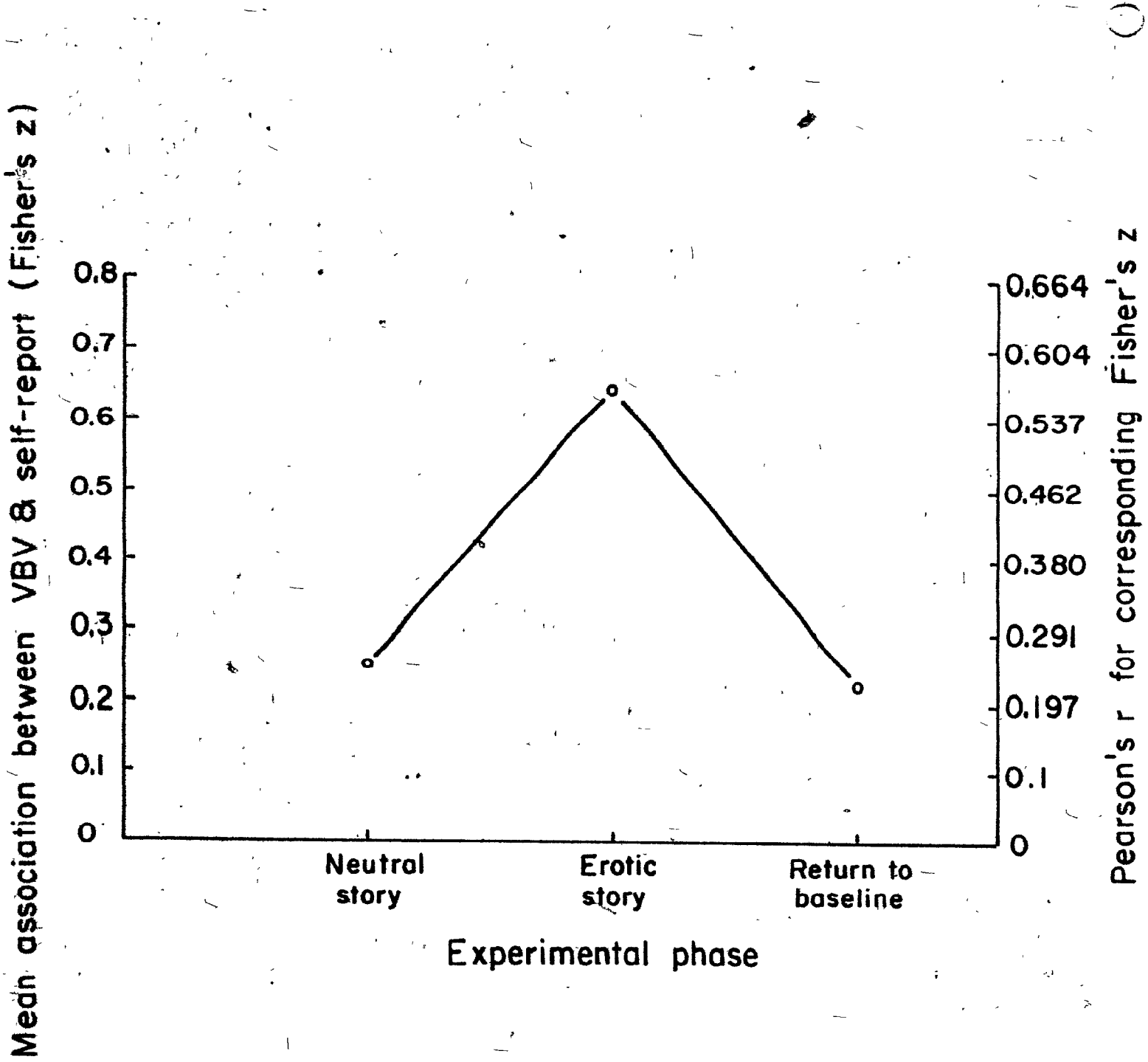

Mean association between VBV & self-report (Fisher's z)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.664
0.604
0.537
0.462
0.380
0.291
0.197
0.1
0
Pearson's r for corresponding Fisher's z
Neutral story
Erotic story
Return to baseline
Experimental phase

TABLE 15

Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on LEAD/LAG 0 Correlations Between Vaginal Blood Volume and Self-Report

SOURCE	SS	dF	MS	F
Total	70.3940	143		
Erotic Story Intensity (I)	0.3314	1	0.3314	<1
Self-Report Type (R)	0.5488	1	0.5488	1.13
IR	0.0377	1	0.0377	<1
S(IR)	21.3070	44	0.4842	
Experimental Phase (P)	8.2161	2	4.1080	10.26***
PI	2.8067	2	1.4033	3.50*
PR	1.3135	2	0.6568	1.64
PIR	0.5886	2	0.2943	<1
PS(IR)	35.2443	88	0.4005	

* $p < 0.05$ $F(2,88)$

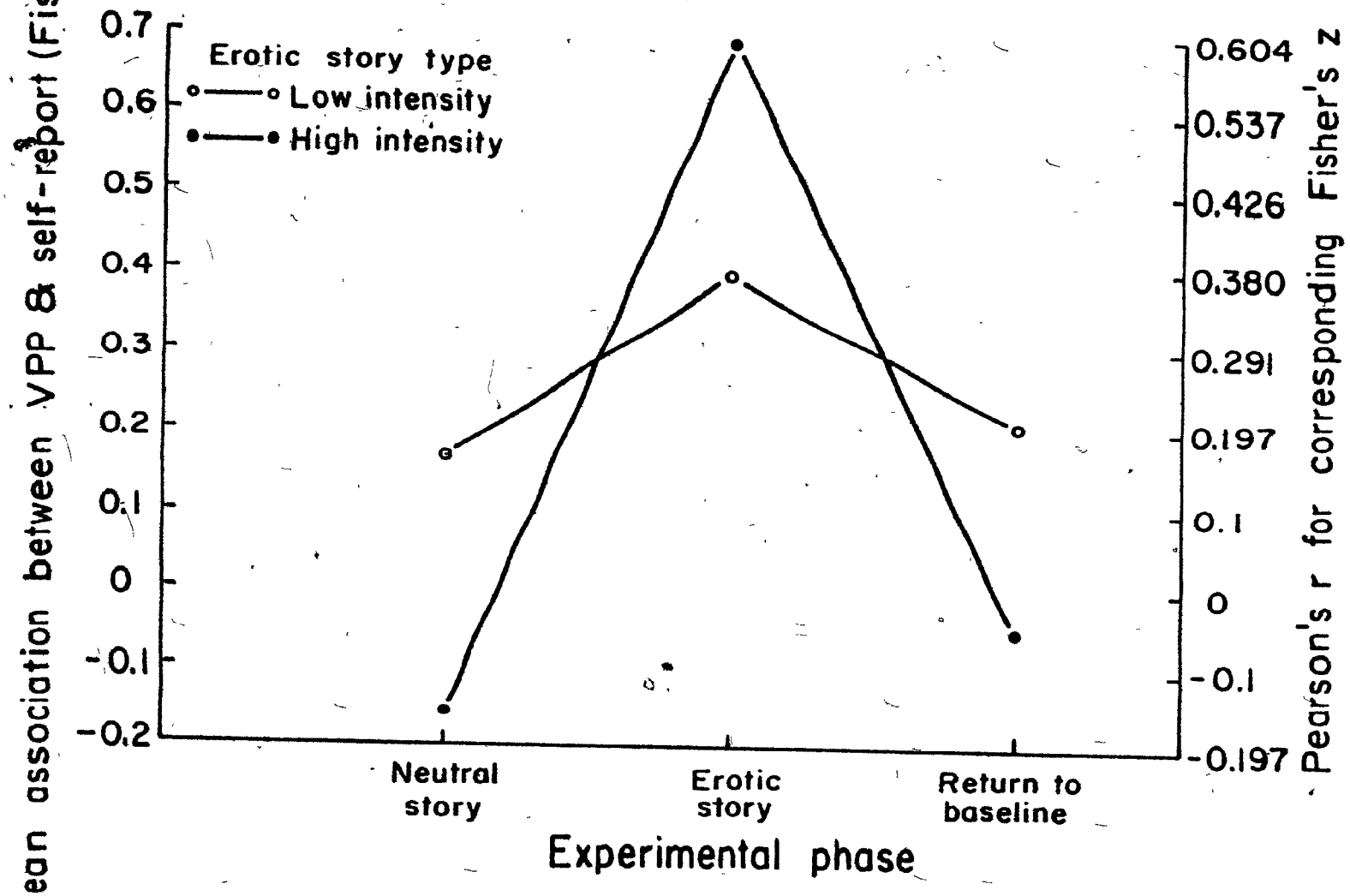
*** $p < 0.0001$ $F(2,88)$

in the High Intensity ($F(2,88) = 12.86$, $p < 0.0001$) but not in the Low Intensity ($F(2,88) < 1$) condition. There was no clear indication of precisely where the Phase x Intensity interaction was occurring probably because of the "pooled" error term in the single degree of freedom comparisons assessing the interaction. Since the simple main effect for Low Intensity was not significant, pinpointing the interaction is not crucial. Moreover, to be consistent with the interpretation of analyses for association between VPP and Self-Report, the LAG OPT analysis will be considered as the more likely result. Recall that LAG OPT analysis takes into account the significant differences between VBV and Self-Report times to maximum and minimum values.

Figure 14 shows the LAG O mean associations between VBV and Self-Report by Experimental Phase and Erotic Story Intensity. The mean correlations between VBV and Self-Report are greater in the Erotic Story period than in the other phases for only the High Intensity story. This was confirmed by a post-hoc Newman-Keuls comparison of means within the High Intensity condition, which revealed that mean correlations between VBV and Self-Report in the Erotic Story period were significantly greater than during Neutral Story ($p < 0.01$) and Return-to-Baseline ($p < 0.01$) periods; and that mean correlations between VBV and Self-Report were not different in Neutral Story and Return-to-Baseline periods.

The low mean correlations in the Return-to-Baseline period reflect the fact that VBV levels did not drop in this period whereas Self-Report levels did. There were no differences in the degree of correlation that could be attributed to erotic story intensity or to type of self-report given.

FIGURE 14. Mean Association Between VBV and Self-Report By Experimental Phase and Intensity (LEAD/LAG 0)


Erotic story type
Low intensity
High intensity
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
0.604
0.537
0.426
0.380
0.291
0.197
0.1
0
-0.1
-0.197
Mean association between VPP & self-report (Fisher's z)
Pearson's r for corresponding Fisher's z
Neutral story
Erotic story
Return to baseline
Experimental phase

Analysis of LEAD/LAG OPT correlations between VBV and VPP. VPP increases have previously been shown to slightly precede VBV increases. In the present research VPP maxima were reached slightly, but not significantly sooner than VBV maxima and VPP minima occurred significantly later than VBV minima. So, LAG OPT correlations were analyzed, and a summary of the ANOVA is given in Table 16. Assumptions underlying the analysis of variance were met, so full degrees of freedom were used to assess within-groups effects. The main effect due to Experimental Phase was significant, $F(2,88) = 4.96$, $p < 0.01$, and so was the Phase x Intensity interaction, $F(2,88) = 3.19$, $p < 0.05$. Analysis of simple main effects within intensity revealed that only the High Intensity simple main effect was significant, $F(2,88) = 7.81$, $p < 0.005$.

Figure 15 shows the mean associations between VBV and VPP by experimental phase and intensity. The source of the interaction was not obvious from the single degree of freedom comparisons across intensity. A post-hoc Newman-Keuls comparison of totals within the High Intensity condition revealed that correlations between VBV and VPP in the Erotic Story period were significantly larger than in the Neutral Story ($p < 0.05$) and in the Return-to-Baseline ($p < 0.01$) periods; and that Neutral Story and Return-to-Baseline associations were not different.

It appears, from Figure 15, that VBV and VPP responses correlated quite highly at all times consistently so in the low intensity condition and differentially so in the high intensity condition. The much smaller Return-to-Baseline correlation in the High Intensity condition reflects the fact that VBV levels did not drop in this period, whereas VPP levels did.

TALBE 16

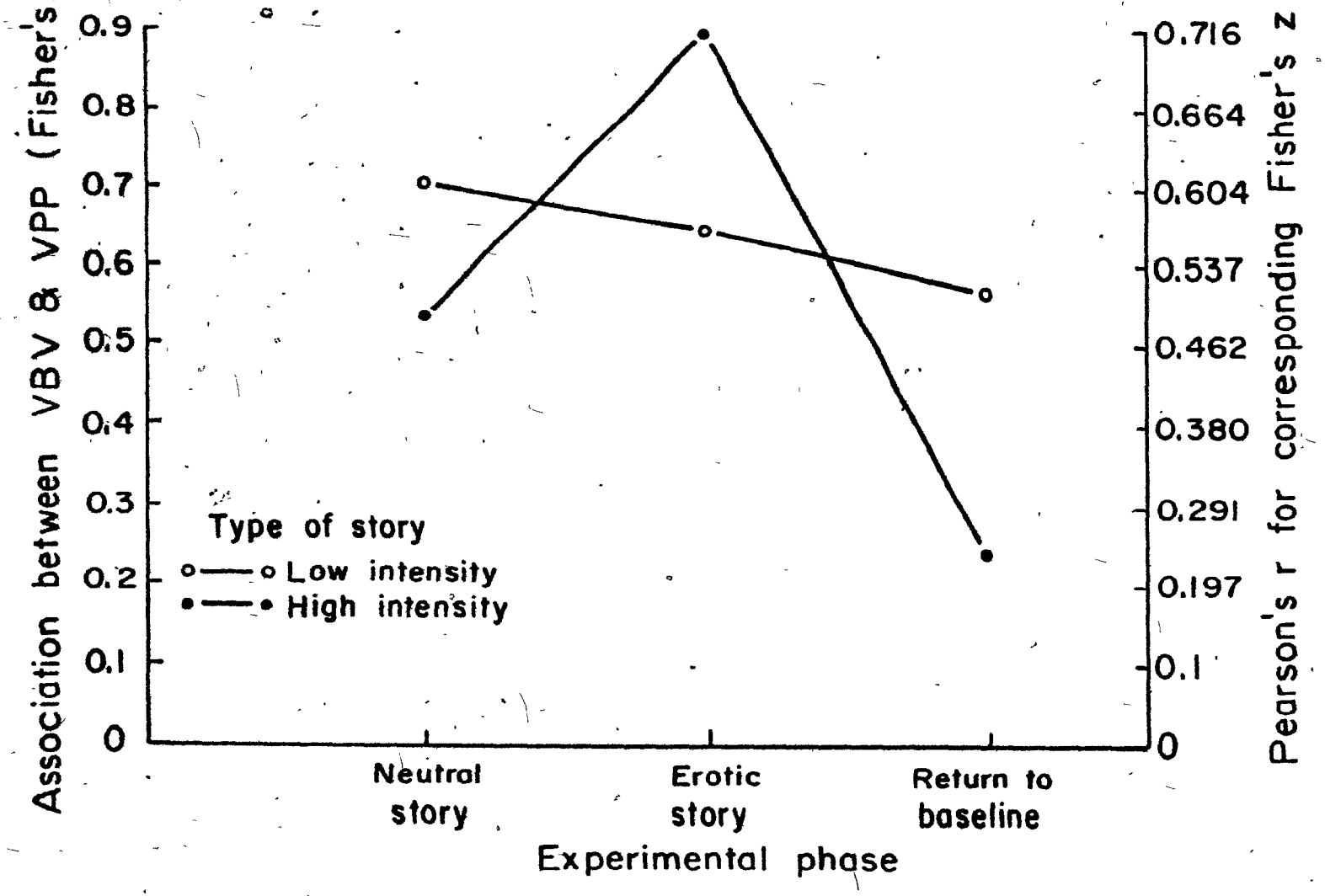
Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on LEAD/LAG OPT Correlations Between Vaginal Blood Volume and Pulse Pressure

SOURCE	SS	dF	MS	F
Total	58.3023	143		
Erotic Story Intensity (I)	0.2477	1	0.2477	<1
Self-Report Type (R)	0.0045	1	0.0045	<1
IR	0.9738	1	0.9738	2.01
S(IR)	21.3415	44	0.4850	
Experimental Phase (P)	3.2668	2	1.6334	4.96**
PI	2.0997	2	1.0499	3.19*
PR	0.6347	2	0.3174	<1
PIR	0.7744	2	0.3721	1.13
PS(IR)	28.9893	88	0.3294	

* $p < 0.05$ $F(2,88)$

** $p < 0.01$ $F(2,88)$

FIGURE 15. Mean Association Between VBV and VPP By Experimental Phase and Intensity (LEAD/LAG OPT)


Association between VBV & VPP (Fisher's z)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.716
0.664
0.604
0.537
0.462
0.380
0.291
0.197
0.1
0
Pearson's r for corresponding Fisher's z
Type of story
Low intensity
High intensity
Neutral story
Erotic story
Return to baseline
Experimental phase

Analysis of LEAD/LAG 0 correlations between VBV and VPP. The ANOVA results for LAG 0 associations between VBV and VPP are summarized in Table 17. The assumptions underlying the ANOVA were met and so full degrees of freedom were used to evaluate within-groups effects. There was a significant effect due to Experimental Phase, $F(2,88) = 6.15$, $p < 0.005$ and the Phase x Intensity interaction was marginally close to significance, $F(2,88) = 3.09$, $p = 0.05$. Analysis of simple main effects within intensity revealed that only the High Intensity condition was significant, $F(2,88) = 8.98$, $p < 0.0005$. Newman-Keuls comparisons of the means within the High Intensity condition showed that correlations between VBV and VPP in the Erotic Story period were significantly higher than in Neutral Story ($p < 0.01$) and Return-to-Baseline ($p < 0.01$) periods; and that correlations between VBV and VPP were not different in Neutral Story and Return-to-Baseline periods.

