One-Dimensional Size Constancy in Two Planes

James Hominuke
Loyola University Chicago

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VITA

Bachelor of Science in Education,
Northwestern University, 1943.

Bachelor of Divinity,
Northern Baptist Theological Seminary
Chicago, Illinois, 1943.

Graduate Studies in Psychology during the past two years.
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INTRODUCTION

Constancy of perception, or the ability to see things as they usually are, is an important factor in a living organism, and as such has intrigued the investigators of human nature for at least two hundred years (31). It remained, however, for the experimental psychology of the last few decades of the nineteenth and of the first few of the twentieth century to probe more deeply into the various aspects of the subject, and to investigate the phenomenon in the light of other psychological research. That such valuable data has been in this way accumulated goes without saying, but that many interesting angles of the factor of constancy of perception have remained unsolved is also evident.

The following investigation is an attempt to subject this factor of constancy in the human beings to a single dimensional measurement in two different planes and then to attempt to relate it to certain fundamental personality traits.
CHAPTER I

THE CONSTANCY PHENOMENON

General Statement

"Why do we generally perceive objects as we know them to be and not as we actually see them?" might seem to be a paradoxical question were it not for the fact that we do not always perceive things exactly as they present themselves to our senses but rather as we actually know them to be through our experience. Even in the case of camouflage where our perceptual responses are cleverly baffled, the integrative characteristics of our behavior and experiences become plainly visible, the organism apparently adding something to perception which is not found in the physical stimulus itself. This integrative behavior has long been recognized as the chief characteristic of all of our perceptual experiences. Whether in learning where it is explained by some in terms of combination, elimination, selection and final integration (33); or in reasoning where it is described by some as simply a process consisting of combination of separate experiences (22), and by others with a greater fidelity to truth as an act of intellect (12), the same fact of integration with its resultants is demonstrable.

Again, imperfect or changing as our perception may be, varying as the conditions of stimulation under which it takes place, we continue to see objects in approximately their true nature and not as they are
presented to our senses. Here we observe another salient characteristic of perception, namely, constancy, which is the ability to see things as they usually are.

The principle of constancy manifests itself in the perception of color, shape and size. Objects retain to some degree their familiar hues or colors at twilight or even at night, though it is well known fact that physically, as far as our eyes are concerned, this is impossible because of the color blindness which accompanies the transition from daylight to scotopic vision. A lump of coal and a piece of chalk when seen at twilight still appear to us as black and white respectively not because of the actual light they reflect on our retina but because our experience tells us they are such. Similarly to our eyes a rose retains its color characteristics even when in deep shadows.

The constancy of perception of form is operating when the round table top is regarded from a distance not as an ellipse as it is actually presented to our visual sense but as a circle; or a ball, when seen directly below is still perceived as a ball rather than a round disc which is visible to our eyes.

Similarly with respect to size constancy, we usually take objects for the size we know them to be in real life and not as they appear to our sight or according to the size of the image subtended on the retina. A man first seen six feet away usually appears to be about the same height after he had walked twelve, eighteen or twenty-four feet, or even a city block away from us although the image which
he casts upon the retina of our eyes has diminished in inverse proportion to the square of the distance between him and us. Unless this distance becomes extreme, the size of an object is perceived as virtually constant regardless of the variability of the retinal image at different distances.

These few examples will suffice to show that the principle of constancy is continually at work in our daily life. Some investigators as Frank (10) see it well established between the first and seventh year of a child's life; and some, as Cruikshank (7), trace its development to as early infancy as 10 to 50 weeks of age. The tendency to see things as they usually are and not as they are presented to the eye seems to be a well-established characteristic with human beings. Indeed, some psychologists would claim it to be a common trait to some lower forms of animal life, as chimpanzees and three-month old chicks (18).

The Bases of Perception

We know our environment through the sensations we receive from the stimuli acting on our sense receptors. In seeing objects we actually sense them as they are represented to our eyes, that is, their luminous or contrasted surfaces and not as they are absolutely in themselves. Visual sensation must, therefore, be distinguished from visual perception. Whereas the former is concerned with the conscious process which is immediate result of objects affecting the eye and by which one becomes aware of the sensible qualities of these objects, such as their color or form (12), the latter refers to the cognitive process whereby
one becomes aware of the object which gave rise to the sensation (15).

Various theories have been offered as the explanatory concepts of the different factors in perception. As far back as the fifteenth century Leonardo da Vinci concerned himself with perspective and related cues of distance. But it was George Berkeley early in the eighteenth century who first suggested non-visual cues of distance perception and thus gave the problem a distinctive psychological aspect. "We perceive by sight the distance, magnitude and situation of objects," he wrote. But whatever investigators followed him, the explanation of perception was long given as a sum total of sensations.

Wundtian elementarism with its "meaning theory," modified one way or another, explained perception for generations. The constancy of perception was also based on the "meaning theory." According to this theory the core of the percept was the sum total of sensation corresponding point for point to the irregular image of the object upon the retina. This apparent irregularity of the image has a great many experiences behind it - so interconnected that the sensory stimulation of the central core arouses the whole mass of sensation regarding an object, and a true representation of it results. Thus the core of sensation in the course of one's experience acquires varied context, that is, meaning; and it is this meaning that gives the percept its character. The actual perception, so different from the retinal image, is thus related through the process of the association of elements.

It was against this elementarism and associationism that the
Gestalt school of psychology turned its full force. It quickly established the difference between the character of actual perception and that of the local sensory stimulation and the dependence of the perception on the totality of the stimulating conditions was postulated in no uncertain terms.

According to Koehler, perception is a dynamic process arising from the interaction between energy derived from two sources, from the organism and the stimulus itself. The energy from the stimulus is distributed over the cortex where it comes into contact with the organismic energies. The resulting interaction and its final resolution determine the peculiar characteristics of the perceptual experience, that is, whether there is the perception of color, size, form, or a combination of these (19).

On the other hand, perception has been defined as "a cognitive process involving apprehension of organized wholes at the sensory level" (15). And from the empirical standpoint, it is regarded as a process which consists essentially in the assimilation of sensory presentation to the intellectual categories of past experiences, and finally resulting in knowledge that enables the subject to reproduce or describe in sensory detail the object that has been perceived. The characteristics or qualities of matter which are the proper objects of sense perception are unified by the common sense (sensus communis), an integrating mechanism for which the greater part of the central nervous system serves as the organic basis, and the synthesis of discrete
impressions results in perception. In a human being the total act of perception partakes of elements essentially different from that of an animal. For here the mind acts as an agent, it apprehends in a special manner certain things with which it is concerned: integrating sensory data from all sources into definite experiential patterns. Thus sense perception involves the same conscious subject in all his cognitive activities, and the simplest human perception ordinarily involves intellectual activities wherein abstraction and generalization, as well as judgment are closely correlated.

Taken in all its aspects, visual perception is not the mere registration of sensory qualities, nor is it, as the Gestalt psychologists maintain, the configuration of a visual field. Its essential characteristic is the interpretation of experience or meaning. This is clearly seen in case of patients operated on for congenital cataract. When they are presented with a visual picture in all its configuration, there is no normal perception as we know it, for the interpretation, or visual meaning is lacking. A difference is seen between round and square, long and short, but the patient is unable to tell which is short and which is long, which is round and which is square. Hence, percept is not a mirror image of reality and seeing is not knowing. The normal process of adult perception joins the visual impressions "to the sensory and intellectual resultants of past cognitive experience" (25), producing a meaning or interpretation.

