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EFFECTS OF VARIATION
IN FIDELITY LEVEL OF VISUAL STIMULI

by

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PREVIEW

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CHAPTER I

INTRODUCTION

From the advent of man's consideration of himself, perception has been regarded as one of the most basic aspects of individual life. Intensification of this study of perception was made a predominant characteristic of the Introspectionist School of Psychology. Recent developments in the search for explanatory principles have led psychologists to explore new dimensions of the functional qualities implicit in perceptual processes. Within the last decade increased emphasis has been directed toward a new phase of the total problem of perception; this phase was embodied in the exploration of the correspondence of stimulus input and response output.

Purpose of the Study

The purpose of this study was to evaluate the effects of changes in the fidelity of stimulus conditions. In this investigation were considered the differentials in responses to selected items used in the 1966 revision and restandardization of the Hiskey-Nebraska Test of Learning Aptitude (Hearing Form) and the same items presented on 35 mm color transparencies. A second purpose was to evaluate possible administrative advantages of a 35 mm presentation.

Background of this Study

Relevant to the purpose of this study as stated above, three areas of discussion were pertinent to the background development of this problem. The first of these was the pictures or chirographs used in the measurement of aptitudes as attempted by other standardized tests. The second of these was the type of illustrative material used in personality evaluations. The third area, perceptual theorizing, was seen as relevant because therein were found the explanatory principles by which the scientific study of perception has been pursued.

The history of aptitude testing has been characterized by greater and lesser approaches to validity. It would seem reasonable to assume that when people first noted that some persons were more adept than others at given tasks, that aptitude testing, in a casual sense, began. These first evaluations were probably performance tasks or work samples. As the cultural pendulum was seen to swing toward increased literacy, these evaluations were also drafted more and more in terms of verbal abilities. The era of the present century has been characterized by increasingly well-standardized aptitude tests which have been generally quite "schoolish" in nature.

Pictures have been seen to appear rather regularly in the aptitude tests published since 1900. While some of these have been in color, most have been monochromatic. All, however,

have been chirographs. Early examples which might be cited were the Healy Picture Completion I (color) which was a part of the Pintner-Paterson, the Healy Picture Completion II (color), part of the Arthur Point Scale, and the 1916 Stanford-Binet (monochromatic). The tendency to use linear drawings has been seen in recent aptitude tests as well. Among these were the newer Wechsler Scales, the Columbia Mental Maturity Scale and the 1960 revision of the Stanford-Binet Intelligence Scale. Although some color was employed in the Wechsler and the Columbia, it was never used to enhance realism.

The Illinois Test of Psycholinguistic Abilities was identified as an exemplar of a recent instrument in which non-chirographic pictures were used. In the ITPA, the pictures used were photographs selected from other printed materials. The ITPA has generally been used as a diagnostic test supplementary to an individual intelligence test; a psychometrist does not determine an intelligence quotient or a mental age score from it. Accordingly, it was not included with the other aptitude tests.

There has been one other aptitude test which was seen as worthy of parenthetical mention. This was the Seashore measures of musical talents. Whereas the linear drawings that were first included in intelligence tests have not been changed particularly, the Seashore has been characterized by a metamorphosis catalized by modern technological change. Only a generation ago the Seashore items were recorded on a 78 rpm disc. As advances have been made in sound reproduction, the records were changed first

to 33 1/3 rpm, high fidelity, and then to tapes from which very high fidelity music can be reproduced. One might find it interesting to speculate why illustrative material has been characterized by such a great cultural lag when this has not held true for audio materials.

The concept of fidelity in visual material has been especially interesting in the area of personality measurement. In the measurement of intellectual ability, the psychologists sought an illustration which would not be mistaken for any other object; this was to insure validity. However, in personality testing, psychologists have sought just the opposite, namely, the production of a stimulus vague enough to permit the subject to structure it in terms of his own perception. Curiously enough, this too was considered as productive of validity. This paradox has resulted in an emphasis on the operational meaning of the term "validity".

The next term which required definition at the present point in this discussion was "fidelity". When, to illustrate an object, the object itself has been used, it can be said that the fidelity was perfect. Usually fidelity must be considered because a surrogate has been substituted for the object itself. A surrogate has been defined by Gibson (1954) as an artificial stimulus. He went on to specify that a picture of high fidelity was

...a delimited physical surface processed in such a way that it reflects (or transmits) a sheaf of light rays to a given point which is the same as would be the sheaf of rays from the original to that point (p. 14).

Fidelity was therefore to be considered as a continuum characteristic which would be said to exist to the degree that the above definition was approximated.¹³

In the light of the consideration of the definitions of these two terms, the paradox of a valid, low fidelity picture as the stimulus for a personality measure was resolved.¹⁴ Accordingly tests such as the Thematic Apperception Test, the Children's Apperception Test, the Rorschach Inkblot Test, the Blacky Pictures, and various other similar personality measures have been devised and found productive in clinical and research settings.¹⁵

At this point of the background development, the reader might very well ask just how important a high fidelity surrogate or picture is for aptitude testing. Isn't it sufficient that a surrogate be valid? The purpose of this study has been to add light to this question. If a higher fidelity picture such as a 35 mm color transparency was not found to be associated with responses superior to those given to a lower fidelity line drawing, then the conclusion might be drawn that in intelligence testing the fidelity of the surrogate was not crucial in the eliciting of responses.

