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Male-Female Differences in Underwater Sensory Isolation*

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Since the pioneering studies of Hebb and his associates (2) on the effects of sensory deprivation on human beings, numerous investigators have conducted experimental studies under varying conditions in an effort to establish consistent trends in behaviour of subjects exposed to such conditions. Since only two other laboratories, both using male subjects, have reported underwater studies in deprivation (1, 5), an attempt to replicate our findings of sex differences in response to the situation by use of this method seemed to be in order.

Our first explanatory study was aimed at examination of two aspects of the deprivation experience; first, the differences observed in male/female responses to the experience; and second, an evaluation of the influence of the interaction between sex of subject and sex of interviewer on the reports obtained. A rationale for predictions of behaviour was developed from the Witkin *et al.* (11) framework of field dependency *vs.* bodily orientation. It was expected that females would be more field dependent than males as measured by stimulus bound (SB) responses, i.e. responses reflecting attention to and preoccupation with external stimuli; while males were expected to be more bodily oriented as measured by non-stimulus (NSB) responses, i.e. responses reflecting attention to internal stimuli.

Medical students served as subjects for the first study and results revealed an opposite trend from that predicted. That is (1) females had a significantly higher proportion of NSB responses than the males; (2) no difference was found in total psychological content of interviews; and (3) despite efforts to achieve a standard interview, the social-sexual role of both subject and interviewer influenced the reports obtained about the experience.

A possible limitation of the above study was the use of medical students, which constituted a restricted population. The purpose of the present experiment is twofold: first, to attempt to cross-validate the results of the first study in a more varied population; and second, to explore in greater detail male/female differences in response to the experience.

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Method

Subjects were twenty paid volunteer participants who worked in or around the Medical Center and others who had heard about the experiment from those employed in the Center. Males and females were matched in age, education and socio-economic background (3). They did not differ significantly in order of birth. The Mf scale on the MMPI was used to measure masculine and feminine interests and subjects were selected on the basis of a ten-point or greater difference between highest score for males and lowest score for females.

Subjects reported to the laboratory at 8 a.m. where two interviewers, one male and one female, were present. Pulse rate, respiration rate, oral temperature, and systolic and diastolic blood pressure were obtained before the run by one of the examiners, and the same indices were taken after the run by the other examiner. Each subject was exposed individually to three hours of underwater sensory deprivation in the isolation chamber, and all verbal responses during this period were recorded and transcribed. Description of the chamber is reported elsewhere (8).

Following isolation, an equal number of subjects were interviewed by either the male or female interviewer. A standard interview of twenty open-ended questions was used for the post-isolation interview. Answers to five of the questions (feelings of fright, unpleasantness, sex, what the subjects learned about themselves and what the experience was remindful of) were

used for measurement of psychological content.

Responses recorded during isolation were classified into either SB or NSB categories by two experienced clinical psychologists who were not involved in the study. A six-point rating scale of psychological content of responses to the five questions was also scored independently by the two judges. This scale was designed to measure the amount of intimate, personalized information given to interviewers of the same or opposite sex. The scale was previously demonstrated to be of sufficient reliability. Details of scoring procedure are given in the earlier publication (10).

Results

Correlation (rho) between judges on rating of SB–NSB responses was ·97. The Mann-Whitney U Test (Table I) shows that differences between males and females on number of NSB responses is significant at the ·06 level, a finding consistent with results of the first study. In both instances the males consistently gave fewer NSB responses.

Correlation (r) between judges on scoring of psychological content of interviews was ·81. Difference between sexes on psychological content of interviews was not statistically significant (Table II), a finding also consistent with the results of the first study.

Table II

Comparison of Scores on Psychological Content of Interviews

	Group I (Female)	Group II (Male)
Varied Population (N=20)		
Mean	25·0	25·4
Median	24·5	25·0
Standard deviation	5·73	6·32
Mean difference	·4 N.S.	
Medical Students (N=16)		
Mean	31·7	26·1
Median	35·0	30·0
Standard deviation	7·7	10·7
Mean difference	5·6 N.S.	