The phenomenon of constancy of perception is not so easily
explained. For Harmon it depends to an extent upon the total pattern of stimulation and partly upon the organization of conscious activity (15). For Woodworth, the laws which control the estimate of visual magnitudes are psychological and apply to all actions of the mind in constructing its sense data into the presentations of sense. However, the more elaborate activities of the mind when distance, size, and shape are estimated and deliberately expressed in terms of some standard, are dependent upon experience (41).

The difficulty involved in explaining size constancy can be understood only in the structure of the eye, particularly as this refers to the action of the lens which serves as the main focusing mechanism. It will be remembered that the double-convex lens throws its image in an inverted position and reverse from left to right; and also that the surface of the image is inversely proportional to the square of the distance between the object and lens, and that the linear dimensions of the image vary also inversely in proportion to this distance. Now, the eye not only possesses such a lens but together with the aqueous and the vitreous humor acts as one large focusing mechanism in the manner of a compound lens, following the same laws of optics, and showing the same variability of size of optical image in both the area and the linear dimensions. Thus, for example, the image projected on the retina, will be only one quarter of its former surface area when the distance between the object and the lens is doubled; and its linear dimensions will be reduced by one half. When this distance is increased to three times, the surface area of the image will accord-
ingly diminish to one-ninth and the linear dimensions to one-third of the former size.

It would appear, therefore, that the presentation of the visual sense, that is, of the eye, is dependent upon the retinal image for the data from which it is constructed, and the retinal image in its turn is dependent for its formation and size, upon the object, shape and distance from which the reflected rays of light reach the retina; and the whole upon the integrating powers of a conscious subject. Thus, though Woodworth says that "strictly speaking we see neither the external object nor the retinal image; the field of vision is a subjective affair and is like neither" (41), yet perception, especially as it is manifested in its constancy, whether of color, size or shape, is real enough, but must always be an act of a conscious subject. As such it commands the concern of psychology.

The importance of the concept of constancy in any consideration of the theory of perception has merited a good deal of study and careful experimentation by both European and American psychologists. Some aspects of it, e.g., that of color, have been investigated as early as 1866 by Helmholtz and soon after by Hering. Both agreed that the function of vision is to supply information regarding objects rather than regarding light. Attempts have been made to determine to what degree perception was a discriminatory factor in the behavior of animals. Koehler found that hens and chimpanzees respond selectively to color stimuli.
Though many other well-known names in psychology grace the list of investigators of the factors of constancy of perception, there are still some aspects of the subject which demand further research. It seems probable that until all of these angles of the problem of constancy have been determined experimentally, there could not be formulated a full explanation of why our perception is usually a more true representation of the real object than its retinal image. The investigation of visual size constancy in both the vertical and the horizontal planes with stimuli varying only in one dimension might be, it is believed, a contribution towards that end.

Another objective of this study was that of ascertaining the extent to which the one-dimensional size constancy in two planes could be related to some significant personality traits.
CHAPTER II

THE PROBLEM

The Problem Stated

The main problem as here presented was to investigate experimentally the visual size constancy in both the horizontal and the vertical planes with stimuli varying only in one dimension.

The secondary purpose was to explore the relationship between the constancy scores obtained in the main experiment described above and the extroversion-introversion traits as measured by the "Neymann-Kohlstedt Diagnostic Test for Introversion-Extroversion."

No standard equipment was available for the main experiment. Home-made apparatus had to be constructed, the description of which follows below:

Materials

The materials consisted of:

(1) Sixteen pieces of black-stained dowelling, one-half inch in diameter and graduated by one-quarter inch intervals from 4.25 to 8.00 inches in length.

On one side of each piece of dowelling and approximately in the middle were drilled two small holes one inch apart, to fit over the
prongs which held the variables against their background.

(2) The background for the variables, two feet square, consisting of a light gray piece of heavy reinforced cardboard with two small holes one inch apart, in the middle.

(3) A wooden stand two feet wide and one and a half foot high to hold the background in a perpendicular position. The background was "threaded" on the two prongs at right angles to the stand. The piece of dowelling serving as the variable was fitted over these prongs protruding through the background, so that it presented a clear-cut contrast against the gray background without obtruding its means of support upon the Subject's consciousness.

The background was attached to the stand in such a way that it could rotate on its axis, so that the same stimulus could be presented in either the vertical or in the horizontal plane.

(4) The Constant:

This was a black-stained piece of dowelling, 5 inches long and 3/8 of an inch in diameter, mounted in a similar manner on a background 18" x 18" of the same color as above, and attached to a similar stand enabling the position to be changed also from horizontal to vertical plane, and vice versa.

Chicago, Illinois. The extroverts are indicated by a plus (+) and introverts by a minus (−) sign.

The Administrative Procedure

Forty-five adults, ranging from 18 to 50 years, were used in the experiment and the test. Twenty-one of these were of the female and twenty-four of the male sex. Their occupations were distributed as follows:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Students</td>
<td>24</td>
</tr>
<tr>
<td>School Teachers</td>
<td>10</td>
</tr>
<tr>
<td>College Instructors</td>
<td>4</td>
</tr>
<tr>
<td>Nurses</td>
<td>3</td>
</tr>
<tr>
<td>Office Clerks</td>
<td>2</td>
</tr>
<tr>
<td>Minister</td>
<td>1</td>
</tr>
<tr>
<td>School Superintendent</td>
<td>1</td>
</tr>
</tbody>
</table>

The Subjects were picked at random at Loyola University Summer School. Care was taken to make them enter into the spirit of the experiment, and a fine co-operation was evident throughout.

The Subject sat in a straight-backed chair, facing the two backgrounds on which the stimuli were to be presented. The larger one of these, for the variables, was 12 feet straight ahead of him. When the variable was placed in position it was approximately at his eye level. The background for the constant was 6 feet distant and 15 degrees to the Subject's right. The constant was approximately 5 or 6
degrees below the eye level.

A uniform distribution of light was arranged from the rear of the Subject so that no interference was possible with his vision. At the same time there was a complete elimination of shadows on the two backgrounds in front of him. Tape-line was used to check the distance between the two backgrounds and the Subject's eye.

The method of "equal-step interval," where the judgment of the variable was made in terms of the standard, was employed in comparing the vertical variable with the vertical constant, and the horizontal variable with the horizontal constant.

Instructions to the Subject

The following instructions were read to each Subject immediately prior to the presentation of the vertical and horizontal stimuli:

"You will be asked to compare the length of a rod straight ahead of you with the length of a rod nearer you." (Pointing to each rod in turn).

"Make yourself comfortable in this chair, relax and feel at home. While being at ease, however, please try to maintain the same position and do not move your chair nor tilt your head. You will be given a two-minute rest period after a certain interval of time.

"When I say 'Ready,' you first look on the rod nearer you (pointing to the constant) and then on the one further away (pointing
to the variable) and at once tell me if this second rod is longer, shorter or equal to the nearer rod."

