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THE USE OF BIOIMPEDANCE AND PLETHYSMOGRAPHY IN A CLINICAL SETTING

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This working paper is available in French. Ce document de travail est disponible en français.

Executive Summary

There were four principal objectives to the present study. One aim was to investigate a newly developed method of assessing sexual arousal. This method consists of attaching electrodes to the penis and measuring changes in the electrical resistance of the penile tissue with increased arousal. It differs from traditional plethysmography, wherein simple changes in the circumference of the penis are assessed. In simplified terms, the former is a bio-electric measure while the latter is bio-mechanical. With regard to the current study, the relationship between these two alternate measures was examined under various experimental conditions.

A second aim of the study was to examine the differential effects of alcohol and explicit suppression instructions on rapists' (rapists and sexual aggressives) and nonrapists' (nonrapist sex offenders) sexual arousal to varying sexual stimuli (audiotaped narratives).

A third component comprised an investigation of the interrelation of the two facets of a multimethod assessment system for arousal, one method being machine-recorded arousal (mercury strain guage, bioimpedance), and the second being self-reported arousal.

The fourth and final purpose of the study was an examination of the relationship between machine-recorded physiological arousal and a variety of variables including age,

blood alcohol levels, the blood levels of several hormones (testosterone, luteinizing hormone, follicle stimulating hormone, and prolactin), and intelligence.

The results are summarized as follows:

(1) Mercury strain guage (MSG) and bioimpedance measured arousal correlated moderately inversely (r=-.19). This is in the expected direction since the electrical resistance of the penile tissue should decrease as circumference increases. However, given the magnitude of the correlation, it appears that bioimpedance is sensitive to more variables than the MSG. This became obvious in the correlations of MSG to bioimpedance in the 'with alcohol' conditions, whereby the correlations became highly variable. One explanation is that the alcohol causes actual electrical changes in the penile tissue. Another more likely reason is that the bioimpedance apparatus is sensitive to the increased blood pressure and blood flow (among other factors) that accompany alcohol intoxication, whereas the MSG is not. Of course, these extraneous physiological influences would also exist to a lesser degree, in the 'no alcohol' condition and therefore led to the weak correlations.

It is noted that the average MSG readings produced a curve that slopes positively as a function of time, and is of a single period. Contrastingly, the average bioimpedance curve is of lower amplitude, begins with a negative slope, and is somewhat cyclic (see Appendix B). Hence, it is clear that additional research is needed to determine exactly what is being measured through penile bioimpedance, as it is decidely more complex than what is being measured through the MSG.

(2) Offender type differences and experimental effects were tested using a change score based on the difference between baseline arousal 15 seconds after narrative stimulus onset and peak arousal during the narrative presentation. It was found that, contrary to expectation, nonrapists became significantly more aroused than rapists. However, this difference was caused by a few nonrapists who evidenced unusually high arousability, irrespective of the experimental condition.

The finding that rapists' arousal actually increased under the influence of alcohol, while nonrapists' arousal decreased, could prove important. The high prevalence of alcohol intoxication at the time of offense for the total sample suggests that alcohol increases the approach behaviour related to the commission of a sexual offense. Yet the concomitant decreased capacity of physiological arousal may be lacking for rapists in which case completion of the offense would more likely.

To control for the influence of the several highly arousable nonrapists on their respective group means, additional analyses of variance were performed using ratio scores for rape (rape÷mutually consented) and assault (nonsexual assault÷mutually consented) indices, and difference scores for rape (rape-mutually consented) and assault (nonsexual assault-mutually consented) subtraction scores. The results were comparable to those obtained using base-to-peak scores, yet most were nonsignificant.

Notwithstanding this, a significant result was obtained with the MSG rape subtraction scores, whereby rapists' arousal increased and nonrapists' arousal decreased under instructions to suppress arousal. This finding illustrates the importance of cognitive elements in deviant arousal in that it appears rapists either lack the ability to control arousal in rape situations (as presented in audiotaped scenarios), or the message to suppress arousal actually becomes an arousal signal in rape situations. This latter interpretation holds interesting implications for the use of behaviour modification to treat deviant sexual arousal.

(3) Participants were able to self-report their arousal quite accurately. Correlations between self-reported and machine-recorded arousal were typically in the $\underline{r}$=.60 to .70 range. Interestingly, perceptions of arousal did not decrease in accuracy under the influence of alcohol. In all, the participants appear to have been quite aware of their actual arousal and were cooperative in accurately reporting it.

(4) The multiple regression analyses revealed that between 66% and 85% of the variance of both bioimpedance and MSG measured arousal could be accounted for by age and hormonal variables.

However, several odd results emerged within the multiple regressions, such as testosterone correlating negatively with arousal. On further examination, it was found that part of the problem resided in the base-to-peak scores themselves and it was concluded that the multiple regressions were unreliable.

(5) To test for the proposed influence of cognitive factors, intelligence scores (WAIS) were obtained for the subjects. The offender groups were subdivided according to higher and lower intelligence groups (median split, WAIS Full Scale IQ of 91), and the intelligence grouping was used as an additional factor in the model.

In partial confirmation of what has been suggested elsewhere, it was found that only the low IQ rapists' rape subtraction scores increased under instructions to suppress arousal; other groups' arousal diminished. In other results, the alcohol-by-offender type interaction noted earlier was found to be attributable to the low IQ rapists, in that their arousal increased while under the influence of alcohol, whereas the other groups' arousal decreased--nonrapists' arousal still decreased more that that of the remaining rapist group. Also, it was found that low IQ rapists displayed the highest arousal to the rape stimulus whereas the high IQ rapists displayed their highest arousal to the mutually consenting sex narrative. This result has the interesting implication that rape, as presented in this scenario-laboratory manner, is more stimulating to only a subset of rapists. Lastly, the intelligence scores themselves were unrelated to average arousal, age, and the biochemical data, except in the case of FSH, where strong negative correlations were found.

In the final section of the paper the problems encountered in the study were discussed, in particular that of the baseline reading. In addition, avenues for future research were proposed, based upon the current findings.

A formal literature review is not included in this paper. Those who are interested in the research pertaining to the measurement of deviant sexual arousal and related issues are referred to a previously circulated User Report (Wormith, 1985).

Two Psychophysiological Measures of Deviant Sexual Arousal and their Relationship to Instructions, Intelligence, Hormone Level and Alcohol Ingestion

Method

Subjects

Subjects were male inpatients of the Sexual Behaviour Clinic of the Royal Ottawa Hospital, a community psychiatric hospital. The clinic is operated by the hospital's Forensic Services and accepts sex offenders referred by court, parole board, and the provincial and federal correctional systems. Subjects in the present study were 23 successive first admissions to the Sexual Behaviour Clinic who gave their informed consent to participate in the research.

Subjects had an average age of 31.13 (SD=12.48) years. Their diagnoses included the following: 13 rapists, 4 heterosexual pedophiles, 3 homosexual pedophiles, 3 exhibitionists, and one sexual sadist. Two subjects were charged with murder, 4 with rape, 1 with murder and rape, 12 with aggravated sexual assault or attempted rape, 3 with indecent exposure, and 1 with arson.

Subjects were assigned to Offender Type groups based on their charge and clinical history. A Rapist group (*N*=13) consisted of rapists and sexually aggressive offenders. The nonrapist group (*N*=7) was comprised of other paraphiliac offender types of a nonviolent nature.

Apparatus and Procedure

Subjects were brought to a laboratory for testing on two separate occasions approximately one week apart. They were seated alone in a soundproof room where they were presented audiotaped scenarios through a speaker. There was an inter-stimulus interval of one minute or return to baseline, whichever was longer, following each audio presentation.

Penile circumference was measured by a mercury-in-rubber strain guage (MSG), with recordings in millivolts taken from a voltmeter every 15 seconds. Penile response was measured simultaneously by electrodes attached to the penis which recorded the electrical resistance or bioimpedance of the penile skin in ohms per second (Miller and Horvath, 1978; Bradford, in press), by means of a bioimpedance analyzer (BioMed Medical Manufacturing). Subjects were also asked to report their perceived sexual arousal according to a five-point scale (0, not aroused, 5, highly aroused).

Assessments were made by psychiatrists on admission to the hospital. One evaluation was made according to the Ottawa Forensic Psychiatric Questionnaire Form One (Bradford, Adams and Lynch, 1979), which takes into account social, criminal, medical and psychiatric history. A second evaluation was made according to the Diagnostic and Statistical Manual of Mental Disorders, 2nd Ed. (American Psychiatric Association, 1968). It is noted that in the diagnosis of a particular type of paraphilia, plethysmography may be used as a subsidiary component of the assessment--it is never used in isolation. Arousal assessments were conducted after intake psychiatric evaluation. Blood-hormone level assessments were made by medical laboratory staff.

Design

Two groups of subjects, Rapists and Nonrapists, received the audiotape scenarios on four occasions in a 2-by-2 factorial design, the within-subjects factors being Instructions and Alcohol Level.

Two separate sets of instructions (arouse, suppress) were given on alternate presentations of a stimulus. The specific instructions were,

Arouse instructions:

> "You are about to hear a series of audiotape descriptions, each lasting about 2 minutes. There's nothing for you to do except listen to each tape, relax and move as little as possible. During the pause after each tape is over, mark down the way you feel on the paper you've been given."

Suppress instructions:

> "For the next series of tapes, continue to listen to them as you have been doing, but from now on, try to suppress your sexual arousal. Use whatever mental means you wish to prevent yourself from feeling any sexual excitement. Continue to circle your responses on the paper."

Each subject was first presented the audiotapes without ethanol alcohol (clear condition), and then returned to the laboratory for an assessment while under the influence of ethanol (drink condition). In the drink condition, subjects were give successive .4 ounce oral doses of ethanol (vodka) mixed with orange juice, until blood alcohol levels reached the .08 level--the level at which one is declared intoxicated by law in Ontario. Blood alcohol levels were measured both before initial stimulus presentations and in the pauses between subsequent stimulus presentations, to check if the .08 level was maintained. Those whose blood alcohol levels were dropping would be given additional alcoholic drinks. Blood alcohol levels were measured by means of breath tests (Smith & Wesson Breathalyzer Model 900A).

The order of stimulus presentation and conditions was not counterbalanced as all subjects proceeded through the experiment in the same manner. The progression was clear-arouse, clear-suppress, drink-arouse, and drink-suppress.

Stimuli

The current study is based primarily on responses to a set of three audiotaped narrations, each 150 seconds in length. Twenty out of 23 subjects were presented this 'rape tape' which consisted of three naratives that depicted rape, mutually consenting sex and assault (nonsexual) encounters (Abel, Becker, Murphy & flanagan, 1981). Eight subjects were presented various combinations of 17 other narratives comprising 2 sets, depending on their clinical condition. These tapes included homosexual pedophilia (9 scenarios depicting homo- and heterosexual sex with children and adults) and heterosexual pedophilia (8 scenarios depicting heterosexual sex with children and adults). Data from these pedophilia tapes were used for clinical purposes and in the calculation of subjects' mean correlations between bioimpedance and MSG measures.

Treatment of Data and Analyses

Bioimpedance and the MSG recordings were taken simultaneously at the end of 15 second intervals for each stimulus. Thus, for each 150 second narrative, 10 simultaneous MSG and bioimpedance values were recorded. Self-reported arousal was recorded at the end of each narrative. For MSG, the first value (taken 15 seconds into the narration) was subtracted from the largest penile response elicited by each narration. In the case of bioimpedance, the smallest electrical resistance reading was subtracted from the first reading taken within each stimulus presentation. This was done since electrical skin resistance decreases with arousal as blood flow increases. For both MSG and bioimpedance these were called "base-to-peak" scores. Lastly, for each narrative and dependent variable the minimum value of the 10 readings was subtracted from the maximum value of the 10. These were called "maximum-minus-minimum scores". Hence, for each narrative there was one base to peak and one maximum-minus-minimum score for each of MSG and bioimpedance, as well as one self-reported arousal score.

The first set of analyses compared rapists (rapists and sexual assaultists) against nonrapists (pedophiles and exhibitionists) on age of admission to hospital, marital status, presence of intoxicants at time of offense, substance abuse as defined by DSM2 categories (303. and 304., APA, 1968), blood alcohol levels during the drink conditions of the experiment, and testosterone, luteinizing hormone (LH), follicle stimulating hormone (FSH) and prolactin levels.

The second set of analyses tested the relationship between MSG and bioimpedance. First, zero-order correlations were calculated for each set of 10 simultaneous MSG and bioimpedance measures. Means of the resulting 439 correlations were then calculated according to subject, experimental condition, and narrative stimulus. Base-to-peak and maximum-minus-minimum MSG with bioimpedance Correlations were obtained according to subject and experimental conditions.

