A PILOT STUDY OF CHILDREN'S REACTIONS TO VISUAL ILLUSIONS AND THE RELATION OF ILLUSION TO TOLERANCE FOR AMBIGUITY

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A B S T R A C T

A PILOT STUDY OF CHILDREN'S REACTIONS TO VISUAL ILLUSIONS AND THE RELATION OF ILLUSION TO TOLERANCE FOR AMBIGUITY

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In a pilot study of children's reactions to visual illusions, the hypothesis is confirmed that there is a positive relationship between the following variables: a) stimulation, b) tolerance for ambiguity. Restricted to seven psycho-physiological illusions accompanying the perception of space, a perception and an attitude test were administered with reference to three categories of visual discriminations orally reported by children 10-12 years and 7-9 years. The conclusions obtained from statistical analysis were interpreted as follows: 1) correlations: .92 for children 10-12 years and .85 for children 7-9 years. The degree of ambiguity was discovered to be half that of the degree of stimulation for children 10-12 years indicating the effect of change and experience on learning. 2) More change took place in older children. 3) Not all children saw visual illusions, some saw them with help and others not at all. 4) High excitement accompanied the perceptions.

An inquiry into a fundamental problem, this study has interdisciplinary significance of especial importance to non-linguistic forms of learning in relation to psychology, education and art. The above results refer to the participants in this study only, pending further investigation under more controlled conditions.

PREFACE

An interdisciplinary study of psychology and art, this investigation seeks to link the content of the two disciplines through an effort at greater understanding of some elements of their common search.

Explored by an artist and art educator and intended for teachers and students of art unfamiliar with psychology, the contents of this paper, at times, may seem obvious to the more experienced reader. Of necessity, it has been limited in scope.

The concepts contained in the truth of "folklore" have been confirmed by this investigation which concludes with the finding that we must "learn" to distinguish illusion from reality. Individual differences are implied.

This thesis is therefore concerned with "learning about learning."

C O N T E N T S

LIST OF CHARTS AND GRAPHS

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PROBLEM

This document presents a pilot study of children's reactions to visual illusion and the hypothesis that there is a positive relationship between the following variables:

(a) stimulation (whether or not a child responded to an illusion, visually presented), and

(b) tolerance for ambiguity (whether or not two interpretations or "two perceptions" of any given stimulus figure was orally reported).

Ambiguity is investigated in this document as the key to our knowledge about perception and art. Ambiguity is also related to the process of learning as has been revealed in this study.

Three categories of visual illusions have been chosen for exploration, presenting a need for visual discrimination. They are listed as follows:

(a) equivocal, ambiguous figures

(b) figure-ground discriminations

(c) geometrical-optical illusions

THE NATURE OF THE STUDY

Much of the current literature related to learning is based on verbal structure. The understanding of the non-linguistic forms of learning, basic to human development remain obscure.

Sensory perception, in which visual perception is paramount, is considered one of man's means of interpreting the nature of the world and gateway to knowledge and even survival. Illusion may be dangerous and/or serve as an impetus to further learning and an aid to behaviour.

The type of illusion discussed in this study is mainly of the static kind due to errors in the visual mechanism, judgment or intellect. Hallucinations, mirages or optical tricks of magicians were not within the scope of this inquiry. Attention was restricted to the psychophysiological illusions accompanying the perception of space.

This is an inquiry into a fundamental problem and its implications are cross-disciplinary, reaching into individual modes and strategies of operation, including seeing, feeling, thinking, and acting. Perceptual functioning is involved in determining behaviour, personality and even some psychological states. The perceptual functioning of both the artist and the viewer are significant in art and in the subject-object relationships, generalized to other disciplines.

REVIEW OF LITERATURE

The review of literature has been selected from diverse sources and represents the search for an understanding of the three categories of visual illusions which form the basis of this study. They are: (1) equivocal, ambiguous figures (2) figure-ground fluctuations, and (3)

geometrical-optical illusions. The assembly of the literature deemed relevant has involved selectivity and inter-disciplinary research into the theory and experimental evidence, and data presented by the disciplines of physiology, psychology, philosophy, and art. Of necessity, choice and scope were deliberately limited. The above mentioned types of illusions are here presented against the background of information and ideas which have been obtained and it is hoped that the reader will be provided with some of the current knowledge gleaned from the various sources.