A copy of typed instructions was laid on the table beside the Subject and he was told to read it or to ask questions if anything was not clear. Only a comparatively small number of the Subjects did either one of these.

The Presentation of the Stimuli

With his back to the O, the Experimenter picked up a variable, which was concealed from the view of the Subject, placed it in the position upon its background, and called out "Ready." After counting silently "one-two-three," (approximately three seconds), the variable was removed from its background. Thereupon O gave his comparison which was immediately recorded by E.

The first problem encountered was to establish the range within which the Subject's judgments of equality were centered. This was done by using the regularly ascending order of presenting the variable stimuli for the first series of presentations, followed by the regularly descending order in the second series for each plane. That is, beginning with 4.5 inch stick, the variables followed each other in orderly sequence until the 8.00 inch length was reached. This procedure was reversed in the second series where the presentation began with the 8.00 inch variable and proceeded in a descending order until 4.5 inch length was reached.
Once the Subject's range was thus determined, the remainder of the presentations were continued in random order until all the variables falling within this range were utilized. The same procedure was followed in both the vertical and the horizontal planes.

To lessen or preclude the factors of fatigue and eye strain, the A-B-B-A and B-A-A-B method of presenting the stimuli was employed, where A represented the vertical and B the horizontal stimuli. Since there were ten series of comparisons in each plane for every Subject, the total number of twenty series was thus divided into four equal groups.

Beginning with the vertical plane, every odd-numbered Subject, twenty-three in all, received the stimuli in the A-B-B-A order; and every evenly-numbered Subject, twenty-two in all, in the B-A-A-B order. This could be represented as follows:

**Subject No. 1:**

- Vertical plane  
  - - - - - - - 5 series of comparisons
- Horizontal plane  
  - - - - - - 5 series of comparisons
- Horizontal plane  
  - - - - - - 5 series of comparisons
- Vertical plane  
  - - - - - - 5 series of comparisons

**Subject No. 2:**

- Horizontal plane  
  - - - - - - 5 series of comparisons
- Vertical plane  
  - - - - - - 5 series of comparisons
- Vertical plane  
  - - - - - - 5 series of comparisons
- Horizontal plane  
  - - - - - - 5 series of comparisons
This alternating method of presentation of the variables had this further advantage - it tended to cancel or at least to reduce the practice effect in the experiment.

A two-minute interval was allowed between every group of presentations for every Subject.

Table I shows the resulting constancy scores in terms of their P.S.E.'s.
<table>
<thead>
<tr>
<th>Initials</th>
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<th>Horizontal Scores</th>
<th>Average Scores</th>
<th>Neymann-Kholschedt Scores</th>
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<tr>
<td>S P</td>
<td>6.150</td>
<td>5.887</td>
<td>6.018</td>
<td>- 4</td>
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<tr>
<td>S M B</td>
<td>5.889</td>
<td>5.662</td>
<td>5.766</td>
<td>- 2</td>
</tr>
<tr>
<td>D Z</td>
<td>5.712</td>
<td>5.687</td>
<td>5.699</td>
<td>+ 6</td>
</tr>
<tr>
<td>R G</td>
<td>5.712</td>
<td>5.420</td>
<td>5.566</td>
<td>+ 6</td>
</tr>
<tr>
<td>N M G</td>
<td>5.662</td>
<td>5.860</td>
<td>5.766</td>
<td>+ 4</td>
</tr>
<tr>
<td>G R C</td>
<td>5.662</td>
<td>5.967</td>
<td>5.767</td>
<td>+ 4</td>
</tr>
<tr>
<td>R X</td>
<td>5.625</td>
<td>5.637</td>
<td>5.661</td>
<td>+ 4</td>
</tr>
<tr>
<td>F S C</td>
<td>5.612</td>
<td>5.400</td>
<td>5.506</td>
<td>+ 4</td>
</tr>
<tr>
<td>K M</td>
<td>5.587</td>
<td>5.426</td>
<td>5.506</td>
<td>+ 7</td>
</tr>
<tr>
<td>N S</td>
<td>5.575</td>
<td>5.675</td>
<td>5.725</td>
<td>+ 8</td>
</tr>
<tr>
<td>N M</td>
<td>5.575</td>
<td>5.437</td>
<td>5.506</td>
<td>- 4</td>
</tr>
<tr>
<td>A J G</td>
<td>5.562</td>
<td>5.662</td>
<td>5.612</td>
<td>- 4</td>
</tr>
<tr>
<td>A S</td>
<td>5.562</td>
<td>5.475</td>
<td>5.518</td>
<td>+ 2</td>
</tr>
<tr>
<td>O D</td>
<td>5.560</td>
<td>5.662</td>
<td>5.566</td>
<td>- 16</td>
</tr>
<tr>
<td>A P N</td>
<td>5.637</td>
<td>5.462</td>
<td>5.499</td>
<td>+ 4</td>
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<td>R N H</td>
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<td>5.850</td>
<td>5.681</td>
<td>0</td>
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<td>R H</td>
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<td>4.860</td>
<td>5.160</td>
<td>- 4</td>
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<tr>
<td>D S</td>
<td>5.437</td>
<td>5.687</td>
<td>5.562</td>
<td>- 6</td>
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<tr>
<td>H A</td>
<td>5.457</td>
<td>5.302</td>
<td>5.399</td>
<td>+ 6</td>
</tr>
<tr>
<td>W W W</td>
<td>5.457</td>
<td>5.397</td>
<td>5.412</td>
<td>0</td>
</tr>
<tr>
<td>J J</td>
<td>5.400</td>
<td>5.137</td>
<td>5.268</td>
<td>+ 10</td>
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<tr>
<td>J B S</td>
<td>5.400</td>
<td>5.460</td>
<td>5.425</td>
<td>- 6</td>
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<tr>
<td>J C R</td>
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<td>5.525</td>
<td>5.462</td>
<td>0</td>
</tr>
<tr>
<td>J B N</td>
<td>5.375</td>
<td>5.625</td>
<td>5.450</td>
<td>+ 2</td>
</tr>
<tr>
<td>M W</td>
<td>5.375</td>
<td>5.450</td>
<td>5.412</td>
<td>- 4</td>
</tr>
<tr>
<td>O Y</td>
<td>5.362</td>
<td>5.630</td>
<td>5.508</td>
<td>+ 6</td>
</tr>
<tr>
<td>M M F</td>
<td>5.362</td>
<td>5.232</td>
<td>5.312</td>
<td>- 18</td>
</tr>
<tr>
<td>E M</td>
<td>5.350</td>
<td>5.400</td>
<td>5.375</td>
<td>+ 10</td>
</tr>
<tr>
<td>P V S</td>
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<td>5.560</td>
<td>5.560</td>
<td>+ 10</td>
</tr>
<tr>
<td>M N L</td>
<td>5.350</td>
<td>5.725</td>
<td>5.587</td>
<td>+ 18</td>
</tr>
<tr>
<td>L R M</td>
<td>5.337</td>
<td>5.387</td>
<td>5.332</td>
<td>+ 12</td>
</tr>
<tr>
<td>C T</td>
<td>5.325</td>
<td>5.425</td>
<td>5.375</td>
<td>- 4</td>
</tr>
<tr>
<td>E T G</td>
<td>5.312</td>
<td>5.612</td>
<td>5.462</td>
<td>- 2</td>
</tr>
<tr>
<td>V S</td>
<td>5.257</td>
<td>5.250</td>
<td>5.258</td>
<td>- 6</td>
</tr>
<tr>
<td>M S</td>
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<td>5.332</td>
<td>5.306</td>
<td>+ 3</td>
</tr>
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<td>5.460</td>
<td>5.360</td>
<td>- 6</td>
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<td>S L</td>
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<td>J W</td>
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<td>5.400</td>
<td>5.293</td>
<td>0</td>
</tr>
<tr>
<td>C H</td>
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<td>5.200</td>
<td>5.137</td>
<td>+ 2</td>
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<tr>
<td>J D</td>
<td>5.182</td>
<td>5.112</td>
<td>5.137</td>
<td>- 18</td>
</tr>
<tr>
<td>J C L</td>
<td>5.137</td>
<td>5.112</td>
<td>5.124</td>
<td>- 12</td>
</tr>
<tr>
<td>B R</td>
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<td>5.487</td>
<td>5.306</td>
<td>+ 2</td>
</tr>
<tr>
<td>L T</td>
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<td>5.262</td>
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<td>+ 12</td>
</tr>
<tr>
<td>F J</td>
<td>5.022</td>
<td>5.462</td>
<td>5.237</td>
<td>+ 14</td>
</tr>
<tr>
<td>S M R</td>
<td>4.887</td>
<td>5.400</td>
<td>5.143</td>
<td>- 4</td>
</tr>
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</table>
CHAPTER III

