SOME METHODOLOGICAL AND THEORETICAL CONSIDERATIONS IN STIMULUS OVERLOAD AND PERCEIVED CONTROL: AN EXPERIMENTAL INVESTIGATION

by

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PREFACE

Since the format of this thesis departs from the format traditionally used in thesis writing, this preface was deemed necessary in order to orient the prospective reader to the specific organization of this thesis. The major deviation from traditional practice is that the body of the thesis has been prepared as two journal articles, in content, format, and length. All additional information, including a literature review, detailed rationale, bibliography, and supplementary tables, is provided in the appendices.

The first experiment, which is reported in Chapter I, was designed to establish an appropriate methodology for the simulation of stimulus overload in the psychological laboratory. Once this methodology had been determined, it was used in two subsequent experiments, which are reported in Chapter II, to investigate a number of predictions derived from Milgram's (1970) theory of overload and the literature on perceived control (cf. Glass & Singer, 1972). A summary of the work reported in Chapters I and II is presented in Chapter III. Appendix A contains a prospectus which reviews the literature in such a form as to emphasize the nature of the problem investigated and include a full bibliography. All tables which would not usually be included in a journal article but which provide additional information about the data collected are presented in Appendix B.

In this enterprise, I was advised and assisted by a number of individuals who, on reading this work will recognize their own contributions. Gratitude is extended foremost to my advisor, Raymond P. Perry; to committee members Daniel Perlman and Dennis G. Dyck; to external exam-

iner Hilary Appleton; to typists Lynne Dobbs, Vikki Hiebert and Dorothy McLeod; and to my confederate in the third experiment, Arliss Levine.

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CHAPTER I

A METHODOLOGICAL STUDY OF OVERLOAD

Abstract

The purpose of this research was to establish a methodology for studying stimulus overload in the psychological laboratory. It was argued that in order to maximize the conditions of overload in simulation, the dimensional criteria of maximal intensity, maximal diversity, and minimal patterning must be included in the methodology. In addition it was suggested that the psychological phenomenon of overload be operationally defined in terms of the individual's perception of overload rather than the input-output capacity of the system. In a 3 x 2 design, 60 subjects performed either an overload or no overload version of a proofreading-vigilance task, a driving-memory task, or a computation-interruption task. The driving-memory task, which was intended to be most extreme on the dimensions of intensity, diversity, and patterning, was perceived as the most overloading of the three experimental tasks. This led to the conclusion that this driving-memory task represented a substantial improvement over existing methods and that this warranted its future use as a standard methodology. In addition, it was suggested that the concept of interference be considered as a critical dimension of overload.

A METHODOLOGICAL STUDY OF OVERLOAD

Despite the widespread use of such terms as "overstimulation" and "stimulus overload" by laymen and psychologists alike to explain the stress of urban living, there is a surprising scarcity of empirical studies which have dealt directly with this issue. What makes this even more surprising is that the seemingly less relevant issue to our urbanized society, stimulus underload or sensory deprivation, has received a great deal of attention (Haythorn, 1973; Zubek, 1969). The present study was undertaken in order to establish a methodology for studying stimulus overload in the laboratory, with the intention of improving on earlier methods used in the area.

Overload has been defined as the condition in which the amount of input into a system exceeds the processing capacity of that system. This input glut can occur when too many inputs are presented simultaneously or when successive inputs occur in such rapid succession that input A cannot be processesd by the time input B is presented (Milgram, 1970). There appear to be at least three major dimensions of overload worth differentiating (Wohlwill, 1974): maximal intensity, maximal diversity, and minimal patterning. These dimensions roughly correspond to the decision and stress concepts of frequency, complexity, and coherence/continuity (Fitts, 1964; Trumbo, 1973). This theoretical consistency suggests that a laboratory task for assessing maximum effects of overload should include an extreme element from each of these dimensions.

Two recent experimental investigations of overload are worth mentioning in this regard. Krupat and Epstein (1973) used a paperwork task to experimentally induce an overloaded state, while Sherrod and

Downs (1974) used a proofreading-vigilance task. In the former, subjects were required to sift through and evaluate a large pile of scouting reports, being told that they would have to work very hard to do their job well. In the latter study, subjects were required to proofread a prose passage, listen to an audio taped series of random numbers, and note the frequency of occurrence of the number "2" in the number series. The random numbers were superimposed over a mixed recording of raucous music and a story being read at a rapid pace. In both experiments, a post-experimental assessment of the perception of overload indicated that subjects in these overload conditions found the tasks aversive and distracting, relative to no overload ratings.