Figure 16 shows the VBV:VPP correlations by experimental phase and erotic story intensity. As in the LAG OPT analysis, there is always a moderately high association between VBV and VPP which is enhanced in the Erotic Story period in the High Intensity condition, but remains consistent in the Low Intensity condition.

Summary of Analysis of Correlations

1. Perhaps the single most consistent result is that the mean correlation between any two measures significantly increased during the Erotic Story period.

2. The correlations between VPP and Self-Report are generally better than those between VBV and Self-Report in the Erotic Story period, and always better in the Return-to-Baseline period where VBV levels do not decline.

TABLE 17

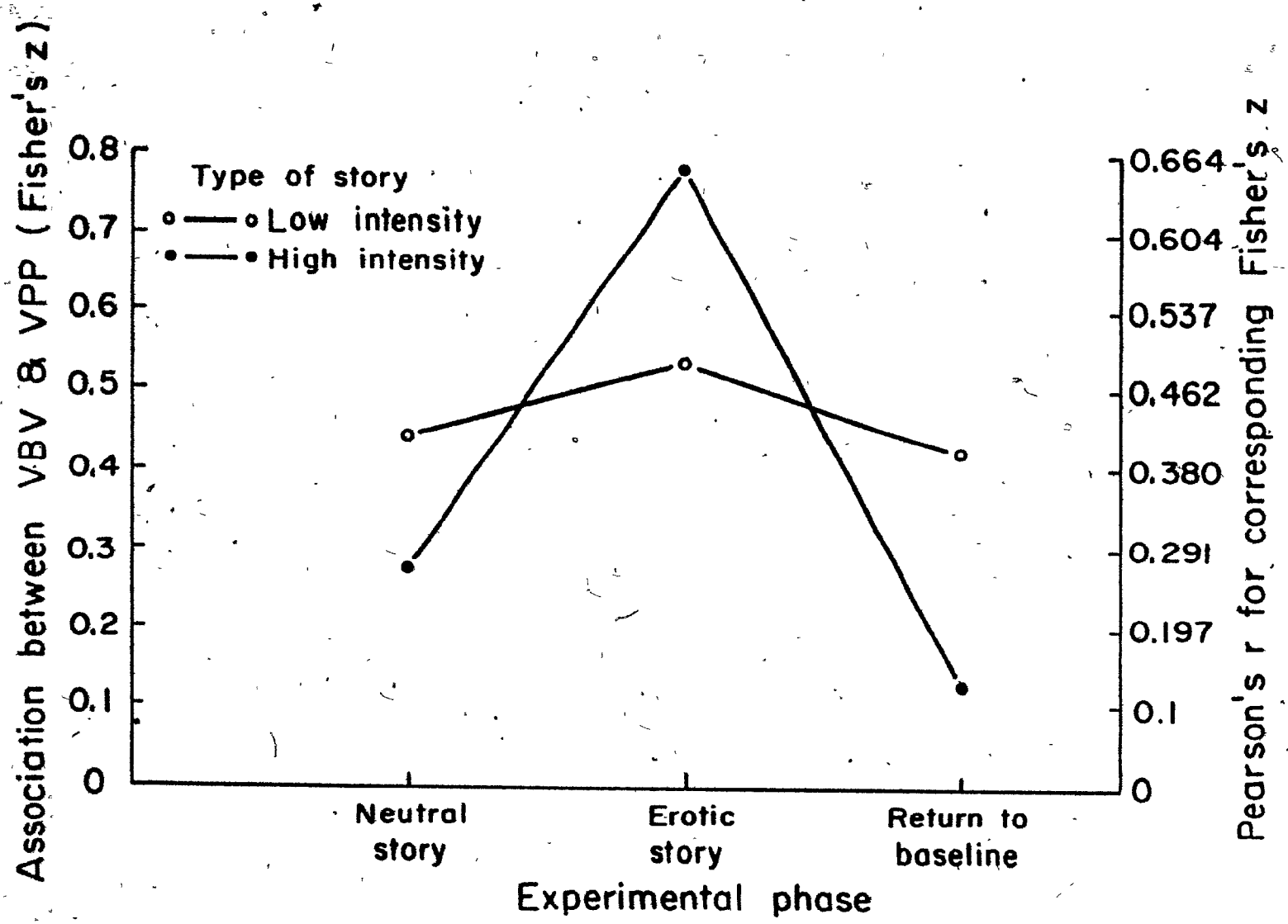
Three-Way Analysis of Variance of the Effects of Erotic Story Intensity, Self-Report Type, and Experimental Phase, on LEAD/LAG 0 Correlations Between Vaginal Blood Volume and Pulse Pressure

SOURCE	SS	dF	MS	F
Total	66.6833	143		
Erotic Story Intensity (I)	0.1903	1	0.1903	< 1
Self-Report Type (R)	0.0852	1	0.0852	< 1
IR	1.3848	1	1.3848	1.97
S(IR)	30.9983	44	0.7045	
Experimental Phase (P)	3.8820	2	1.9410	6.15**
PI	1.9491	2	0.9745	3.09*
PR	0.3056	2	0.1528	< 1
PIR	0.1122	2	0.0561	< 1
PS(IR)	27.7758	88	0.3156	

* $p < 0.05$ $F(2,88)$

** $p < 0.005$ $F(2,88)$

FIGURE 16. Mean Associations Between VBV and VPP By Experimental Phase and Intensity (LEAD/LAG 0)


Association between VBV & VPP (Fisher's z)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Type of story
Low intensity
High intensity
0.664
0.604
0.537
0.462
0.380
0.291
0.197
0.1
0
Pearson's r for corresponding Fisher's z
Neutral story
Erotic story
Return to baseline
Experimental phase

3. In addition, the correlation between VPP and Self-Report of sexual arousal during the low intensity Erotic Story was significantly lower than all other correlations between VPP and Self-Report in that same period. Otherwise, correlations were equivalent for both Self-Report types.

4. Erotic Story intensity increased the degree of association between VPP and Self-Reports in the LEAD/LAG OPT analysis, between VBV and Self-Reports in the LEAD/LAG 0 analysis, and between VPP and VPV in both LEAD/LAG OPT and LEAD/LAG 0 analyses.

5. The LEAD/LAG OPT and LEAD/LAG 0 analysis yielded similar patterns in each separate case.

Table 18 provides a summary of all mean correlations between physiological and self-report measures in the Erotic Story and Return-to-Baseline periods. This summary clearly reflects the generally high mean correlations in all experimental conditions except VBV Return-to-Baseline.

Correlations Among Summary Physiological and Self-Report Data

The physiological and self-report data were analysed to determine if increases in the levels of physiological responses during the Erotic Story period were significantly related to one another, to self-report increases, and to the strength of agreement between responses. Consequently, summary measures of these responses in the Erotic Story period were cross-correlated.

The summary measures for each subject were:

1. Increase in VPP and VBV, expressed as the ratio of the maximum value attained in the Erotic Story period (MAXVAL) to the mean value in the Neutral Story period (N).
2. Increase in Self-Report, expressed as the difference between MAXVAL and (N).

TABLE 18

Correlation Matrix of Summary Physiological and Self-Report Measures for High (above diagonal) and Low (below diagonal) Intensity Erotic Stories

VARIABLE	MAXVAL /- $\bar{x}_N$		(MAXVAL- $\bar{x}_N$)	FISHER'S Z ASSOCIATIONS		
	VPP	VBV	SELF-REPORT (SR)	VBV:VPP	VBV:SR	VPP:SR
VPP	1.0	.46*	.21	.58***	.47*	.40*
VBV	.70***	1.0	.07	.50**	.40*	.53**
SR	.002	-.10	1.0	.31	.25	.32
VBV : VPP	.44*	.28	-.04	1.0	.78***	.67***
VBV : SR	.46*	.42*	-.21	.36	1.0	.70***
VPP : SR	.50*	.26	.11	.39*	.10	1.0

* p 0.05

** p 0.01 Based on N within Intensity; Low, N = 25; High, N = 28.

*** p 0.001

3. One lag optimized correlation, expressed as a Fisher's Z score, from each of VBV, VPP, and Self-Report.

The correlation matrices obtained separately for subjects in the high and low intensity conditions are shown in Table 19. All subjects, including those without coital experience, were included in deriving the correlations.

The physiological summary data were consistently correlated among themselves and the pattern of correlations was similar for high and low intensity conditions.

For example, VPP and VBV increases were significantly correlated in high ($r(26) = 0.46$, $p < 0.05$) and low ($r(23) = 0.70$, $p < 0.001$) intensity conditions. In other words, larger changes in VPP were associated with larger changes in VBV. The smaller correlation in the high intensity condition may reflect the greater tendency for VBV levels to reach asymptote in this condition.

Subjects with larger VPP and VBV increases were also more likely to show significantly greater agreement between their physiological and self-report responses. Thus, VPP increases were significantly correlated with VBV-SR associations ($r(26) = 0.47$, $p < 0.05$, high intensity; $r(23) = 0.46$, $p < 0.05$, low intensity) and with VPP-SR associations ($r(26) = 0.40$, $p < 0.05$, high intensity; $r(23) = 0.50$, $p < 0.05$, low intensity). VBV increases were significantly correlated with VBV-SR associations ($r(26) = 0.40$, $p < 0.05$, high intensity; $r(23) = 0.42$, $p < 0.05$, low intensity) and with VPP-SR associations in the high intensity condition only ($r(26) = 0.53$, $p < 0.01$). In short, subjects were more likely to show greater agreement between their self-reports and physiological responses if they showed larger physiological responses to the erotic story.

TABLE 19

Correlations Between Summary Measures During High (above) and Low (below) Intensity Erotic Stories and Questionnaire Data

		MAXVAL/$\bar{x}_N$		(MAXVAL- $\bar{x}_N$)	FISHER'S Z ASSOCIATIONS		
VARIABLE		VPP	VBV	SELF-REPORT	VBV:VPP	VBV:SR	VPP:SR
HIGH	SAI	.13	.06	.44*	.14	.01	.002
	APC	-.13	-.14	.34	.17	.01	-.08
	AGE	-.41	-.19	-.09	-.32	-.20	-.02
	EXPER	.06	.18	.24	-.01	-.05	-.08
LOW	SAI	.03	-.28	.16	-.03	.11	.32
	APC	-.15	.02	-.21	-.33	-.12	-.08
	AGE	-.004	.05	-.01	-.23	-.15	.37
	EXPER	.18	.15	.14	-.05	-.01	.16

* $p < 0.05$ N = 28

Larger VPP responses were also associated with significantly higher correlations between VBV and VPP in high ($r(26) = 0.58$, $p < 0.001$) and low ($r(23) = 0.44$, $p < 0.05$) intensity conditions. Put another way, the degree of "coupling" between physiological measures was likely to increase as a function of increasing VPP amplitude. Similarly, larger VBV responses also predicted signficiantly greater coupling between VBV and VPP in the high intensity condition ($r(26) = 0.50$, $p < 0.01$), but not in the low intensity condition.

In the high intensity condition, all associations among VBV, VPP and Self-Report were significantly correlated. Thus, subjects with large VBV-VPP concordance were significantly more likely to show high VBV-SR concordance ($r(26) = 0.78$, $p < 0.001$), and high VPP-SR concordance ($r(26) = 0.67$, $p < 0.001$). Similarly, when the VBV-SR associations were large, there was a significant tendency for VPP-SR associations to be large also ($r(26) = 0.70$, $p < 0.001$).

In the low intensity condition, there were fewer such relationships among VBV, VPP, and Self-Report and they were considerably weaker, accounting for much less of the variance. Thus, a stronger VBV-VPP correlation significantly predicted a stronger VPP-SR correlation ($r(23) = 0.39$, $p < 0.05$). There was also a comparable predictive relationship between VBV-VPP and VBV-SR correlations, which was not significant ($r(23) = 0.36$, $p > 0.05$). There was no relationship between VBV-SR and VPP-SR correlations.

A final, but a most important point, that is revealed in Table 28 concerns the Self-Report data collected during the experimental period. The increase in Self-Report in the Erotic Story period (MAXVAL - $\bar{x}_N$) did not correlate significantly, or even strongly, with any physiological measure.

In particular, maximum increases in Self-Report and in physiological responses did not correlate at all. Nevertheless, as the previous results showed, there were strong correlations between these responses when time-series correlations were first computed separately for each subject and then across subjects.

Relationships Among Physiological and Questionnaire Data

It was anticipated that there might be relationships between the questionnaire data and the data collected during the psychophysiological recording session. Consequently those summary physiological measures defined in the previous section were cross-correlated with certain of the questionnaire data. The questionnaire summary measures for each subject were:

1. Total score on the Sexual Arousability Inventory (SAI)
2. Total Score on the Awareness of Physiological Changes (APC) during sexual arousal
3. Subject's age
4. Total number of items checked on the Bentler Scale (EXPER).

The cross-correlation matrices obtained separately for subjects in the high and low intensity conditions are shown in Table 20. All subjects, including those without coital experience were included in deriving the correlations.

Inspection of Table 20 reveals that only two of the correlations involving the questionnaire data were significant, and both of these were in the high intensity condition. Relative increase in VPP amplitude during the Erotic Story period ($MAXVAL/\bar{x}_N$) was significantly negatively correlated with AGE, $r(26) = -0.41$, $p < 0.05$. Older subjects were more likely to show

TABLE 20

Mean Correlations Between Psychophysiological Measures and Self-Report by Experimental Conditions

INTENSITY	SELF-REPORT TYPE	EROTIC STORY		RETURN-TO-BASELINE	
		VPP: SELF-REPORT	VBV: SELF-REPORT	VPP: SELF REPORT	VBV: SELF-REPORT
Low	Genital Sensation	.70	.30	.70	.43
Low	Sexual Arousal	.40	.61	.69	.17
High	Genital Sensation	.74	.63	.60	.07
High	Sexual Arousal	.79	.68	.64	.16

smaller increases in VPP amplitude than were the younger subjects. Nonetheless, AGE was not significantly associated with any other summary measure implying that within this age range it was not a useful predictor of any other response.

The other significant correlation involving the questionnaire data, was that between SAI score and Self-Report, $r(26) = 0.44$, $p < 0.05$. Subjects reporting greater sexual arousability on the SAI also tended to show greater increases in Self-Report during the Erotic Story period. These two different forms, the one a general rating of arousability the other an immediate rating, of Self-Report corroborate one another to some extent. The lack of a similar correlation in the low intensity condition may be due simply to the lower self-reports in this condition. Although there is agreement between these two forms of Self-Report, the SAI score is not significantly correlated with any other summary measure. Thus, the rating of sexual arousability, based upon the SAI, was not related to physiological response increases, nor to the agreement between physiological and self-report measures.