A third set of analyses comprised between-subjects, repeated measures analyses of variance (ANOVA). These analyses were based on responses to the rape audiotape series since it was the only one the majority of subjects had heard (N=20; 13 rapists, 7 nonrapists). The remaining 3 subjects were assessed only on the pedophile tapes. The resultant design was 2 (offender types) by 3 (narrative stimuli) by 2 (alcohol conditions) by 2 (instructions). Separate ANOVA's were computed using MSG and bioimpedance base-to-peak scores as dependent variables. ANOVA's using maximum-minus-minumum scores were not performed since these values were similar to base-to-peak scores.

The fourth set of analyses tested the relationship between self-reported and machine-recorded physiological arousal. Zero-order correlations were computed according to subject, experimental conditions and narrative stimulus. Base-to-peak scores for both MSG and bioimpedance were the arousal measures used.

The fifth set of analyses comprised multiple correlations of age and hormone levels with average base-to-peak arousal across all conditions. An additional multiple regression using the above mentioned variables and blood alcohol level was performed using average base-to-peak arousal for the "with alcohol" conditions. Since the sample size was insufficient to conduct multiple correlations for both offender types, results pertain to the total sample.

Results

Age. The mean age of rapists was 26.08 (SD=6.40) years. This was significantly lower than the 37.7 (SD=15.35) year mean for nonrapists (F (1,21) =6.02, p<.05). Age was also found to be inversely correlated with average MSG measured arousal using base-to-peak scores (total sample r=-.30, p<.05). Therefore, additional analyses of covariance were performed controlling for the effects of age (ANCOVA). This had the effect of adjusting upwards the arousal scores of the nonrapists. It is noted that age was not significantly correlated with bioimpedance measured arousal (total sample r=-.13, ns.).

Marital Status. Rapists did not differ from nonrapists in terms of marital status (X^2 (2) =.97, ns.), although the proportion of rapists who were single was larger than the proportion of single nonrapists (69.2% versus 50.0%). In all, 60.9% of the sample were single, 21.7% were married or currently living in a common-law situation, and 17.4% were separated, divorced or widowed.

Presence of Intoxicants at Time Of Offense. Groups did not significantly differ on this variable (X^2 (3) =1.07, ns.), but it is important to note that of the 20 subjects for which this information was available, only 2 were not under the influence of an intoxicant at the time of the offense. Sixteen (8 rapists, 8 nonrapists) were under the influence of alcohol, and two were under the influence of other intoxicants.

Substance Abuse (DSM2 303. and 304.). The two offender groups did not differ significantly (X^2 (3) =2.65, ns.). However, a high proportion of alcohol abuse characterized these sex offenders. Six subjects (3 rapists, 3 nonrapists) were diagnosed as being episodic excessive drinkers (303.0, APA, 1968), six subjects (2 rapists, 4 nonrapists) were diagnosed as being habitual drinkers (303.1, APA, 1968), and three (2 rapists, 1 nonrapist) were listed as alcohol addicts (303.2, APA, 1968). Thus, 15 of 23, or 65.2% of the sample have serious alcoholism problems.

An additional two subjects had drug and/or other stimulant abuse problems, one with solvents (304.5, APA, 1968), and a second with hallucinogens and cocaine (304.4 and 304.7, APA, 1968). In total, 74% of the sample were diagnosed as having substance abuse problems.

Blood Alcohol Levels. The average blood alcohol level for rapists was .080 (SD=.020), and for nonrapists was .098 (SD=.028), in the drink condition of the experiment. This difference was nonsignificant (*F* (1,19) =3.90, ns.).

Hormone Levels. The offender groups did not differ in terms of testosterone levels (*M*=27.81, SD=5.30 Moles/litre blood), LH levels (*M*=13.21, SD=4.66 IU/litre blood), and FSH levels (*M*=9.68, SD=4.29 IU/litre blood). However, the groups did differ in terms of prolactin levels (rapist *M*=10.17, SD=5.34 UG/litre blood; nonrapist *M*=19.52, SD=11.93; *F* (1,15) =4.74, p .05). Since prolactin was found to be positively correlated with average MSG base-to-peak arousal (*r*=.455, p .05), it was used as a second variate to be controlled for in the ANCOVA. This would have the effect of adjusting downwards the arousal scores of the nonrapists. It is noted that prolactin was not significantly correlated with average bioimpedance base-to-peak scores (*r*=.087, ns.).

Table 1

Mean Correlations Between Simultaneous MSG and Bioimpedance Recordings of Sexual Arousal (N=10), Presented by Subject and Experimental Condition.

Subject Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	n	12	3	11	9	11	3	8	3	8	3	3	3	3	20	3	11	3	3	3	3	3	3	3
Clear Arouse	*r*	-10		34		-83		-37	-43	-06	-65	-23	-35	-91	-22			-14	-23	-44		-72	16	-59
Clear Suppress	*r*	-31		43		-34		-33	-12	12	00	-24	-23	-90	-31			-09	-27	-44		-24	-46	-50
Drink Arouse	*r*	13	13	-53	-35	-59	-03	07	18	25	-75	-43	-45	-21	-25	69	-01	-15	61		05	-01	-15	30
Drink Suppress	*r*	-01	62	-51	-24	-27	-03	26	-16	25	-81	-63	-75	-28	-35	-11	-35	09	21		42	-38	29	13
Per Subject Overall	*n*	47	6	44	18	37	6	28	12	29	12	12	12	12	66	6	22	12	12	6	6	12	12	12
	r	-08	38	-07	-30	-50	-03	-14	-13	13	-55	-38	-44	-58	-28	29	-18	-07	08	-44	24	-34	-19	-17

n = number of stimulus presentations.
Overall *r*=-.19, *n*=439. Clear Arouse *r*=-.26, *n*=97. Clear Suppress *r*=-.18, *n*=87. Drink Arouse *r*=-.14, *n*=129.
Drink Suppress *r*=-.19, *n*=126.

Mercury Strain Guage (MSG) to Bioimpedance Correlations

Tables 1 and 2 present the mean correlations of the sets of 10 simultaneous readings for MSG with bioimpedance. In Table 1 mean correlations are presented by subject and conditions (alcohol, instructions). Table 2 lists mean correlations according to the 20 narrative presentations (3+9+8) and four conditions (2 alcohol by 2 instructions).

On inspecting Tables 1 and 2, it is found that a high degree of variability exists. Nonetheless, an overall mean correlation of $r=-.19$ ($n=473$, $p<.001$) was produced, which indicates a small relationship in the expected direction, as bioimpedance (electrical skin resistance) should decrease as penile circumference increases.

An interesting result which emerged is that the "no" alcohol conditions (clear-arouse, clear-suppress) have a smaller proportion of mean correlations which are positive than the "drink" conditions (drink-arouse, drink-suppress), among both subjects, as in Table 1, and narrative stimuli, as in Table 2. In the clear conditions, from 12% to 20% of the mean correlations are in the unexpected positive direction, whereas in the drink conditions from 14% to 36% are positive. Since MSG simply reflects a mechanical change in the penis during arousal (circumference), it is unlikely that the alcohol could introduce an actual alteration in the measurement of arousal. However, since bioimpedance is an electrical measure, it may be that

Table 2

Mean Correlations Between MSG and Biompedance Recordings of Sexual Arousal (N=10), Presented by Stimulus and Experimental Condition.

		Rape Tape			Homosexual Pedophile Tape									Heterosexual Pedophile Tape							
Audiotape		11	12	13	21	22	23	24	25	26	27	28	29	31	32	33	34	35	36	37	38
Clear Arouse	r	-45	-47	-30	-68	-03	-06	-23	30	-68	-22	-84	24	-23	-16	-04	06	-04	-18	-29	-06
	n	13	13	13	2	2	2	2	2	2	2	2	2	5	5	5	5	5	5	5	5
Clear Suppress	r	-25	-24	-22	-83	-29	-65	-54	-90	-84	-02	14	44	-01	-20	-05	17	10	-18	-47	-01
	n	13	13	13	1	1	1	1	1	1	1	1	1	5	5	5	5	5	5	5	4
Drink Arouse	r	-14	-22	12	04	17	33	50	-11	-16	07	-03	-74	-28	-33	-13	-64	-32	-22	11	-46
	n	19	19	19	3	3	3	3	3	3	3	2	3	6	6	6	6	6	6	5	5
Drink Suppress	r	-22	-24	-05	-20	-04	-09	-35	-09	-01	-49	03	-39	-36	-33	-34	-04	-36	-26	05	-29
	n	19	19	19	2	3	3	3	3	3	3	3	3	5	6	5	5	5	5	6	6

n = number of subjects.
Overall r=-.91, n=439. Clear-Arouse r=-.26, n=97. Clear-Suppress r=-.18, n=87. Drink-Arouse r=-.14, n=129.
Drink Suppress r=-.20, n=126.

alcohol carried in the blood to the penis produces different electrical changes during arousal than that experienced in nonalcohol situations, and even this effect is variable. Alternatively, alcohol causes several vascular changes to take place, such as blood pressure changes, which may not necessarily affect penile circumference, but would affect bioimpedance. Such phenomena may have caused greater variability in bioimpedance readings with respect to corresponding MSG readings, resulting in fewer inverse correlations for the "drink" conditions.

Tables 3 and 4 list correlations between MSG and bioimpedance base-to-peak and maximum-minus-minimum scores calculated according to conditions (alcohol, instructions) and subject.

It is found that the overall MSG with bioimpedance base-to-peak scores correlations is $\underline{r}=.23$ ($n=416$, $p<.001$), and the overall maximum-minus-minimum scores correlation is $\underline{r}=.35$ ($n=428$, $p<.001$). The difference in the $\underline{n}$'s between MSG and biompedance correlations is attributable to a small amount of missing data in biompedance recordings. Again, moderate relations are found, and much variability exists. However, in these correlations, the increased variability in correlations for the drink condition is not observed. Nonetheless, it may be noted that the clear-arouse condition has the largest proportion of correlations in the expected positive direction (85%). The three other conditions have approximately 30% of their

Table 3

Correlations Between MSG and Bioimpedance Base-to-Peak Score, Presented by Experimental Condition and Subject.

Subject Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Clear Arouse	r	53		-20		83		11	32	-14	64	57	99	99	36			99	-50	96		94	99	93
	n	12		11		11		8	3	8	3	3	3	3	20			3	3	3		3	3	3
Clear Suppress	r	66		-53		-26		85	-100	73	100		100	100	-03			70	98	-05		23	-20	40
	n	12		11		11		8	3	8	3		3	3	20			3	3	3		3	3	3
Drink Arouse	r	-07	99	73	-09	61	93	08	98	-40	98	03	68	87	61	-100	49	-100	100		92	73	-99	-59
	n	12	3	11	9	11	3	4	3	8	3	3	3	3	3	3	11	3	3		3	3	3	3
Drink Suppress	r	-13	-58	37	46	39	92	17	34	-80	37	-16	-16	-100	57	-46	36	31	-66		95	-87	76	-95
	n	12	3	11	9	11	3	4	3	8	3	3	3	3	3	3	11	3	3		3	3	3	3
Overall Per Subject	r	24	-24	01	06	37	90	17	51	27	66	-20	63	19	39	-72	44	31	59	12	79	28	48	29
	n	47	12	44	36	44	12	28	12	32	12	12	12	12	79	12	44	12	12	12	12	12	12	12

n= number of stimulus presentations (one MSG and one bioimpedance base-to-peak score calculated for each stimulus presentation).
Overall r=.23, n=418. Clear-Arouse r=.37. Clear-Suppress r=.18. Drink-Arouse r=.33. Drink-Suppress r=.11.

