où \( n_i \) et \( n_i \) sont les effectifs des deux échelons groupés. On montre aisément que, pour tout couple de variables \( x_i \) et \( y_i \) positives, l'expression (1) ci-dessus est une fonction croissante du produit \( i = n_i n_j \). Il suffira alors de grouper les deux classes pour lesquelles le produit \( n_i n_j \) est minimum.

**Rapports entre \( C_x \) et \( C_y \)**

Les réponses des sujets aux items étant consignées dans un tableau, les colonnes correspondent aux items et les lignes aux sujets, l'entropie des distributions marginales permet de calculer \( C_x \) et \( C_y \). L'entropie de la distribution marginale \( H(x) \) est égale à \( I \) quand on considère globalement chaque item, et à \( I \) quand on distingue bonnes réponses et erreurs. L'entropie de la distribution \( H(y) \) est égale à \( H_y \) quand les sujets sont groupés en échelons et à \( H \) quand ils sont groupés par patterns.

**Bibliographie**


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**Discussion**

James Zubin: The rather stimulating presentation by Professor Guttman of facet design theory has led to a simplification of a system for the classification of measuring techniques in abnormal psychology as well as in general psychology. Burdock, Sutton, and I have tried to classify the available measuring techniques in terms of the type of stimulus and type of response. The result is a two-way table with examples of the way in which each type of stimulus, energy or signal, can give rise to either a physiological,  

sensory, perceptual, psychomotor or conceptual response. This classification, of course, disregards other aspects of the classification problem, e.g., effect of instructional variable, effect of previous experience, etc. The framework of facet theory suggests the following extension of our two-dimensional classification:

A response, \( R \), may be considered a function of the multiplex of conditions under which it arises, viz. \( R = f(x, y, z \ldots) \).

To the extent that we can specify these variables, we can explain the variation in \( R \). In the limit, a complete determination of \( R \) would account for all its variance, save only error of measurement. In so far as the determination is incomplete, unknown factors, such as personality variables, may be postulated.

In Guttman's terms, our \( x \)'s, \( y \)'s and \( z \)'s may be grouped into sets to form a Cartesian product:

\[
R = (S) \times (R_e) \times (I) \times (O) \times (E) \times \ldots \times (P).
\]

\( R \), the response selected for observation, may take the form of either a physiological, sensory, perceptual, psychomotor or conceptual behavior. \( S \) may represent the type of stimulus presented, \( R_e \), the type of receptor organ stimulated, \( O \), the state of the organism dealt with, \( I \), the type of instructional variable, \( E \), the type of previous experience, \( P \), a set of personality variables. In order to specify these facets more exactly, we can proceed as follows:

We can specify \( S \), the stimulus facet as follows: 1. Physical parameters—frequency range (or wave length) of electromagnetic energy impinging on the organism or strength of gravitational field, intensity, duration, area, interval between repetitions of stimulus; 2. Signal components—configurations, signs, symbols.

The receptor organ, \( R_e \) (anatomical) can be specified as follows: 3. appropriate vs. inappropriate. If the stimulus impinges on a receptor which is particularly sensitive to the range of energy—sound on the ear, light on the eye, we may regard the receptor organ as appropriate to the stimulus. Otherwise, it is inappropriate, e.g. pressure on the eye ball evokes phosphene, but the eye is not essentially a pressure receptor. 4. Specific involvement of receptor organ—in vision, for example, monocular vs. binocular viewing, size of pupillary opening, location of stimulus on retina, visual angle subtended by stimulus patch, etc.

The instructional variable, \( I \), usually determines the attitudinal set of the subject. Thus, the instruction to respond as quickly as possible may produce responses quite different from those which would follow instructions to respond as carefully as possible.
The state of the organism, $O$, includes constitutional and physiological characteristics as well as temporary states. Thus, age, sex, physique, psychopathology, hereditary characteristics etc. are included as well as fatigue, degree of light or dark adaptation, metabolism, nutrition, body temperature, drugs, presence of intersensory effects, etc.

The past history of the subject, $H$, includes not only the types of development and maturation which characterize an entire species, but also the cultural and social characteristics acquired during the life of the individual. Thus, it includes the "unlearned" behavior, the developmental and maturational factors, as well as the culturally acquired meanings which serve as internal stimuli to behavior.

Under $P$, personality, belong such systematic tendencies as impulsiveness, caution and other personality characteristics which may modify the response.

Let us now apply this type of facet analysis to a specific experiment, size constancy judgments, in which a variable circle of light is matched with a standard at a given distance.

$R$, the response characteristically selected for observation, is a perceptual response, since it involves discriminating among a variety of sizes and matching them to the standard.

The stimulus consists of light energy impinging on the retina, its luminous intensity, wave length, saturation, temporal duration and distribution depending upon the light reflected by the object under view and by its surround. The distribution of energies in the retinal image, according to Gibson<sup>4</sup>, is sufficiently rich and variegated to account for size, shape, hue, brightness, slant, texture, distance, depth and other perceived properties of the object. The stimulus correlates for each of these parameters are not yet fully identified. When they are finally known, a more direct and conclusive analysis of the size constancy problem will be possible. The fundamental parameter is, of course, physical size, but the other determinants are probably critical.

Not only the light energy impinging upon the retina, but the distances between observer and standard (object to be viewed) and observer and variable (object to be selected as matching the standard) can be varied independently.

As for the receptor organ, the eye, the following features may be varied: monocular vs. binocular view, size of pupillary opening, position of image on the retina (foveal or other) and visual angle subtended by the object.

The instructional variable refers to the directions given the subject.

<sup>4</sup> The perception of the visual world, New York: Houghton Mifflin and Co.
The instructions can be varied so as to induce an object-oriented attitude or a retinal-image-oriented attitude, or a compromise between these two extremes.

The state of the organism can vary with reference to age, physique or body type, fatigue, level of metabolism, etc.

The past history of the organism is relevant in terms of previous knowledge of the object being viewed, practice in making size judgments, etc.

Significant personality variables include such factors as caution in making judgments, attentiveness, level of motivation, anxiety, and perhaps such traits as introversion and extraversion.

Both the main effects and the interactions of these parameters need to be considered.


It becomes clear that the grouping of these sets into facets, produces a tremendous number of possible patterns of choice for a given experiment. The sagacious experimenter can review the various patterns possible and select either arbitrarily, where no knowledge is at hand, or advisedly, the particular pattern most suitable for answering the question he is asking.

Perhaps, random sampling from each of the facets will have to be undertaken in order to obtain a representative set of parameters for experimental procedures. This may yield the goal which Brunswik sought. Application of facet design should facilitate the choice of the most useful set of parameters and also help to explain differences among results from different laboratories.