Conceptual Dimensions of Crowding Reconsidered

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A recent and noteworthy facet of crowding research has been the exploration of the perception of high density/crowding experiences. A review of the methods and results of these investigations reveals considerable variation across studies on the dimensions of stimulus domain and selection, attention to intersubject differences, and approaches to interpreting results. The outputs of these studies do not appear as clearcut as has been suggested. It is hoped that the raising of these issues will result in more careful and fruitful research in this area. The links between conceptual crowding, situational variables, intrapersonal variables, and behavioral responses to high density/crowding are discussed.

There has been a recent upsurge of interest in how people perceive high density and crowded situations (Schopler, Rusbult & McCallum, 1977, 1978; Stockdale & Schopler, 1978; Stockdale, Wittman, Jones & Greaves, 1977, 1978; Taylor, 1978, 1979). These recent studies have been concerned with understanding the dimensions of crowding from the viewpoint of the perceivers. To avoid experimenter bias, these studies have used nonmetric multidimensional scaling (MDS) techniques (Kruskal, 1964). In the present paper these studies will be briefly reviewed. The overview of recent work in this area reveals considerable variation across studies in terms of method (particularly stimulus domain/selection and analysis of the contribution of intersubject differences) and results. The implications of this variation are discussed in relation to improving future

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research in this area. Finally, some parallels between the results of studies to date and past conceptualizations of crowding experiences are noted.

A RESEARCH SYNOPSIS

Schopler et al. (1977, 1978) felt that an understanding of how people conceptualized crowding experiences could provide evidence in favor of one of the several existing definitions of crowding. To obtain crowding stimuli, 70 undergraduates each wrote an essay about one time in their lives when they felt very crowded. The experimenters removed from this set incomprehensible, ungrammatical, and duplicate essays. Similarity judgments (rankings) on the remaining 46 crowding situations were obtained from another 41 subjects. The resulting dissimilarities matrix was submitted to a nonmetric MDS program (ALSCAL). A three dimensional stimulus space and a subject space (salience weights of each dimension for each individual) were obtained. To help interpret the MDS dimensions, alignment between ratings of the stimuli on 14 experimenter-chosen scales and positions of the stimuli in the MDS were computed. This additional information indicated that the three dimensions in the stimulus space were: (I) physical-psychological, (II) familiar-unfamiliar, and (III) resultant stress.

Stockdale et al. (1977, 1978) carried out a study in England which was fairly similar to the study by Schopler et al. (1977, 1978). Descriptions of 100 crowded situations were obtained and then rated by four judges on 20 experimenter-chosen scales. Principal components analyses of the scale X scale and stimuli X stimuli correlation matrices were carried out. Fifteen stimuli which exemplified the important principal components were then selected. Similarity judgements between pairs of stimuli were obtained from 32 subjects, and results were submitted to INDSCAL, a version of nonmetric MDS which provides both a stimulus space and a subject space. In order to interpret the resulting four stimulus dimensions positions of the stimuli on the INDSCAL dimensions were correlated with ratings of the stimuli on experimenter-supplied scales. The INDSCAL dimensions were labeled as: (I) interpersonal overload vs. interference, (II) alienation, (III) anger vs. claustrophobia/helplessness, and (IV) stress plus negative affect vs. behavioral response. A hierarchical clustering analysis grouped the crowding experiences into a "physical crowding" cluster, and a "psychological crowding" cluster.

Taylor (1978, 1979) explored the perception of neutral-secondary crowding experiences. [Stokols (1976) has recently proposed a fourfold typology of crowding experiences. The two dimensions of the typology are (a) personal thwarting (attributed to intentional social forces) vs. neutral thwarting (attributed to unintentional sources), and (b) primary environments where an individual spends a lot of time and relates to others on a personal basis vs. secondary environments where one stays for a shorter period of time and interacts with unacquainted others.] A pool of graduate and undergraduate pilot subjects generated examples of neutral-secondary types of crowding experiences. Guided by these examples, the experimenter constructed 12 stimulus situations which varied on type of activity (standing in the airport waiting room vs. attending the first dance of the year at a nearby college where you do not know anyone), spatial density, and group size. Pairwise similarity judgments were obtained from 30 subjects and submitted to a modified Tucker and Messick (1963) individual differences approach to multidimensional scaling. The Q-mode principal components analysis indicated that intersubject agreement accounted for 37 percent of the variation in the subjects X subjects matrix. Three clear-cut groups of subjects accounted for most of the remaining variation. Using TORSCA, a nonmetric MDS program, a stimulus space was derived for each of the three groups.