Table 4

Correlations Between MSG and Bioimpedance Maximum-minus-Minimum Score, Presented by Experimental Condition and Subject

Subject Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Clear Arouse	r	37		48		79		75	32	-02	77	-53	96	99	56			99	82	04		78	99	99
	n	12		11		11		8	3	8	3	3	3	3	20			3	3	3		3	3	3
Clear Suppress	r	60		-12		-07		74	85	72	20	-19	100	64	83			-45	97	-12		98	-99	-98
	n	12		11		11		8	3	8	3	3	3	3	20			3	3	3		3	3	3
Drink Arouse	r	08	07	51	-01	72	19	92	84	11	-73	99	02	99	40	100	39	-100	100		96	90	42	-76
	n	11	3	11	9	11	3	8	3	8	3	3	3	3	20	3	11	3	3		3	3	3	3
Drink Suppress	r	-22	93	31	16	66	97	-99	75	60	-15	-26	-52	-90	34	-59	88	-17	-95		99	42	60	55
	n	12	3	11	9	11	3	4	3	8	3	3	3	3	19	3	11	3	3		3	3	3	3
Overall Per Subject	r	16	30	26	07	64	83	71	78	30	57	-19	51	07	64	40	55	33	98	-05	83	35	15	-13
	n	47	12	44	36	44	12	28	12	32	12	12	12	12	79	12	44	12	12	12	12	12	12	12

n= number of stimulus presentations (one MSG and one bioimpedance maximum-minus-minimum score calculated for each stimulus presentation).
Overall r=.35, n=430. Clear-Arouse r=.50. Clear-Suppress r=.40. Drink-Arouse r=37. Drink-Suppress r=.22.

correlations in the unexpected negative direction. It would appear that the use of derived scores introduces a different type of variability than that found in the raw scores.

Analyses of Variance

Table 5 presents the means of individual subjects on all 4 derived arousal variables. Table 6 lists the derived arousal means that were used in the analyses of variance, presented by Offender Type (2), Stimulus (3), Alcohol (2) and Instructions (2). Table 7 summarizes the analysis of variance results for the full experimental design with MSG base-to-peak scores as the dependent variable. Table 8 does likewise, with bioimpedance base to peak scores are the dependent variable.

A complete least-squares model ANOVA (type III expected mean squares) was performed. This model was used since interactions did emerge, and type III expected mean squares control for all other effects when testing one specific effect within a factorial model (Freund and Littell, 1981).

Turning to Table 7, it is noted that there is no between-subjects main effect of Offender Type, despite the fact that Table 5 shows nonrapists to have much higher arousal. This result can be accounted for by the fact that within-group variability was so high. Notwithstanding this, the higher nonrapist means are an odd result considering that the narrative stimuli concerned rape, mutually consenting adult sex and nonsexual assault, and not situations of pedophilia, which should

Table 5

Mean[1] Arousal Response Presented by Subject and Type of Arousal Measure

Subject Number	Age	Subject Type	MSG Base-to-Peak	MSG Max-Min	Bioimped. Base-to-Peak	Bioimped. Max-Min
1	22	Nonrapist	39.091	39.290	.428	2.212
2	34	Rapist	.688	1.236	.405	.612
3	18	Nonrapist	42.010	42.072	1.578	2.346
5	35	Rapist	22.859	24.268	.948	1.502
6	18	Rapist	18.629	18.701	.987	5.335
8	25	Rapist	4.376	4.918	.783	1.011
10	30	Rapist	3.278	3.620	1.031	1.433
11	37	Nonrapist	.688	1.239	.990	1.041
12	35	Rapist	1.582	3.078	1.668	2.391
13	70	Nonrapist	.651	1.585	1.613	2.268
14	47	Nonrapist	3.217	3.889	.968	1.027
15	22	Rapist	.327	.875	1.048	2.428
16	27	Rapist	4.345	4.783	.555	1.018
17	25	Rapist	3.251	3.947	1.284	1.575
18	34	Nonrapist	.823	1.786	.833	1.935
19	22	Nonrapist	.453	1.022	.652	1.200
20	18	Rapist	9.250	11.354	2.583	3.000
21	21	Rapist	.562	.815	1.338	2.433
22	37	Rapist	2.889	2.251	1.241	3.148
23	22	Rapist	.618	1.578	.392	.768

Average Arousal Across all Conditions

	MSG Base-to-Peak	MSG Max-Min	Bioimped. Base-to-Peak	Bioimped. Max-Min
Rapist (n=13)	5.589	6.332	1.107	1.889
Nonrapist (n=7)	12.419	12.983	1.039	1.817

Mercury Strain Guage=millivolts,
Bioimpedance=ohms/second.

1. Arousal response averaged over 3 Rape Tape Simuli.

Table 6

Mean Arousal Response for Rapists and Nonrapists Presented by Stimulus Experimental Condition, and Type of Arousal measure

Offender Type	Tape	Alcohol	Instructions	MSG Base-to-Peak	MSG Max-Min	Bioimped. Base-to-Peak	Bioimped. Max-Min
Rapist	11	Clear	Arouse	4.687	5.438	.860	1.466
			Suppress	9.053	9.355	1.247	1.928
		Drink	Arouse	7.758	8.528	1.561	2.229
			Suppress	10.299	10.800	1.501	3.048
	12	Clear	Arouse	6.052	6.415	1.960	2.150
			Suppress	4.961	5.418	1.280	1.534
		Drink	Arouse	8.101	9.550	1.091	1.712
			Suppress	5.046	5.728	1.073	1.888
	13	Clear	Arouse	2.962	3.662	.551	1.277
			Suppress	3.906	4.720	.896	1.597
		Drink	Arouse	2.715	3.689	.458	1.473
			Suppress	1.526	2.685	.986	1.902
Nonrapist	11	Clear	Arouse	15.901	16.293	1.495	2.038
			Suppress	15.761	16.138	1.000	1.288
		Drink	Arouse	12.574	13.256	1.953	3.808
			Suppress	8.511	9.330	1.000	2.128
	12	Clear	Arouse	14.770	15.086	1.072	1.238
			Suppress	15.784	15.956	.660	1.370
		Drink	Arouse	10.504	11.387	.922	2.138
			Suppress	10.187	11.216	.897	2.247
	13	Clear	Arouse	13.611	14.086	.825	1.067
			Suppress	13.744	14.120	.580	1.372
		Drink	Arouse	8.637	9.136	1.025	1.490
			Suppress	9.037	9.726	.810	1.678

Mercury Strain Guage units=millivolts
Bioimpedance units=ohms per second

Tape 11=rape
12=mutually consented sex
13=nonsexual assault

Table 7

Analysis of Mercury Strain Guage Base-to-Peak Sexual Arousal Scores by Offender Type, Audiotape (Stimulus), Alcohol and Instructions.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F value
Offender Type (OT)	2546.962	1	2546.962	1.34
Between SS Error	34152.742	18	1897.375	
Audiotape (A)	478.369	2	239.185	4.04*
Alcohol (E)	262.218	1	262.218	4.43*
Instructions (I)	.079	1	.079	.01
OT * A	95.755	2	47.878	.81
OT * E	436.907	1	436.907	7.37**
OT * I	11.430	1	11.430	.19
A * E	22.647	2	11.324	.18
A * I	21.863	2	10.932	.19
E * I	45.114	1	45.114	.76
OT * A * E	35.756	2	17.878	.30
OT * A * I	156.350	2	78.175	1.32
OT * E * I	.331	1	.331	.01
A * E * I	8.770	2	4.385	.07
OT * A * E * I	11.681	2	5.841	.10
Within SS Error	11731.833	198	59.252	

*p<.05

**p<.01

be even more stimulating to the nonrapists. However, a glance at Table 5 shows that the large differential can largely be accounted for by subjects 1 and 3, nonrapists who displayed inordinately high arousal across all situations. Subjects 5 and 6, rapists, also had very high arousal scores, but they were only 14% of the rapist sample. Hence their effect on the means of the whole rapist group was minimal. Conversely, the highly aroused nonrapists comprised 29% ($^2/_7$) of the membership of their respective group. Hence their effect on the group means was much greater. Disregarding these fewer subjects, mean MSG base-to-peak arousal scores would have been 1.67 and 2.83 for nonrapists and rapists, respectively.

A significant within-subjects main effect emerged for narrative-stimuli. In this case, MSG base-to-peak arousal means for the rape and mutually consented narratives were not significantly different from each other (M=9.78 and 8.41, respectively), but were significantly different from the nonsexual assault segment (M=5.75). Since there was not an Audiotape-by-Offender Type intraction, it appears that the sexually-oriented narratives were more stimulating for both offender groups.

A second significant within-subjects main effect was observed for alcohol. Arousal scores were significantly higher in the nonalcohol condition (M=8.65) than in the alcohol condition (M=7.31).

The final significant result which emerged from the analysis of variance, summarized in Table 7, was an interactive effect for Offender Type and Alcohol. Figure 1 graphically illustrates this result. The arousal of rapists, although tending to be lower overall, did not decrease while under the influence of alcohol, whereas nonrapists' arousal did decrease upon alcohol injestion. This is contrary to what may be expected since ethanol is a depressant. Therefore, arousal should be reduced under its influence, as is the case for nonrapists. Taking this result together with the high prevalence of alcohol intoxication at the time of the offense for both groups makes for compelling speculation: alcohol may have a disinhibiting effect on both rapists and nonrapists as far as approach behaviour toward committing the offense is concerned, yet it does not have the concommittant sexual arousal depressing effect on rapists, which would thus lead to a following through with the offense.

In view of the Offender Type-by-Alcohol interaction, it becomes apparent that the significant Alcohol main effect, noted previously, can be attributed to the nonrapists. Specifically, nonrapists arousal scores were so much higher than those of rapists that the scores of rapists were overshadowed in the alcohol analysis. In other words, the alcohol main effect primarily reflects the differences in the nonrapists' arousal from clear to drink conditions.

Figure 1

Penile Circumference Change for Rapists and Nonrapists as a Function of Stimulus Presentation and Alcohol Condition.

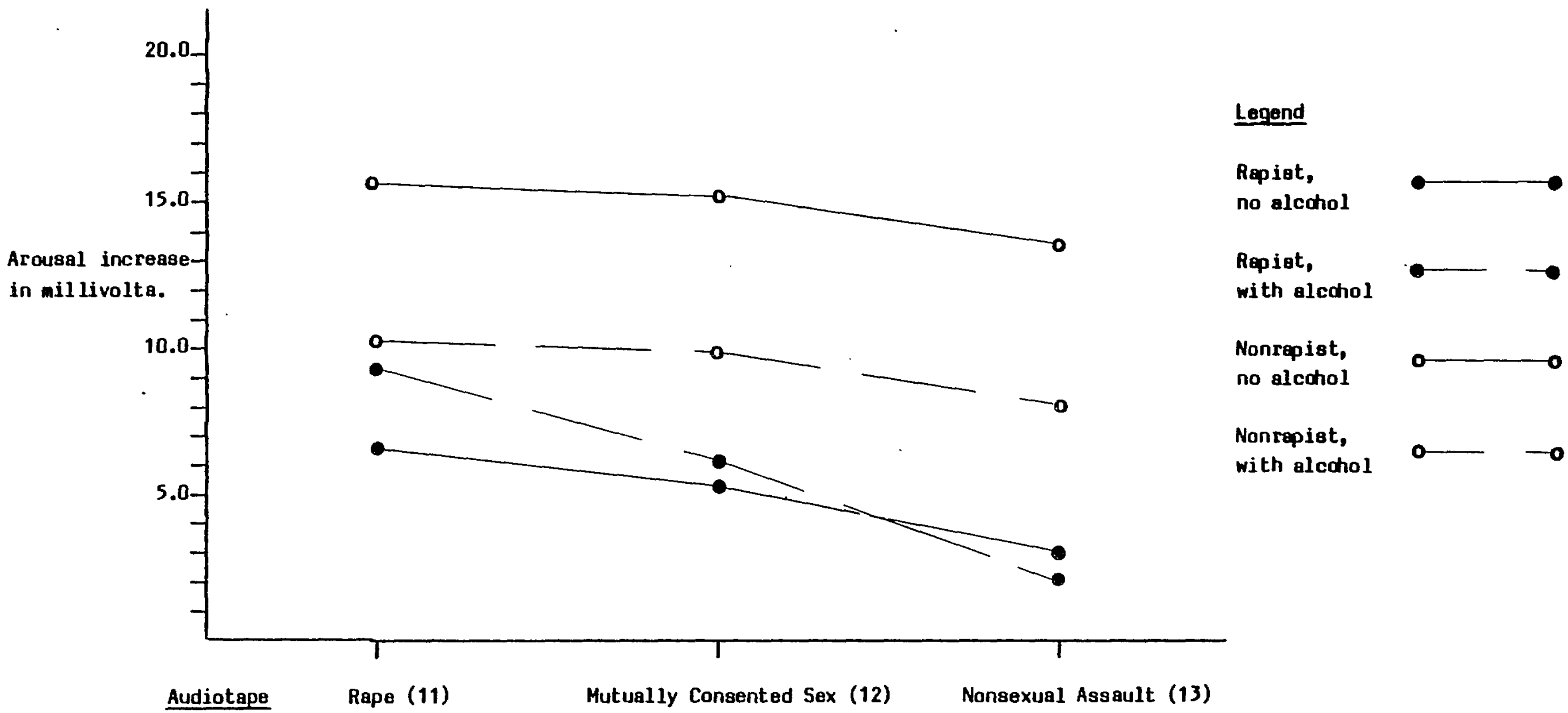


Table 8

Analysis of Bioimpedance Base-to-Peak Sexual Arousal Scores by Offender Type, Audiotape (Stimulus), Alcohol and Instructions.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F value
Offender Type (OT)	.572	1	.572	.25
Between SS Error	41.161	18	2.287	
Audiotape (A)	7.774	2	3.887	3.77*
Alcohol (E)	.036	1	.036	.04
Instructions (I)	.703	1	.703	.68
OT * A	3.111	2	1.556	1.51
OT * E	.254	1	.254	.25
OT * I	1.831	1	1.831	1.78
A * E	2.364	2	1.182	.68
A * I	1.398	2	.699	1.15
E * I	.037	1	.037	.04
OT * A * E	.927	2	.464	.45
OT * A * I	2.039	2	1.020	.99
OT * E * I	.041	1	.041	.04
A * E * I	1.890	2	.945	.92
OT * A * E * I	.074	2	.037	.04
Within SS Error	142.270	138	1.031	

*$p < .05$

**$p < .01$

Table 8 summarizes the analysis of variance results with bioimpedance base-to-peak scores as the dependent variable. As can be seen, the lower variability of bioimpedance scores (see Tables 5 and 6) resulted in fewer significant results. The high MSG arousal scores evidenced for subjects 1, 3, 5 and 6 were not reflected in bioimpedance scores, and this likely accounts for the absence of a significant Offender Type main effect. Similarly, an Offender Type-by-Alcohol interaction did not emerge, possibly for the above noted reason and the earlier speculation that alcohol may have a random effect, or undocumented differential effect, on electrical skin resistance during arousal. Figure 2 illustrates the nonsignificant Offender Type-by-Alcohol interaction.