Neither Awareness of Physiological Changes (APC) during sexual arousal nor EXPER as rated by subjects, was significantly related to any of the response indices. In this sample then, APC ratings predicted neither physiological responses nor the extent of agreement between these and self-report.

Analysis of Individual Responses

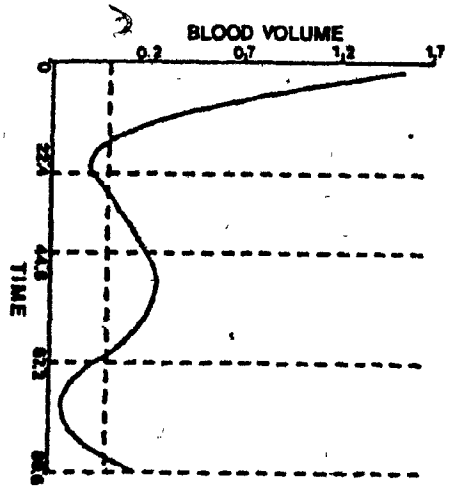
Although the findings of the group analyses are clear, by analysing individual responses it was possible to examine other, more complex ways, in which self-reports could be related to physiological response. One of

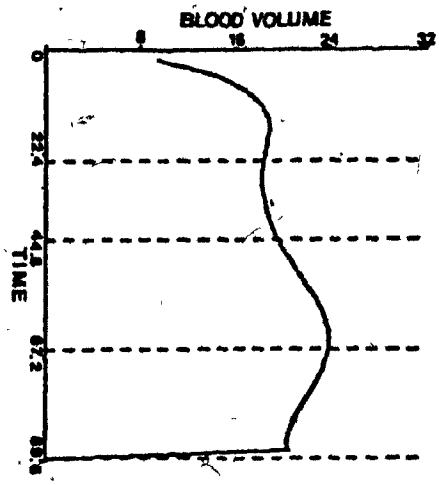
these analyses was based on the assumption that subjects may be responding to changes in physiological levels rather than to actual levels. For this reason, the responses of individual subjects across the four experimental phases were expressed in terms of changes and direction of change.

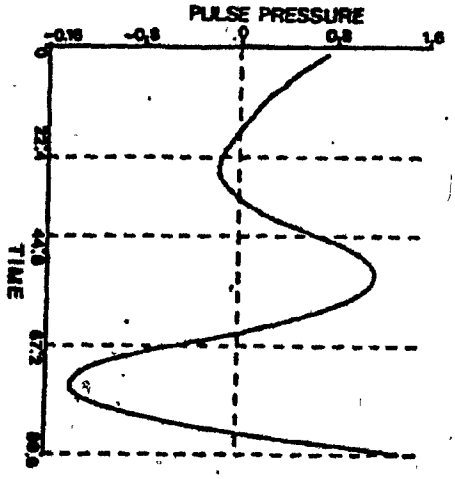
The data for each subject's physiographically recorded responses were analysed using an unweighted least-squares B-spline approximation (de Boor, 1978; Chambers, 1977). This procedure generated cubic polynomials that were fitted to the data in each experimental phase for VBV, VPP, and Self-Report using all 893 data points in each response channel. A principal advantage of the procedure is that both the original functions and their derivatives can be plotted against time. The derivatives display the rate of change of the original functions with time and the direction of these changes.

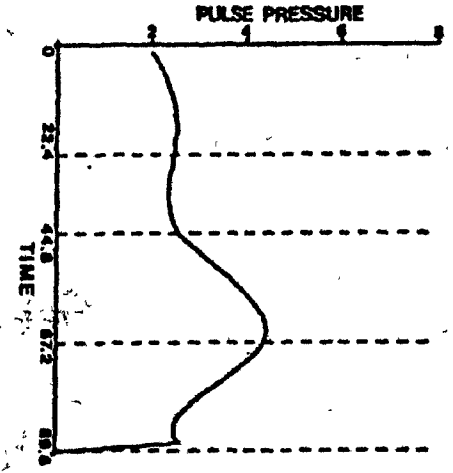
Figure 17 shows the B-Spline curve fits for subject LOGEN 11 who heard the LO(W) intensity erotic story and reported strength of GEN(ITAL) sensations. The upper half of Figure 17 depicts the original functions and the lower half that of the first derivatives. The vertical dotted lines mark the boundary points of the four experimental phases: Baseline, Neutral Story, Erotic Story, and Return-to-Baseline respectively. Time, in seconds, is marked on the abscissae. The levels of VBV, VPP amplitude, and level of Self-Report are marked on the ordinates of the original functions (upper) and the ordinates measure moment-by-moment values of the first derivative (lower). The horizontal dotted line marks the point of zero slope, and the derivatives cut this at the turning points of the original functions.

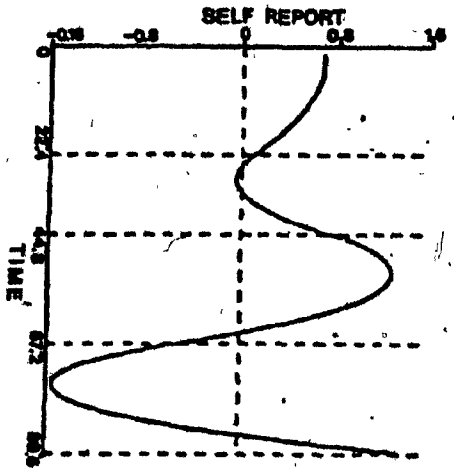
FIGURE 17. Vaginal Blood Volume, Pulse Pressure and Self-Report Responses of Subject LOGEN 11

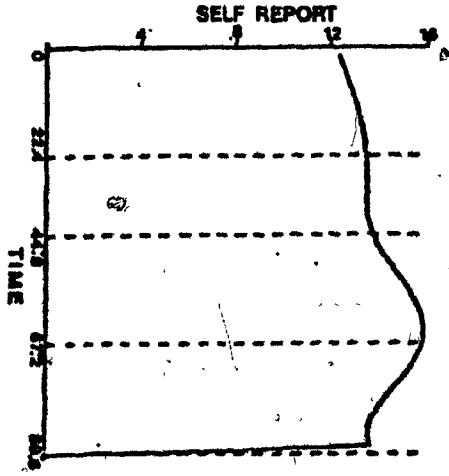

BLOOD VOLUME
0.2
0.7
1.2
1.7
TIME


BLOOD VOLUME
8
16
24
32
TIME


PULSE PRESSURE
-0.8
0
0.8
1.6
TIME


PULSE PRESSURE
2
4
6
8
TIME


SELF REPORT
-0.8
0
0.8
1.6
TIME

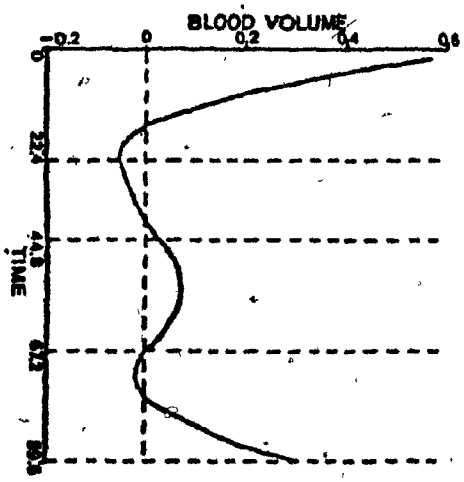

SELF REPORT
4
8
12
16
TIME

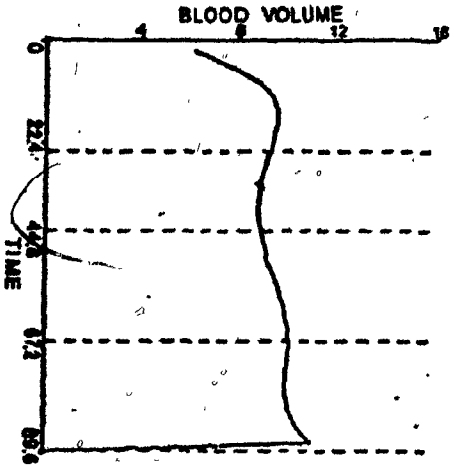
There are clearly discernible similarities among the original functions shown in Figure 17, most noticeably where the responses are changing during the Erotic Story and Return-to-Baseline periods. These correspondences are adequately summarized, for the most part, by the Pearson product-moment correlations between the responses. The only negative correlation was that between VPP and Self-Report in the Neutral Story period (r = -0.35) that occurred because VPP amplitudes were generally decreasing whereas Self-Report levels were generally increasing.

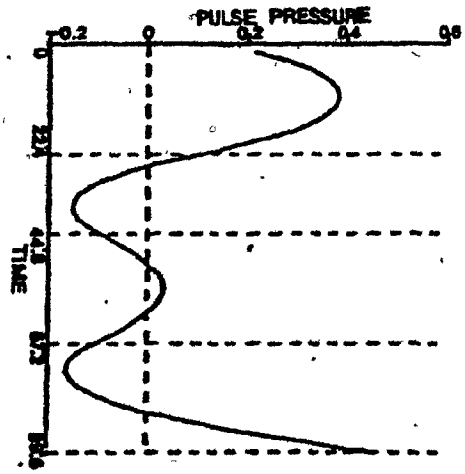
Examination of the response derivatives in Figure 17 shows that the pattern of slopes of the three responses is also very similar, each having an inverted "W" shape. The turning points of the functions occur at much the same times and the slopes are positive and negative over very similar periods. Despite the negative correlation between VPP and Self-Report in the Neutral Story period, it can be seen that there is a close physical correspondence between the derivatives of VPP and Self-Report in this period except that the derivative of VPP is displaced negatively compared to that of Self-Report. So, even though the original functions are, on average, moving in different directions their slopes are decreasing and increasing in similar fashion. Both reach minima close to the beginning of the Neutral Story period and increase thereafter.

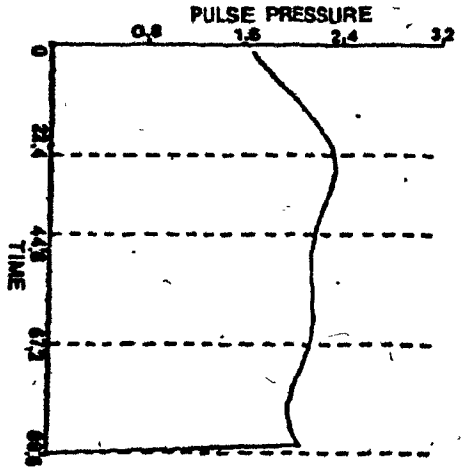
This suggests that the correlation between the original functions may not always be the best means of demonstrating the relation between responses. Consider the VPP and Self-Report responses of subject LOSEX 2 in the Erotic Story and Return-to-Baseline periods, shown in Figure 18. There is no obvious correspondence between original responses during the Erotic Story period (r = 0.36), but somewhat more during Return-to-Baseline (r = 0.43).

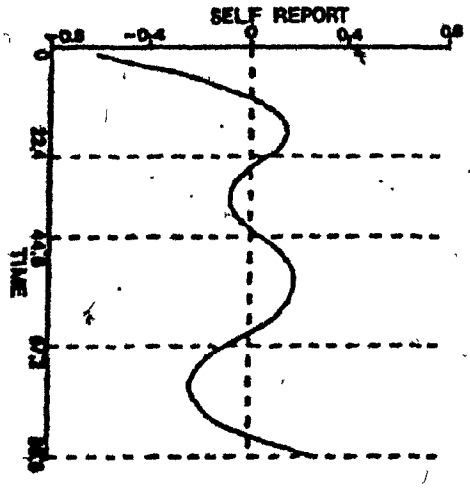
FIGURE 18. Vaginal Blood Volume, Pulse Pressure and Self-Report Responses of Subject LOSEX 2

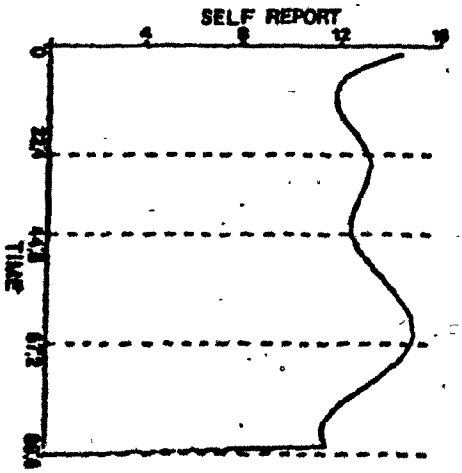

BLOOD VOLUME
-0.2
0
0.2
0.4
0.6
TIME


BLOOD VOLUME
4
8
12
16
TIME


PULSE PRESSURE
-0.2
0
0.2
0.4
0.6
TIME


PULSE PRESSURE
0.8
1.6
2.4
3.2
TIME

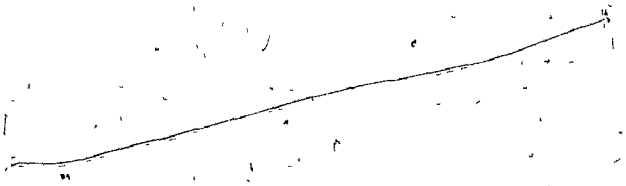

SELF REPORT
-0.8
-0.4
0
0.4
0.8
TIME

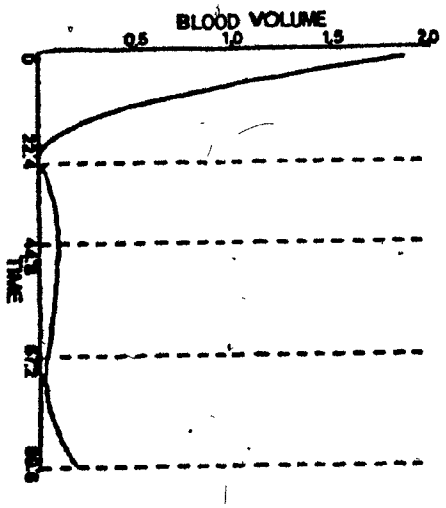

SELF REPORT
4
8
12
16
TIME

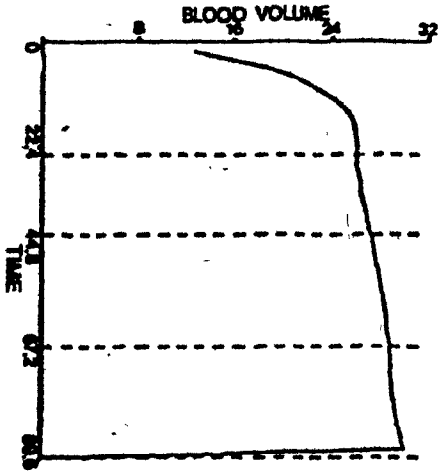
Inspection of the derivatives for VPP and Self-Report shows that they have similar general shapes, reaching maxima and minima and turning points at about the same time. In particular, at the beginning of the Erotic Story period VPP slope, which is initially negative indicating falling VPP amplitudes, is becoming less negative, indicating a tapering off in amplitude changes. At the same time Self-Report slope, which is positive indicating increasing reported arousal, is becoming more positive indicating an acceleration. In other words, both response slopes are moving in a generally positive direction at the same time and continue to do so until they reach approximately contemporaneous maxima. The correspondence becomes clearer if it is assumed that there are two processes each with its own initial rate of change; VPP amplitudes falling and Self-Report remaining roughly constant. The Erotic Story has a comparable arousing effect on these two different rates of change; it arrests the drop in VPP and creates a rise in Self-Report. If it is assumed furthermore, that Self-Reports are based in part on genital response changes, then it seems that in this case the arrest in the fall of VPP was detected and interpreted as a relative increase in arousal. The broader implication is that comparing rates of change of genital and self-report responses might give a better indication of the degree of agreement between the responses. It also implies that self-reports may be based more closely on changes in physiological responses than on their absolute levels.