SIZE CONSTANCY AND THE MEASURE OF EXTROVERSION AND INTROVERSION

Personality "Types" and Extroversion and Introversion

Very early in the history of man's thought attempts have been made to classify human beings into "types" on the basis of some dominant phase of personality. Thus it was that the ancient Greeks came to believe in four distinguishing temperamental classes, the sanguine, the choleric, the melancholic and the phlegmatic. Such attempts at division of men on personality basis have not only not abated but actually increased in recent times as is shown by Jung, Kretschmer, Rosanoff, McDougall and Jaensch, to name only some of the outstanding ones of our day. While the theories of these investigators have not been universally accepted because of the lack of conclusive scientific validation, still some of them have been shown to possess, when proper modifications are made, certain practical applications. And as a result, words expressing some of these assumptions have come not only into scientific and professional use, but into popular vogue as well. This is particularly true in the case of Carl Jung's two main "types" of "extroversion" and "introversion." The former was advanced to denote that personality trend or tendency which directs a person's interests away from oneself and toward others, tending in the main towards an objective type of personality; whereas the latter "type" manifests its interests in exactly the opposite direction, tending toward extreme subjectivity, self-
centeredness, introspection and inward orientation generally.

Thus it is said that the respective interests of persons of two "types" lead them to regard even a purely objective situation in a decidedly different way. This is claimed to be particularly true with regard to the constancy of perception. The extroverts are presumed to be more object-directed and the introverts to treat an external object as a sensation or a phenomenon rather than as a real object (40). If this is true, the converse of what has been stated above would hold equally well, namely, that the way a person regards an objective situation would indicate the "type" of personality he belonged to, that is, whether he is predominantly an extrovert or an introvert. The manner of regarding reality would be, therefore, one criterion of intro-extroversion.

Common observation shows that the reality one sees depends on the individual and his experience. What may be real to one person, or to one "type" of person, might not be so real to another. The degree to which this objectivity or subjectivity manifests itself differs, but constancy of perception may be, as will be shown later, measurable. But the nature of objectivity itself is not so easily determined, as the following paragraphs will attempt to show.

It is commonly agreed that constancy of perception in normal life manifests itself in a tendency toward objectivity. The more one is affected by the stimulus value, that is, the retinal impression of an object at the moment of perception, the less objective he is. It
is just here that the introverts, as it is held, fail in their objectivity, for they seem to be so influenced. For example, the white paper in a shadow, the object at a distance, the round table top seen obliquely appear to them as sensations rather than real objects. From this standpoint introverts seem to be less objective in their personality make-up than are the extroverts who are not misled by these perceptual cues but tend to see objects as they actually are. To the extrovert, it is claimed, the white paper in the shadow still is seen as white paper, the object of a given size at a distance still retains approximately the same proportions (size), and the oblique table top is seen as table and not at all as merely an ellipse.

Yet one might say that the extroverts at the same time show certain marked deviations from true objectivity in certain situations. They generally tend to see color, size, or form where these do not actually exist in their entirety. In other words, they seem to "read into" the objects, so to speak, qualities which at the moment are nonexistent. It is a fact that the white paper or a given color in the shadow is not as white or the color the same as when seen in the daylight. Neither are the impressions of size or form always corresponding exactly to the object perceived. It is the introverts in such instances who are in their turn not misled by the perceptual cues but tend to see the reality as it presents itself to the senses. They do not see form or size or color where these do not exist as do the extroverts. Regarded from this standpoint the introverts are more objective
than are the extroverts.

From these considerations it would seem that while in the social situations the extroverts are probably rightly held as the more objective and the introverts as the more subjective, in situations involving sensory perception and constancy the conclusion is debatable since it depends on the viewpoint from which objectivity is regarded.

The Measure of Perception

As has been already mentioned constancy of perception is to a certain degree measurable. It was Thouless, the British psychologist, noted for his research into the constancy of color, form and size, who attacked the problem experimentally and at the same time tried to relate the phenomenon of constancy to certain personality traits. He was led to these undertakings by the apparent individual differences which he found to exist in visual constancy as exhibited by introvertive and extrovertive subjects.

According to Thouless, "under ordinary conditions of binocular vision, the actually experienced character of the object (or the 'phenomenal character') is a compromise between the 'real' character of the object and the character given by peripheral stimulation, whether this character is shape, relative size, or relative brightness. In all these cases the phenomenal character shows a tendency away from the stimulus character towards the 'real' character of the object. As a general name for this tendency, in whatever kind of perceptual character it is found,
we may use the term phenomenal regression to the 'real' object, or more shortly, 'phenomenal regression'" (35), which is Thouless' name for constancy.

(It must be noted here that Thouless defines 'real' characters as "those of a continuous extension, constant brightness, etc., attributed to the object of common experience, an object of common sense, not the metaphysically real object or noumenon, and not the real object of the physicist, a discontinuous collection of molecules which are not perceived and whose properties are not attributed to the object in ordinary experience" (36). It is in the same sense that the term "real" is used in the present study.

The degree to which this regression takes place, that is the tendency of the phenomenal character away from the stimulus character and toward the 'real' (commonsense) character, or in other words, the amount of constancy, is measurable, and Thouless' formula for this is:

\[
\frac{\log P - \log S}{\log R - \log S}
\]

where \( S \) = the symbol of a stimulus character,
\( P \) = the symbol of the corresponding phenomenal character,
\( R \) = the symbol of corresponding 'real' (physical) character.

This measure Thouless called the index of "phenomenal regression." It shows "the fraction of the distance separating the real from the perspective character over which the phenomenal character regressed:
that is, the fraction \( \frac{P - S}{R - S} \). Its value is zero if there is no phenomenal regression (constancy), that is, if the phenomenal character is identical with the stimulus character; while it is unity if regression is complete, that is, if the phenomenal character coincides with the 'real' character of the object" (35). In other words, a zero index shows no constancy while a unity index points to a perfect constancy.