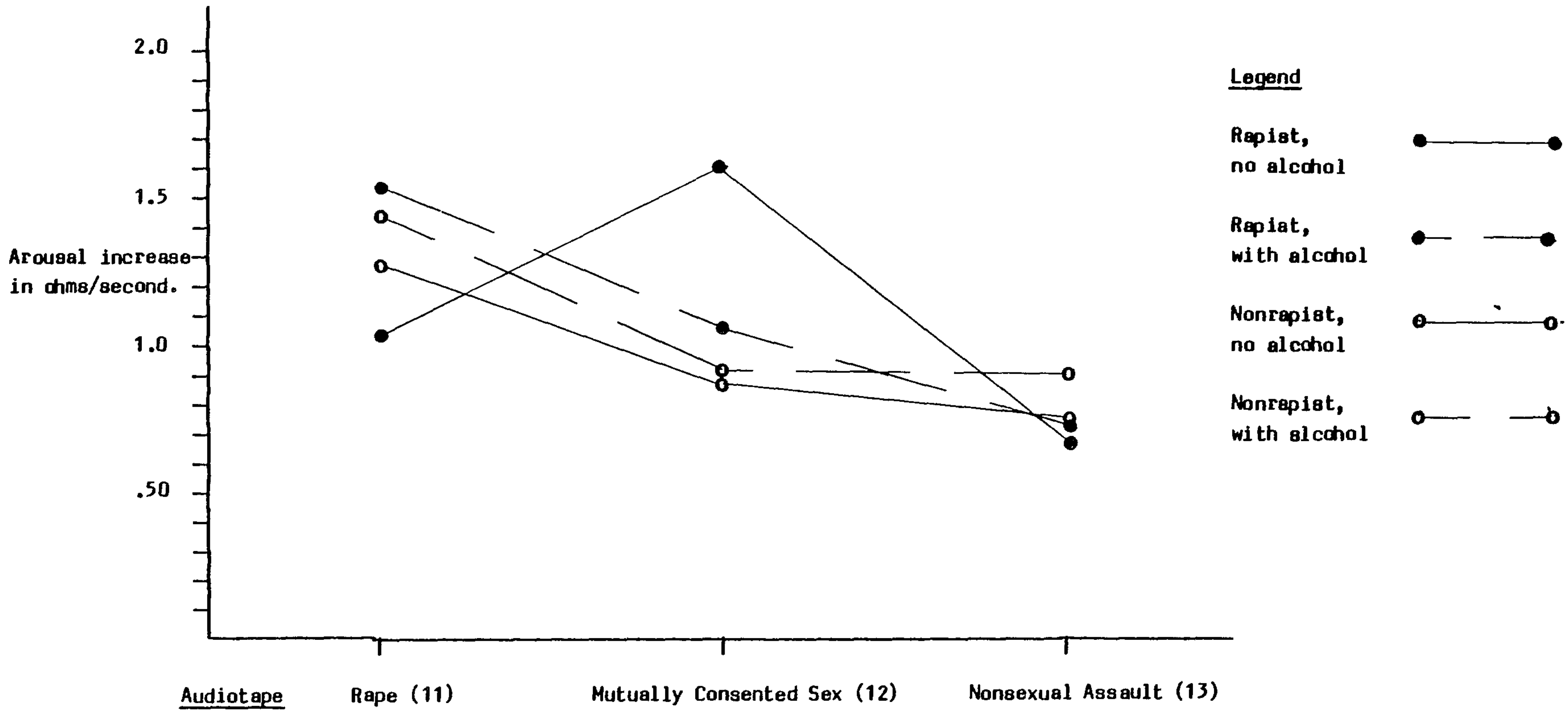
The only significant result from Table 8 was a main effect for Stimulus Type. In this, the rape and mutually consenting segments ($\underline{M}$=1.36 and 1.13, respectively) produced readings significantly different from the assault segment ($\underline{M}$=.76). This result is consistent with the previously noted MSG differences for Stimulus Type, where the sexually-oriented narratives, regardless of violence level, produced the largest arousal scores.

<u>Analyses of Covariance</u> (ANCOVA)

Since the offender groups were found to differ significantly with respect to age and prolactin level, since

Figure 2

Penile Electrical Skin Resistance Change for Rapists and Nonrapists as a Function of Stimulus Presentation and Alcohol Condition.



age was inversely related to arousal, and since prolactin was positively correlated with arousal, the analyses of variance were repeated, this time controlling for the effects of age and prolactin level (n=13 in these analyses due to missing data on prolactin). The results, which are presented in Tables 9 and 10, are similar to those in Tables 7 and 8, with the one additional difference, a significant main effect for Offender Type, using MSG scores. The finding of a significant Offender Type main effect in the ANCOVA indicates that the decreased difference in mean scores through prolactin level was less than the increased difference in mean scores through age. Offender type differences on bioimpedance were largely unaffected by the controls.

Rape Index and Assault Index Analysis

As noted previously, the high level of arousability among certain subjects (i.e S no. 1, 3, 5 and 6) that occurred accross stimuli and experimental conditions proved to be problematic. They alone accounted for the arousal differential between groups. Because of this fact, all previously reported between-group comparisons must be interpreted cautiously. However, in an attempt to control for this nonspecific arousability, the analyses of variance were rerun using ratio scores instead of responses to each stimulus category.

First, a rape index was calculated by dividing the score for the rape narrative by the score for the consenting sex narrative. Second, a nonsexual assault index was calculated by dividing the response to the assault narrative by the consenting

Table 9

Analysis of Mercury Strain Guage Base-to-Peak Sexual Arousal Scores by Offender Type, Audiotape (Stimulus), Alcohol and Instructions Controlling for Age and Prolactin Levels.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F value
Offender Type (OT)	6652.420	1	6652.420	4.31*
Between SS Error	17005.030	11	1545.912	
Audiotape (A)	243.973	2	121.987	3.42*
Alcohol (E)	614.029	1	614.029	17.19***
Instructions (I)	16.478	1	16.478	.46
OT * A	93.700	2	46.850	1.31
OT * E	417.919	1	417.919	11.70***
OT * I	.465	1	.465	.01
A * E	5.628	2	2.814	.08
A * I	8.944	2	4.472	.13
E * I	29.309	1	29.309	.82
OT * A * E	5.167	2	2.584	.07
OT * A * I	42.851	2	21.426	.60
OT * E * I	3.721	1	3.721	.10
A * E * I	9.704	2	4.852	.14
OT * A * E * I	20.386	2	10.193	.29
Within SS Error	5106.744	143	35.711	

*$p<.05$

**$p<.01$

Table 10

Analysis of Bioimpedance Base-to-Peak Sexual Arousal Readings by Offender Type, Audiotape (Stimulus), Alcohol and Instructions Controlling for Age and Prolactin Levels.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F value
Offender Type (OT)	4.812	1	4.812	1.636
Between SS Error	32.349	11	2.941	
Audiotape (A)	7.572	2	3.786	3.65*
Alcohol (E)	.237	1	.237	.23
Instructions (I)	.369	1	.369	.36
OT * A	2.924	2	1.462	1.41
OT * E	1.647	1	1.647	1.59
OT * I	.733	1	.733	.71
A * E	.970	2	.485	.47
A * I	.958	2	.479	.46
E * I	.043	1	.043	.04
OT * A * E	1.691	2	.846	.81
OT * A * I	.696	2	.348	.33
OT * E * I	.018	1	.018	.02
A * E * I	2.550	2	1.275	1.23
OT * A * E * I	.573	2	.287	.28
Within SS Error	103.850	100	1.038	

*$p < .05$

**$p < .01$

sex narrative response (Abel, Barlow, Blanchard and Guild, 1977). It is noted that the ratios were derived using maximum-minus-minimum and not base-to-peak scores. This was done since some of the base-to-peak scores were zero (meaning the base reading yielded the highest arousal value) which consequently produced a rape index of zero.[1]

The analyses of variance using ratios did not produce any significant main effects for Offender Type. This was expected since the effect of the aforementioned subjects' scores would be controlled. Aside from this, several points are worthy of mention.

First, rapists evidenced a higher rape index than nonrapists (MSG, M=1.74 versus M=1.35; bioimpedance, M=1.98 versus M=1.45). Rapists also produced a higher assault index (MSG, M=1.18 versus M=.87; bioimpedence, M=1.20 versus M=.99), which is consistent given the relatively more violent nature of their crimes. Second, as seen in Figures 3 and 4, the rape indices were higher than the assault indices among both groups. This is consistant with the earlier finding that the sexually-oriented tapes (rape and mutual consent) were more stimulating than the nonsexually-oriented tape (nonsex assault).

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[1]Theoretically, a base-to-peak score should be a positive value since a 'true' baseline value would be the lowest level of arousal. In the present study, the first reading was taken 15 seconds into a narrative presentation, and was not always "neutral" in content. Although different investigators' definitions of baseline condition and value may differ, it is apparent that the baseline values used presently were less than ideal, hence the occasional base-to-peak score of zero occurred.

Figure 3, which concerns the MSG-derived indices, shows that rapists are proportionately more aroused to rape scenes when not under the influence of alcohol, but the inverse is true for nonrapists. Interestingly, when under the influence of alcohol, the rapists' rape index is quite similar to their assault index, which could mean that the violence aspect of rape is that which is most arousing to them when intoxicated. However, this cannot be said for the nonrapists, since their average assault index is considerably lower than that for rape when intoxicated. However, nonrapists appear to be aroused by rape scenarios when under the influence of alcohol.

It must be noted that the index results do not detract from the significant Offender Type-by-Alcohol interaction found in the base to peak scores' ANOVA. The indices can show if a given group is proportionately more aroused to rape and assault versus mutually consented sex, with or without alcohol. The indices cannot test if absolute base-to-peak arousal decreases or increases as a function of alcohol conditions, as the earlier analyses of variance did. It is also noted that no significant interactive effects emerged in the analyses involving the indices.

Figure 4, which concerns the bioimpedance-derived indices, shows rapists are proportionately more aroused to rape than consented sex when under the influence of alcohol then when they are clear of alcohol. This finding occurred because rapists evidenced inordinately high bioimpedance-measured arousal to the

Figure 3

Index of Penile Circumference Change for Rapists and Nonrapists as a Function of Stimulus Presentation and Alcohol Condition.