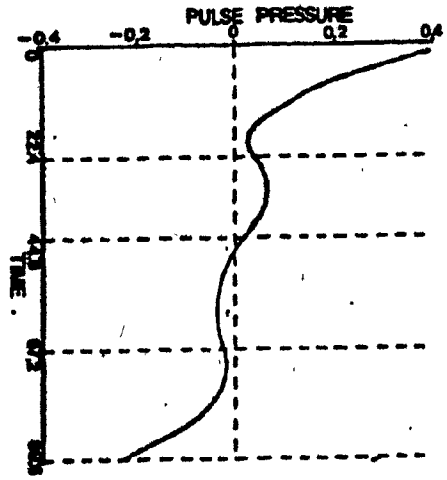
A second point is exemplified by Figure 19 which shows the responses of subject LOSEX 6. In this case there is no clear physiological response to the Erotic Story although there is a discernible increase in self-reported arousal. The Pearson product-moment correlations indicated no

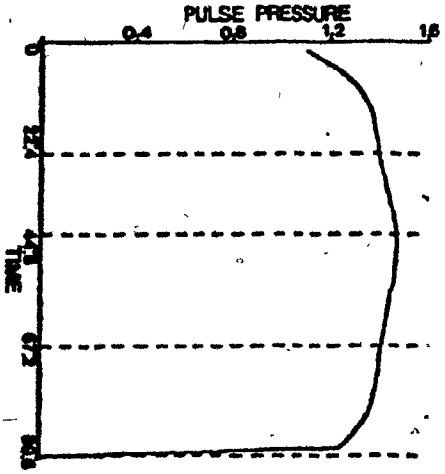
FIGURE 19. Vaginal Blood Volume, Pulse Pressure, and Self-Report Responses of Subject LOSEX 6

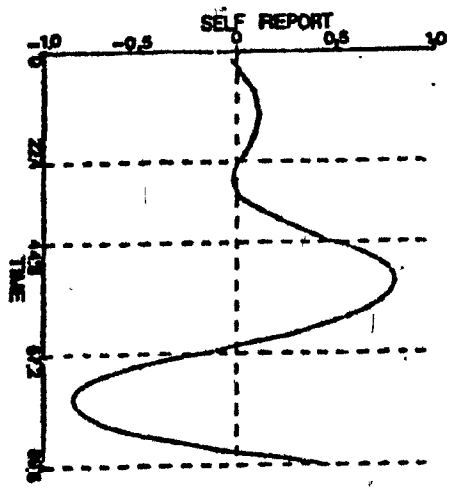


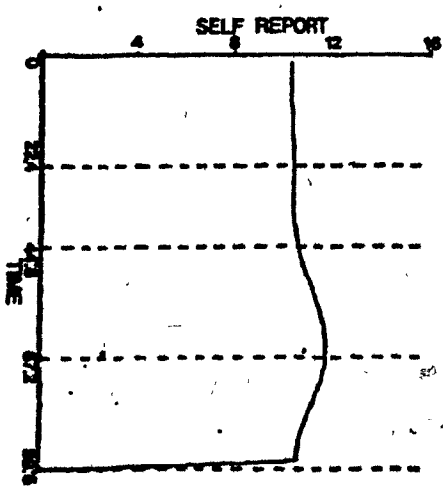

BLOOD VOLUME
0.5
1.0
1.5
2.0
TIME


BLOOD VOLUME
8
16
24
32
TIME


PULSE PRESSURE
-0.4
-0.2
0
0.2
0.4
TIME


PULSE PRESSURE
0.4
0.8
1.2
1.6
TIME

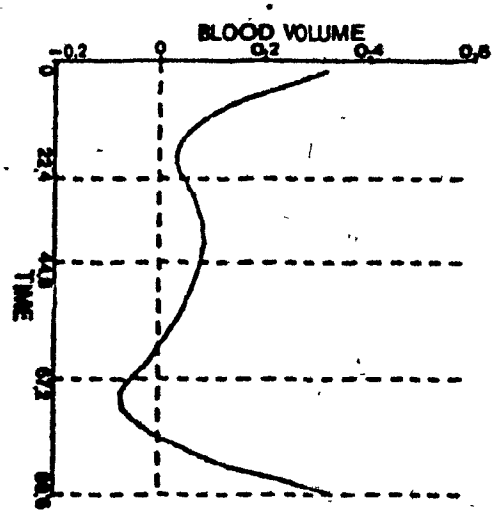

SELF REPORT
-1.0
-0.5
0
0.5
1.0
TIME

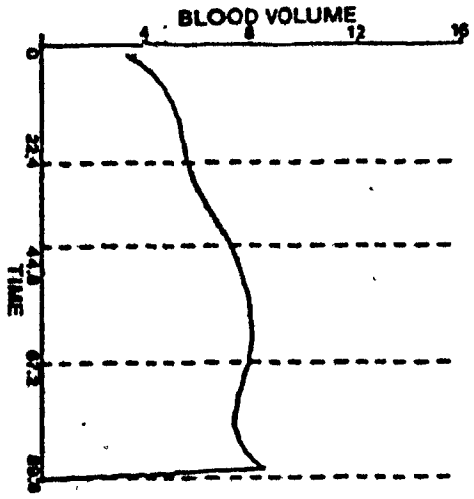

SELF REPORT
4
8
12
16
TIME

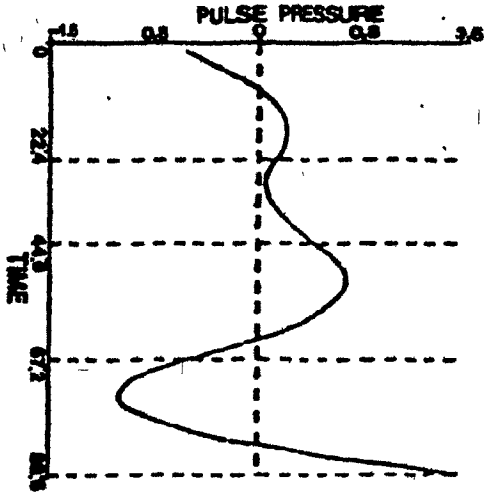
covariation between the responses. Inspection of the response derivatives likewise reveals no physical correspondences so that not even the slopes covary. Taken together, these points strongly suggest that for this subject there is no obvious relationship between physiological and self-report responses. This implies that the self-reported arousal was not based on these genital changes and perhaps indicates that the subject was reporting what she believed she was supposed to report.

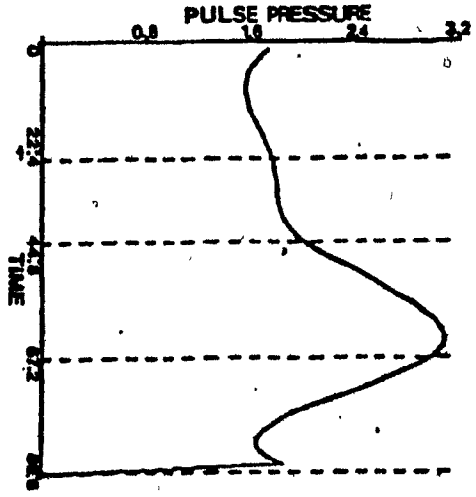
A third point is illustrated by Figures 20 and 21. In both of these cases the physiological response during the Erotic Story and Return-to-Baseline periods is quite evident but self-reports of sexual arousal and of genital sensation are much less so. Pearson product-moment correlations between the genital responses and self-reports indicate strong agreement in these last two periods. What is not obvious, however, is how closely the self-reports seem to track the physiological responses. Although simply expanding the self-report scale would make the covariation among the original responses more apparent, the response derivatives provide additional information. Thus, the derivatives of the responses of subject LOSEX 1, in Figure 20, show that VPP and Self-Report slopes have a remarkably similar pattern across the entire experimental period suggesting that they are both affected by similar processes. Even in the Neutral Story period where the original responses have opposite trends (VPP positive, Self-Report negative) the slopes are being similarly influenced. One interpretation of these results is that the self-report of subject LOSEX 1 is closely based on detection of the VPP changes despite the limited arousal reported. The responses of subject LOGEN 10, shown in Figure 21, can be similarly interpreted suggesting that reports of genital sensations are also closely tied to, or perhaps based on, genital responses.

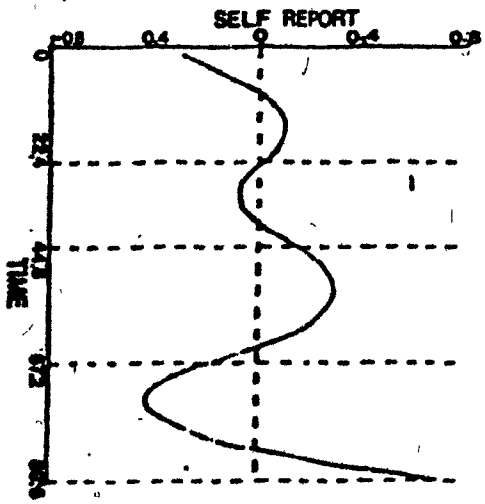
FIGURE 20. Vaginal Blood Volume, Pulse Pressure and Self-Report Responses of Subject LOSEX 1


BLOOD VOLUME
-0.2
0
0.2
0.4
0.6
TIME


BLOOD VOLUME
4
8
12
16
TIME


PULSE PRESSURE
-1.6
-0.8
0
0.8
1.6
TIME


PULSE PRESSURE
0.8
1.6
2.4
3.2
TIME


SELF REPORT
-0.8
-0.4
0
0.4
0.8
TIME

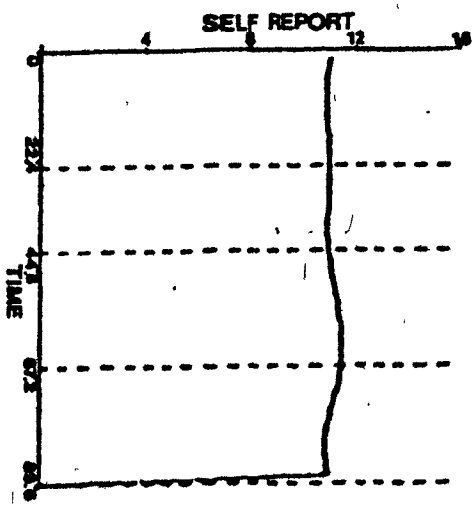
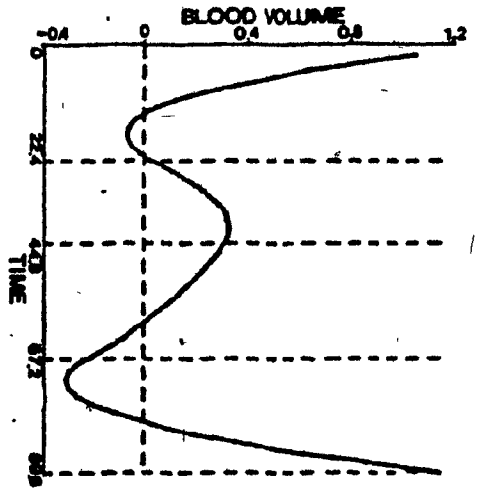
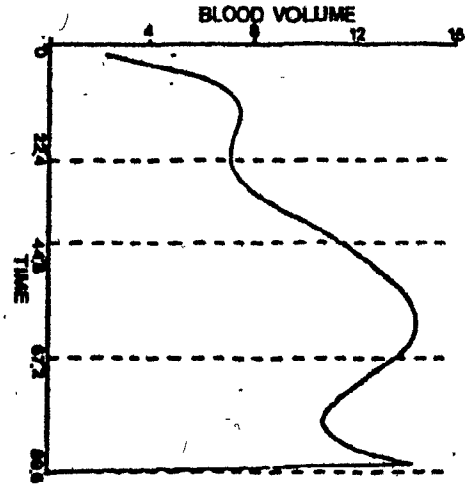
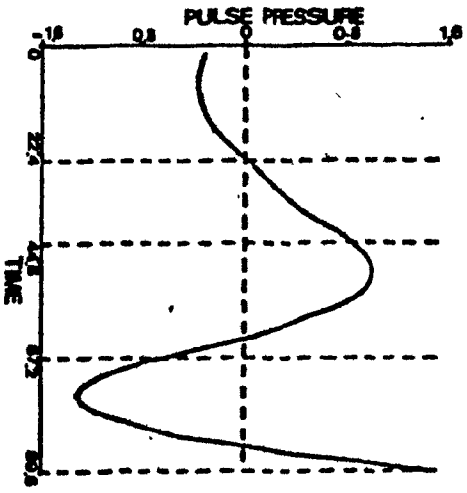
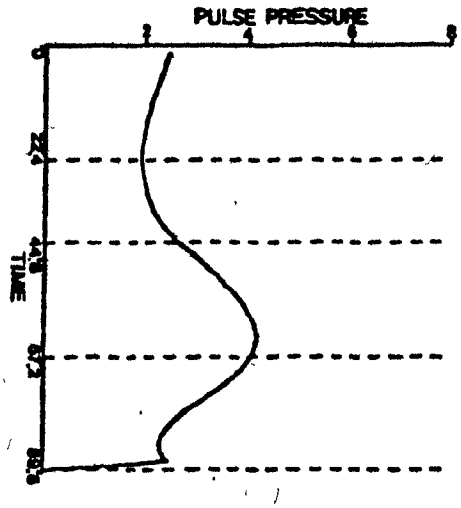

SELF REPORT
4
8
12
16
TIME

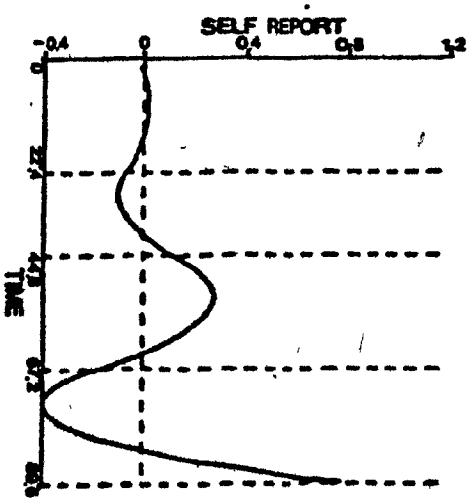
FIGURE 21. Vaginal Blood Volume, Pulse Pressure, and Self-Report Responses of Subject LOGEN 10

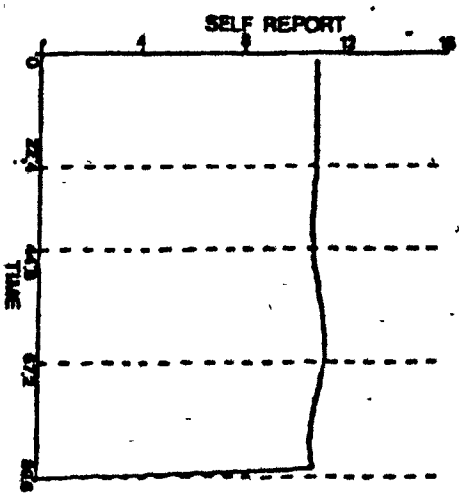

BLOOD VOLUME
-0.4
0
0.4
0.8
1.2
TIME


BLOOD VOLUME
4
8
12
16
TIME


PULSE PRESSURE
-1.6
-0.8
0
0.8
1.6
TIME


PULSE PRESSURE
2
4
6
8
TIME


SELF REPORT
-0.4
0
0.4
0.8
1.2
TIME


SELF REPORT
4
8
12
16
TIME

There is one final point that should be made. The absolute response values of VPP for subjects LOGEN 11 and LOGEN 10 (Figures 17 and 21) are very similar yet those of self-report are not. One possible explanation for this is that the two subjects have different self-report scales. It could be argued, however, that because subject LOGEN 10 reports weaker genital sensations than does LOGEN 11 for similar VPP changes, LOGEN 10 is less able to detect the VPP changes. However, because both subjects show close physical correspondence between their VPP and self-report derivatives, it is proposed that their detection abilities are not necessarily different. Similarly, the limited sexual arousal reported by LOSEX 1 despite a pronounced VPP response does not necessarily indicate a "labelling error" since the derivatives of VPP and Self-Report show close correspondence.

In summary, there are occasions when correlations between the original functions adequately reflect the relation between physiological and self-report responses. This may not always prove to be so, however, for the physiological and self-report levels may change in opposite directions and correlate negatively. In such cases the rates of change of physiological and self-report responses may nonetheless show correspondences. This suggests that in some subjects, or in some circumstances, self-reports may relate to physiological response in a more complex manner than is revealed by simply correlating the responses because each response system is reacting to changes in the underlying processes and not to levels. If neither the original functions nor the derivatives show correspondences this may well indicate that self-reports are the result of response demands. Finally, the derivatives may be useful in determining how sensitive an individual is to detecting and labelling the genital response.