There are two types of misleading perceptions, namely illusions and hallucinations. Illusions have already been mentioned above, hallucinations involve something which is seen but does not exist: the essential factors are supplied by the imagination. To philosophers, neurologists and others concerned with truth as evidenced through the physical senses, the messages of a disturbed mind are suspect. They may arise from the internal conditions of the organism or deficiencies of perception. In hallucinations, an entire world may be mistaken for reality, as is known to occur in drug-induced states such as in the taking of opium, L.S.D. and other hallucinogenic drugs. Gregory presents hallucinations as being similar to dreams and informs us that they may be visual or auditory and may even combine several senses at once. To the mystic, dreams and hallucinations are insights into another world of reality and truth.

The empiricists regard both hallucinations and dreams as the spontaneous activity of the nervous system unchecked by sensory infor-

mation. In brain surgery, Wilder Penfield found that when he stimulated the regions of the brain with weak electric currents, hallucinations involving visual and auditory images were produced.[1] In cases of epileptic seizures, the "aura" is associated with hallucinations and frequently precedes them. In these cases, the perceptual system is moved to activity by central (brain) stimulation rather than through normal signals from sensory receptors. It seems that the sensory system requires stimulation as has effectively been demonstrated in experiments in D.O. Hebb's laboratories at McGill University.[2] After sensory deprivation or hours or days of isolation, the experimental subjects involved in experiments experienced hallucinations, had difficulty in concentration or solving problems. In normal life, the effects of isolation may involve hazards resulting from industrial situations where control is taken from the operator and relegated to automatic machines. This is a particular danger in space travel. Examples drawn from prison behaviour, solitary confinement in wartime, and the fantasies which may dominate the schizophrenic individual in his restricted contact with his environment show the effects of isolation.

THE DISCOVERIES OF PHYSIOLOGY AND PSYCHOLOGY

Gregory brings together the experimental discoveries of both physiology and psychology in order to give us a comprehensive account of

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[1] R.L. Gregory, Eye and Brain (New York, N.Y.: McGraw-Hill Book Co., 1967), Pp. 132.

[2] Ibid. Pp. 132.

how man sees the world. He puts forward a general theory of illusions giving distortion of visual space and relates them to the artist's problems. In his book, Eye and Brain, Gregory explains that objects emit or reflect light and that the optical mechanism known as the eye focuses images of the object upon the retina. A distorted upside-down image appears in the eyes and we see separate solid objects in surrounding space. From the patterns of stimulation on the retinas, we perceive the world of objects as the eyes feed the brain with information coded into neural activity, chains of electrical impulses, which by their code and patterns of brain activity represent objects. When we look at something, the pattern of neural activity represents the object and to the brain is the object. No internal picture is involved and according to Gregory the seeing of objects involves many sources of information beyond those meeting the eyes when we look at an object. It generally involves knowledge derived from previous experience and this experience is not limited to vision but may also include the other senses: touch, taste, smell, hearing, and perhaps also temperature or pain. Gregory presents objects as far more than patterns of stimulation; objects have pasts and futures; when we know their past or can guess their future, objects transcend experience and become embodiments of knowledge. Without knowledge and expectation, Gregory has stated, life, even of the simplest kind of impossible.[1] Gregory has noted that: "although we are concerned with how we see the

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[1]R.L. Gregory, Eye and Brain (New York, N.Y.: McGraw-Hill Book Co., 1967), Pp. 7.

world of objects, it is important to consider the sensory processes giving perception--what they are, how they work and when they fail to work properly. It is by coming to understand these underlying processes that we can understand how we perceive objects."[1]

"Ambiguous figures" illustrate clearly how the same pattern of stimulation at the eye can give rise to different perceptions and how the perception of objects goes beyond sensation. These ambiguous figures are known as illusions and seem to belong to the subject who has an active role in the construction of the perceptual situation. According to Gregory, the seeing of "ambiguous figures" may involve a process of hypothesis testing. The sensory information is constant, yet the perception changes as each possible hypothesis goes up for testing. He elaborates this viewpoint as follows:

> Why should the perceptual system be as active in seeking alternative solutions as we see it to be in ambiguous situations? Indeed it seems more active, and more intellectually honest in refusing to stick with one of the many possible solutions than is the cerebral cortex as a whole--if we may judge by the tenacity of irrational belief in politics or religion. The perceptual system has been of biological significance for far longer than the calculating intellect. The regions of the cerebral cortex concerned with thought are comparatively juvenile. They are self-opinionated by comparison with the ancient striate area responsible for vision.
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> The perceptual system does not always agree with the rational thinking cortex. To the cortex the distance of the moon from the earth is a quarter of a million miles; to the visual part of the brain it is a mere few hundred yards.