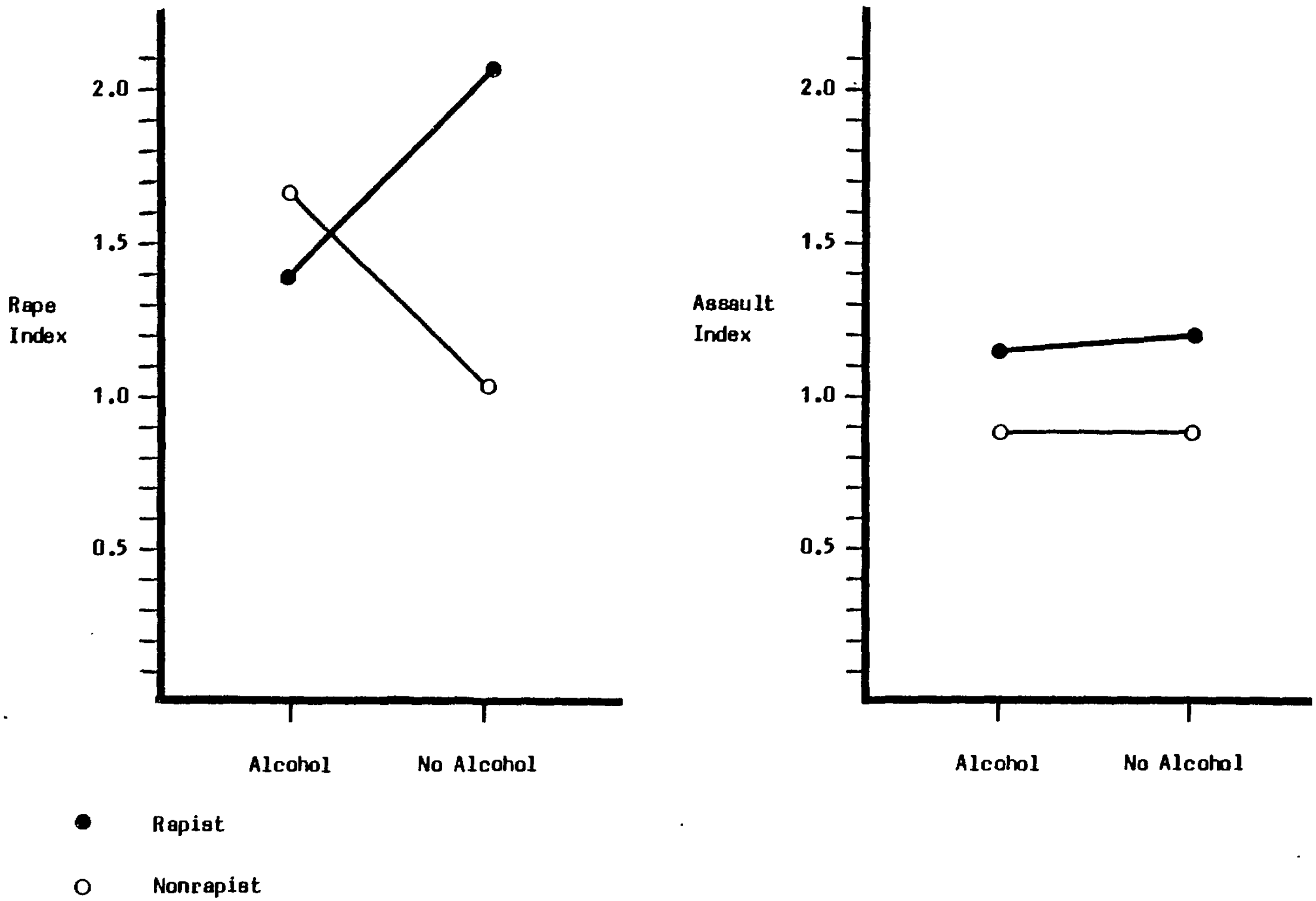
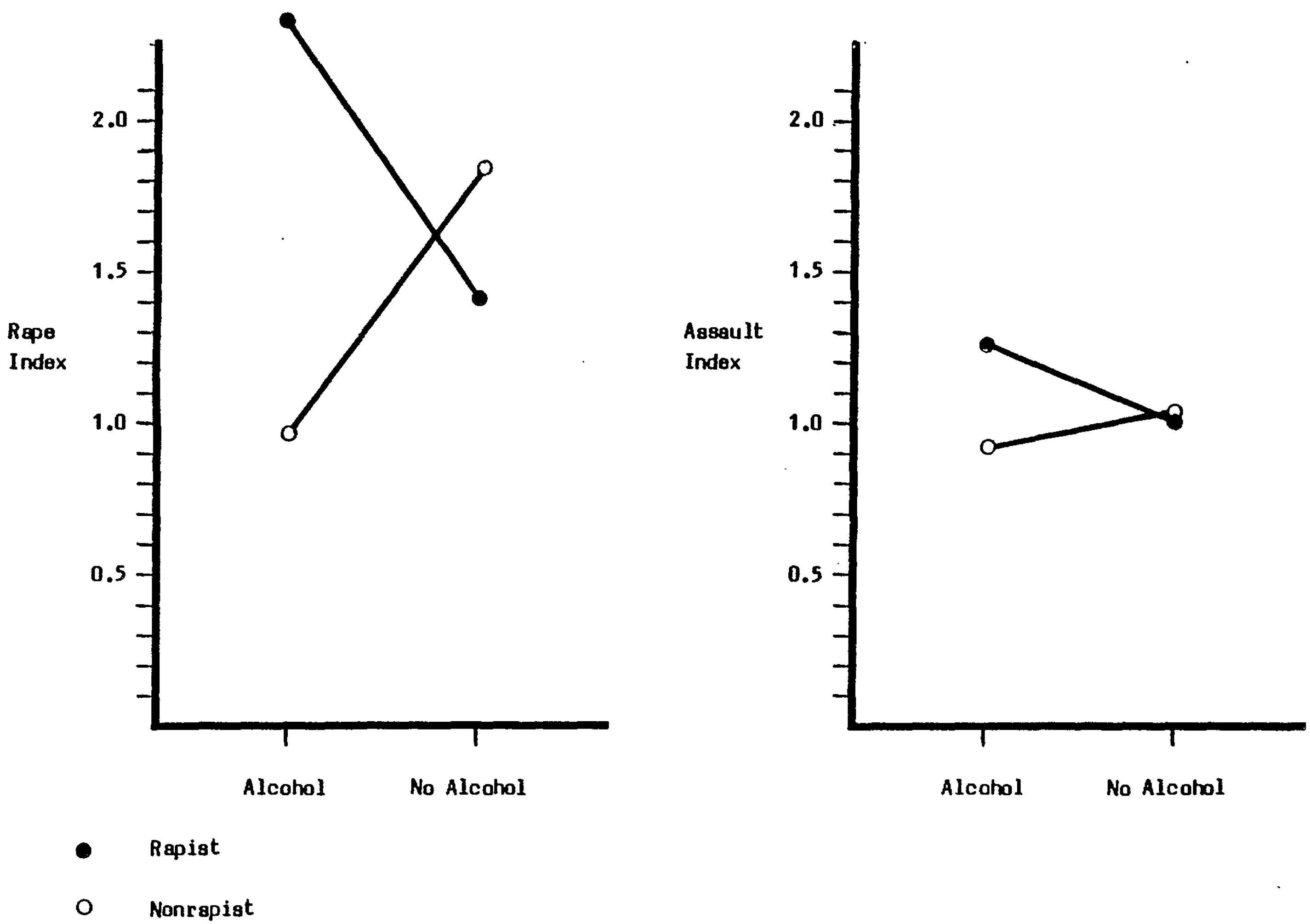


Figure 4

Index of Electrical Skin Resistance Change for Rapists and Nonrapists as a Function of Stimulus Presentation and Alcohol Condition.



consented Sex narrative in the "no alcohol" conditions, but not in the "with alcohol" conditions (see figure 2). Hence their rape and assault indices are quite low for "no alcohol". Given the variable effect that alcohol may have on bioimpedance readings, as noted earlier, this result is difficult to interpret with the data available.

Rape Subtraction and Assault Subtraction Score Analysis

In addition to the indices, a second derived variable was calculated, which is presently referred to as the "subtraction score". This was used as a second method by which to control for individual difference in levels of general sexual arousability. The use of this variable as opposed to indices has been reported by Quinsey (1982).

Briefly, the rape subtraction scores were calculated by subtracting the base-to-peak score for the mutually consenting narrative from the score for the rape narrative. The assault subtraction scores were calculated by subtracting the mutually consenting narrative response from the assault narrative base-to-peak scores.

The subtraction scores' ANOVA yielded several interesting results which were more consistent with the base-to-peak scores' ANOVA's than was the case with the indices.

First, rapists produced a higher rape subtraction score than nonrapists, for the MSG (rapist *M*=1.95, nonrapist *M*=.04). Although both negative, nonrapists displayed a higher MSG-derived assault subtraction score (*M*=-1.55, versus rapist *M*=-3.38). Consistent with earlier results (see Table 7), rapists evidenced a greater MSG rape subtraction score while under the influence of alcohol (*M*=2.56, versus *M*=1.36 no alcohol) than nonrapists, who were stable across alcohol conditions. Assault subtraction scores were also stable across alcohol conditions for both rapists and nonrapists. It is noted that all the above mentioned results, although consistent with expectation and earlier findings, were statistically nonsignificant.

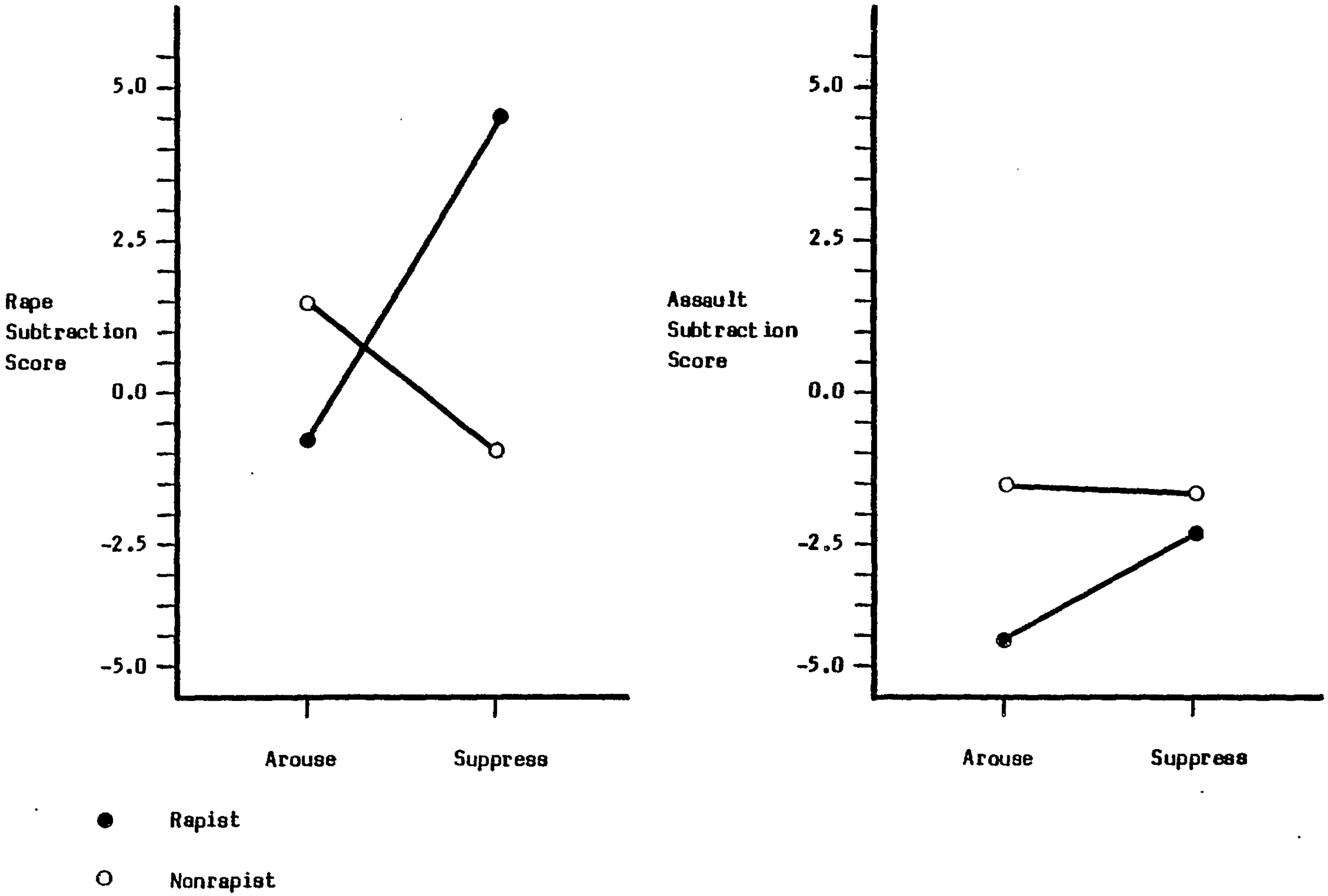
It is further noted that the bioimpedance subtraction scores were highly similar across offender types and conditions. The one notable bioimpedence result was an Offender Type-by-Alcohol interaction which bordered on significance. In this analysis, rapists evidenced higher rape subtraction scores while under the influence of alcohol, whereas nonrapists' rape subtraction scores were only slightly higher where alcohol was present (rapist-clear *M*=-.50, rapist-drink *M*=.40; nonrapist-clear *M*=.40, nonrapist-drink *M*=.46, $F_{1,17}=2.81$, $p<.10$). This finding is consistent with what emerged using bioimpedance base-to-peak score indices in the earlier analysis of variance. Again, the result is due to the rapists' unusually high average response to the mutually consenting narrative in the no alcohol conditions.