DISCUSSION

Physiological and Subjective Response Patterns

The first major finding with respect to the analysis of response slopes and of mean responses was the effect of the erotic stories, relative to the preceding control phases and thereafter, and the effect of erotic story intensity. The changes in VPP and Self-Report were remarkably alike across all experimental periods in that increases were specifically produced by the erotic stories. Story intensity affected subjective report more than it affected physiological response. Since VPP and Self-Report responses were so similar they will be discussed together as a function of experimental phase, followed by a discussion of VBV response. The effects of erotic story intensity will be examined and then effects due to self-report type.

Response to Erotic Story phase. During Baseline, both VPP amplitudes and Self-Report levels were constant and moreover did not change when the Neutral Story was presented. So subjects reported that during the Neutral Story they were no more sexually or genitally aroused than during Baseline, and consistent with this, VPP amplitudes did not change. This indicates that whatever effects were subsequently produced by the erotic stories were specific to that phase and did not occur as a function of the setting, or of the male narrator's voice, or of expectations of an erotic story (cf. Geer et al., 1976; Heiman, 1975b), or of stimulation from the photoplethysmograph.

Both erotic stories produced significant increases in the slopes and mean levels of VPP and reported arousal. That is, the VPP measure, reported sexual arousal and reported strength of genital sensations (genital arousal), were all specifically affected by

the erotic stories. Increases in VPP during erotica have been noted before; but unlike previous studies which measured retrospective reports of sexual arousal (Heiman, 1977; Osborn and Pollack, 1977; Wilson and Lawson, 1976; 1978) and genital arousal (Heiman, 1975b; Rubin and Henson, 1979), the present study found such increases together with immediate reports of sexual and genital arousal.

In the Return-to-Baseline period the slopes of VPP and Self-Report responses were significantly reversed. In other words, the erotic stories having ended, VPP amplitudes and self-reports of arousal began to decrease. They did so steadily and by the end of the Return-to-Baseline period had reached minimum levels equal to their levels in the two initial control periods. Thus the mean value of these responses remained the same as during the erotic story periods. VBV levels, in contrast, remained elevated indicating that decreases in the forces leading up to vasocongestion (VPP) took place before any detectable decreases in level of pooled blood in the tissues (VBV). Since reported arousal did decrease, the clear implication is that self-report is related to changes in the forces leading to vasocongestion, not to the actual level of vasocongestion at any particular time.

In sum, the specificity of VPP responses and of subjective reports of arousal provide convincing evidence that they are both valid indices of sexual and genital arousal.

A considerably different picture was presented by the VBV response. In the Baseline period there was a pronounced positive slope, indicating increases in VBV levels, that resembled a "warm-up" response. This may have occurred because the photoplethysmograph required time to reach vaginal temperature, or it may indicate a reflexive VBV response to insertion though

this seems dubious in the absence of a comparable VPP response. Since the overall positive slope continued into the Neutral Story period but by this time was reaching asymptote, there was evidently no serious response drift. Such drift in some photoplethysmographs can occur as a function of the intensity and duration of prior light exposure (Novelly, Perona and Ax, 1973). Because of the initially large increase, VBV baseline data were not a suitable reference point against which to measure response change. Instead, data collected during the Neutral Story provided a reference point.

When the erotic stories were presented, mean VBV level was significantly increased. In this particular respect VBV level changed specifically as a function of the erotic stimuli. This supports previous findings (Geer et al., 1974; Heiman, 1977; Hoon et al., 1976; Osborn and Pollack, 1977). However, since there were generally positive slopes during both the Neutral and Erotic Stories this result should be viewed cautiously. Furthermore, it was observed that VBV responses to the erotic stories were less likely to occur than were VPP responses. Why some subjects showed VBV responses whereas others did not is unclear. Despite constant experimental procedures it is possible that photoplethysmograph placement varied somewhat from subject to subject. If so, this could have influenced VBV measurement which Gillan and Brindley (1979) have shown is probably affected by the firmness with which the photoplethysmograph contacts the epithelial surface of vaginal tissue.

Return-to-Baseline VBV level reached asymptote, and mean level remained the same as during the preceding period. Some decrease in VBV levels did occur, principally the result of decreasing VBV following the low intensity story, but even by the end of the Return-to-Baseline period

the average minimum VBV level did not approach basal level in the Neutral Story period. It has frequently been observed that VBV level does not diminish as rapidly as VPP amplitude (Gillan and Brindley, 1979; Heiman, 1977; Henson et al., 1979).

Since VBV did not react differentially to the experimental phases, it is not a specific or sensitive index of reaction to the erotic stories. Considering the overall changes which took place in the Baseline period and subsequently, it may be a more general arousal response or it may measure more general vasocongestive changes.

Effects of erotic story intensity. There were two significant effects attributable to the intensity of the erotic story. First, the high intensity story was rated as significantly more arousing than the low intensity story. This differential rating applied equally to reports of both sexual and genital arousal.

Perhaps self-reports consistently differentiate among erotic stimuli because such reports are based on judgments which are sensitive to the content of the erotic stimuli. Thus when the stimulus content is explicitly sexual it may lead to reports of more arousal than do stimuli with less explicit content because subjective reports might be based more on cognitive appraisal of the stimulus. In other words, physiological arousal must be ascribed erotic meaning which for one stimulus may be sexual and for another romantic.

Second, the VBV slope in the high intensity condition was significantly steeper than VBV slope in the low intensity condition across all four experimental periods. This average trend is not easy to interpret but there was evidence that it was partly due to the effects of the two erotic stories.

Thus, relative to the preceding period, the high intensity erotic story accelerated VBV increases whereas they were decelerated by the low intensity erotic story. Moreover, in the Return-to-Baseline period following the high intensity erotic story, VBV slope decelerated; and following the low intensity story, VBV slope became slightly negative indicating that VBV level was falling. Thus, although the effect was a general one, not specific to any one period, VBV slopes did distinguish between high and low intensity erotic stories and thereafter. In contrast, VPP slopes and mean levels and VBV mean levels were not significantly affected by the intensity of the erotic stories. This is similar to previous findings in which VBV levels did not differentiate among erotic stimuli even though self-reports of sexual arousal were significantly different (Osborn and Pollack, 1977; Wincze et al., 1977). It is unlike previous findings in which both VPP amplitudes and subjective reports of sexual arousal have differentiated various types of erotic story (Heiman, 1975b; Osborn and Pollack, 1977).

In keeping with other results VBV levels did not distinguish between the erotic stories although there was some suggestion that VBV slopes did, but only at a general level. Why VPP amplitudes did not significantly differentiate the two erotic stories is perplexing in view of previous findings. The dilemma may be partly resolved by noting that VPP amplitudes were somewhat larger during the high intensity story than during the low intensity story. Perhaps another reason is that in previous research maximum levels of VPP have been measured whereas mean levels were measured in the present study.

Whatever the reasons, one principal point arises from this paradox namely, that there are no a priori nor empirical reasons for selecting the objective response in preference to the subjective response. This point

is particularly relevant to the clinical assessment of sexual arousal deficits, an issue which will be discussed in more detail later.

Effects of self-report type. There were two significant interactions involving self-report type, both of which were related to mean VBV levels. First, in the low intensity condition, the average VBV level of subjects reporting genital arousal was lower than that of subjects reporting sexual arousal. Second, mean VBV levels of subjects reporting genital arousal were lower than those of subjects reporting sexual arousal in each experimental period. Since there were no other observed effects of self-report type on physiological response it is difficult to interpret the VBV results. It is possible that attention to general sexual arousal had a stimulating effect which in turn heightened VBV levels but this is a tenuous explanation.

The main finding was that reports of sexual and genital arousal were very similar across experimental phases and levels of stimulus intensity. Thus, during the erotic stories there were comparable increases in subjective reports of sexual and genital arousal and both decreased comparably thereafter. There seems little doubt that the two subjective responses function in the same way in that they are linked specifically to erotic stimulation.

Thus, it is apparent that VPP, and reports of sexual and genital arousal respond similarly to erotic and non-erotic stimuli but differently from VBV. These differences raise further questions concerning the relationship between VBV and VPP and of the relationship between physiological and subjective reports. These will now be discussed with reference to the correlation analyses.

Relation Between VPP and VBV Responses

In general, the two physiological measures were moderately well correlated during non-arousal states, became more strongly coupled during erotic stimulation and in amount directly related to the increase in arousal. Following psychosexual stimulation, the correlation between the responses was significantly reduced because VBV levels remained elevated whereas VPP amplitudes decreased.

There are five major findings from the present research that address the nature of the relationship between VPP and VBV and which may clarify the meaning of these two physiological responses. First, the two responses were moderately correlated in the control, or Neutral Story, period. Second, the correlation between VPP and VBV was differentially affected by the two story intensity conditions; only the high intensity erotic story significantly increased the correlation above the Neutral Story correlation. Third, the correlation between VPP and VBV was directly related to response intensity, that is to the amount of response change in the erotic story period. Fourth, following the high intensity erotic story the correlation between VPP and VBV was significantly reduced. Fifth, VPP maxima preceded VBV maxima in the erotic stories by a slight though not significant amount. These findings are consistent with the framework of physiological functioning that has emerged from previous research.

The correlations between VPP and VBV in the low intensity condition were the same in all three phases. So, under relatively stable control conditions the physiological responses were moderately well correlated although increases in physiological responses did not always result in an increase in response correlation. However, there was a direct relationship

between the strength of the physiological responses during the erotic story period and the response correlation, which was independent of stimulus intensity. When a subject's physiological response increases were large they were also likely to be more strongly correlated.

There are four main factors which must be considered in an explanation of the relationship: the stability or change of the physiological system, stimulus intensity, and the rate of decline of the responses. The role of these factors can best be explained within a framework of the possible underlying processes. Therefore a description of the basic framework follows.

VBV is considered to be a measure of the pooled blood in vaginal tissue (Geer et al., 1974; Gillan and Brindley, 1979). It is therefore a measure of the difference between the rates of influx and efflux of blood to and from the tissue; when these rates are equal blood volume remains constant. Such tissue probably becomes congested when marked dilation of blood vessels bringing blood into the tissues occurs together with a concomitant increase in resistance to blood efflux (Dorr and Brady, 1967), processes which may be parasympathetically mediated (Burton, 1972). This is consistent with recent thermographic evidence showing that during excitation abdominal veins constrict, increasing pooled blood levels in the labia (Seeley, Abramson, Perry, Rothblatt, and Seeley, 1980), and would account for labial temperature increases (Henson et al., 1977). When vasocongestion decreases it may be due to the combined effects of increased influx resistance and decreased efflux resistance (Dorr and Brady, 1967; Seeley et al., 1980), processes which may be sympathetically mediated (Burton, 1972).

VPP is regarded as a measure of vasodilatory changes that are the precursors of vasocongestive or VBV changes (Zingheim and Sandman, 1978).

In this respect VPP is also a measure of the forces leading to vasocongestion, and is consistent with the present finding that VPP maxima preceded VBV maxima during the erotic stories and also with previous research (Gillan and Brindley, 1979). Using this framework, it is possible to describe the physiological events occurring during the phases of the present study and to incorporate the effects of the four factors on the correlation.

During the Neutral Story period when physiological responses were essentially constant, so too would be the rates of blood influx and efflux which would also be approximately equal. If parasympathetic processes principally mediate influx resistance and sympathetic processes principally mediate efflux resistance the two systems would be generally balanced at this time. The observed moderate correlation between VPP and VBV might then reflect this balance and the generally equivalent influx and efflux rates. There would be less than complete agreement between VPP and VBV responses because the two mediating autonomic systems, while generally balanced, would most probably not be exactly inversely related (Wenger, Averill, and Smith, 1968). In terms of an electrical analogy, the vascular capacitance would be charged through a pathway with a parasympathetically controlled variable impedance. It would discharge through a pathway with a sympathetically controlled variable impedance. The input and output impedances would, on average, be equal so that the overall blood volume would be constant. If the assumption of their partially separate control is valid, the moderate correlation would also reflect the degree of independence between the processes.

When the high intensity erotic story was presented the influx resistance was reduced and the efflux resistance increased. That is, there was an increase in the rate of flood flow to the vaginal tissue and a

corresponding decrease in the rate of blood flow from it. The observed significant increase in VBV mean level and the acceleration of VBV slope would suggest that vasocongestion increased because efflux resistance increased. Consider the extreme condition in which efflux resistance was so great that no blood drained from the tissue. Under such circumstances, the level of VBV would be completely determined by the rate and duration of blood influx. In other words, the vaginal capacity would be charged through a parasympathetically mediated low resistance pathway resulting from increased vasodilation (VPP increases). There would be no discharge pathway and VPP and VBV would be perfectly correlated. This extreme condition would be unlikely, since a high resistance discharge pathway would permit some blood efflux. Under such conditions, VBV levels would be highly, but not completely, correlated with VPP changes as observed. It also took significantly longer for VBV levels to reach maximum levels in the high intensity erotic story than in the low intensity erotic story. This is consistent with the assumption that VBV level would additionally depend on the duration for which these conditions were maintained.

When the low intensity erotic story was presented, influx resistance decreased but efflux resistance does not appear to have much increased. Although there was an increase in the rate of blood influx, efflux rate seems to have remained approximately constant. Under these conditions VBV level would increase reflecting the increased influx rate but more slowly because of the unchanged efflux rate. So the vaginal capacitance would be charged through a pathway whose resistance had decreased tending to increase VBV levels, but would simultaneously be discharging through a pathway whose resistance was essentially unaltered. Therefore, VBV levels would not be as strongly related as when the efflux pathway resistance increased.

This account is consistent with the observed increases in VPP amplitude, VBV level, with the decelerating VBV slope indicating a slower increase in VBV, and with the slight but not significant increase in correlation between VPP and VBV.

If the above explanation is correct, it follows that strong physiological responses to either erotic story would increase the correlation between the responses, but possibly in differential ways. In the high intensity erotic story where VBV levels were closely determined by VPP increases because the efflux rate was low, larger VPP increases would more completely determine VBV level. In other words, the larger the increase in influx rate the smaller would be the observed effect of the low efflux rate. Thus VBV level would be more completely determined by VPP when VPP is high. This was found to be the case. In the low intensity condition, where the efflux rate was not reduced, vasocongestion was less completely determined by increased vasodilation. However, a strong increase in influx rate would produce a larger increase in VBV than would a weak increase in influx rate, given an essentially constant efflux rate. Because the efflux pathway offered less resistance in this intensity condition, VBV levels would be less likely to reflect the increased coupling between VPP and VBV. This too is consistent with the observed results.

What then accounts for the fact that VBV and VPP were more strongly correlated in the high intensity condition? Putting the question in another way why were the efflux rates differentially affected by intensity? It is proposed that the subjective perception of arousal may influence efflux resistance more than influx resistance, perhaps by a centrifugally mediated imbalance between parasympathetic and sympathetic systems. The high intensity erotic story which was rated as more arousing, might have produced a

greater corresponding increase in efflux resistance and therefore vasocongestion than the less arousing low intensity erotic story. Although this is a tentative explanation, there is evidence that cognitive processes can influence both vasodilation and vasocongestion (Cerny, 1978; Heiman, 1975b; Hoon et al., 1977; Zingheim and Sandman, 1978).

Following the high intensity erotic story, there was a significant reduction in vasodilation without a corresponding decrease in vasocongestion. Although influx resistance increased and influx rate decreased, the efflux resistance remained relatively high thereby maintaining pooled blood volume. So, when VPP amplitudes decreased and VBV levels did not the correlation between the responses was significantly reduced. The fact that efflux resistance and VBV remained high requires explanation although it is consistent with other findings (Geer and Quartararo, 1976; Gillan and Brindley, 1978; Heiman, 1977; Henson et al., 1977; Osborn and Pollack, 1977; Seeley et al., 1980). One possible explanation is that once the efflux pathways have closed there is some mechanism which, independently of centrifugal processes, maintains this state. The mechanism may be involved in maintaining blood volume at the plateau phase (Masters and Johnson, 1966) as a preparatory precursor to orgasm. Following orgasm, rapid decreases in vaginal blood volume have been observed and it has been suggested that this response reflects intense sympathetic nervous system activity (Geer and Quartararo, 1976). In present terms this would be due to a large rapid decrease in efflux resistance.