The difficulty inherent in both of these studies is that it is doubtful that subjects were actually overstimulated or overloaded by the tasks. Although subjects in the overload conditions found their task more distracting (a question concerning the degree of overstimulation or overload experienced was never posed) than control subjects, the difference was merely a relative one. The task used by Krupat and Epstein (1973) met none of the dimensional criteria mentioned earlier, i.e. the stimulation was only moderately intense in that the work load was explained but no time restrictions were given; the task involved minimal diversity in that it simply involved the evaluation of scouting reports, and the situation was maximally patterned in that the structure was such that scouting report followed scouting report. Thus, even though the subject was told that there was a lot of work to be completed, it was he who regulated the intensity of input such that any overload experienced would necessarily be self-induced. The Sherrod and Downs

(1974) study suffers from similar inadequacies in that neither definitional nor dimensional overload criteria were met. For although the combination of stimuli may have had maximal intensity and the proofreading-vigilance task maximal diversity, the numbers to be attended to occurred at 5-sec., patterned intervals. In addition, although the amount of simultaneous input was great, the processing demands were not. The only inputs which required processing were the numbers and the errors in the passage being proofread; all other inputs, i.e. the raucous music and story reading, could be disregarded or filtered out (Broadbent, 1971; Milgram, 1970). Thus, although overload may have occurred at the physical or sensory level, it may not have occurred at a perceptual or cognitive level. This distinction is an important one, especially when overload is conceptualized as a psychological phenomenon rather than a physical one (Wohlwill, 1974), i.e., the necessary condition for overload is whether or not the individual <u>feels</u> overloaded rather than whether or not he is required to process x bits of information.

Can the major dimensions of overload be included in a laboratory simulation of overload? Were Sherrod and Downs' subjects actually overloaded or merely distracted? The present experiment was conducted in order to answer these and other questions. It departs from previous methodologies in two important respects: (1) the introduction of an overload task which was designed to simulate maximal overload conditions by adhering to the dimensional criteria of maximal intensity, maximal diversity, and minimal patterning (see Task 2 below); and (2) the definition of overload as the <u>perception</u> of overload rather than input-output discrepancy. Three overload methodologies were compared in order to

determine the most appropriate method for use in further experimentation, and to improve on previous methods. It was hypothesized that the closer a given method approximated maximal intensity, maximal diversity and minimal patterning, the greater would be the perception of overload. Specifically, it was hypothesized that Task 2 (see description below) and its control procedure would represent upper and lower extremes of these dimensions, and would therefore give rise to the greatest and least perception of overload, respectively.

Method

Subjects and Design

Subjects were 30 male and 30 female students drawn from the introductory psychology subject pool at the University of Manitoba. Ten subjects, randomly assigned, constituted each of the three overload and three no-overload groups. This yielded a 3 x 2 factorial design with type of task being the 3-level factor and overload no-overload being the 2-level factor.

Materials and Procedure

Each subject was run individually. The same cover story was read to all subjects, i.e., that the experiment dealt with the process of dual modality learning, a process which focuses on how effectively people can simultaneously process unrelated visual and auditory material. Subjects were then given specific instructions on the task that they had been assigned to.

Task 1. This is the task which was used by Sherrod and Downs (1974). Subjects were required to proofread a prose passage while

listening to a recording of raucous music, a series of random numbers, and a story being read at a rapid pace. They were instructed to read the proofreading material carefully, underline each error, and then place a checkmark in the margin beside the line in which the error was found. At the same time, they were required to attend to the series of random numbers (presented at 5-sec.intervals by a female voice) and place a mark on the blank paper provided every time they heard the number "2" presented. Control (no overload) subjects merely performed the proofreading task while listening to a soundtrack of soft, gentle music (control music).

Task 2. This task was a modified version of a method used by Finkelman and Glass (1970). Subjects were required to track a moving course on a T.K.K. Aptitude Testor for Automobile Drivers (item #110) while maintaining enough pressure on the accelerator to keep a white, peripheral view lamp illuminated. While doing this, subjects were required to brake and clutch when central red and yellow lights were presented, respectively. While performing the requisite operations on the driving simulator, subjects listened to a soundtrack consisting of letter and number sequences. Three letters would be presented and followed by a 3-digit number (Peterson & Peterson, 1959). Subjects were required to remember the three letters while counting backward from the 3-digit number for 10-sec., and then recall the three letters in response to a tone. The control subjects for this task simply followed the correct course on the driving simulator, while listening to the control music.

Task 3. In the third overload condition, subjects were required to perform mathematical operations on long columns (25 numbers) of

multi-digit data, first addition and then division to determine column means. Simultaneously, subjects were required to provide immediate responses to verbal questions presented at 30-sec. intervals. These questions were general knowledge items (WAIS) requiring limited cognitive activity. Subjects were instructed to guess or say they didn't know if the correct answer to a particular question evaded them. Control subjects simply worked on the columns of data while listening to the control music.