Two steps were taken to help interpret the results. First, subjects were asked to describe in their own words the most important attribute on which the stimuli differed. The type of attribute offered was a good predictor of the grouping (in the subject space) to which each subject belonged. Second, subjects were asked to describe in their own words how situations at opposite ends of the stimulus space differed from each other. The multidimensional structure of each group included dimensions of social constraint and spatial constraint. The main difference across groups was the relative weight assigned to these dimensions.

AN ASSESSMENT OF THE VARIATION ACROSS STUDIES

This brief outline of the Schopler et al. (1977, 1978), Stockdale et al. (1977, 1978), and Taylor (1978, 1979) investigations indicated that there is substantial variation, on several dimensions, across studies. This variation will be discussed with regard to three sets of issues: (a) stimulus domain and stimulus selection, (b) the role of intersubject differences, and (c) interpreting stimulus spaces.

STIMULUS DOMAIN AND SELECTION

The original application of MDS was to similarity judgments of varying shapes (Torgerson, 1958) and colors (Carroll, 1972; Shepard, 1972). In this psychophysical realm the characteristics of the stimulus domain—a definition of stimulus parameters and a statement of limiting values on those parameters—are usually known or at least readily computed. It is important to know the bounds of the stimulus domain for two reasons. First, use of a slightly different stimulus domain can drastically alter the resulting stimulus space (Torgerson, 1965). Second, the stimulus sample should have a stimulus domain which adequately represents the stimulus population, and it is important to know whether or not this is the case. There are a couple of technical issues that complicate the discussion of obtaining representative stimuli for MDS procedures. First, MDS solutions are influenced more by large distances (which would result if extreme items from the stimulus domain were included), than they are by smaller distances (which would result if items from the midrange of the stimulus domain were included). However, this difficulty can be overcome in that many MDS programs permit large distances to be "ignored." Thus, the program can be run once with the large distances and again without, and the two solutions compared. Second, representativeness is limited by the number of stimuli that particular MDS programs or subjects can handle. This problem can be partially handled by using programs that allow different subjects to provide distance judgements for different portions of the stimulus domain.

Unfortunately, as we move from the realm of psychophysical stimuli to the realm of more psychological stimuli, it becomes increasingly difficult to clearly define the stimulus population and, consequently, more difficult to obtain a representative sample of stimuli whose domain adequately covers the population. (See, for example, Rosenberg & Sedlak, 1972 on the problem of drawing representative samples of trait words.) In the crowding realm researchers have had varying levels of success in dealing with the problem of drawing representative stimulus samples.

Schopler et al. (1978) note that it is desirable to avoid biasing the stimulus set in favor of one of the several existing definitions of crowding. The authors are also conceptually clear about the differences between obtaining a stimulus population and a sample stimulus set (p. 232). However, as described above, in the actual study these two steps are confused. Their procedure can probably best be interpreted as obtaining a stimulus sample whose representativeness is unknown. Related to this problem is the fact that, aside from eliciting one crowding experience from each of 70 undergraduates, Schopler et al. made little effort to define the parameters or limiting values of the stimulus domain. Nonetheless, the experimenters' failure to delimit and bound the stimulus domain is understandable as part of their efforts to avoid introducing experimenter bias.

Stockdale et al. were procedurally clear about distinguishing between the stimulus population of crowding experiences and the stimulus sample. The stimulus sample may have been biased in that it was based upon the principal components analyses, and these analyses used rating scales that were chosen by the experimenters. Thus the resulting scale dimensions, and the crowding situations which are extreme on those dimensions, are somewhat arbitrary. [Experimenter-supplied scales encourage raters to discriminate among the stimuli on *those* dimensions; variation among the stimuli along other, potentially important dimensions is not revealed in the ratings. Thus, the resulting principal components analyses may reveal only a portion of the underlying dimensions. A fruitful attack on this problem is to compare experimenter-supplied and subject-supplied dimensions to determine the degree of overlap (e.g., Taylor & Stough, 1978).] The parameters of the stimulus domain were principal components which were derived, and the limiting values were the extreme stimuli on the dimensions. Again, given that the rating scales were experimenter-supplied, the delimitation of the stimulus domain is potentially biased.