The interaction effects between sex of subject

Table I

Comparison of Differences Between Males and Females on SB and NSB Responses

Pair No.	Raw Data: Females SB	Females NSB	Males SB	Males NSB
1	3	0	150	12
2	23	14	47	3
3	23	9	0	0
4	48	38	11	5
5	8	5	0	0
6	40	47	4	0
7	20	9	3	0
8	11	5	3	0
9	8	4	7	10
10	2	0	2	0
	186	131	227	30
Mean	18·6	13·1	22·7	3·0
Median	15·5	7·0	3·5	0
Standard deviation	15·5	16·2	46·9	4·6
Mean differences	5·5		19·7	

NSB—Mann-Whitney U Test $p < .06$.

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and sex of interviewer was upheld for this study in the direction of the differences, but to a lesser degree than for the first group. As in the first study, analysis of variance revealed that type of question (A) elicited significantly different responses (Table III), so again it was necessary to make an after-the-fact analysis of the five questions used for measurement.

TABLE III

Analysis of Variance of Responses to Interview Questions (Psychological Content)

Source of Variation	df	Sum of Squares	Mean Squares	F
Total	99	913		
Bet. Ss ..	19	123	6·5	
Sub. (C) ..	1	3	3·0	
Int. (B) ..	1	0		
B×C	1	3	3·0	
Error	?	?	?	
Within ..	80	790		
Responses (A)	4	274	68·5	9·5*
A×B	4	7	1·7	
A×C	4	10	2·5	
A×B×C ..	4	38	9·5	1·2
Error	64	461	7·2	

* $p < .01$.

Table IV presents the means for the ratings of psychological content of responses to each question for both groups, and Table V presents the F tests for the five questions for the separate groups.

Although none of the F tests are significant for the second study, it will be noted that the interaction for three of the questions (unpleasantness, sex, remindful) shows a similar trend to that observed in the first study.

Table VI presents proportion of responses to eight other questions used in the interview. Reports of feeling rested, those of hunger and of difficulty in breathing, reveal significant differences between the sexes.

Women report more feelings of being rested while the men report more difficulty in breathing and more feelings of hunger.

DISCUSSION

Cross Validation

The prediction that sensory deprivation would elicit a greater number of SB responses from women and a greater number of NSB responses from men was not upheld by this study nor the previous one. In both instances the women were more internally oriented (as measured by NSB responses) and thus appeared to be less field dependent than the men. For a detailed discussion of the possible explanations of the above reversal, the reader is referred to the previous study. In brief, we stated that the Witkin findings indicate that women vary in their approach to a task according to the task "demand". Pine and Holt (6) have also reported that women vary more than men in their performance, and suggest that this greater variability may reflect a greater field dependency (in that their

TABLE IV

Means for Five Questions

	Fright	Unpleasantness	Sex	Learning	Remindful
Varied Population (N=20)					
Group I (Fs F_I)	5·2	2·9	4·4	6·6	5·0
Group II (Fs M_I) ..	3·8	2·9	3·2	8·2	7·9
Group III (Ms F_I) ..	4·6	3·6	2·0	7·0	7·4
Group IV (Ms M_I) ..	5·0	3·0	4·6	6·9	6·0
Medical Students (N=16)					
Group I (Fs F_I)	6·0	4·2	5·7	8·5	8·5
Group II (Fs M_I) ..	5·0	6·2	2·0	9·4	7·5
Group III (Ms F_I) ..	2·5	6·5	2·0	6·0	5·7
Group IV (Ms M_I) ..	5·7	3·2	6·2	6·2	8·0

TABLE V

F Tests for Five Questions

	Fright	Unpleasantness	Sex	Learning	Remindful
Varied Population (N=20)					
Between pairs	0	1·4	1·1	1·0	1·2
Between interviewers ..	0	0	0	2·3	0
Between sexes	0	1·8	0	0	0
Interaction	0	2·8	2·4	3·2	2·4
Medical Students (N=16)					
Between pairs	·0	1·2	4·2	3·1	3·1
Between interviewers ..	·0	·0	·0	·0	1·0
Between sexes	·0	·0	·0	16·6†	5·0
Interaction	1·2	3·5	24·6†	·0	11·0*

* $p<.05$.
† $p<.01$.