Experimental sessions in all conditions were 15-min. in length. At the end of the session, subjects filled out a questionnaire concerning their reactions to the experiment. These reactions were in the form of ratings, each on a 7-point scale (Miller, 1967), to the following items: (1) How much did you enjoy being in this experiment? (2) How distracting did you find this task? (3) How irritating did you find this task? (4) How likely would you be to volunteer for another session of this experiment? (5) To what extent did you feel overstimulated or overloaded in this experiment? When subjects finished filling out the questionnaire, they were debriefed.

Results

Means for each item in the questionnaire are shown in Table 1. A task (3) x overload (2) multivariate ANOVA (Table 2, Appendix B) yielded significant task ($F = 12.68$, $df = 10$ and 94, $p < .0001$) and overload ($F = 8.59$, $df = 5$ and 47, $p < .0001$) main effects and a significant task x overload interaction ($F = 2.10$, $df = 10$ and 94, $p < .02$). The task main effect can be largely accounted for by the distract ($F = 3.65$, $df = 2/54$, $p < .03$) and irritate ($F = 2.68$, $df = 2/54$, $p < .08$) items.

Table 1

Means and SD for Questionnaire Items in Each Stimulus Condition

Question*	TASK 1				TASK 2				TASK 3			
	Over-load		No Over-load		Over-load		No Over-load		Over-load		No Over-load	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1. Enjoy	4.67	1.29	5.40	1.32	4.42	1.06	4.73	2.13	4.50	1.68	4.80	1.28
2. Distract	3.33	1.93	3.80	2.12	6.17	1.28	3.18	1.46	5.50	1.19	4.00	1.93
3. Irritate	3.33	2.04	2.80	2.01	3.67	1.10	3.00	1.69	5.10	2.17	3.70	2.10
4. Volunteer	5.17	1.75	6.00	2.19	4.50	.70	5.00	2.13	4.90	2.36	4.80	1.49
5. Overload	3.92	1.27	3.20	1.92	5.83	.70	2.73	2.08	4.50	1.20	4.30	1.60

*1. Extremely Unenjoyable (1) - Extremely Enjoyable (7)
2. Not at all Distracting (1) - Extremely Distracting (7)
3. Not at all Irritating (1) - Extremely Irritating (7)
4. Totally Improbable (1) - Totally Probable (7)
5. Not at all Overstimulated (1) - Extremely Overstimulated (7)

The overload effect can be explained in terms of the distract ($F = 10.55$, $df = 1/54$, $p < .002$), irritate ($F = 3.31$, $df = 1/54$, $p < .07$) and overload ($F = 12.88$, $df = 1/54$, $p < .0008$) items. Finally, the significance of the task by overload interaction can be accounted for by the distract ($F = 5.79$, $df = 2/54$, $p < .005$) and overload ($F = 5.53$, $df = 2/54$, $p < .006$) items. All other univariate relationships were not statistically reliable (see Table 1, Appendix B).

An a priori analysis (Bonferroni) of the critical task by overload interaction indicated that the driving memory task was significantly more distracting and overloading than the proofreading vigilance task ($p < .01$) and significantly more overloading than the computation-interruption task ($p < .01$). In addition, it was found that the computation-interruption task was significantly more distracting ($p < .01$) but not more overloading ($p > .05$) than the proofreading vigilance task. Control subjects felt least overloaded and distracted in the driving memory task suggesting that the overload - no overload manipulation was most effective for this task.

Intercorrelations between the questionnaire items indicated that overstimulation was positively correlated with distraction (r [59] = .41, $p < .01$) and irritation (r [59] = .40, $p < .01$) while distraction and irritation were also related (r [59] = .32, $p < .05$).

A subsequent analysis of individual performance data on each of the three tasks yielded a task by sex interaction (F (2/54) = 4.82, $p < .01$), indicating that females performed better on the proofreading (task 1) and mathematical operations (task 3) tasks, while males performed better on the driving task (task 2).

Discussion

The results of this experiment demonstrate that a condition of stimulus overload can be simulated in the laboratory, and that this condition can be maximized with the inclusion of the major dimensions of the stimulation. In addition, it would seem that overload is a multidimensional phenomenon and that distraction and irritation are two of its components. This latter point illustrates the value of the use of multiple indices to measure a phenomenon which is little understood. The interrelationships between measures as well as the effects of a given manipulation on each individual measure can be readily assessed through the use of multivariate analysis.