However, in real life, this index is rarely if ever a zero, or a unity, but fluctuates between the two extremes. This is usually the case in ordinary everyday perception. The objects seen are not exactly as they actually are, yet at the same time they are not what the retinal images reflect. They are a compromise between the two.

These conclusions are in line with those of Woodworth. Judgments, usually lie between two extremes, he maintains, one conforming to the stimulus and the other to the object. If 0 matched, for example, strictly according to color intensity, he would be showing zero tendency toward 'color constancy'. If at the other extreme he matched exactly in accordance with object color he would show 100 percent color constancy. His actual judgment can be assigned to be a percentage value according to its position in this continuum (42). This is given expression by using the Brunswik Ratio:

\[
\frac{R - S}{A - S}
\]

where \( A = \) numerical value for object,
where \( S \) = numerical value for stimulus,
\[ R = \text{numerical value for response}. \]

Thouless was impressed by the different reactions in his constancy experiments which were apparent between the extroverts and the introverts. He noted that "extroverted or cycloid subjects tend to show larger amounts of visual constancy than do introverted or schizothymic subjects" (39). Was it that the introverts saw the external objects in terms of their stimulus character rather than in terms of their real character?

To investigate the possible relationship between these two personality "types" and visual size constancy Thouless devised an experiment whereby a group of 14 members, each resembling Kretschmer's schizoid temperament was matched by another group of 14 members of decidedly cyclothymic disposition. Both groups were subjects to constancy tests for brightness, form and size. Circular discs were used for size experiments.

The records of these two opposing groups on the constancy tests show that the extroverts showed greater constancy or "phenomenal regression," as Thouless prefers to call it, for brightness, form and size than did the introverts (39). "Experiments seemed to indicate that those of introverted or 'schizothymic' temperament saw much more closely to the stimulus or perspective than did the extroverted or the cyclothymic. It seemed even possible that this might be a measurable result of the greater interest in outside reality of the cyclothyme and in the subjective
world of the schizothyme" (36). These results seemed to bear out his initial observations. He concluded that "phenomenal regression (i.e., constancy) is found to depend not on memory of the 'real' character of the object observed but on the actual reception of cues to that character" (36).

**Personality Traits Related to Constancy of Perception**

Following the lead thus given by Thouless, and the examples of some other psychologists such as R. B. Cattell, J. W. Prince, Guilford and others (13) who tried to establish the existence of personality traits by means of laboratory method rather than be content with the "paper" tests of such traits, C. O. Weber (39) performed certain experiments to corroborate Thouless' findings and to base a psychology of traits on constancy of perception. His method was somewhat similar to that employed by Thouless. Out of a group of 76 subjects he formed one group of the 25 most extroverted, and another of the 25 most introverted. For this purpose he used Guilford's new test (13) based on the new method of factor analysis and Allport's A - S Reaction Study, supplementing them by personally rating the subjects on a seven-fold scale on intro-extroversion based on his personal acquaintance with them.

The two opposed groups thus formed were then compared as regards their visual constancy. Using stereograms of round discs to determine the visual constancy tendencies of the subjects, he tried to explore the relationship of size constancy to extroversion-introversion, ascendancy-submission and low-and-high emotionality.
While some of Weber's results are rather inconclusive, he reports that his experiments show that "intro-extroversion appears to be the most definitely associated with the visual constancy" (39) and that extroverts show greater size constancy than do the introverts (39), which he ascribes to the objective-directed attitude of the former.

That size constancy had possibilities with respect to other personality traits was also shown by Thouless (36) when he endeavored to establish correlation between it and intelligence. A negative correlation of .245 was the result he obtained with a group of adults.

Similarly Locke (21) in his study posited the possibility of the inverse relationship between size constancy and intelligence. Without giving definite data he concluded that constancy of perception was only relative.

Using filled and unfilled spaces, Olson (28) tried to relate the factor of size constancy to intelligence in children. The position of the constant and of the variables was reverse to the positions used in the present experiment, but the principle of constancy was fully evident. The results were regarded as insignificant, and the comment made that "the low correlation between intelligence and judgments of size seems to indicate that distinct operations are involved in the two processes ... that sensory operations as such do not require much intelligence" (28).

Since a tendency towards size constancy within the middle range
of vision and its variability from person to person seem to be established facts and again since the concept of extroversion-introversion seems to be generally accepted as a valid expression of certain aspects of personality, and further, since neither Thouless' nor Weber's findings, so far as is known to the writer, were subjected to any corroboration, it was deemed worthwhile to explore the possible relationship between the constancy scores obtained in the above experiment and the traits of extroversion-introversion as measured by some reliable test.

The Neumann-Kohlstedt Introversion-Extroversion Test

For this purpose the 1928 Revision of the Neumann-Kohlstedt Test for Introversion-Extroversion, published by C. H. Stoelting Co., Chicago, was used. The authors of the test standardized it upon one hundred typical schizophrenics and one hundred typical manic-depressives, as well as on one thousand individuals from various walks of life. On this basis they claim for it both clinical and general significance. No question, it is stated, which did not show a reliability index of more than seventy-five percent was included. Thus it was hoped that a normal curve of distribution was well established, with the result that, according to its authors, the test is used extensively in many hospitals for differentiating between borderline cases of schizophrenic and manic-depressive insanity.

Procedure

In the present study immediately after the completion of the
size-constancy measurements with each Subject, the Neymann-Kohlstedt Test was administered. The Subject was told that this was the "second part" of the whole experiment. He was told to take his seat at the adjoining table, and was read the following instructions:

"On the long sheet which I have in my hand, there are printed fifty sentences. Each of these sentences is followed by the words 'Yes' and 'No'. There is no implication of right or wrong in any of these sentences, and you are asked to consider them from the viewpoint of personal like or dislike. For example, in the sentence 'Blue color is preferrable to green,' there is nothing right and nothing wrong. It is all a matter of taste or preference. Read each sentence, and if you like the idea it expresses, draw a line under 'Yes'. If you dislike it, draw a line under 'No'.

"Pay no attention to what you think your feeling toward a statement ought to be. Indicate your like or dislike of the idea expressed, not whether you feel you ought to like it or dislike it. Put down your immediate reaction to the statement, do not think it over deeply. Snap judgment is preferred. There is no time limit but you are to finish as quickly as you can."

The heavy black lettering which appeared on the top of each test sheet, stating the name of the test, was folded under by the Experimenter, so that the Subject was unaware that he was being tested for any specific personality trait with which the questions were concerned. As a result it was hoped that the answers would thus come more
spontaneously. All the papers were returned without any undue delay.