TABLE VI

Differences in Proportion of Responses to Eight Interview Questions

Question	Males	Females
1. Thirst	13 out of 18	9 out of 18
2. Hunger	12 out of 18	1 out of 18*
3. Sleeping dreams	9 out of 18	6 out of 18
4. Daydreams	16 out of 18	14 out of 18
5. Annoyance	16 out of 18	14 out of 18
6. Rested	4 out of 18	12 out of 18*
7. Difficult in breathing	9 out of 17	1 out of 18†
8. Boredom	11 out of 18	7 out of 18

* $p<.025$.
† $p<.005$.
‡ $p<.001$.

responses vary with the task demand), or it may reflect a differing "response set". That is, males and females may differ in their approach to a task depending on the implicit assumptions they have regarding what is expected of them. The findings of our second study, confirming the reversal of the predicted trend, plus some additional observations, led us to consider a third possible explanation.

The Witkin (11) studies show that when subjects are tested with their eyes closed, no differences are found in males and females in field dependency. In other words, if cues are available, the women readily use them, but if they are not available, their performance does not differ from the males. Although Witkin *et al.* have termed this behaviour on the part of the females greater variability in response to the task demand, and therefore greater field dependency, it may also be thought of as greater adaptability. There is some evidence to suggest that this concept might be useful in accounting for the reversal found in the deprivation experience. For example, the greater incidence of reports by women that they felt rested after the experience, plus a greater incidence of reports of difficulty in breathing by men, tends to indicate that the women seemed to be more relaxed in the isolation chamber. In addition, the men more frequently reported feelings of hunger,

thirst, and boredom. Further, additional evidence of possible greater adaptation on the part of the women was revealed in answers to the question, "How was your mood?" Forty adjectives taken from Roget's (7) word list referring to pain and pleasure were used to measure the content of answers to this question. There was no difference between the sexes in the number of pain adjectives used, but differences in the number of pleasure adjectives used was significant at the ·05 level (t-test), with the women giving the greater number.

Thus, our findings do suggest that there may be differences between the sexes in their adaptation to the underwater isolation experience. The reasons for such differences, however, remain obscure, owing to their complex nature. Perhaps the prolonged immersion in warm water may have contributed to the more relaxed state of the women. It has been commonly observed that men seem to prefer showers, while women generally prefer tub baths. One way of testing the role or psychological meaning of the water *per se* would be to compare males and females in the "air" sensory deprivation experiment.

Regarding the interview concerning reports of the experiences, it will be noted that results of the second investigation reveal that none of the five questions in the interview attain statistical significance. The direction of the differences, however, is the same as that observed in the first study, with the exception of the question about what the experience was remindful of. A possible explanation of the difference in degree of interaction for the two populations may be found upon closer examination of the relationship between examiners and subjects. Although the medical students were relatively unknown to either of the examiners, a number of the subjects from the second group had frequent occasion to come in contact with the examiners during the course of their work in the Center and thus were better acquainted with them. The greater degree of familiarity may have been a contributing factor to the decreased amount of interaction between interviewers and subjects.

By combining the data for both groups, the question dealing with sexual information remains the only statistically significant one. This finding suggests that while the sex of the interviewer may or may not be a determining influence on information obtained regarding most personal items, it does appear to be an important variable when information of a sexual nature is being elicited. Further, the possible effect of degree of familiarity demonstrates the complexity of the interviewing situation and emphasizes the necessity for examining all interrelated factors operating at a given time in a given situation.

Additional Findings

In the first study the question arose whether medical students constituted a representative sample of maleness and femaleness in other than biological terms. In choosing subjects for both studies, the Mf scale on the M.M.P.I. served as a screening device for measuring masculine-feminine interest patterns. Eighteen medical students were tested, and sixteen were selected who were within average limits for their respective sexes. On the other hand, in the more varied population group, it was necessary to test 38 subjects before finding twenty who fitted the prescribed criteria. This finding raised the question of why the sexes appeared to be more sharply differentiated in the medical students than in the second group. An overlap of scores on the Mf scale has been shown to be a function of age and education (9) and this function may account for the difference. The medical students who were tested ranged in age from 22 to 34 and included first to fourth year students, while those tested for the second study ranged in age from 19 to 43 and level of education ranged from high school to post-doctoral level.