The value in simply asking subjects how overstimulated or overloaded they felt in performing a given task rather than how distracted or irritated they felt, is illustrated by the task main effect for distract and irritate but not for overload. For if a task is to be maximally overloading and its control task is to be minimally overloading, any task main effect should be masked by these extremes, with a real effect being reflected in the task by overload interaction. Since this neutralization of extremes did not occur for the distract and irritate items but did occur for the overload item, it is suggested that the latter is the most appropriate index of overload.

One problem in interpreting the results of the present experiment lies in the failure to replicate Sherrod and Downs (1974) results. That is, they found that their overload condition was perceived as significantly more distracting than their no overload condition, whereas, in the present experiment, no differences were found using the same procedure (see Table 1, Task 1). This discrepancy may be attributable to the

fact that Sherrod and Downs' subjects were asked how distracting they found the background sound whereas the subjects in the present study were asked how distracting they found the task. Since the background sound was varied more across conditions than the task was, the outcome obtained in the present study is not surprising.

The obtained rank ordering of the three tasks on the overload item may be understood by examining their respective positions on the previously stated dimensions. Without a proper psychological definition of intensity, it can be assumed that subjects received higher levels of excess stimulation in the driving-memory task than in either of the other tasks. This is because the amount of information that had to be processed, perhaps analogous to the decibel of sound intensity, was greatest in the driving-memory task. The second major dimension, diversity, was also greatest in the driving-memory task. This is because the amount of variation in input as well as output, a quantifiable index of diversity, was greater in the driving-memory task than in either of the other tasks. Finally, the amount of patterning which is essentially a qualitative variable in this context, was least evident in the driving-memory task. This is primarily due to the aperiodicity of distracting stimulation in this task as opposed to its regularity in the other tasks, i.e. the central lights on the driving simulator were illuminated irregularly and at aperiodic intervals whereas the numbers in the proofreading-vigilance task and the questions in the computation interruption task were presented at regularly occurring intervals. The fact that the latter (task 3) was perceived as more overstimulating than the former (task 1) may be attributable to the unpatterned content of the distracting stimulation (questions) in the former and the patterned content (numbers) in the latter.

In order to test a given set of hypotheses concerning the effects of overload on the adaptation process and/or on subsequent behavior, one first requires an adequate methodology to induce a condition of overload. The present data suggest that the driving-memory task represents the most appropriate method which has been explored to date. First, this task produced the greatest perception of overload relative to the other tasks investigated. The importance of this factor can be understood if one considers that in order to examine the aftereffects of overload, an experimenter must first insure that overload is experienced by his subjects. Second, the driving control task which was used led to the least relative perception of overload. Differential effects of a given manipulation can only be obtained if the experimental and control treatment levels are substantially different. Finally, the driving-memory task represents the strictest adherence to the theoretical dimensions of overload, as previously discussed.

Although the Krupat and Epstein (1973) methodology was not compared in the present experiment, its efficacy as an overload procedure is certainly questionable. Theoretically, it lacked intensity, in that this dimension was entirely regulated by the subject; diversity, in that competing stimuli were relatively absent; and minimal patterning, in that the sequence of events was easily predictable. The Sherrod and Downs (1974) technique was similarly inadequate theoretically, and in addition, was less overloading in the present experiment than either of the other tasks and not reliably different from its control task in the perception of overload induced.

One alternative dimension which might represent a sufficient condition for overload, one which as been neglected by Wohlwill (1974), Fitts

(1964), Trumbo (1973), and others, is the concept of interference . Although Lindsley (1961) has devoted a limited discussion to this factor, his analysis is limited to a sensory-physiological framework. However, on examining the tasks which were used in the present experiment, it would seem reasonable to infer that the greater the interference inherent in a situation, the greater will be the perception of overload. For example, on the driving-memory task in the present experiment, the processing demands of following the correct course on the driving simulator were interfered with by the demands of light interpretation, acceleration, braking, clutching, memory, verbalization, reverse order transpositions, and all of the cognitive activity required to organize these processes. The number of interfering factors in the other two tasks should have been considerably less, by merit of the smaller number of demands alone. The fact that a maximal spread in the perception of overload was achieved in the driving-memory task's overload - no overload conditions, should suggest that the amount of interference incorporated in these conditions was greatest and least, respectively. Future research is needed to test this possibility.