Before proceding to examine the relationship between physiological and subjective responses, some more speculative aspects of the vascular processes will be discussed.

There are likely to be definite limits in the degree to which VPP and VBV can increase although the limiting factors may not be the same for both. These factors, although numerous and likely to involve complex interactions between vascular, hormonal, and central processes, would include vascular distensibility and localized pressure limits. If so, then approaching these limits would meet with increasing opposition to further VPP and VBV changes. The response systems might be complex negatively accelerated as a function of response strength. Some aspects of the data support this proposition and are also consistent with the view that vasocongestion represents the balance between influx and efflux rates of blood flow.

In all four experimental groups maximum VPP amplitudes were reached at the same time. This suggests that the time to reach maximum was independent of the actual maximum value attained. If so, one probably oversimplified model that depicts the overall response processes would be a first-order differential system. The system parameters might be analogous to electrical resistance (or complex impedance) and capacitance (Westerhof, Elzinga, Spikema, and Van den Bos, 1977). The solution of a differential system depicting the charging of a capacitor through a resistive input pathway is a negatively accelerating Naperian exponential. Moreover, its time constant (the time to reach about 0.63 of maximum) is independent of the aiming potential (the maximum to be attained). Assuming rough equivalence among the parameters of different individuals, times to reach maximum levels of VPP would be equal regardless of the actual maximum level attained. The time constant would be determined by complex physical properties of the response system. In a system where the parameters were fixed so too would be the time constant. It is much more likely that the system parameters would themselves change as complex functions so the true picture would be considerably more complicated. It is conjectured that the overall pattern of

sustained VBV increases might be described by a similar model in which vaginal capacitance is charged through a complex variable input impedance. This input impedance would be unidirectional (ie. offering extremely high reverse impedance) and correspond to influx resistance changes accompanying vasodilation. The model would be rendered more complex because there would additionally be the variable complex output impedance of the efflux pathways. The proposition is consistent with decelerating VPP and VBV increases observed as orgasm approaches (Geer and Quartararo, 1976; Gillan and Brindley, 1979).

Similarly, in all four experimental groups VPP steadily decreased reaching minimum levels at the same time in the Return-to-Baseline period Moreover, the slopes of VPP increases and decreases in the Erotic Story and Return-to-Baseline periods were mirror images and highly correlated. This implies that the models depciting increases and decreases in VPP and the underlying mechanisms are closely similar. There is one other result which supports the view that VPP decreases are also described by a first-order model. The mean VPP amplitudes in the Return-to-Baseline period were less than in the Erotic Story period and converged towards one another. When different tensions are released from equivalent first-order systems they equilibrate in the same time period, which VPP did. Moreover, the decaying exponential is a mirror image of, and will consequently have a lower mean than, the rising exponential. The mean values of a family of decaying exponentials defined by the same time constant must also converge.

One of the advantages of recording immediate self-report was that the similarity of VPP and self-report processes became evident. Thus self-reports of all experimental groups reached maxima at the same time in both

erotic stories even though the high intensity erotic story produced significantly higher self-reports. Time to maxima was independent of maximum levels attained. Similarly times to minima were equivalent and independent of starting levels. The slopes of increasing and decreasing self-reports were also mirror images and highly correlated. Return-to-Baseline means were lower than Erotic Story means and converged towards one another. In short, if a first-order model describes VPP changes then it applies equally well to self-report changes. More importantly, whatever the actual model may be the present results suggest that it is the same for both response systems. The implication is that if self-reports are partially based on physiological events then they are most probably those events related to VPP changes.

Correlations Between Physiological and Subjective Responses

The correlations between physiological and subjective responses during the erotic stories were generally high. In other words, there was a direct relationship between subjective reports of sexual and genital arousal and the physiological responses assumed to underlie such reports. Furthermore, the sequence of these responses suggests that subjective reports are directly based on the detection of physiological changes.

There are seven main findings that clarify and expand the nature of the relationship between physiological and subjective responses. First, during the control periods preceding the erotic stories, physiological and subjective responses were only weakly correlated. Second, these correlations increased significantly when the erotic stories were presented. Third, the LEAD/LAG OPT correlations were larger than LEAD/LAG 0 correlations. Fourth, the correlation between physiological and subjective responses was directly related to physiological response intensity, that is to the maximum amount

of physiological response to the erotic story. Fifth, subjective responses were somewhat more strongly correlated with VPP than with VBV. Sixth, the magnitude of the correlation between subjective and physiological responses was a function of self-report type. Finally, subjective reports in the Return-to-Baseline period correlated strongly with VPP but weakly with VBV.

During the control periods when physiological responses were constant, indicating no changes in vasodilation or vasocongestion, subjective reports were of constant sexual and genital arousal. At the same time, physiological and subjective responses were weakly correlated. This implies that sensory adaptation to the constant physiological conditions was the likely explanation for the constant self-reports.

The erotic stories produced significant increases in the physiological and subjective responses and in the correlation between them. So, when vasodilation and vasocongestion went from a static to a dynamic condition reports of arousal were very closely related to these physiological changes. Moreover, the larger correlations obtained when physiological response data were paired with later occurring subjective response data shows that physiological changes preceded subjective response changes. This is supported by the fact that physiological response maxima preceded subjective response maxima. It is proposed, therefore, that when physiological response changes occurred they were detected and reported as genital arousal soon afterwards. In addition, reported sexual arousal also followed after physiological arousal. In sum, it appears that physiological response change may be one crucial factor increasing the degree to which physiological and subjective reports correlate, possibly because sensory adaptation occurs in the absence of response change and the system responds to, or detects changes.

A second factor which influenced the correlation between physiological and subjective responses was the intensity of the physiological responses

to the erotic stories. In individuals experiencing stronger VPP and VBV responses, there was closer agreement between physiological and subjective responses. There was no such relationship as a function of subjective response intensity. That is, agreement between physiological and subjective responses was enhanced by strong physiological response but not by reports of stronger arousal. This supports the view that the basis for closer tracking of the physiological response is the degree of vasodilation and vasocongestion and not subjectively perceived strength of arousal. When stronger physiological responses occurred, the ensuing genital sensations were possibly easier to detect and the changes more readily discriminable; subsequent reports of genital and sexual arousal could for this reason have more closely reflected the physiological responses.

A third factor influencing the correlation was the nature of the physiological response. Although direct statistical comparisons were not made, in general subjective reports in the erotic story period were more strongly correlated with VPP than with VBV confirming earlier results (Heiman, 1975b; Henson et al., 1979). One explanation is that VPP changes may be easier to discriminate than VBV changes, although exactly why this should be so is not clear. Present data and that of others (eg. Heiman, 1975b) indicate that VBV is a slow changing response and therefore it may be harder to detect than VPP. However, Henson et al. (1979) found that labial temperature, which is also a slow changing response, was strongly related to self-reports of genital arousal. But, since labial temperature was more closely related to VPP than to VBV during the erotic film, it could be argued that self-reports were based on concurrent changes in VPP. The fact that reported genital arousal correlated strongly with both labial temperature and VPP but only weakly with VBV does suggest, as do the present findings, that

vasodilation changes were more discriminable than vasocongestive changes.

To what extent vasocongestive changes were used is difficult to determine. The agreement between subjective report and VBV during the erotic story phase may indeed indicate that vasocongestive changes are detectable and contribute to reports of genital and sexual arousal as Heiman (1977) suggested. However, there are reasons for supposing that the relationship may be an indirect reflection of the correlation between VBV and VPP. Thus, during the erotic story VBV and VPP were correlated with one another as well as with subjective report. In the Return-to-Baseline period VPP and VBV were not correlated, and at this time only VPP correlated with subjective report. When the erotic stories ended, vasodilation and subjective reports both decreased whereas vasocongestion remained pronounced. In conclusion, the basis for reports of genital arousal are events more closely related to VPP or vasodilatory changes, than to VBV or vasocongestive changes.

The erotic stimulus was a fourth factor influencing the correlation between physiological and subjective responses. Although VPP, or vasodilatory, changes may be the most probable basis for reports of genital arousal there was evidence implying that the relationship between VPP and subjective report of sexual arousal is more complex. In the low intensity erotic story, the correlation between VPP and reported sexual arousal ($r = 0.40$) was significantly lower than the corresponding correlation between VPP and reported genital arousal ($r = 0.70$). Thus, vasodilatory changes were strongly related to the strength of genital sensations but were almost unrelated to perceived sexual arousal. Both types of self-report were equally, and strongly related to decreasing vasodilation in the Return-to-Baseline period. During and after the high intensity erotic story, subjective reports of sexual and genital arousal were strongly related to

vasodilatory changes. There are two important implications stemming from these findings. First, reports of sexual arousal are not simply the result of detecting genital arousal. Second, erotic story intensity had a differential effect upon self-reported sexual arousal but no similar effect on reported genital arousal.

In the low intensity erotic story significant increases in physiological responses occurred in both the group reporting genital arousal and the group reporting sexual arousal. However, VPP responses were highly correlated with reports of genital arousal but only weakly with reports of sexual arousal. The low correlation between vasodilation increases and reports of sexual arousal was thus not due to an inability to detect genital arousal since report of genital arousal was strongly correlated with VPP at the time. What then, accounts for the fact that although there was an equivalent physiological response in the group reporting sexual arousal, this response did not correlate with subjective report?

One possible explanation is that subjectively experienced sexual arousal depends on the presence of both physiological responses and situational cues which indicate that sexual arousal appropriately specifies the physiological arousal (cf. Berschied and Walster, 1974; Schacter, 1964). In other words, it seems likely that other, more cognitive factors, related to the intensity of the erotic stories were responsible for the lack of agreement between VPP and reported sexual arousal in the low intensity erotic story. The low intensity erotic story differed from the high intensity story in that it depicted a more slowly progressing romantic and erotic theme with very little explicitly sexual language. Such stimuli have been shown to produce significant genital responses (Heiman, 1977; Osborn and Pollack, 1977), and this is consistent with present results. It is possible,

however, that the cues provided by the low intensity erotic story were not used to label the VPP physiological response as sexual arousal, but rather as some other emotion more closely associated in their experience with a social or romantic experience. If so, this was done principally on the basis of erotic story content and not on physiological response. Alternatively, in situations where the erotic cues are not explicit, subjective reports of sexual arousal may be made only after more prolonged physiological arousal and a more comprehensive evaluation of the cues. Both of these alternative explanations are consistent with the observed results that following the low intensity erotic story reported sexual arousal and VPP changes were highly correlated. When the story cues were no longer present, subjects seem to have based their objective state of arousal more directly on their physiological arousal. Subjects asked to report on genital sensations may have been less influenced by cognitive factors related to the stimulus because of their narrower attentional and response sets. For these subjects the response target was the presence and strength of genital arousal which probably required less cognitive processing of the erotic stimuli.

In sum, when subjects were asked to report genital arousal they did so with considerable agreement with VPP and this was enhanced by response change and response intensity. Reports of sexual arousal were in similar agreement with VPP and were enhanced by the same factors, except when the erotic stimulus was less explicitly sexual. Therefore, reports of sexual arousal are not simply the result of detecting genital arousal but are influenced by contextual factors. This is consistent with the assumption that reporting sexual arousal involves cognitive as well as physiological factors and that the two may not always be coordinated.

Some Methodological Implications

Although the present study found that physiological and subjective responses were strongly correlated under certain conditions, attempts by others have not always been consistent with this finding (Geer et al., 1974; Hoon et al., 1976; Morokoff and Heiman, 1980; Osborn and Pollack, 1977; Wincze et al., 1977; Wilson and Lawson, 1976; 1978). The conditions under which these correlations were found have been discussed in relation to stimulus, mediating response and cognitive factors. Several other issues, mainly methodological, were proposed to account for previous failures to demonstrate this correlation. These included, retrospective self-report, response independence, and methods of response measurement.

Retrospective reports. When the erotic stories ended, reports were of steadily decreasing arousal that were closely accompanied by decreases in VPP. Retrospective reports typically require subjects to recall the maximum sexual or genital arousal experienced to the erotic stimulus. This act of recall is unlikely to be accurately performed by all subjects for it may be more difficult for some to remember their physical and subjective reactions than it is for others. Moreover, the recall may be adversely affected by differential post-stimulus reactions, for instance some subjects may continue to think about the stimulus after it has ended, and there may be interference from present physiological state. If physiological responses are diminishing, retrospective report may be based on a combination of present state with memory for past subjective experience thereby introducing report bias.

Independence of responses. The results of the present research do not support the claim that the particular physiological measures and subjective reports are independent. For the most part not only are they closely related but subjective reports of genital arousal are most probably the clear result of events monitored by VPP. Amoroso and Brown (1973) proposed that the information from genital measures are potentially subject to problems such as voluntary control, movement artefact, and the effect of the device upon genital response itself. Consequently, they suggested that physiological measures be used as an index of general arousal and self-reports as specifying the kind of arousal. While it could be argued that self-report of sexual arousal was sometimes "independent" of VPP response, for example in the low intensity erotic story, this exception was more informative when the physiological and subjective responses were cross-checked with one another. The fact that they did not covary in that particular instance, pointed to the important consequences of contextual factors.

While the presence of response bias can never be ruled out, there is no reason to suspect that self-reports are any less influenced by instructional set, than are physiological processes by the presence of a measuring device. Recent thermographic measurement, in which genital temperatures are sensed remotely so instrument-induced stimulation did not occur, shows that the changes in temperature during sexual arousal are quite consistent with photoplethysmographic changes (Seeley et al., 1980). The present results suggest that if biases are present both physiological and subjective responses were similarly affected. It seems unlikely that subjects would react to instrumentally introduced bias in a way that would equally affect both response systems.

Unit of Analysis. At the outset it was asserted that one factor which might influence the magnitude of the correlation between physiological and subjective responses was the unit of analysis used in such correlations. If the objective of the analysis is to examine the relationship between subjective reports of arousal and the physiological response hypothesized to underlie it, then the analysis should focus on the two responses as they occur together in time. The present study therefore examined the correlation between these two responses within an individual as they occurred simultaneously and with several amounts of time lag. The optimum correlation was chosen, and in most cases this represented the relationship between say, VPP and a slightly later occurring self-report. Thus the unit of analysis was an index of the maximum relationship between the two responses as they occurred in one individual within a short time span. Neither the actual level of an individual's response, nor her response bias to use more or less of the rating scale, nor affects due to the menstrual cycle (Abramson, Repczynski, and Merrill, 1976; Palti and Bercovici, 1967) could affect this index.

In contrast, the units of analysis are quite different in studies which arbitrarily selected two scores to represent a subject's response, for example maximum physiological level and retrospective self-report. These two indices are less likely to exhibit any relationship because they are not sampled from close time periods and there is no reason to assume that a person would report or remember her peak response. Furthermore, this correlation is calculated across rather than within a subject and so would reflect individual differences in physiological and subjective response scales rather than parallel changes occurring within a single system over time.

Furthermore, the spline plot derivatives suggested that in certain instances, the correlation between responses might not be the best index of covariation. Thus, there was an indication that although the absolute values of the responses were changing in opposing directions, slope changes could be covarying in the same way as one another. This suggests that the relationship between physiological and self-report responses is likely to be considerably more complex than a simple monotonic covariation. It implies that the relationship might be one in which receptors, or processing units, sensitive to rate-changes are involved in the assessment of arousal. If so, these processes might be similar to the current view that muscle spindles may be sensitive to rate changes which contribute to sense of limb position and movement (Matthews, 1972).

Finally, the problems posed by response measurement may best be resolved by single-case statistical analyses, a number of which have been developed (see eg. Hersen and Barlow, 1976; Kratochwill, 1978). Perhaps the most promising of these for application to psychophysiological data is time-series analysis (Box and Jenkins, 1970; Gottman and Glass, 1978). Such analyses taken into account peculiar attributes of serial data from the same subject, such as autocorrelation, which make the data unsuitable for more conventional parametric analyses and seriously bias the Type I error rate (Gottman and Glass, 1978). One recent approach which appears especially suited to psychophysiological data permits assessment of the effects of planned interventions on multiple time-series (Abraham, 1980). The application of such analyses may further clarify the processes relating physiological and subjective responses and aid in formulating a more refined model.