Table II shows the results of this Test.
<table>
<thead>
<tr>
<th>Initials</th>
<th>Sex</th>
<th>Sex Scores</th>
<th>Constancy Scores</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ver.</td>
<td>Hor.</td>
<td>Avg.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N-K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ver.</td>
<td>Hor.</td>
<td>Avg.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initials</th>
<th>Sex</th>
<th>Sex Scores</th>
<th>Constancy Scores</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ver.</td>
<td>Hor.</td>
<td>Avg.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N-K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ver.</td>
<td>Hor.</td>
<td>Avg.</td>
</tr>
</tbody>
</table>

**TABLE II**

DISTRIBUTION AND RANK OF THE NEYMAN-KOHLSTEDT TEST SCORES WITH THEIR CORRESPONDING SIZE CONSTANCY SCORES AND RANKS

<table>
<thead>
<tr>
<th>Initials</th>
<th>Sex</th>
<th>Sex Scores</th>
<th>Constancy Scores</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ver.</td>
<td>Hor.</td>
<td>Avg.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N-K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ver.</td>
<td>Hor.</td>
<td>Avg.</td>
</tr>
</tbody>
</table>
CHAPTER IV

STATISTICAL RESULTS AND INTERPRETATION

General

Ever since the days of Fechner there has been no lack of attempts to measure scientifically the interrelations between the physical and the mental. Each of these attempts at the measurement of sensation or mind, however, was far from an unqualified success. Certain aspects of intensity and their relation to physical factors are not always amenable to measure, for intensity within any given modality depends usually not only upon the frequency of nerve impulse and the number of fibers innervated, but also upon some hidden and not well-known factors as well. One of these is the lack of point-for-point relationship between the physical and the psychophysical stages of the cognitive process.

But though psychophysics proved to be untenable because of the original "fallacious assumption that consciousness is a physical continuum divisible into units which can be measured in much the same way as any other form of matter" (15), still the attempt to measure such human reactions was prolific in developing methods which are applicable in many psychological investigations. However, the problem of measurement always involves the necessity of a standard. It is just here that psychophysics ran into still another difficulty, for many of the psychological phenomena, due to their subjectivity and evanescence, are not
amendable to measurement by any objective standard. Since there was thus no possibility of establishing any reliable standard of impressions, psychologists hit upon a method of judging sensations in terms of a standard difference between impressions. This difference between two stimuli necessary to produce discernible impressions came to be known as the "differential threshold" or "limen," and the smallest possible difference between two impressions came to be regarded as the "just noticeable difference."

Every psychophysical method employs a standard stimulus (also known as "constant") and a variable comparison stimulus. The judgment or comparison is always given in terms of the standard. One of these methods is that of the constant stimuli, also known as the method of "equal-step interval," used in the present experiment. It employs a number of comparison stimuli, graduated by a certain definite interval above and below the standard stimulus. The technique has been refined to a high degree of reliability. The variables are presented to the S in a haphazard manner, either following the presentation of the constant, or having the constant in the Subject's view all the time. As used in the present experiment three categories of response were permitted, the judgment being always expressed as either "greater," "less," or "equal" to the constant.

When the comparison stimuli are close to the constant in size, the judgments given are necessarily indefinite, and may be "equal," "greater," or "less" for the same stimuli, because these stimuli are
near the "just noticeable difference" or "limen." However, when this range is widened with the successive comparisons considerably in one direction - either towards "greater" or "smaller" stimuli, there comes a time when the observer sees these stimuli as either all "greater" or all "smaller." That is, at a certain distance above the constant, depending on the individual, the stimuli are seen as all "greater" and a certain distance below the constant they are seen as "smaller." Between these two extremes there will be a zone of uncertainty where occasional judgments of "greater" on one side, and of "smaller" on the other, will appear. Somewhere between these is the "Point of Subjective Equality" where the judgments would be close the standard. This is arrived at by a definite statistical procedure.

In the present experiment, the "Point of Subjective Equality" was derived by summation method, using Spearman's formula:

$$P.S.E. = \frac{M_g + M_l}{2},$$

where $M_g = A - \frac{i}{2} - i \times \text{Sum } g,$
and $M_l = B + \frac{i}{2} + i \times \text{Sum } l.$

In these equations, $M$ is the symbol for the main transition point; sum "g" for the upper, and sum "l" for the lower.

A = the first variable which marks complete transition of comparisons to "greater" judgments.

B = the first variable marking such a transition for "smaller" judgments.
Sum \( g \) = the total sum of percentages of "g" comparisons falling below the line of transition.

Sum \( l \) = the sum total of such percentages of all "l" comparisons falling above the line of transition.

\( i \) = the equal step interval. (In the present experiment it was .25 of an inch.)

**Individual Size Constancy**

It would have been possible to calculate the size constancy score for each individual, but the "Point of Subjective Equality" for each individual as derived by the above formula gave the necessary rank, inasmuch as greater P.S.E.'s correspond to less constancy. Table I shows these ranks in the vertical and in the horizontal plane, together with their averages.

The experiment seems to show that there is a fairly high and consistent visual linear size constancy in the conditions described under procedure. Allowing for the margin of fairly wide individual differences, each 0 showed the fact of size constancy in operation. The following is a tabular presentation of the P.S.E. data. This gives a general picture of scatter in a simple form.
TABLE III

SHOWING MEAN AND CENTRAL TENDENCY

<table>
<thead>
<tr>
<th></th>
<th>Vertical</th>
<th>Horizontal</th>
<th>Average for 2 Planes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mean</td>
<td>5.412</td>
<td>5.463</td>
<td>5.438</td>
</tr>
<tr>
<td>2. Median</td>
<td>5.400</td>
<td>5.450</td>
<td>5.425</td>
</tr>
<tr>
<td>3. Maximum individual score</td>
<td>6.150</td>
<td>5.837</td>
<td>6.018</td>
</tr>
<tr>
<td>4. Minimum individual score</td>
<td>4.887</td>
<td>4.850</td>
<td>5.124</td>
</tr>
<tr>
<td>5. Range for the group</td>
<td>1.263</td>
<td>0.987</td>
<td>0.994</td>
</tr>
</tbody>
</table>

It is interesting to note that only one Subject in each plane was found to have constancy score below that of the standard, namely, 4.887 in the vertical and 4.850 in the horizontal. Both of these 0's, however, gave responses very close to the average in the opposite planes (5.400 and 5.450 respectively). Their average size constancies, of course, fell below the group average, to 5.150 and 5.143 respectively. These were the only two Subjects out of the total of forty-five who thus over-estimated the five-inch variable at twelve foot distance. This is in conformity with the accepted notion that approximately four per cent of the normal population are subject to this tendency.

It might be noted at the same time that these two 0's were of different sex, and both gave the same score of -4 on the Neymann-Kohlstedt Test.

Only one Subject scored evenly in the both planes, obtaining a
P.S.E. of 5.350 inches. Fourteen 0's showed a difference of less than .100 of an inch between the two planes. The remaining thirty Subjects showed a wide variation in their judgments, which is quite in conformity with the principle of individual differences.

The extent of spread or "scatter" of the individual P.S.E. scores about their center was fairly well concentrated around the middle range in both planes. In the vertical plane the scatter tended towards the lower scores, the peak centering between 5.375 and 5.625; while in the horizontal plane it was between 5.375 and 5.875. The distribution of the average P.S.E. scores formed a fairly uniform bell-shaped curve, falling practically within the same range limits, but tending towards eliminating some of the irregularities of the separate vertical and horizontal curves of distribution.