One result of particular interest was a significant (p .07) Offender Type-by-Instruction interaction, using MSG rape subtraction scores. As seen in the left side of Figure 5, rapists were more aroused when under instructions to suppress arousal. Conversely, nonrapists were able to somewhat suppress arousal when instructed to do so. One might hypothesize that this effect emerged because rapists were less conforming to experimental demands. Yet it also happens that rapists were able to control arousal more under other conditions, as indicated by their assault subtraction scores (right side of Figure 5). Therefore, these results suggest that rapists lack the cognitive skills to suppress arousal in a rape situation, or in circumstances which simulate a rape. Alternatively, it indicates that the message to suppress arousal actually becomes an arousal signal, but only in a rape context.

It was stated earlier that for rapists alcohol may have an influential effect regarding approach behaviour and completion of sexually aggressive acts. However, the present result indicates that there is also a cognitive element which is important, and given the lack of an Offender Type-by-Alcohol-by-Instructions interaction, it may be the cognitive element which is relatively more important. The above interpretation must be considered cautiously since the alcohol and instructions finding emerged

Figure 5

Subtraction Score of Penile Circumference Change for Rapists and Nonrapists as a Function of Stimulus Presentation and Instructions.



using two different dependent variables. Aside from this, the subtraction scores might be considered more reliable since they adjust for nonspecific arousability.

Self-Report and Machine-Recorded Arousal

Table 11 lists the zero-oder correlations of self-reported and physiologically recorded arousal, by individual subject. As was the case in the ANOVA, only data pertaining to the rape tape series were analyzed. From the table, a great range of correlations is apparent (MSG, -.42 to .87; bioimpedance, -.29 to .85) with the average correlations being for MSG and .23 for bioimpedance. Collapsing across subjects, the overall correlation for MSG was .65, and the group differences are slight (rapist, r=.61; nonrapist, r=.75). There are only 4 negative correlations for MSG base-to-peak arousal to self-report, and 3 others near zero.

Considering bioimpedance and self-reported arousal from Table 11, results are less consistent than for MSG and self-report. The overall correlation indicates little association between these two arousal measures (r=.09). In addition, rapists produced a low positive (r=.26) and nonrapists a low negative (r=-.13) result.

Table 12 again presents correlations of self-reported to machine-recorded arousal, this time according to offender type, stimulus and conditions. Considering the MSG findings, the results are remarkably consistent across Offender Type, Stimuli and Conditions. As was the case in Table 11, correlations tend

Table 11

Correlations of Self-Reported and Machine-Recorded Physiological Arousal, Presented by Subject Number and Subject Type.

Subject Number	Subject Type	Self-Report with MSG Base to Peak r	n[1]	Self-Report with Bioimped. Base to Peak r	n
1	Nonrapist	-.25	12	-.10	12
2	Rapist	.02	12	.80	6
3	Nonrapist	.01	12	.37	12
5	Rapist	.85	12	.78	6
6	Rapist	.78	12	.68	6
8	Rapist	.46	12	-.09	11
10	Rapist	.51	12	.34	11
11	Nonrapist	.40	12	-.13	10
12	Rapist	-.38	12	-.08	11
13	Nonrapist	.13	12	.39	10
14	Nonrapist	--	--	--	--
15	Rapist	.04	12	.11	5
16	Rapist	-.01	12	.11	4
17	Rapist	.10	12	-.07	11
18	Nonrapist	-.42	12	-.19	11
19	Nonrapist	--	--	--	--
20	Rapist	.79	12	.85	6
21	Rapist	.31	12	.12	12
22	Rapist	.87	12	.28	12
23	Rapist	.06	12	-.29	12
	Average	.24	-	.23	-

Self-Report with Arousal Correlation by Offender Group

	r	n	r	n
Rapist	.61	156	.26	113
Nonrapist	.75	84	-.13	67
Overall	.65	240	.09	180

1. n= number of stimulus presentations to each subject (i.e., stimuli presented across four experimental conditions.

to be in a moderate to high range (approximately .60). In all, participants self-reported their MSG level of arousal quite well and did so, regardless of condition or stimuli. This is an interesting result in that one might expect subjects to report being less aroused to the relatively less socially desirable narratives (rape, assault) given the nature of the assessments (ie., court or parole board referral). Notable exceptions occured among Rapists in the Drink-Suppress condition with the consenting and assaultive stimuli.

As displayed by individual case in Table 11, the bioimpedance and self-reported arousal correlations are much less consistent than those using MSG readings. It is noted that 12 of the 24 correlations are negative, whereas not one was obtained in the MSG correlations. Since the same self-reported values were were correlated with both MSG and bioimpedence arousal, and the mercury strain guage is an established arousal measure, one is left with the possibility that electrical penile skin resistance is a pure measure of arousal because such electrical readings are influenced by a number of additional vascular changes, such as blood pressure and blood flow.

Another possible explanation concerns the base-to-peak scores, and the fact that a baseline reading at stimulus onset was not recorded. In the case of MSG, this problem was not as severe since the minimum value occurred at the first reading in 37% of the cases, and the maximum occurred at readings 6 through 10 in 70% of all cases.

Table 12

Correlations of Self-Reported and Machine-Recorded Physiological Arousal, Presented by Offender Type, Stimulus and Conditions.

Offender Type	Tape	Alcohol	Instructions	Self-Report with MSG Base to Peak r	n	Self-Report with Bioimped. Base to Peak r	n
Rapist	11	Clear	Arouse	.76	13	.57	7
			Suppress	.91	13	.01	6
		Drink	Arouse	.89	13	.21	10
			Suppress	.90	13	.29	12
	12	Clear	Arouse	.43	13	.14	7
			Suppress	.52	13	-.09	7
		Drink	Arouse	.33	13	.18	13
			Suppress	.02	13	.40	13
	13	Clear	Arouse	.98	13	.01	13
			Suppress	.95	13	.01	5
		Drink	Arouse	.67	13	-.10	13
			Suppress	.20	13	-.45	13
Nonrapist	11	Clear	Arouse	.95	7	.26	6
			Suppress	.73	7	-.23	5
		Drink	Arouse	.81	7	-.06	6
			Suppress	.99	7	.15	6
	12	Clear	Arouse	.44	7	-.62	6
			Suppress	.80	7	-.15	6
		Drink	Arouse	.97	7	.06	5
			Suppress	.80	7	-.03	6
	13	Clear	Arouse	.70	7	-.31	6
			Suppress	.54	7	-.67	4
		Drink	Arouse	.84	7	-.31	6
			Suppress	.96	7	-.44	5
Average				.71	-	-.05	-

n= number of subjects

Tape 11=rape
12=mutually consented sex
13=nonsexual assault

For bioimpedance the maximum value occurred at the first reading (as it should have) only 28% of the time. Although the minimum value was obtained at readings 6 through 10 in 68% of all cases, it is also found that the maximum value was found 49% of the time within this interval, contrary to expectation. In fact, the maximum bioimpedance readings have a "U-shaped" distribution over time during stimulus presentation. This probably accounts for the inconsistencies obtained. Consequently, the reliability of all analyses in which bioimpedance base-to-peak scores were used is called into question. The distributions of minimum and maximum values for both MSG and bioimpedance are noted in Appendix "A".

Multiple Correlations

Table 13 presents the intercorrelations of age, blood alcohol, testosterone, LH, FSH, SHBG and prolactin levels, for the total sample and by Offender Type. It is noted that the intercorrelations for each Offender Type should be considered lightly owing to small sample sizes.

Nevertheless, high positive correlations are found for prolactin and blood alcohol levels (.60 to .80), and as expected LH and FSH have moderate positive correlations (.31 to .68). Large correlational differences between offender types were found on LH and prolactin (rapist, r=-.50, nonrapist, r=.89).

Table 14 lists details of the multiple correlations of average MSG and bioimpedance base-to-peak arousal scores, with age and the biochemical levels as predictors. Table 15 does likewise, with the exception that arousal scores pertain only to the "with alcohol" conditions, and blood alcohol level is included as an additional predictor. It is noted that Tables 14 and 15 refer to the total sample of subjects on whom a complete set of data was available. The sample size was insufficient to permit separate multiple regression analyses for each offender type. However, Tables 16 and 17 provide the zero-order correlations of age, blood alcohol, and biochemical levels with arousal for rapists and nonrapists separately.

Regarding the multiple correlations, it is found that the predictor variables can account for between 66% and 85% of the variance of both bioimpedance and MSG measured arousal ($\underline{R}^2$=.660 to .854). This appears to be an impressive result until the subject-variable ratio, relative variable contributions, and correlations of the individual predictors to the base-to-peak scores are examined. Specifically, there were several findings which run contrary to those typically found in the literature.

To illustrate, testosterone is consistently the first or second highest contributor to $\underline{R}^2$ for both dependent measures, but contrary to the expected, testosterone displays a moderate to high negative correlation with arousal. This is illustrated in Tables 14 through 17.

One explanation for this finding once again concerns the value used as a baseline reading in computing base-to-peak

Table 13

Intercorrlations of Age, Blood Alcohol, Testosterone, Luteinizing Hormone, Follicle Stimulating Hormone, Sex Hormone Binding Globulin, and Prolactin Levels Presented for Total Sample and by Offender Type.

Total Sample	Age[1]	Blood Alcohol[2]	Testosterone[3]	LH[4]	FSH[5]	Prolactin[6]	N
Age							23
Blood Alcohol	-.266						23
Testosterone	.278	-.325					22
LH	.098	-.175	.254				22
FSH	.126	.198	.124	.446			20
Prolactin	-.167	.832	.029	.062	.083		16

By Offender Type, Rapists in Upper Diagonal, Nonrapists in Lower Diagonal

	Age	Blood Alcohol	Testosterone	LH	FSH	Prolactin	N
Age		-.184	.199	.403	.441	-.430	13
Blood Alcohol	-.712		-.611	-.548	-.100	.591	13
Testosterone	.456	.129		.115	.047	-.179	13
LH	-.142	.221	.478		.307	-.504	13
FSH	-.155	-.151	.263	.680		-.712	11
Prolactin	-.366	.916	.176	.894	-.085		10
N	10	7	9	9	9	6	

[1]Age, unit=years. [2]Blood Alcohol=maximum Blood Alcohol Level during the Alcohol injest condition, unit=percent/litre blood. [3]Testosterone, unit=N mole/litre blood. [4]LH=Luteinizing Hormone, unit=IU/litre blood. [5]FSH=Follicle Stimulating Hormone, unit=IU/litre blood. [6]Prolactin, unit=UG/litre blood.

Table 14

Multiple Correlations of Age and Hormone Levels with Subject's Average Arousal Readings as Measured by Bioimpedance and the Mercury Strain Guage, Across all Experimental Conditions.

Mercury Strain Guage Base to Peak (o) N=13				Bioimpedence Base to Peak (o) N=13			
Predictor (p)	$Beta_p$	r_{op}	$(Beta_p)(r_{op})$	Predictor (p)	$Beta_p$	r_{op}	$(Beta_p)(r_{op})$
Age[1]	-.197	-.402	.079	Age	.181	-.063	-.011
Testosterone[3]	-.344	-.456	.157	Testosterone	-.746	-.458	.342
LH[4]	-.236	-.119	.028	LH	.426	.346	.147
FSH[5]	.408	.522	.213	FSH	-.610	-.309	.188
Prolactin[6]	.475	.455	.216	Prolactin	.221	.087	.019
			$R^2_{(7,5)}$=.693, ns.				$R^2_{(7,5)}$=.685, ns.

Table 15

Multiple Correlations of Age, Blood Alcohol and Hormone Levels with Subject's Average Arousal Readings as Measured by Bioimpedance and the Mercury Strain Guage, for the "With Alcohol" Conditions.