Diagnosis and Assessment Problems

If the photoplethysmograph is to be used to diagnose and assess deficits in female sexual arousal the response measures must first be shown to be valid. The present research confirms this validity. Nevertheless the use of the physiological measures requires careful attention to special problems. On the basis of present results one would conclude that the absolute levels of physiological and subjective responses may not be the best criteria for diagnosing and assessing arousal deficits. The best index would be within-subject correlations between physiological and subjective responses in conjunction with response patterns. The basis for this conclusion will now be examined.

There are several potential problems associated with the use of physiological measures to diagnose deficits and assess therapeutic gains in female sexual arousal. These include, whether or not reported arousal deficits are accompanied by response deficits in both VBV and VPP, how to interpret discrepancies between physiological and subjective responses, which responses should be therapeutic targets, and what constitutes the best measure of therapeutic gain. If women reporting low states of sexual arousal showed concomitant deficits in both physiological responses and if subjective and physiological responses were enhanced by therapy, most of these issues would be settled.

These problems are exemplified in the following reported studies. Wincze et al. (1976) found that the VBV response of a group of women reporting low sexual arousal was significantly lower than that of a control group. Nevertheless, both groups reported equivalent sexual arousal to the erotic stimuli presented. Wincze et al. concluded that the reduced VBV response was

the true manifestation of the dysfunction and that the clinical group's self-reports were falsely elevated by response demands. Morokoff and Heiman (1980), found that the VPP responses to erotic stimuli of a clinical group reporting low arousal were no different from those of a carefully matched control group. Clinical subjects, however, reported significantly less sexual arousal than did control subjects.

Similar difficulties are evident in the assessment of therapeutic gain and are further compounded because it is not clear how gains might best be measured. Thus, the VBV deficit observed by Wincze et al. (1976) was later accepted as valid evidence of a deficit in "arousal capacity" (Wincze et al., 1978). Consequently, when VBV levels of women reporting arousal deficits were not increased by therapy, resultant increases in reported arousability were rejected as unlikely evidence of gain and as attempts to please the therapists. Morokoff and Heiman (1980) found significant increases in a clinical group's subjective reports of sexual arousal to the erotic stimuli following therapy but no increases in VPP. Reasoning that dysfunctional subjects may differ from nondysfunctional subjects in that they may be less able to relate subjective to physiological responses, Morokoff and Heiman also obtained pre- and post-therapy correlations between the responses. Morokoff and Heiman (1980) expected that therapy would significantly enhance the correlation between the responses and found partial support for this hypothesis.

The problems pertaining to diagnosis and assessment can be resolved by considering the available choices when a discrepancy occurs. One such choice is to accept the physiological response as the valid measure of arousal and invalidate self-reports. This is most likely to occur when the physiological responses differentiate clinical from non-clinical groups but

self-reports do not. Conversely, self-reports are more likely to be accepted as valid measures of arousal when physiological responses do not discriminate clinical from non-clinical groups.

There are no acceptable a priori reasons for selecting physiological responses in preference to subjective report. The VBV deficit observed by Wincze et al. (1976) is currently the only available evidence for a physiological response deficit but this may well have been due to an enhancement of the control group's VBV response. Thus, the control group viewed an anxiety provoking film immediately preceding the erotic film whereas the clinical group did not. Hoon, Wincze, and Hoon (1977) have shown that VBV responses to erotica are enhanced under such circumstances. Moreover, there was no evidence which suggested that bigger physiological responses were better responses since the subjective reports of arousal were equivalent (Wincze et al., 1976). Data from the present study also indicated that, while within-subject physiological and subjective responses covaried, the magnitude of physiological response did not predict the magnitude of subjective reports of arousal between-subjects. Finally, one only avoids the question of what forms the basis of self-report when one unquestioningly accepts self-report as the basis for classification of dysfunctional status and then later denies its validity. If, for example, the arousal deficit was a specific situational or interpersonal problem, then self-reports to the laboratory erotic stimulus may have been completely valid.

Morokoff and Heiman (1980) were confronted by the converse dilemma. Clinical subjects' self-reports of sexual arousal to the laboratory stimulus were consistent with their complaint of low arousal whereas their VPP responses were not. It could be argued that the vasocongestive (VBV) response

is somehow more related to this particular dysfunction than is the vasodilatory (VPP) response. In support of this, present results did suggest that the degree of vasocongestion might be more centrally influenced than vasodilation, when the cognitive assessment was that the erotic stimulus was not especially sexually arousing. These results also support Morokoff and Heiman's suggestion that the equivalent VPP responses of clinical and control groups might show that the arousal deficit was primarily due to differences in cognitive and affective processes. Morokoff and Heiman (1980) further suggested that the clinical group may have been less aware of, or interpreted differently, their genital responses and speculated that genital and subjective reports of sexual arousal might tap different constructs. Based on this speculation, they recommended that self-reports of sexual and genital arousal be compared with one another and with vaginal responses.

Such was a principal aim of this thesis, and although a clinical group was not used, the findings are relevant to the diagnostic and assessment issues. The present conclusions apply strictly to women of the same population. However, the present participants were not demographically different from those of a large sample of women drawn from undergraduate and graduate populations in Canada and the United States (Hoon and Hoon, 1978; Hoon et al., 1976). There are, moreover, no reasons to suppose that the physiological and subjective responses of present participants differ from those of a more general population. Present results showed that non-clinical subjects can detect genital responses to erotica and subjective reports of sexual arousal were also highly correlated with VPP responses, except in the low intensity erotic story. Thus, reports of sexual arousal may not always coincide with physiological response even though these

responses can be detected. The present results also suggest a resolution to the diagnostic and assessment problems, and of one possible goal for therapy.

One diagnostic goal would be to measure the extent to which both physiological responses covary with immediate subjective reports of arousal to a variety of erotic stimuli. This covariation should be measured by correlating within-subject responses and, if group comparisons are undertaken, the correlations so obtained are the appropriate units for comparative analysis. Similarly, one goal of therapy and measure of assessment of therapeutic gain might be to maximally enhance the correlation between subjective and physiological responses. The thesis points to a number of stimulus conditions, response sets, cognitive labels, and aspects of the physiological response which can influence the correlation between physiological response and immediate subjective report.

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APPENDIX A

Questionnaire Completed by Subjects

SAI INVENTORY

Instructions: The experiences in this inventory may or may not be sexually arousing to you. There are no right or wrong answers. Read each item carefully, and then circle the number which indicates how sexually aroused you think you would feel if you actually experienced it. Be sure to answer every item. If you aren't certain about an item, circle the number that seems about right. The meaning of the numbers is given below:

-1 adversely affects arousal; unthinkable, repulsive, distracting
0 doesn't affect sexual arousal
1 possibly causes sexual arousal
2 sometimes causes sexual arousal; slightly arousing
3 usually causes sexual arousal; moderately arousing
4 almost always sexually arousing; very arousing
5 always causes sexual arousal; extremely arousing

ANSWER EVERY ITEM	How you feel or think you would feel if you were actually involved in this experience
1. When a loved one stimulates your genitals with mouth and tongue	-1 0 1 2 3 4 5
2. When a loved one fondles your breasts with his hands	-1 0 1 2 3 4 5
3. When you see a loved one nude	-1 0 1 2 3 4 5
4. When a loved one caresses you with his eyes	-1 0 1 2 3 4 5
5. When a loved one stimulates your genitals with his finger	-1 0 1 2 3 4 5
6. When you are touched or kissed on the inner thighs by a loved one	-1 0 1 2 3 4 5
7. When you caress a loved one's genitals with your fingers	-1 0 1 2 3 4 5
8. When you read a pornographic or "dirty" story	-1 0 1 2 3 4 5
9. When a loved one undresses you	-1 0 1 2 3 4 5
10. When you dance with a loved one	-1 0 1 2 3 4 5

11. When you have intercourse with a loved one	-1	0	1	2	3	4	5
12. When a loved one touches or kisses your nipples	-1	0	1	2	3	4	5
13. When you caress a loved one (other than genitals)	-1	0	1	2	3	4	5
14. When you see pornographic pictures or slides	-1	0	1	2	3	4	5
15. When you lie in bed with a loved one	-1	0	1	2	3	4	5
16. When a loved one kisses you passionately	-1	0	1	2	3	4	5
17. When you hear sounds of pleasure during sex	-1	0	1	2	3	4	5
18. When a loved one kisses you with an exploring tongue	-1	0	1	2	3	4	5
19. When you read suggestive or pornographic poetry	-1	0	1	2	3	4	5
20. When you see strip show	-1	0	1	2	3	4	5
21. When you stimulate your partner's genitals with your mouth and tongue	-1	0	1	2	3	4	5
22. When a loved one caresses you (other than genitals)	-1	0	1	2	3	4	5
23. When you see a pornographic movie (stag film)	-1	0	1	2	3	4	5
24. When you undress a loved one	-1	0	1	2	3	4	5
25. When a loved one fondles your breasts with mouth and tongue	-1	0	1	2	3	4	5
26. When you make love in a new or unusual place	-1	0	1	2	3	4	5
27. When you masturbate	-1	0	1	2	3	4	5
28. When your partner has an orgasm	-1	0	1	2	3	4	5

CIRCLE A NUMBER INDICATING TO WHAT DEGREE (IF ANY) YOU NOTICE THE FOLLOWING CHANGES WHEN YOU ARE SEXUALLY AROUSED

		Never						Always
29.	Vaginal lubrication (dampness)	1	2	3	4	5	6	7
	Mild genital sensations (warmth, pulsations)	1	2	3	4	5	6	7
	Moderate genital sensations	1	2	3	4	5	6	7
	Strong genital sensations	1	2	3	4	5	6	7
	Nipple erection	1	2	3	4	5	6	7
	Breast swelling	1	2	3	4	5	6	7
	Muscular tension	1	2	3	4	5	6	7
	Sex flush (reddening skin)	1	2	3	4	5	6	7
	Hyperventilation (rapid breath)	1	2	3	4	5	6	7
	Heart rate increases	1	2	3	4	5	6	7
	Decreasing awareness of the environment	1	2	3	4	5	6	7
30.	In general, how often are you aware of body sensations when you are sexually aroused?	1	2	3	4	5	6	7

31. How old are you? _____

32. Circle the last year of schooling you have completed.

1 2	1 2 3 4	1 2 3 4
C.E.G.E.P.	University (undergrad.)	University (graduate student)

33. Occupation _____

34. Circle your marital status: single married separated divorced remarried unmarried but living with partner

35. How many children do you have? _____

36. Circle the number of times per year (approximately) you have intercourse (make a reasonable estimate).

none 1-5 6-10 11-49 50-100 100 or more

37. Circle your present frequency of intercourse.

never experienced intercourse | presently not occurring | 1-10 times per year | 1-4 times per month

2-4 times per week | 5 or more times per week

38. Circle how often you have experienced orgasm.

never | sometimes | frequently | always

39. Circle the method of reaching orgasm you most prefer.

masturbation | intercourse | vibrator | partner's fingers

partner's mouth and tongue

40. Do you prefer sex with: one of the opposite sex? one of the same sex? sometimes male, sometimes female? by yourself? (Circle appropriate response)

41. Circle the number of different partners with whom you have experienced sexual intercourse (make a reasonable estimate):

none 1 2 3-6 7-10 11-14 15 or more

42. Are you using some method of birth control at the present time? YES ___ NO ___

If so, what method are you using? _____

43. How many days have passed since the first day of your last menstrual period (make a reasonable estimate): _____ days.

44. Check how pleased you are with your present state of sexual responsiveness:

a) ___ not at all pleased. I/we have a problem.

b) ___ I don't care, one way or the other.

c) ___ I'm pleased some of the time.

d) ___ I'm usually pleased, hope it improves.

e) ___ I'm pleased most of the time.

f) ___ I'm extremely happy, it couldn't improve.

45. Please circle every number that describes a sexual activity that you have experienced at least once.

1. one minute continuous lip kissing
2. manual manipulation of female breasts, over clothes, by male
3. manual manipulation of female breasts, under clothes, by male
4. manual manipulation of female genitals, over clothes, by male
5. kissing nipples of female breasts, by male
6. manual manipulation of female genitals, under clothes, by male
7. manual manipulation of male genitals, over clothes
8. mutual manual manipulation of genitals
9. manual manipulation of male genitals, under clothes
10. manual manipulation of female genitals to massive secretions, by male
11. manual manipulation of male genitals to ejaculation
12. oral contact with female genitals, by male
13. oral contact with male genitals
14. sexual intercourse, face to face (ventral-ventral)
15. oral manipulation of female genitals, by male
16. oral manipulation of male genitals
17. mutual oral-genital manipulation
18. mutual manual manipulation of genitals to mutual orgasm
19. sexual intercourse, ventral-dorsal (rear entry)
20. oral manipulation of male genitals to ejaculation
21. mutual oral manipulation of genitals to mutual orgasm

APPENDIX B

Control Story

It was Friday--a clear April afternoon--and Beth was in the mood for some company. Her work was tiresome lately and she was looking forward to seeing Andy.

He had promised to repair her car in exchange for some last minute help with organic chem. She hoped her car had a better prognosis than his future in chem. He missed the class at least once/week and the only way he could pass was if he knew it when he came into the course. Ah well, it was worth a try. And anyway, she liked Andy--they had been friends for quite a while and she knew he was fun and interesting...and very turned off to the pre-med program.

Beth knocked on the door. He opened it and welcomed her in. He had on his work clothes, looking like he was serious about the car deal. He brought out some wine and she poured herself a glass and settled back to drink for a few moments. "I haven't seen you in a couple of days," he finally said.

She looked up. "Well," she sighed, "I've been busy and you haven't been to chem." He gave her a smile and shrugged his shoulders. Well, she thought, I bet he is just going to drop it, he's acting pretty cool about the whole thing.

She was right. He was not only switching out of organic, he was dropping pre-med altogether. And going into anthropology. She looked at him and realized that he seemed more relaxed than she had ever seen him before. They talked about pre-med for a while. They had seen how cut-throat the program made people. It was ironical and sad that people with potentially huge responsibilities were non-plussed to screw up someone's titration in chem., or permanently remove a journal article to effectively prevent classmates from

reading it. Probably the only way to stop it Beth mentioned, was to not allow MDs to make over $25,000 a year. Andy saw it as more than that--doctors have too much unearned reverence and power--some may deserve but others merely take advantage of it.

They paused for a while and Andy suggested that he do a little "doctoring" on her car while it was still light. She told him its symptoms and he took a few tools outside. She followed him and watched him probe under the hood, twisting things off, looking at its innards. By the time a half-hour had passed he was finishing and telling her it was just a loose spark plug and a slippery fan belt. Easy.

Beth was visibly relieved. Andy suggested she come in--he had a couple of cheeses that she might like to try. That sounded fine, since the wine had made her hungry. She sat down on the floor again and he brought out the cheese. "One's Danish and the other is domestic. See which you like.". He sat the cheese, and himself, down next to her. He helped himself too. She was so hungry that it took a few pieces to really taste the difference. The domestic she rated as good but the Danish was super. He agreed and asked her how the domestic could be better. She had trouble describing what it needed, but made an effort and asked him why he wanted to know. He admitted that he made the cheese.

She looked at him--genuinely surprised. He saw her expression and started to joke with her about not needing to pass organic chem in order to learn how to make cheese. She laughed. "Better yet," he said, "when the second big depression comes, you'll be begging for a morsel of the stuff. Maybe I'll make my fortune in bootlegging green cheese."

It was dark and Beth had to get home. She gathered her purse and decided on the spur of the moment to invite him over to her house on Sunday. He could

bring a friend and some of his cheeses. She and three other people had planned a sort of mini-Smorgasbord. He was clearly pleased and accepted the invitation. Much more fun than getting tutored in chem, anyway.