The Means and the Deviation

In spite of the wide individual differences, the two group means for both planes were nearly identical. Neither was there any marked difference in their Standard Deviation. Averaging the P.S.E.'s in the two planes for each 0, the group average, mean, and S. D. thus obtained showed a similar close correspondence. An inspection of the following tabulation will readily disclose these results:
It will be noted that the difference between the two planes is wholly insignificant. This insignificance is further confirmed by calculating its probable error, which is 0.03, and yields a critical ratio of approximately 1.6.

It seems probable, therefore, that there is no great difference in visual linear size constancy between the vertical and the horizontal plane. Apparently this size constancy is a well-established phenomenon in human nature, not subject to any appreciable changes by minor environmental circumstances, such as vertical or horizontal plane of vision.

Correlation

The experiment called for a number of correlations. The correlation coefficients were originally calculated by Rank-Difference Method and corrected to read in terms of "r" or products-moments values.

In these correlations with the Neymann-Kohlstedt Test top rank was given to high extroversion score and to high P.S.E., equivalent to

<table>
<thead>
<tr>
<th>Plane</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Probable Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical</td>
<td>5.412</td>
<td>0.226</td>
<td>.0227</td>
</tr>
<tr>
<td>Horizontal</td>
<td>5.463</td>
<td>0.212</td>
<td>.0213</td>
</tr>
<tr>
<td>Average</td>
<td>5.438</td>
<td>0.190</td>
<td>.0191</td>
</tr>
</tbody>
</table>
low constancy. It will be remembered that the Neymann–Kohlstedt Test indicates extroverts by a plus and introverts by a minus sign. The following is a tabulation of the results obtained:

**TABLE V**

SHOWING CORRELATION BETWEEN SIZE CONSTANCIES AND NEYMAN-KOHLSTEDT SCORES

<table>
<thead>
<tr>
<th>Items Correlated</th>
<th>Correlation Coefficient</th>
<th>Probable Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Vertical and Horizontal Size Constancy</td>
<td>.529</td>
<td>.073</td>
</tr>
<tr>
<td>(b) Vertical Size Constancy</td>
<td>-.217</td>
<td>.104</td>
</tr>
<tr>
<td>and Neymann-Kohlstedt Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Horizontal Size Constancy</td>
<td>-.199</td>
<td>.101</td>
</tr>
<tr>
<td>and Neymann-Kohlstedt Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Average of the two Size Constancies and the Neymann-Kohlstedt Test</td>
<td>-.257</td>
<td>.098</td>
</tr>
</tbody>
</table>

The low correlation of the linear size constancy between the two planes could have been inferred by casual inspection of the data sheets. Many Subjects whose size constancy score was high in one plane had a low score in the other. As it could be readily observed though the correlation of the visual size constancy between the two planes is not very high, still it could be held as significant. Since its coefficient is more than five times the Probable Error, there seems to be a definite proof that some common factor or factors are present.

The correlation for the group as a whole and the extroversion
and the introversion tendencies as revealed by the Neymann-Kohlstedt Test and linear visual size constancy was nearly the same for both planes. The vertical plane gave a correlation coefficient with extroversion of \(-.217 \pm .10\) while the horizontal plane yielded a correlation coefficient of \(-.199 \pm .10\). A slightly higher correlation appeared when the Neymann-Kohlstedt scores were compared with the combined constancies of the two planes, namely, \(-.257 \pm .09\).

**Interpretation**

The significance of these correlation figures lies chiefly in the fact that they seem to oppose directly the findings of both Thouless and Weber. Whereas in their experiments they claim higher size constancy was most definitely associated with extroversion and lower size constancy with introversion (36, 39), the present study points to the contrary, namely, that extroversion is associated with lower and introversion with the higher size constancy. Figures on Table II show that as a group, Subjects who secured greater P.S.E.'s and thus obtained lower linear size constancy standing, tended toward extroversion as revealed by the Neymann-Kohlstedt Test. Those with the lower P.S.E.'s approximated more toward a greater linear size constancy, and were placed by the same test in the introverted category.

In view of the differences between the results obtained in the present experiment and those of Weber and Thouless the statement that "introversion-extroversion appears to be most definitely associated with visual constancy" (39), could hardly be of much significance. Indeed,
Sheehan might be right when she says that on the basis of her experiments she "questions any use of the term constancy which implies the existence of a unit trait" (31). It may be that such objective factors which she lists as the amount of visible detail, the degree of deviation of the object from its normal condition, misleading context material, etc., are influential in determining the degree of constancy, as are the subjective factors such as sensory efficiency, use of guiding cues, various adjustments to preceding situation, susceptibility to suggestion and contrast effects, etc. As a matter of fact, Sheehan goes further and makes a rather sweeping statement which leaves very little to the concept of constancy in general. "We question any suggestion that constancy is more characteristic of one age or intelligence level than another. To the extent that age or intelligence might directly affect certain of subjective factors (enumerated above), either might indirectly affect constancy, but the influence would be limited to those situations where such subjective factors played the dominant role" (31).

On the other hand, the difference or contradiction between the results of the present experiment and those of Thouless and Weber might be more apparent than real. The number of subjects involved in any of them is too small to make any sweeping generalization. Besides, there might be factors underlying the difference between introverts and extroverts which are not subject to statistical analysis. Granted for a moment that an extrovert is characterized by an "object-directed attitude" (39), his size constancy has to do with three or at least two-dimensional objects. In the present experiment only one dimensional
size constancy was under consideration. As such it might be something of a more abstract nature (and length is such) enabling an introvert to achieve a higher constancy. In other words, stimuli varying only in one direction as they did in this study might not be "objective" enough for an extrovert, and so he fell down in his size constancy; whereas such stimuli were more appropriate to the nature of an introvert since presumably he likes to deal with abstractions and he was thus enabled to make higher constancy scores.

So far the results obtained between the linear size constancy and introversion-extroversion personality traits were contrary to the seemingly prevalent notion that high size constancy correlates highly with extroversion and that low size constancy correlates highly with introversion. Neither does the converse of this notion seem to be true, namely, that there is a high correlation between extroversion and high visual size constancy. If anything, the tendency seems to be in the contrary direction, that is, introversion follows high and extroversion low size constancy. However, no definite conclusion could be drawn in this respect from the data available at present.

One of the interesting facts in the experiment was the way some Subjects manifested their individual differences. As Table II indicates, the Subject obtaining the greatest P.S.E. score in the linear size constancy and the one showing the smallest P.S.E. ranked equal on the Neymann-Kohlstedt Test, both obtaining a score of -4. The wide individual variation is again exemplified by still another Subject who secured the high-
est extroversion score of +24 on the Neymann-Kohlstedt Test but who rated low in the vertical constancy, obtaining a P.S.E. constancy score of 5.362, which is below the group average for that plane.

The discrepancy between the results obtained in the present study and those of both Thouless and Weber might be due to a number of factors, some of which have been already mentioned. It may be even possible that the Neymann-Kohlstedt Test for Introversion-Extroversion does not adequately measure the middle range between the extremes of extroversion and introversion, or that it does not ascertain these traits in the same way that Weber measured them in his experiment. Again, there might be a possibility that visual linear size constancy is not indicative to any appreciable extent of either of these personality tendencies.