What contributions to this gap in existing knowledge have been made by modern perceptual theory? Perceptual theories have been classified in many ways. However, those relevant to the purpose of this study, the significance of fidelity, have been characterized by the importance attached to the

realism of the surrogates involved. Leonardo da Vinci, working in the 1580's, tried to set down rules for the making of realistic pictures. He attempted to copy the physical characteristics of the scene in such a way as to produce the same impression as would be given by the scene itself. The method used was to begin with a pane of glass which was held so that the scene or object to be painted was viewed through the glass. Da Vinci next traced the necessary outlines of the picture as they appeared on the surface of the glass. The drawing which was produced by this technique was a fairly accurate optic array of the light rays which had been reflected from the original. On the basis of this approach, da Vinci developed the laws of perspective which have been reported to the present time in books on art and psychology.

Although perception was the central feature of the Structuralist or Introspectionist school led by Wundt, the experimental work done was concerned with the response to the stimulus in terms of its own value. Its preoccupation was primarily with developing analytic introspection as a technique for the study of sensation, the elemental unit of perceptual experience. Although this was an early and honest attempt to apply the emerging scientific method to the study of psychology, it was criticized by many as being too subjective to be defensible. These criticisms of course have been proven valid by later studies in perception. The main point relevant to the historical study of perception was that once these scathing remarks had been leveled at the Structuralists, other psychologists for several decades were unwilling to venture into

the theoretical or experimental development of the area, according to Woodworth and Sheehan (1964). As the Behaviorists, who had been particularly cutting in their remarks about the Structuralists, began to experience a metamorphosis in the development of their school of thought in the 1930's, the study of perception once again was accorded a position of respect. The growth of perceptual studies was somewhat interrupted by World War II, but the ensuing years have been characterized by much serious and noteworthy work both theoretical and experimental.

In the later days of World War II Morris (1946) contended that signs could be studied on a behavioral basis. His definition of a sign was as follows,

If A is a preparatory-stimulus that, in the absence of stimulus-objects initiating response-sequences of a certain behavior family, causes in some organism a disposition to respond by response-sequences of this behavior-family, then A is a sign (p. 354).

Between language and images or pictures, Morris made a distinction based on iconicity. To be considered iconic a sign had to have in some degree the properties of its denotata. As can be seen from this definition, language would be non-iconic while images and pictures would be iconic. The extent of iconicity was obviously a variable feature and could be rather limited as in the case of a line drawing or, somewhat greater, as in the case of wax models.

Since Morris set forth his original theory, much thought has been stimulated among psychologists, particularly those involved in training and communication. The theories that have been produced have been classified on a continuum of greater and

lesser "realism". Morris, of course, took the position of a realist. The sign-similarity theory of Carpenter (1953) has been considered as a realism theory too (Dwyer, 1967, p. 251), but there have been aspects of this position which vary from the pure realistic approach. The least realistic aspects of his sign-similarity theory were embodied in the Personal Need Hypothesis and the Personal Involvement Hypotheses. In each of these hypotheses attention was given to the status of the respondent; this approach of necessity was associated implicitly with diminished significance being accorded the stimulus conditions. It should be noted that these two hypotheses were also related to a recognition of individual differences referred to below.

Carpenter (1953) stated that there were basically three considerations to be recognized in dealing with the problem of realism in media. The first aspect was the problem of representing objects, situations, and processes as they actually appeared. This was, of course, an intensely realistic statement. However, this was tempered by the second aspect of realism, the problem of representing objects, situations, and processes in such a way as to facilitate a particular perception and understanding. In this was contained regard for the point of view that the object, situation, or process itself was possibly not always the best representation for the purpose of understanding, analyzing, and so forth. Beyond these lay the third aspect to be considered in realism, the problem of representing abstract ideas and the force of ideas. In his work with sound films, Carpenter said he had found the following to be true.

It is possible with the sound film medium to introduce correctives in the stimuli of the visual and auditory stream of events, taking into account limitations, distortions, and selective processes of normal human perception in order to insure the intended accuracy of perceptions, dependent cognition, and understanding. Thus, action may be slowed down or speeded up, small objects may be magnified, inaccessible parts of machines or organisms may be shown in animation...In other words, film instruction should take into account and correct for the known characteristics, "filters", and limitations of selective sensory-perceptual processes, and introduce adjustments in such ways as to correct and supplement these processes in the interest of evoking the desired significances, understandings, impressions, meanings, and responses in the film viewers (p. 41).

In the development of the above ideas, Carpenter formulated the Sign Similarity Hypothesis as a position available for testing. He stated,

That films whose signals, signs, and symbols have high degrees of similarity ("iconicity") to the objects and situations which they represent will be more effective for most instructional purposes than films whose signals, signs, and symbols have low degrees of "iconicity".

The experimentation associated with this hypothesis (see Chapter II) by Vander Meer (1952), Tye (1950), and others has not been supportive of any clear cut conclusions relative to the significance of fidelity of stimuli.