Although differences in sexes constituted the primary focus for both studies, similarities of a psychological nature were also observed. No consistent differences were found in visual or auditory images, incidence of sleep or dreams, feelings of annoyance, or tactual sensations. There was no difference between the sexes in birth order, and this variable was not related to type of response or psychological content of interviews. In addition, the mean difference between sexes in estimated time spent in the

chamber was only four seconds. The average underestimation of the three-hour period by women was one hour and three minutes, while the men averaged one hour and seven minutes underestimation. When asked the question, "How would you feel about repeating the experience?" all subjects indicated that they would be willing to participate again, although there was considerable variability in enthusiasm expressed.

In summary, the overall results of the present investigation show that the differences observed in male and female responses to the deprivation experience are the same as those observed in the first exploratory study. In addition, the differences in the post-isolation interview revealed similar direction, although the differences were markedly stronger for the medical students than for the more varied population. Sexual differences in response to the sensory deprivation situation re-affirm the recent observation by Kagan and Moss (4), "It is likely that many studies in the literature or in a file drawer would have led the investigators to draw different conclusions if separate analyses had been made for males and females" (Kagan *et al.*, p. 275).

Summary

The study reported here is a replication of an earlier investigation of sex differences in response to underwater sensory isolation, and differences in reports of these experiences as a function of different interviewers. The subjects for the first study were paid medical students while those of the present study were drawn from a more varied population. The conditions of sensory isolation described elsewhere (10) were the same for both studies, but in the second study, the number of subjects was increased from sixteen to twenty.

Results of the present investigation confirmed the findings of the first study for the isolation experience: women gave more non-stimulus bound responses than men. However, although differences in the post-isolation interview revealed the same trend, the differences were markedly stronger for the medical students than for the more varied population.

References

1. Camberari, J. D. (1958). *The Effects of Sensory Isolation on Suggestible and Non-Suggestible Psychology Graduate Students.* Unpublished doctoral dissertation. Salt Lake City: University of Utah.
2. Heron, W., Bexton, W. H., and Hebb, D. O. (1953). "Cognitive effects of a decreased variation in the sensory environment." *Amer. Psychol.*, **3**, 366.
3. Hollingshead, A. B. (1957). "Two-factor index of social position", *in* Boek, W. E., Lawson, E. D., Van Kaver, A., and Sussman, M. D.: *Social Class, Maternal Health, and Child Welfare.* (Mimeographed.) Albany, N.Y.: New York State Department of Health.
4. Kagan, J., and Moss, H. J. (1962). *Birth to Maturity: A Study in Psychological Development.* New York: Wiley & Sons, Inc.
5. Lilly, J. C. (1956). "Mental effects of reduction of ordinary levels of physical stimuli on intact, healthy persons." *Psychiat. Res. Rep. Amer. Psychiat. Ass.*, **5**, 1–28.
6. Pine, F., and Holt, R. R. (1960). "Creativity and primary process: a study of adaptive regression." *J. Abnorm. Soc. Psychol.*, **61**, 370–379.
7. Roget, P. M. *Thesaurus.* Ed.: Morehead, A. H. New York: New American Library of World Literature., 1962.
8. Shurley, J. T. (1960). "Profound experimental sensory isolation." *Amer. J. Psychiat.*, **116**, 539–545.
9. Terman, L. M., and Miles, C. C. (1936). *Sex and Personality: Studies in Masculinity and Femininity.* New York: McGraw-Hill.
10. Walters, Cathryn, Shurley, J. T., and Parsons, O. A. (1962). "Differences in male and female responses to underwater sensory deprivation: an exploratory study." *J. Nerv. Ment. Dis.*, **135**, 302–310.
11. Witkin, H. A., Lewis, H. B., Herzman, M., Machover, K., Meissner, P. B., and Wapner, S. (1954). *Personality Through Perception.* New York: Harper.

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