On the other hand, the concept of introversion-extroversion itself might not be a fully substantiated distinction in the human nature. Despite Weber's statement that "the distinction between introversion and extroversion is somehow valid" (39), and that "introversion and extroversion are true personality traits" (39), it may be that the differentiation boundary between the two traits is not so clear cut after all, the difference probably being more apparent than real. Certainly there are many reputable psychologists today who are careful not to endorse unreservedly any "type" psychology (15).
SUMMARY AND CONCLUSION

This experiment had as its primary purpose the investigation of visual size constancy in both the vertical and the horizontal planes with stimuli varying only in one direction; and as its secondary purpose the exploration of the relationship between the constancy scores obtained in the two planes and the extroversion-introversion personality traits as measured by the Neymann-Kohlstedt Test for Introversion-Extroversion.

Sixteen pieces of black-stained dowelling one-half inch in diameter, and graduated by \( \frac{1}{4} \) inch from 4.25 to 8.00 inches, were used as variables. They were presented twelve feet from the Subject, for approximately three seconds, on a light gray background two feet square in size. The constant was a 5-inch piece of black-stained dowelling, three-eights of an inch in diameter, mounted on a similar light gray background, but eighteen inches square. Both backgrounds were reversible, so that the vertical position could be changed to the horizontal, and vice versa.

The method of equal step interval was used. The Point of Subjective Equality was derived by the summation method. Forty-five adult Subjects completed the experiment. The principle of constancy was markedly evident in both planes, but there was no significant difference between them, though, of course, individual differences in the Points of Subjective Equality were found to exist. The size constancy as measured
P.S.E. was high in both planes, namely, .92 in the vertical and .91 in the horizontal and the scatter in scores notably narrow. The correlation for size constancy between the two planes was +.529 ± .07.

Small but negative correlation was found between visual size constancy in both planes and extrovertive tendencies as revealed by the Neymann-Kohlstedt Test. The vertical plane yielded a correlation coefficient of -.217 ± .10, and the horizontal -.199 ± .10. The average of the size constancies for the two planes gave a correlation coefficient with extroversion as measured by the Neymann-Kohlstedt Test of -.257 ± .09.

Subjects with higher extrovertive tendencies as revealed by the Neymann-Kohlstedt Test obtained higher P.S.E.'s and consequently showed less constancy than did those with introvertive tendencies. This is opposed to the findings of both Thouless and Weber. It may be that the stimuli varying only in one direction were not "objective" enough for the subjects showing extrovertive traits.

The difference between the results found in the present experiment and those of Thouless and Weber might be due to the different reactions of the extrovertive personalities to stimuli involving only one dimension, namely, length. Probably introverts find it easier to deal with such abstractions. Among other factors responsible for this discrepancy might be the different personality tests used by Weber, the inability of the Neymann-Kohlstedt Test to measure adequately middle range of extroversion and introversion, or the inappropriateness of size
constancy as a measure of these personality traits. Then again, the concept of introversion-extroversion might not be such a marked characteristic of human nature as some take it to be.
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APPENDIX I

A SAMPLE OF RECORD OF THE EXPERIMENT IN SIZE CONSTANCY

Recording for:
- Vertical Plane
- Horizontal Plane (check)

NAME: K. M.  DATE: 6/30/44

<table>
<thead>
<tr>
<th>Interval</th>
<th>RANDOM TRIALS</th>
<th>&quot;Longer&quot;</th>
<th>&quot;Shorter&quot;</th>
<th>&quot;Equal&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>LL</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>7.75</td>
<td>LL</td>
<td>0.9</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>7.5</td>
<td>LL</td>
<td>0.8</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>7.25</td>
<td>LL</td>
<td>0.2</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>7</td>
<td>LL</td>
<td>0.1</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>6.75</td>
<td>LL</td>
<td>0.0</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>6.5</td>
<td>L</td>
<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

A two-minute interval

\[
\text{Sum}_{g} = 2.0 \quad \text{Sum}_{1} = 1.4 \quad 1.6
\]

\[
\text{"L"} \quad \text{"S"}
\]

A = 6.25

B = 4.75

\[
M_{g} = A - \frac{i}{2} - i \times \text{Sum}_{g}
\]

\[
= 6.25 - \frac{.25}{2} - .25 \times 2 = 6.25 - .125 - .5 = 5.625
\]

\[
M_{1} = B + \frac{i}{2} + i \times \text{Sum}_{1}
\]

\[
= 4.75 + \frac{.25}{2} + .25 \times 1.4 = 4.75 + .125 + .35 = 5.225
\]

P.S.E. = \[
\frac{M_{g} + M_{1}}{2} = \frac{5.625 + 5.225}{2} = \frac{10.850}{2} = 5.425
\]
The Neymann-Kohlstedt Diagnostic Test for Introversion-Extroversion (1928 Revision)

Name .............................................................................................. Occupation ............................................. Age .....................

This test is composed of fifty statements, each being followed by the words "Yes" and "No." There is no implication of right or wrong in any of the statements and you are asked to consider them from the viewpoint of personal like or dislike. Read the first statement and if you like the idea it expresses, draw a line under "Yes." If you dislike it, draw a line under "No." Proceed in the same way with the rest of the statements.

1. Be by yourself a great deal

2. Think of life in terms of pleasure

3. Always be calm and collected

4. Have a great deal of confidence in others

5. Think or dream of what you will do five years from now

6. Stay at home during a social affair.

7. Work with many people around you

8. Do the same kind of work all the time

9. Enjoy social gatherings just to be with people

10. Think a great deal before deciding anything

11. Accept suggestions rather than working them out for yourself

12. Quiet rather than exciting amusements

13. Dislike having people watch you

14. Quit a tiresome task

15. Save money rather than spend it

16. Seldom (infrequently) analyze your thoughts or motives

17. Indulge in reverie (day-dream) or thought

18. Have people watch you do things that you do very well

19. Let yourself go when angry

20. Work better when people praise you

21. Have excitement

22. Often meditate and think about yourself

23. Be a leader at a social affair

24. Speak in public

25. Do the things that you dream about (day-dream)

26. Rewrite social letters

27. Get things done very quickly rather than being slow and sure in movement

28. Think a great deal

29. Be able to express your keenest feelings (joy, sorrow, anger, etc.)

30. Pay little attention to details

31. Be exceedingly careful in meeting people

32. Associate freely with people holding views opposed to your own

33. Puzzles

34. Act on suggestions quickly rather than stopping to think

35. Read about rather than do a thing

36. Enjoy the story more than the way it is written

37. Keep a personal diary

38. Keep quiet when out in company

39. Act on the spur of the moment

40. Dislike thinking about yourself

41. Always plan out work before you begin it

42. Change from one type of work to another frequently

43. Avoid trouble rather than face it

44. Believe that rumors are important

45. Confide in others

46. distrust people you have just met until you get better acquainted

47. Study others rather than yourself

48. Spend your vacation at some quiet place rather than at a lively resort

49. Change your opinions easily even when formed

50. Take an active part in all conversations going on around you

No. Right.................. No. Wrong..................
Score Rt.................. Minus Wr..................
The thesis submitted by Mr. James Hominuke has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form and mechanical accuracy.

The thesis is therefore accepted in partial fulfilment of the requirements for the Degree of Master of Arts.

May 21, 1945
Date

[Signature of Adviser]