Carpenter's (1953) second research hypothesis was the Releaser-Organizer Hypothesis. In it was stated that "... the signals, signs, and symbols of ... pictures function principally as releasers and organizers of meanings and responses in human subjects". The significance of this hypothesis was found in its regard for individual differences. Carpenter

observed that given a constant presentation, different individuals reacted and interpreted quite differently. This was suggestive of the concept that the significance of the stimulation was both dependent (or inter-dependent) on the stimulation and the brain processes activated in the experiencing subjects. From this Carpenter concluded that the functions of signals, signs, and symbols was,

to release responses in subjects. The stimulus values of communication signs...are not inherent in the signs themselves. Signs and symbols do not transmit meanings; they release meaning when and only when the subjects respond (p. 43).

From this it followed that the individual differences of the subjects themselves were an integral part of the planning of a communication.

Carpenter (1953) also considered a hypothesis which was to find even greater development in information theory discussed later in this chapter. He stated,

That there are definable limits to the amount of content which can be channelled through a sound motion picture, i.e., through the visual and auditory modalities of perception; and there are limits to the capacities of individuals for reacting to, imprinting, and retaining the information or content (p. 43).

This hypothesis has been developed along two lines: a) there were optimal amounts and rates of presentation and levels of difficulty for different kinds of materials, and b) that there were wide individual differences for reacting to and assimilating information. An additional concern pertinent to channel capacity was the organizational outline of the material. The explanatory

principles underlying organization in stimulus materials were, Carpenter felt, contained in "gestalt" psychology. Essentially the same ideas were considered later by information theory under the heading of redundancy.

Shortly after the sign-similarity theory appeared, Gibson (1954) presented another theory of pictorial perception. His work, the result of a contract for the United States Air Force, was a theory about basic factors underlying the psychological functioning of audio-visual materials as aids to learning and perception.

Gibson (1954) began the exposition of his theory by saying,

A distinction is possible between what is commonly called experience at first hand and experience at second hand. In the former one becomes aware of something. In the latter one is made aware of something (p. 4).

The first process has been called perception; the second Gibson referred to as indirect perception. The principle vehicle for this kind of indirect perception has been language. However, pictures and models have become an increasingly prominent vehicle for indirect perception in the last two generations, and accordingly Gibson saw a need to clarify some background thinking about them.

An obvious fact about perception, Gibson asserted, was that it was different for different things. Perception referred to specific things, and as one discriminated and identified his perceptions, he was said to have learned. So, Gibson continued, learning implied both sensitivity to the stimuli and correctness of reaction. However, the actual stimuli were not always as

presented in the training situation, and the expedient was to train the learner in artificially constructed situations, and to assume transfer. These artificial stimuli were termed "surrogates" by Gibson. Use of surrogates was associated with many questions. What kinds of surrogates were best? Were different surrogates more effective for different situations? What were the advantages of pictures? Should pictures be realistic or schematic? Is the perception of three-dimensional space reproduced by pictures?

Gibson sought to clarify his theory by defining a surrogate as

a stimulus produced by another individual which is relatively specific to some object, place, or event not at present affecting the sense organs of the perceiving individual (pp. 5-6).

He went on to say that he was accordingly primarily interested in how perceptions mediated by surrogates also came to correspond to realities. The precision of the apprehension of the surrogate maker was hence a determining factor in the specificity of the indirect perception.

Some distinctions were drawn by Gibson (1954) to set his term, surrogate, apart from Morris's term, sign. Morris (1946) considered signs to be inclusive of words, images, and pictures. As mentioned earlier, iconicity was the quality that separated them. This separation was not clear cut, but rather something of a forced dichotomy imposed upon a continuum wherein words (non-iconic) were isolated from pictures (iconic) by graphs and charts which were both iconic and non-iconic. Having made this point, Morris then developed his theory around words instead

of pictures as Gibson did. Surrogates were restricted by Gibson to mean the stimulating aspects of the environment which had been produced by another individual. Also excluded from the classification, surrogate, were the "expressive" or "emotive" signs so that only cognitive features have been incorporated.

One classification made of surrogates involved the degree to which they were similar to the thing denoted. Some surrogates were arrived at by social agreement; these have been termed "conventional" surrogates. A pointed example of this would be a person's Social Security number. Although no resemblance of the individual was borne by the digits assigned to him, this number has been equated to him in far-reaching ways. Non-conventional surrogates, on the other hand, were projective or replicative. A finely detailed wax model would be an example of a non-conventional surrogate. Conceivably the surrogate could be constructed to represent the object itself to the extent that a perceiver might not be able to distinguish the two. Gibson (1954) made a point quite relevant to training situations on the basis of these two types of surrogates. He said that the more nearly a surrogate was projective or replicative, the less associative learning was needed. Much associative learning was required however in the case of conventional surrogates.

The ability to represent a specific object Gibson (1954) termed "fidelity". He said,

A faithful picture is a delimited physical surface processed in such a way that it reflects (or transmits) a sheaf of light-rays to a given point which is the same as would be the sheaf of rays from the original to that point (p. 14).