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CHAPTER II

The Effects of Stimulus Overload and Perceived Control on Subsequent Attentional and Prosocial Behaviors

Abstract

The purpose of this research was to investigate the effects of stimulus overload and perceived control on subsequent attentional and prosocial behaviors. Specifically, it was hypothesized that adaptations to overload would include (1) the allocation of less time to each input, (2) a disregard of low priority inputs, (3) shifting personal responsibilities to others, and (4) a decrease in helping behavior. In addition, it was expected that the deleterious effects of overload would be ameliorated by the perception of control. Two experiments were conducted in order to test these hypotheses. In the first phase of both experiments, 40 subjects performed either an overloading or a non-overloading task, either with or without a perception of control. In the first experiment, on a subsequent attention task, performance measures were obtained on time allocated to each input and retention of low priority inputs. In the second experiment, subjects were subsequently provided the opportunity to assume or shift personal responsibility for a proofreading task, and on leaving the experiment were approached by a stranger with a request for help. For all but the helping hypothesis, data trends were in the predicted direction, although not statistically significant. It was suggested that the helping measure was potentially confounded by a number of procedural variables. In addition, it was concluded that in order for the results to be considered definitive, a more powerful test of the hypotheses is required.

The effects of Stimulus Overload and Perceived Control On Subsequent Attentional and Prosocial Behaviors

Such terms as overstimulation and overload have been bandied about with considerable ease in recent years. To the professional and layman alike, such terms have become descriptive of the quality of life in modern day cities as well as most of modern society itself. And although we have probably discerned for ourselves that we are continually being overstimulated by our hectic environment, we do not have to look very far to be reminded of this fact. Typical of the sensationalist warnings about the debilitating effects of overload which are being handed down to us from "reputable sources", is the following headline: HUMAN BRAIN AT BRINK OF RUIN, SCIENTIST SAYS (Los Angeles Times, November 10, 1974). Bestsellers like Toffler's Future Shock (Toffler, 1970) tell us that the ultimate effect of overstimulation is an inability to cope with change accompanied by a state of psychological immobilization.

Although such views may be intuitively credible, especially when they are espoused by our scientific intelligentsia, they must be qualified as speculative and somewhat lacking in empirical support at this time. For although the study of information processing has included situations which could be classified as overloading, caution should be observed in considering the social applications of information processing theory. The analogies which Toffler has drawn between the problems which exist in the real world and information processing limitations which have been discovered in the psychological laboratory are rela-

tively loose, and careful research linking the concepts from the two areas is lacking. It would seem necessary, therefore, that a model be designed to accommodate the psychological aspects of urban overstimulation and to substantiate some of the generalizations offered by Toffler.

Such a model has been proposed in a recent treatise on the experience of urban living (Milgram, 1970). In that paper, Milgram suggested that "psychology needs an idea that links the individual's experience to the demographic circumstances of urban life" (p. 1462). This linking principle, he suggests, is provided by the overload concept. The sheer numbers of people and other environmental inputs that one encounters in the city results in a vast amount of information impinging on a person in his daily routine. Since people have a limited processing capacity, much of this information overload cannot be dealt with effectively, requiring that the individual adopt any of a number of coping mechanisms to limit the information load.

Milgram suggests that one mechanism for coping with overload is to allocate less time and attention to each environmental input. A second adaptive mechanism is the establishment of priorities such that low priority inputs are disregarded or blocked out. A third mechanism is to reverse demands so that the processing burden becomes the responsibility of others. Collectively, these responses of adaptation imply a fourth mechanism - a general reduction in prosocial behavior or a total lack thereof. For illustrative and clarification purposes, consider the overstimulated prototype. Since this individual has limited time

to devote to each input, he has no time to exchange pleasantries with each stranger; brief business-like transactions may therefore be more expedient. In addition, the individual can disregard low priority inputs by employing a receptionist, not looking at people, and generally ignoring inputs that are not particularly salient to his purposes, e.g., a sick drunk in the gutter. Finally, when processing demands become extreme, responsibilities are shifted from self to others, e.g., bus drivers require that passengers have the correct change, doctors require that patients come to them, etc. In all of these situations there appears to exist an overriding tendency to insulate oneself from even minimal "irrelevant" social contacts, and by so doing, lower the probability of overload. By the same token, however, this decreased social contact results in a lower probability of engaging in prosocial behavior, e.g., doing favors, helping strangers in need, or just plain friendliness in countenance and manner.

An experiment designed to test these hypotheses was conducted by Krupat and Epstein (1973). Subjects were required to sift through and evaluate a large pile of scouting reports, being told that they would have to work very hard to do their job well and that once the pile was completed, there were more reports to evaluate. Their findings were generally in accord with Milgram's hypotheses, i.e., overloaded subjects spent less time on each input than control subjects, although more time was spent on low priority than high priority inputs. Overloaded subjects also diffused responsibility to others more often, and in so doing, engaged in less prosocial behavior.