Taylor specified neutral-secondary crowding experiences, a priori, as the stimulus population of interest instead of the less restricted population of crowding experiences. From that population a stimulus sample was constructed. The sample, while not clearly representative, appeared to be at least prototypical of the stimulus population in light of the pilot results.The stimulus domain was artificially defined in that three parameters of crowded situations were varied, and arbitrary limiting values on each of those parameters were selected.

Two of the parameters—spatial density and group size—are not, strictly speaking, artificial or unimportant. Rather, these are the two accepted components of density (Loo, 1973), while density, in turn, has been accepted as a necessary (but not sufficient) condition for crowding (Stokols, 1972,1976,1978).

Thus, studies to date have had varying success in dealing with the tasks of defining the stimulus population, defining the stimulus sample, and being explicit about the stimulus domain of the study; that is, the parameters along which the stimulus sample varied and the limiting values on those parameters. Suggestions for dealing with these tasks in future research are described below. These proposals are not offered in a prescriptive or authoritarian tone, but rather in the hope that consideration of these guidelines will result in better research.

First, the researcher may find it helpful to specify beforehand and as clearly as possible the stimulus population of interest. It is not clear that "crowding" experiences is an adequate description of the population. The crowding construct has recently been better specified (Stokols, 1978), and researchers may find it helpful to take into account these advances.

One approach which may also be helpful in describing the stimulus population would be to ask pilot subjects to keep a diary of situations which were of high density, or where they experienced crowding. If an adequate sample of pilot subjects are used and the diaries are continued for a reasonable length of time, a sufficient stimulus population should result. (Pilot subjects could also be asked to describe, in their own terms using a modified Kelly (1955) Repgrid procedure, how the situations varied). One advantage of deriving the population in such a way is that the situations should be familiar to the subjects who later make similarity judgments.

Second, it would be helpful for future researchers to clearly distingush between the stimulus population and the stimulus sample. To date, different methods for drawing the sample from the population have been used. One approach which may prove useful would be to elicit stimulus-relevant dimensions from subjects, and then obtain ratings of the stimuli on the dimensions. One could then proceed in a fashion similar to Stockdale, et al., selecting the stimuli that describe the major underlying dimensions.

Finally, it is helpful if researchers clearly specify the parameters and limiting values of the stimulus domain. This information may be crucial for evaluating future research in this area. If two studies result in different conceptual crowding dimensions, this may be due in part to differing stimulus domains (see Taylor 1979). If two studies using the same stimulus domain obtain quite discrepant conceptual crowding dimensions this may be due, in part, to subject pool differences or to the inherent stability of the cognitive structures investigated.

THE ROLE OF INTERSUBJECT DIFFERENCES

Schopler et al. (1978) and Stockdale et al. (1978) used INDSCAL MDS programs which derive a stimulus space and a subject space. The subject space indicates how much weight each subject assigns to each dimension of the stimulus space.

The modified Tucker and Messick procedure used by Taylor (1979) involves a Q mode principal components analysis. The size of the first component derived from the subjects X subjects cross-products matrix indicates the degree to which subjects agree with each other in their judgments of the stimuli. Thereafter, the Tucker and Messick approach proceeds in a fashion roughly analogous to INDSCAL, except that the dimensions of the subject space are not explicitly tied to the dimensions of the stimulus space.

Assessing the degree of intersubject agreement is worthwhile on several counts. First, a low figure, such as the 37 percent agreement obtained by Taylor (1979), indicates that people vary in how they perceive high density situations. This suggests that the differential impact of density across persons is due, in part, to differential perceptions. This assumes that the behavioral impact of high density is mediated by the perception of crowding (Verbrugge & Taylor, 1976, 1977; Stokols, 1978, p. 226). (A high degree of intersubject agreement would have also been interpretable in light of research to date. High agreement would suggest that people perceive high density similarly; that is, feel the same type and intensity of crowding, but that they choose differing coping strategies.)

Second, these figures set a rough ceiling on the strength, in regression terms, of density main effects. Thus, for example, in a survey concerning the effects of residential density, the highest R^2 obtained when predicting subjective crowding from physical density would be about .37. This ceiling would be firm if other studies found the some degree of agreement as Taylor (1979). Several studies on the perception of density are actually needed before a ceiling could be firmly established. The actual ceiling which is eventually established may be much lower than .3. To explain additional variance we must look to interaction effects of density with intrapersonal variables.