Mercury Strain Guage Base to Peak (o) N=13				Bioimpedence Base to Peak (o) N=13			
Predictor (p)	$Beta_p$	r_{op}	$(Beta_p)(r_{op})$	Predictor (p)	$Beta_p$	r_{op}	$(Beta_p)(r_{op})$
Age	-.176	-.397	.070	Age	.127	-.164	-.021
Blood Alcohol[2]	-.108	.500	-.054	Blood Alcohol	-.002	.247	-.001
Testosterone	-.365	-.483	.176	Testosterone	-.805	-.536	.431
LH	-.284	-.151	.043	LH	.430	.392	.169
FSH	.463	.543	.251	FSH	-.581	-.249	.145
Prolactin	.480	.362	.174	Prolactin	.402	.325	.131
			$R^2_{(6,6)}$=.660, ns.				$R^2_{(6,6)}$=.854*

[1]Age, unit=years. [2]Blood Alcohol=Blood Alcohol Level, unit=percent/litre blood. [3]Testosterone, unit=N mole/litre blood. [4]LH=Luteinizing Hormone, unit=IU/litre blood. [5]FSH=Follicle Stimulating Hormone, unit=IU/litre blood. [6]Prolactin, unit=UG/litre blood.

*$p<.05$.

scores. Specifically, those with high testosterone levels are typically more sexually arousable (Berlin, 1983). Since the first reading was taken 15 seconds after a narrative began, these individuals would be more likely aroused at this early stage. Thus, the reading presently referred to as a baseline would not be that different from what was their peak value. Hence, their change score (ie., base-to-peak) would be minimized. Conversely, a subject with low testosterone and low initial arousal could evidence a much greater base-to-peak score, hence the artifactual negative correlations between base to peak arousal and testosterone.

To an extent, this was in fact the case. A test of subjects' average first MSG readings with their respective testosterone level yielded a correlation of .07. The correlation between the average maximum MSG recording and testosterone was .04. Similarly, testosterone correlated with the first bioimpedence and the minimum bioimpedance readings -.16 and -.17, respectively. This is to be expected since lower electrical skin resistance is supposed to be found with increased arousal. Recall, however, that bioimpedance base-to-peak should be a positive value that increases as arousal increases. Although these few correlations are not strong, they are in the expected direction, and are dissimilar from those obtained using base-to-peak scores. It is concluded that initial readings were not as distant from maximum readings for the high testosterone participants, which resulted in relatively low base-to-peak

Table 16

Correlations of Age and Hormone Levels with Average Arousal Readings as Measured by Bioimpedance and the Mercury Strain Guage, Across all Experimental Conditions.

	Mercury Strain Guage Base-to-Peak			Bioimpedance Base-to-Peak	
	Rapist (n=8)	Nonrapist (n=5)		Rapist (n=8)	Nonrapist (n=5)
	r	r		r	r
Age[1]	-.259	-.629	Age	-.049	-.062
Testosterone[3]	-.712	-.625	Testosterone	-.597	-.191
LH[4]	.153	-.192	LH	.297	.486
FSH[5]	-.221	.796	FSH	-.268	-.291
Prolactin[6]	.078	.216	Prolactin	.059	.627

Table 17

Correlations of Age, Blood Alcohol and Hormone Levels with Average Arousal Readings as Measured by Bioimpedance and the Mercury Strain Guage, for the "With Alcohol" Conditions.

	Mercury Strain Guage Base-to-Peak			Bioimpedance Base-to-Peak	
	Rapist (n=8)	Nonrapist (n=5)		Rapist (n=8)	Nonrapist (n=5)
	r	r		r	r
Age	-.255	-.614	Age	-.164	-.222
Blood Alcohol[2]	.049	.327	Blood Alcohol	.139	.471
Testosterone	-.752	-.626	Testosterone	-.677	-.190
LH	.220	-.321	LH	.314	.853
FSH	-.215	.863	FSH	-.280	-.315
Prolactin	.024	.081	Prolactin	-.026	.693

[1]Age, unit=years. [2]Blood Alcohol=Blood Alcohol Level, unit=percent/litre blood. [3]Testosterone, unit=N mole/litre blood. [4]LH=Luteinizing Hormone, unit=IU/litre blood. [5]FSH=Follicle Stimulating Hormone, unit=IU/litre blood. [6]Prolactin, unit=UG/litre blood.

scores, which in turn resulted in the negative correlations noted in Tables 14 through 17. However, it also apparent that other factors contribute to the negative correlation. Perhaps the earlier noted problem of the distribution of minimum and maximum arousal readings (with respect to time) contributes as well.

In all, by virtue of these facts the multiple correlations cannot be interpreted reliably. Moreover, these same findings necessitate a cautious interpretation of other analyses which utilized base-to-peak scores. It is noted that the use of maximum-minus-minimum scores, as opposed to base-to-peak scores, would not solve the problem at hand.

Intelligence and Arousal

In an earlier section it was mentioned the potential importance of cognitive factors on arousal, vis-à-vis the experimental conditions. To explore this, intelligence scores, as assessed by the Wechsler Adult Intelligence Scale (WAIS), were obtained and included as an additional factor in the model.

It was found that the average Verbal Intelligence score for the total sample was 87.74, the average Performance Intelligence score was 93.47, and the average Full Scale Intelligence score was 89.21. None of the three intelligence scores were found to be related to average base-to-peak arousal. Offender groups did not differ significantly on intelligence scores except in the case of Performance intelligence (rapists M=97.77, nonrapists M=84.17; F (1,21) =5.32, p .03). Correlations between the three intelligence measures were high, being in the r=0.95 range.

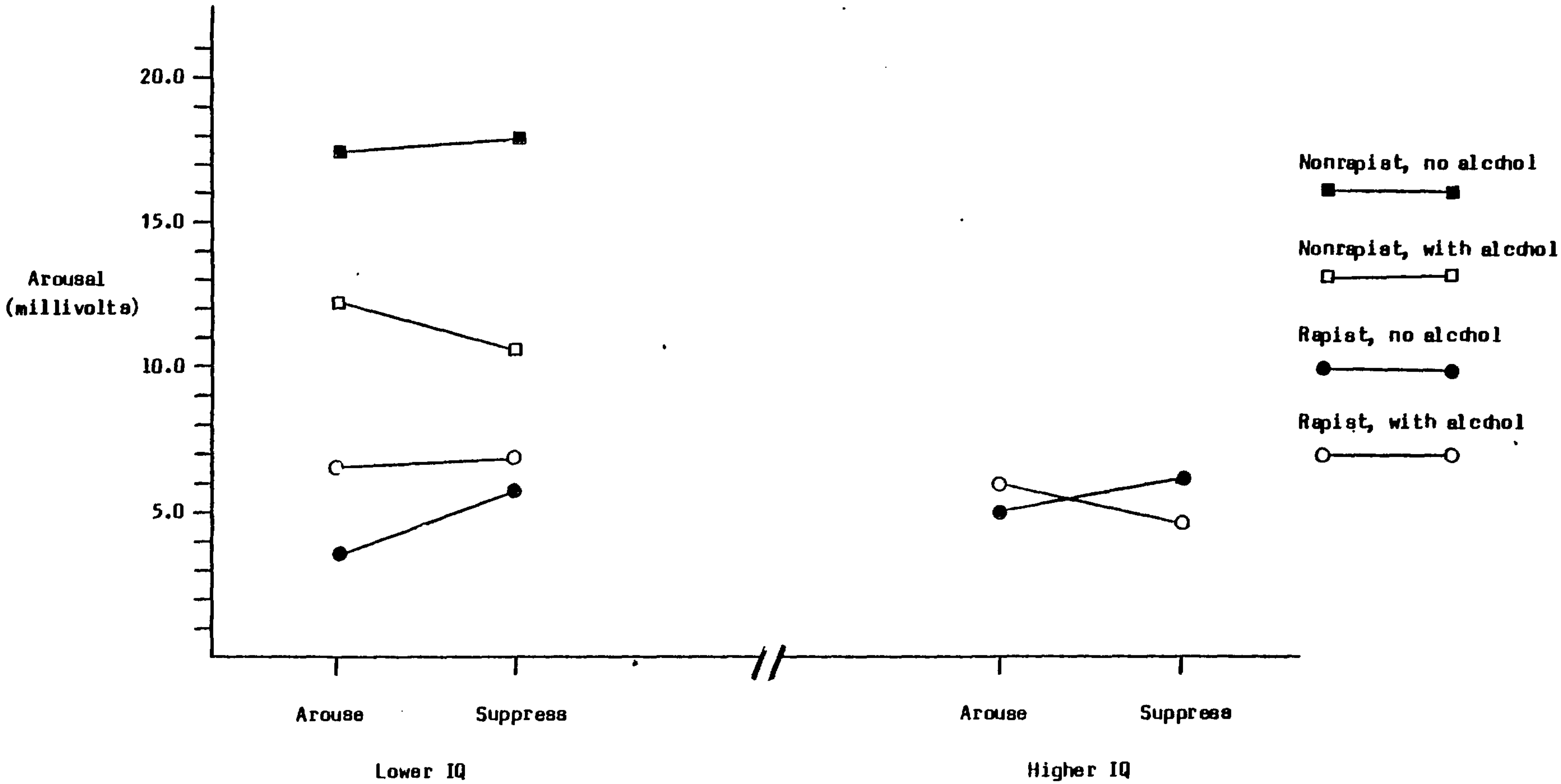
A second between-subjects factor was devised on the basis of the Full Scale WAIS scores, this being higher and lower intelligence quotient (IQ) groups. Subjects were split according to the median Full Scale IQ score of 91. Interestingly, there were no nonrapists in the higher IQ group. Instead, there were 9 nonrapists and 5 rapists in the lower IQ groups, and 8 rapists in the higher IQ group (IQ scores were unavailable for one subject).

With respect to earlier findings, this additional breakdown according to IQ groups proved illuminating. The significant Offender Type-by-Instructions interactive effect for MSG rape subtraction scores was explained by the IQ grouping. Higher IQ rapists and lower IQ nonrapists had similar subtraction scores for both instructional sets, yet lower intelligence rapists evidenced a mean score increase of 1.79 to 8.93 from arouse to suppress conditions. Second, for MSG base-to-peak scores, lower IQ rapists' scores increased while they were under the influence of alcohol (4.77-clear versus 6.45-drink) and lower IQ nonrapists scores decreased while under the influence of alcohol (17.35-clear versus 11.34-drink), consistent with the earlier Offender Type-by-Alcohol interaction. However, higher IQ rapists' scores also decreased slightly while under the influence of alcohol (5.60-clear versus 5.44-drink) indicating that the previous Offender Type-by-Alcohol interactive effect was attributable to the lower IQ rapists.

Figure 6 illustrates this finding with the instructional set as an additional within-subjects factor. The left side

Figure 6

Offender Groups by Intelligence Groups Penile Circumference Change as a Function of Alcohol Condition and Instructional Set.