APPENDIX C

High Intensity Erotic Story

Jenny closed the book, placed it on the night-table near the bed and slowly turned to glance at Robert. He was propped back against the pillows, knees drawn back beneath the covers, resting his book on his thighs. Jenny slipped down between the satin sheets and gazed up at his face. His blue eyes scanned the pages intently and the lines of his strong, angular face were fixed in an expression of keen interest. She looked at the dark hairs on his chest and at the half-hidden nipples beneath, then, she let her eyes drift down towards Robert's navel where the hairs grew more thickly, forming an almost solid line. My God he's beautiful, she thought, and the soft sigh she gave seemed to silently speak her thought. She moved closer and nuzzled her face against his chest. Robert put his arm around her so that his hand now rested between the shoulder blades of her naked back. His fingers made slow, circular, caressing movements and Jenny felt her flesh tingle to the gentleness of his touch.

Jenny fondled the hairs on his chest and felt a shiver of excitement as Robert's body alternately tensed and relaxed in pleasure at her touches. After a few moments, she slid her fingers down slowly and teasingly, shyly letting them stray beneath the sheets that hid the lower part of his stomach. She felt the sheets move, gently drew back her hand and placed it where she could feel, through the bedcovers, the growing hardness of Robert's cock. He moaned softly, and stretched out his legs full length. She sensed that he was about to move so she whispered that he should lie still. Jenny lifted herself, supported on one elbow, and kissed Robert on the lips, the chin and neck. Through half-closed eyes, he watched as she let her tongue flick over his nipples and down his chest with slow, wavy, movements of her head. Jenny

pressed her face and lips against Robert's stomach and drew back the sheets to reveal his erect cock. She looked at his tight, almost shiny, balls that were drawn up against the base of his penis. She licked her fingers and traced a line up along the inside of Robert's thigh, touched his balls, and drew her finger along the shaft of his cock to its swollen head. Robert's penis jerked in response to her touch. Jenny moved her head down, felt his pubic hair tickle her cheek, and drew his cock into her mouth. She tasted the wet droplets that moistened its end and twirled its hard wetness in her mouth, squeezing and stroking it with her tongue. She bobbed her head slowly, down and up, sucking and releasing his cock as she did so. Robert groaned and Jenny, very excited now, reached down and stroked the slit of her cunt. It was wet and slippery with her own sex and she took some of this wetness and smeared it on Robert's bulging cock. Robert gave a long, low moan and slid down so that he was now laying completely flat on his back.

Jenny sat up and eased herself, legs astride, onto Robert's stomach. She leaned forward so that he could suck her hardened pink nipples and she felt his groin thrust up, involuntarily, accentuating the strength of his desire, Jenny leaned back, took Robert's hands and placed them gently on her breasts. With slow, snake-like movements of her hips she slid her groin down his body and over his wet cock. She took his penis in her hand, fondled it tenderly, fascinated by how thick it had become.

Jenny rolled off Robert, entwined her legs with his and helped him to slide on top of her. He drew his body slowly across hers, his eyes half closed, while Jenny continued to stroke his cock and balls. Jenny placed her hands upon his shoulders and guided Robert down her body until she felt his face and tongue press against the wet lips of her cunt. She rolled her hips and gasped as Robert's tongue played against her clitoris. Jenny held his head and pushed her cunt forward insistently moaning ecstatically as Robert's

tongue pressed deeply inside her. Robert was taking short, rapid breaths and she savoured the sensations that the warmth and moistness of his breath created around her cunt. Jenny pulled Robert up on top of her again, their bodies were covered with a light perspiration and they slipped easily against one another.

They rolled over, their bodies intertwined once more and finally Jenny, on top of Robert, grasped his hot throbbing penis and guided it slowly... inch by inch...into her cunt. He gave a few short gasps as Jenny, moving rapidly up and down, darted in and out over his penis. She thrust her hips forward and rolled her pelvis rhythmically, round and round, making deeper and deeper movements, and pressing her cunt mouth hard against his pubic mound.

She raised herself slowly, letting her cunt-lips gently slide along the slippery sides of his shaft. The hungry lips lingered, sucking all the way up his long, stiff rod. When her cunt mouth surrounded the neck of his sensitive cock, she poised and stopped her upward movement. Then gently, but insistently, she contracted the muscles of her inner lips...squeezing and relaxing...squeezing and relaxing...slowly and deliberately.

Jenny relaxed and slid down his shaft once more. When she felt her cunt pressed against his pubic hairs she again began to move her hips in small, slow, sensuous circles. She pushed down so that his cock, already deep inside her, now seemed to fill her insides completely. Robert started to follow her movements and Jenny felt their excitement growing in force. She closed her legs. Robert thrust upward and began pumping into her, making his cock feel even bigger. Jenny's head jerked back and her breasts bounced freely, the nipples hard and erect, as she thrust up and down. Both were breathing heavily now and pulling at each other's bodies. Their movements became more and more rapid. Robert's body tensed becoming one long muscular arch as he strained

upwards to let his cock probe deeper inside as she plunged up and down. Jenny called out, pulling him deeper, until, in the last frantic fury of thrashing, he groaned, his body shuddered and convulsed and she felt the hot explosion of juices burst inside her. Jenny was coming and coming as Robert's hot, slippery orgasm warmed her cunt, and she felt the waves of pleasure radiate seemingly to every part of her body. She rolled off his sweat-drenched body, now without tension, totally relaxed.

Low Intensity Erotic Story

Jenny closed the book, placed it on the floor beside her and slowly turned to glance at Robert. He was propped back against the chair, knees drawn back, staring into the flames of the fire burning in the large stone grate. Jenny studied his face for a few moments. His blue eyes had a dreamy, distant expression, and the lines of his strong, angular face, were fixed, as if he were deep in thought. Jenny got up, poured a drink for herself and Robert and returned to the fireplace. She sat down beside him and gazed into the warm, flickering, tongue-like flames. Images and ill-defined fantasies appeared in her thoughts, created in some mysterious manner by the firelight, then dissolved to be replaced by others in a slow, steady, stream. The fireplace seemed to act as a mirror reflecting her own private thoughts and she found the effect warm and soothing.

Robert shifted slightly and, temporarily, the images faded. She became conscious once more of his presence, moved closer to him and placed her arm around his shoulders. He murmered in a calm, relaxed, voice and, as if compelled by a secret force, they returned their attention to the dancing flames. Now and again, one of them would speak, as if in reply to a question, perhaps one asked silently, and of themselves. The rambling conversations that followed were strangely disconnected, yet each felt perfectly well the thoughts and moods of the other. Jenny enjoyed moments such as these. Intimate, silent moments that drew them closer together. She turned and nuzzled her face against his chest. Robert put his arm around her so that his hand now rested between her shoulder blades. His fingers made slow, circular, caressing movements, and Jenny shivered with pleasure as his sensuous touches sent tingles down her back.

They sat together in this way for a long time. The fire burned less brightly now but the heat radiating from the glowing embers reddened their faces and cheeks, emphasizing the tranquility of their expressions. Robert leaned forward, preparing to place another log on the fire. Jenny thought how beautiful he looked and on impulse kissed him suddenly on the cheek. Caught in mid-motion, Robert rolled over to one side, and Jenny laughed aloud. He growled, and his face grew serious with pretended anger. Jenny, not at all deceived by his mock expression, lunged forward and tickled his ribs and stomach. He wriggled around, trying to escape, but Jenny, half on top of him now, had his body pinned to the floor. They wrestled playfully and Jenny sensed the strength that he was deliberately holding back. She found the contrast between his strength and gentleness exciting as their bodies met and separated in their mock combat. She rolled him over onto his back and sat on his stomach, her knees astride the lower part of his chest. He lay there, breathing rapidly, head turned towards the fire, his eyes half-open. Jenny looked down at his face. His ruffled hair and open shirt front suggested to Jenny an air of vulnerability and sensuality. She leaned forward and fondled the hairs on his chest for a few moments, then slowly she undid the remaining buttons on his shirt and drew it completely open. She rested her fingers lightly on his breastbone and began to move them tenderly in small circles over his skin. Robert shivered slightly, and Jenny felt her own pleasure mounting in response. Gradually, teasingly, she made the circles bigger until her fingers traced over Robert's stomach, which tensed as she did so, then deliberately she made the circles smaller again.

Jenny continued caressing Robert in this manner for a while and then stopped, took off her blouse and stretched out so that she now lay fully on top of Robert's body. She pressed herself firmly against him enjoying the

warmth that passed between their bodies and the prickly tingling of his chest hairs against her breasts. He wrapped his arms around her, tightened them affectionately, and the pressure caused her to sigh softly. She kissed the side of his neck, pinched the skin gently between her teeth, then flicked her tongue over the folds of his ear and kissed him on the lips. It was a hard, lingering, kiss and she felt his hands moving over her back with increasing strength. Jenny slowly drew back, supported herself on her elbows and looked into his eyes. She gave him a quick kiss on the forehead then lifted her head again. She could clearly sense his growing arousal and this sharpened her own feelings. She was enjoying the slow, steady, mounting of her desire, and wanted to task it fully as she might savour a delicious meal.

Jenny sensed that he was about to speak and placed her finger on his lips. She got up, kneeled beside him and slowly helped him to remove his shirt. They both stood, slipped out of their remaining clothes and, fully naked now, lay down together in front of the red, glowing fire. The room was dark and warm, and the familiar objects in it were less distinct, creating a slightly unfamiliar, yet exciting atmosphere. They lay there, side by side, basking in the heat thrown off by the smouldering embers. In the dusky firelight Jenny found Robert's body even more attractive. The shadows emphasized the sleekness of his muscular frame and when the firelight flickered, the movement of the shadows were like sensual caresses over his body. Suddenly she felt curiously jealous of the way the light played upon his body, for it seemed to her that the shadows were competing for Robert's affection. She smiled to herself and reached across to touch him and the feeling of jealousy vanished, as a bubble bursts and vanishes from sight.

Jenny whispered to Robert that he should lie still. She let her hands move gently and freely over the whole length of his outstretched body. She

felt her own desire strongly now, and as she touched him, Robert moaned and sighed. The obvious pleasure that her sensuous stroking fingers were arousing in Robert became too much for her. She rolled over, stretched out on top of him and slowly drew his erect penis inside her.

APPENDIX D

Informed Consent Statement

I am signing this form to acknowledge that I have been fully informed and understand the purpose and nature of this study. I agree to take part and know that my name will not be released or used for any purpose whatsoever and that my name will only appear on this consent form and nowhere else.

I understand that there are two parts to the study:

Part 1 involves completion of a few questionnaires, anonymously.

Part 2 involves listening, in private, to stories. Some of these stories may describe ordinary sexual interactions between a woman and a man. Some physiological measures, the nature of which I fully understand, will be taken at this time.

I understand that it is my right to stop taking part at any time should I feel offended or uncomfortable without need for explanation.

The consent applies only to the two sessions of this study and not for any other study, now or in the future.

Under these conditions I agree to participate and agree that the information I provide may be used as general research information without use of my name or revealing my identity in any way whatsoever.

_____ _____

Name Date

APPENDIX E

Experimental Instructions

As explained to you last time, today you will hear two stories, presented over these headphones. The stories may or may not be erotic. In addition to taking the measures using the vaginal probe, we would like to know about your personal reactions to the stories. In order not to disturb your enjoyment of the stories we want you to tell us how you feel by means of this lever. The position of the lever will let you tell us of these reactions without your having to talk or write anything. I will explain what reactions we want you to report and how to use the lever to do this in a few moments. To make it easier for you, we will ask for your reactions at regular intervals throughout the session. So, while you are wearing the headphones you will hear a soft tone, periodically, even when the stories are being presented. Whenever you hear this tone, move the lever to a position that best seems to describe your reactions. You should only move the lever <u>if your reactions change</u>. Sometimes they may not change and then you should keep the lever in the same position.

<u>A.</u>

We would like you to use the lever to tell us how sexually aroused you <u>actually</u> feel. When the lever is fully over to the <u>left</u>, like this, it represents not feeling sexually aroused at all. When the lever is fully over to the <u>right</u>, like this, it represents feeling extremely sexually aroused. Do not worry about an exact positioning, just remember that all the way over to the left means not at all aroused and all the way over to the right means extremely sexually aroused. Each time you hear the tone then, if your arousal has increased from last time move the lever to the right. If your arousal increased only a small amount you would move the lever only a small way

to the right. If it increased a lot you would move the lever a correspondingly larger way to the right. If your arousal decreased you would move the lever back to the left in a similar way. Just take a few moments to get used to the feel of the lever and how far it can move in each direction. We don't want you to <u>try</u> to become sexually aroused, but if you are aroused just use the lever to report it whenever the tone sounds.

Do you have any questions?

<u>B</u>.

We would like you to use the lever to tell us what kinds of genital sensations you <u>actually</u> feel. When the lever is fully over to the left, like this, it represents not feeling any genital sensations at all. When the lever is fully over to the right, like this, it represents feeling extremely strong genital sensations. Do not worry about an exact positioning, just remember that all the way over to the left means no genital sensations at all, and all the way over to the right means extremely strong genital sensations. Each time you hear the tone then, if your genital sensations are stronger than the last time, move the lever to the right. If your genital sensations become only slightly stronger you would only move the lever a small way over to the right. If they became a lot stronger you would move the lever a correspondingly larger way over to the right. If your genital sensations decreased in strength you would move the lever back towards the left in a similar way. Just take a few moments to get used to the feel of the lever and how far it can move in each direction. We don't want you to <u>try</u> to produce genital sensations, but if you have them just use the lever <u>to</u> report their strength whenever the tone sounds.

Do you have any questions?

All Subjects

Explain that probe has been sterilized and rinsed.

Explain how to insert probe. Stress:

(a) the position of the probe

(b) once inserted subject sits in recliner and reclines to the first position legs slightly astride

(c) subject can close eyes if she wants to

(d) not to bang or drop the probe

(e) not to move during session

After I leave the room, insert the probe, sit back comfortably in the chair, put on the headphones and when you are ready to begin just press the "call" button all the way down. We will be able to hear this over the intercom. (indicate).

During the first 10 mins. you will hear only the tone which, as you remember, is the signal for you to move the lever only if you feel changes in (A. sexual arousal: B. genital sensations). This period will give you a chance to relax, and get used to the sound of the tone and how often it occurs.

During the second 10 mins. you will hear the first of the stories. The tone will still come on at regular intervals as a signal to report (A. how sexually aroused you feel: B. the strength of genital sensations). When the first story finishes there will be a 1 min. interval except for the tones.

During the third 10 mins. you will hear another story and, from time to time, of course, the tone.

At the end of the second story there will be another 10 min period in which all that you will hear is the tone, the signal for you to continue to report (A. how sexually aroused you feel: B. the strength of genital

sensations). Any questions?

After I leave insert the probe, relax and tell me when you are ready. You can be absolutely confident that no-one will enter the room. A voice on the tape will let you know when the session has ended and it will ask you to tell me, by way of the intercom, that you have removed the probe.

Relax, enjoy the stories, and remember to use the lever to report (A. how sexually aroused you feel: B. the strength of your genital sensations).

APPENDIX F

Newman-Keuls Summary Table Comparing Self-Report Totals by Erotic Story Intensity and Experimental Phase

LOW INTENSITY	1. BASELINE	2. NEUTRAL STORY	3. RETURN-TO-BASELINE	4. EROTIC STORY
1.	-	1.471	20.762*	27.067**
2.		-	19.291**	25.596**
3.			-	6.306

HIGH INTENSITY	1. NEUTRAL STORY	2. BASELINE	3. RETURN TO BASELINE	4. EROTIC STORY
1.	-	0.66180	31.189**	57.759**
2.		-	30.527**	52.097**
3.			-	21.570**

* $p < 0.05$ (r, 132)

** $p < 0.01$ (r, 132)

APPENDIX G

Newman-Keuls Summary Table Comparing Vaginal Pulse Pressure-Self Report Correlations by Erotic Story Intensity and Experimental Phase

LOW INTENSITY	1. NEUTRAL STORY	2. BASELINE	3. EROTIC STORY	4. RETURN-TO-BASELINE
1.	-	3.737	10.921**	16.026**
2.		-	7.184*	12.289**
3.			-	5.105

HIGH INTENSITY	1. BASELINE	2. NEUTRAL STORY	3. RETURN-TO-BASELINE	4. EROTIC STORY
1.	-	5.355	12.414**	19.008**
2.		-	7.059*	13.652**
3.			-	6.593*

* $p < 0.05$ (r, 132)

** $p < 0.01$ (r, 132)