Finally, the degree of intersubject agreement on perception of density is important for the purpose of arousal reduction. Several researchers have suggested that it is possible to reduce crowding stress through arousal reduction and attributional techniques (e.g., Baum & Fisher, 1978; Worchel, 1978). To the extent that there is substantial intersubject agreement on the perception of high density or crowding situations, researchers might expect one arousal reduction technique would be adequate for a range of persons. To the extent that there are substantive intersubject differences in perception, researchers might expect that different arousal reduction techniques would be needed for different persons.

Predicting the intrapersonal variables that shape the perception of high density or crowded situations will continue to be an important facet of research on conceptual crowding. Results to date suggest that standard personality batteries are of little help. Taylor found that the attributes subjects applied to the stimuli were associated with their position in the subject space. Such an approach may be useful for predictive purposes and deserves to be explored in future research efforts.

LABELING STIMULUS DIMENSIONS

A problematic aspect of MDS solutions is the labeling of the resultant dimensions. Studies in the conceptual crowding area have differed in their treatment of this problem. Schopler et al. (1978) and Stockdale et al. (1977, 1978) obtained ratings or rankings of the stimuli on experimenter-supplied scales and determined which scales were associated with which dimensions of the MDS stimulus space. The scales most closely associated with each dimension provided the label for it. Such a labeling procedure is somewhat arbitrary in that the range of possible dimension labels is restricted to the range of experimenter-supplied scales. A further problem with this approach is that, when several scales match quite closely with a dimension, several labels are possible for that dimension. For example, Schopler et al.'s first dimension of physical-psychological crowding could also be interpreted as a high density-low density dimension or a control-lack of control dimension. Schopler et al.'s second dimension was labeled as a familiarity-outsider dimension. However, examination of the stimuli at the extremes of this dimension (see Schopler et al., 1978, p. 236) suggests that this dimension separates the two modal patterns of crowding postulated by Stokols (1978, p. 238): personal = primary crowding *vs* neutral-secondary crowding.

Stockdale et al. also obtained scales which closely aligned with the INDSCAL dimensions. Again, however, several of the dimensions were each associated with more than one scale, making interpretation somewhat difficult.

One intriguing finding in Stockdale et al. was that a hierarchical clustering analysis yielded two groups of stimuli, labeled by the authors as physical and psychological crowding. Close inspection suggests that these two clusters correspond to Schopler et al.'s second dimension and to Stokols' two modal crowding patterns of (respectively) neutral-secondary and personal-primary crowding.

The use of experimenter-supplied scale ratings to interpret MDS dimensions may lead to somewhat inflated estimates of comparable results across studies. Thus, while Stockdale and Schopler (1978) were encouraged that their two different studies yielded somewhat comparable results, the comparability may, in part, be due to the fact that the two authors share a similar theoretical orientation (Schopler and Stockdale, 1977). Thus, subjects in their respective experiments may have received comparable experimenter-supplied scales.

The approach used by Taylor (1979) to help label MDS dimensions is one which is less prone to experimenter influence. Subjects were asked to supply bipolar dimensions to describe how stimuli at the opposite end of each dimension were different. Subjects in each grouping provided similar labels for each dimension. While this approach does not *guarantee* insight into the MDS stimulus space, at least in the Taylor study it aided considerably in interpreting the results. This approach would seem to be worthy of further investigation.

CONCLUSION: A LOOK BACK AND A LOOK AHEAD

The recent trend in human density/crowding research toward investigating the perception of high density/crowding experiences is a laudable development. Such investigations offer the possibility of viewing crowding through (relatively) unprejudiced eyes. Furthermore, this trend represents an essential and necessary advance in crowding research. Since the distinction between objective density and subjective crowding was originally made (Stokols, 1972), it has become increasingly clear that to understand the human response to high density we need a firmer grasp on how those situations are interpreted (Stockdale, 1978; Stokols, 1976, 1978).

The studies discussed in this paper represent the efforts to date to obtain an unbiased view of how people perceive crowding. Close inspection of the methods and results suggest that the outputs of these studies are not as clearcut or encouraging as some have suggested (cf. Stockdale & Schopler, 1978). However, close attention to the issues raised in the present paper should spur more careful and more useful research in this area.

Looking ahead, there are two crucial tasks for research in this area. First, the perception of crowding needs to be linked to objective situational dimensions and behavioral responses to crowding. The crowding construct, as a mediating variable, will not be very helpful unless it is firmly anchored at both ends (Hull, 1943; Stokols, 1978). This is probably *the* paramount task for researchers in this area. Second, it is important to identify how (and what) intrapersonal variables are linked to the perception of density. An understanding of this linkage will help in predicting the differential impact of density across persons.

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