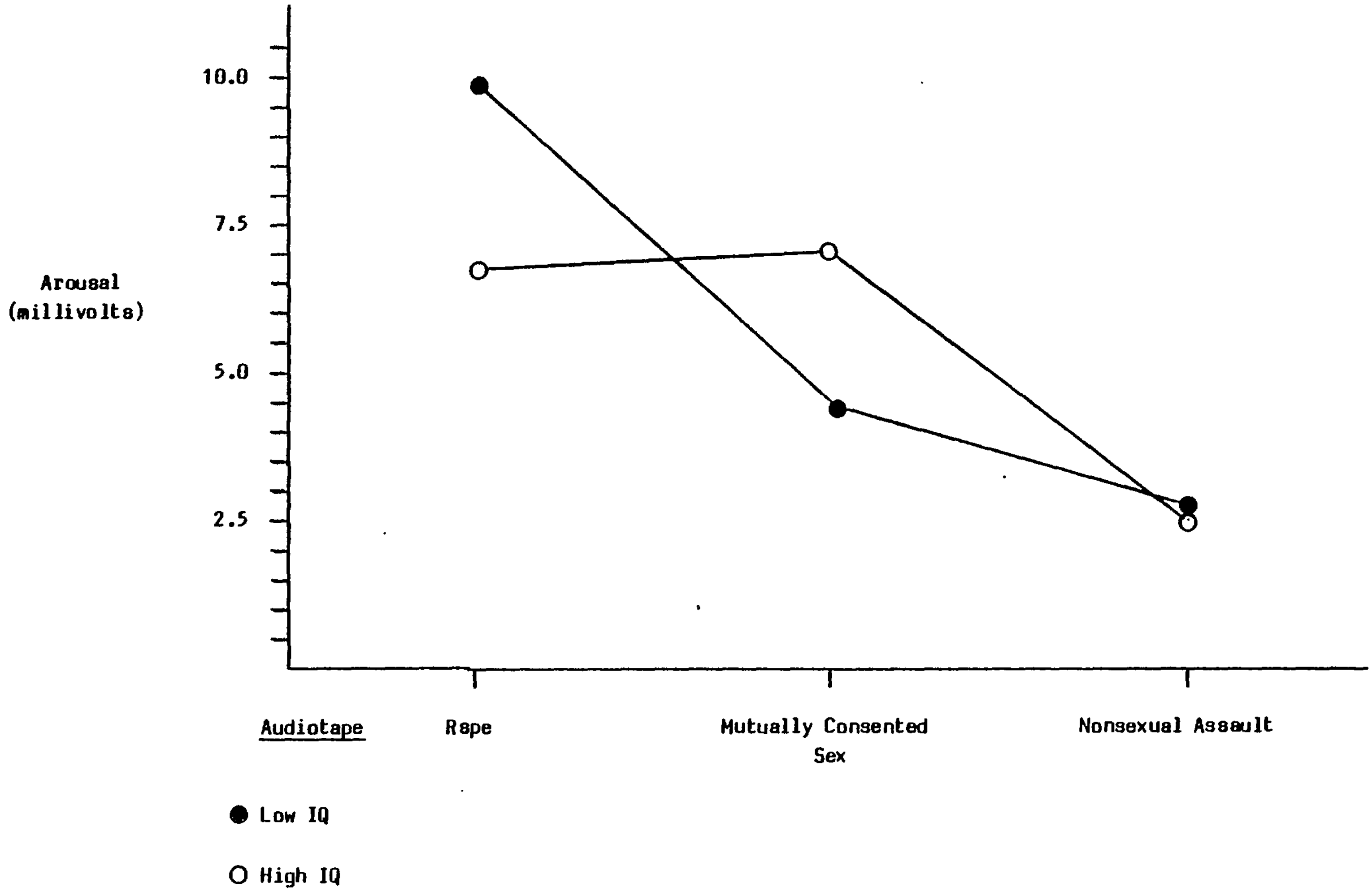


contrasts the lower IQ rapists and nonrapists. As it can be seen, the lower IQ nonrapists' arousal decreases under the influence of alcohol, whereas lower IQ rapists' arousal increases. This effect is significant (F (1,103) =9.35, p .01). The left side also shows that under instructions to suppress, the lower IQ rapists' arousal increases. This contrasts with what is found on the right side in that higher IQ rapists' arousal decreased under instructions to suppress, but only while under the influence of alcohol. Also, the differential in arousal from clear to drink, for the arouse condition, is much smaller for higher than lower IQ rapists. It is noted that these differences between higher and lower IQ rapists were nonsignificant.

Figure 7 illustrates differences in the MSG base to peak arousal for higher versus lower IQ rapists with respect to the audiotaped stimuli. As found before, for rapists as a group, there is a significant main effect for stimuli, whereby the rape tape elicited the highest arousal and the nonsexual assault tape the lowest arousal (F (2,125) =5.75, p .01). However, Figure 7 reveals an interesting point, this being that the effect is attributable to the lower IQ rapists, as higher IQ rapists experienced higher arousal to the mutually consented sex narrative and not to the rape narrative. Although this interactive effect is nonsignificant, it is of more than academic interest.

Figure 7

Lower versus Higher Intelligence Rapists' Penile Circumference Change as a Function of Audiotaped Stimulus.



A final set of results to consider pertains to the correlations of the three IQ's with age and the biochemical data. Generally, there were no relationships apparent, except in the case of FSH. As Table 18 reveals, all three IQ measures had high negative correlations with FSH, but not with the associated LH and testosterone. This is an interesting result which is difficult to decipher given that FSH had strong positive correlations with average arousal, yet the IQ's had none.

Table 18

Intercorrlations of WAIS Verbal, Performance, and Full Scale Intelligence Quotients, and Follicle Stimulating Hormone, Luteinizing Hormone and Testosterone Levels for the Total Sample.

	VIQ[1]	PIQ[2]	FIQ[3]	LH[4]	FSH[5]	Testosterone	N
VIQ							
PIQ	.78						22
FIQ	.96	.92					22
LH	-.15	-.16	-.16				19
FSH	-.63	-.72	-.68	.45			19
Testosterone	-.35	-.28	-.35	.25	.12		19

[1]Verbal IQ

[2]Performance IQ

[3]Full Scale IQ

[4]Luteinizing Hormone

[5]Follicle Stimulating Hormone

Suggestions for Further Research

(1) In the present study, considerable problems were encountered in obtaining an arousal change score that at once controlled for noncondition-specific arousability (where the subject was highly aroused at baseline), and at the same time did not force a forfeiting of arousal information. One attempt at control was the use of indices for rape and assault.

Another possibility, not used presently, is to calculate *z* scores for each subject, based upon all the responses during a given session (Quinsey and Chaplin, 1982). However, for the present study, this may not work since subjects were not necessarily given clear and drink conditions in the same session. If *z* scores were calculated separately for clear and drink sessions, alcohol effects would not be assessable. This is because absolute levels of alcohol-induced arousal changes would be standardized among themselves, thus erasing any such absolute changes attributable to alcohol.

However, a solution to this could have been to present all alcohol and instruction conditions within the same session. The difficulty with this procedure is that subjects would hear the same stimulus four times in succession. If alcohol was given later in the session, any reduced arousal could not be considered an alcohol effect--it would more likely be the result of boredom with the same tape. Moreover, a counterbalanced design could not be used if alcohol is given in the first presentations, since the subject would have to be given time to "dry out" before the clear conditions. This is impractical given the clinical nature of the research.

The main problem in the current study concerned baseline values and the fact that the base-to-peak scores were not true base-to-peak scores. The first reading was taken 15 seconds into the narrative, and the first 15 seconds of a narrative was not always "neutral" in sexual content. In this situation, one recommendation is to adopt the procedure of Quinsey and Chaplin (1982) where each narrative starts with a short description of a nonsexual heterosexual encounter. Collecting readings on such an initial narrative piece could serve as a true baseline, where arousal effects (or lack thereof) emanating from the experimental setting could be accounted for.

This, of course, is assuming that the subjects consider such a stimulus neutral, which could be an erroneous assumption. Hence, the most attractive alternative would be to take readings for each narrative (tape segment) at the point immediately before the narrative begins (time=0 seconds).

(2) Given the controls noted in item one, additional study is recommended into the apparent differential effect on arousal that alcohol has for rapist and nonrapists. One possible route would be the study of the effect of alcohol on the inhibiting and disinhibiting mechanisms of the central nervous system, and how this differs for rapists, nonrapists and nonsex offenders.

(3) Study should be undertaken to assess the effect of alcohol in the blood on electrical readings of skin resistance. The present study circumstantially indicates that alcohol may have an effect on such readings for certain persons.

(4) In addition to electrical skin resistance (bioimpedance), other measures of arousal such as penile blood flow may be studied, on their own and in comparison with the traditional MSG measures.

(5) The administration of alcohol should be precisely controlled. One approach (McCarty, 1981) is to give subjects dosages of alcohol according to their body weight (ie. .48 millilitres of ethanol per kilogram of body weight). Also, McCarty ensured that breath tests were taken at 20 minute intervals throughout the session to monitor the metabolism of ethanol and to ensure that blood alcohol levels remained above a predetermined level.

Appendix A

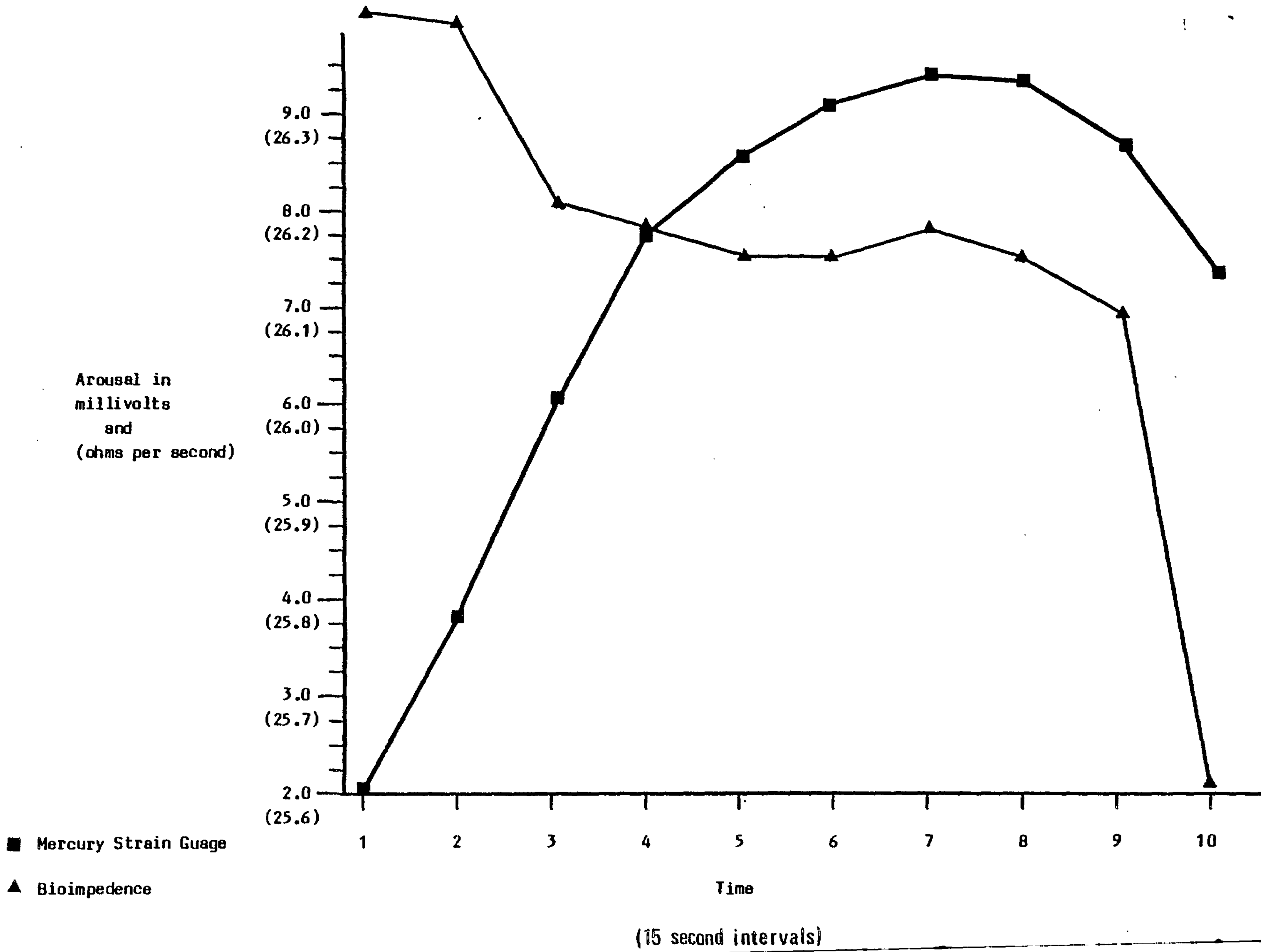
Distributions of Mercury Strain Guage and Bioimpedance Maximum and Minimum Readings with Respect to Time.

Mercury Strain Guage Minimum Reading			Mercury Strain Guage Maximum Reading		
Time	Frequency	Percent	Time	Frequency	Percent
1	197	36.5	1	49	9.1
2	62	11.5	2	24	4.4
3	50	9.3	3	29	5.4
4	36	6.7	4	45	8.3
5	37	6.9	5	53	9.8
6	32	5.9	6	68	12.6
7	24	4.4	7	70	13.0
8	25	4.6	8	76	14.1
9	24	4.4	9	57	10.6
10	53	9.8	10	69	12.8

Bioimpedance Minimum Reading			Bioimpedance Maximum Reading		
Time	Frequency	Percent	Time	Frequency	Percent
1	30	5.6	1	153	28.3
2	45	8.3	2	46	8.5
3	37	6.9	3	34	6.3
4	32	5.9	4	22	4.1
5	30	5.6	5	23	4.3
6	28	5.2	6	19	3.5
7	41	7.6	7	16	3.0
8	49	9.1	8	40	7.4
9	56	10.4	9	20	3.7
10	192	35.6	10	167	30.9

Appendix B

Average Values of Mercury Strain Guage and Biompedence Measured Arousal as a Function of Time, Collapsed Across Offender Type and Experimental Conditions.



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	DATE DUE		