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[1] R.L. Gregory, Eye and Brain (New York, N.Y.: McGraw-Hill Book Co., 1967), Pp. 10.

> The visual brain has its own logic and preferences which are not understood cortically. Some objects are beautiful, others ugly; but we have no idea, for all the theories which have been put forward, why this should be so. The answer lies a long way back in the history of the visual part of the brain, and is lost to the new mechanisms which give our intellectual view of the world.[1]

Learning seems to be involved in this hypothesis testing. Problems of interpretation of stimuli from our environment are part of our every-day life. A type of interpretation requiring specialized perceptual skill and learning is one that is made in the reading of X-rays, charts or diagrams or in the work of geologists, botanists, or accountants. The visual system of the brain has developed the ability to use non-visual information and to go beyond the immediate evidence of the senses. By building and testing hypotheses, action is directed not only to what is sensed, but also to what is likely to happen. If the brain were unable to fill in the gaps and speculate on meagre evidence, in the absence of sensory input, activity as a whole would come to a halt. Gregory claims that making mistakes (or suffering from hallucinations and illusions) is the price we pay for gaining our freedom from the immediate stimuli in determining behaviour, as shown by the example of insects which are helpless in unfamiliar surroundings or a frog who will starve to death surrounded by flies.

Illusions depend on previous past experience as evidence from observation of human infants and children suggest. Illusions also occur

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[1] R.L. Gregory, Eye and Brain (New York, N.Y.: McGraw-Hill Book Co., 1967), Pp. 223.

in less developed eyes and brains as experiments with hens and fish have shown. Non-western people make little or nothing of drawings or photographs of familiar objects and the history of art points to different views of reality and culturally based phenomena.

In examining the perceptual processes, D.O. Hebb, world renowned psychologist, shows that "simple" perceptions are, in fact, complex and that their apparent simplicity is only the end of a long learning process. The theory he presents is in direct opposition to the Gestalt theory of psychology which postulates that when one perceives a simple figure (such as a square or a circle) one perceives it directly as a distinctive whole without need of any learning process and not through a prior recognition of the several parts of the figure. Hebb does agree with the Gestaltists and with Rubin that in one respect, the figure-ground relationship, simple figures do sometimes act as wholes, which distinguishes them from other perceived figures.[1] The pattern of sensory excitation and the inherited characteristics of the nervous system on which it acts seems to produce the unity and segregation from the background of a figure which Hebb has defined as "primitive unity."[2]

As evidence for his views, Hebb presents the work of Senden (1932) which shows that patients who have been born blind and have been operated on for congenital cataracts always responded to certain objects as

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[1]D.O. Hebb, Organization of Behaviour (New York, N.Y.: John Wiley and Sons, 1949), Pp. 19.

[2]Ibid. Pp. 19.

wholes and could, on occasion, detect differences between objects. Hebb interprets the information as an indication of the operation of an innate, figure-ground mechanism, which may be independent of experience. Hebb's theories also include various sets of assemblies of neurons which correspond to various retinal patterns. These would gradually acquire "interfacilitation" and arousing one set, would, given time and repeated experience, arouse the others. Seeing any particular object would correspond to activity in the central nervous system and brain and seeing would involve eye movements and fixation on one part of the visual field followed by similar activities in another, the continued activity of this nature would yield the desired result.

According to Hebb, "facilitation" has exactly the same meaning as "stimulation" except that it is customary to distinguish between (1) events which excite the neuron from outside the central nervous system--these are referred to as stimuli; and (2) the excitation of one neuron by another--as facilitation.[1] A stimulus is defined as any energy which excites a receptor.

Hebb describes "limen" as "referring to the point at which an excitation becomes capable of producing a reaction. It is a term originally used in the understanding of sensation and in the field of physiology but the conceptions to which it refer are accepted as fully applicable to our problem of identifying mental processes."[2]

Hebb has presented a view which applies to the problem of discri-

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[1]D.O. Hebb, Textbook of Psychology (Philadelphia: W.B. Saunders Co., 1958), Pp. 93.

[2]Ibid. Pp. 37-38.

mination as follows: "The problem of validity does not arise in the determination of sensory limens. Generally speaking, what we do is measure by establishing physical methods, some property of a stimulus (such as energy, frequency or extent) which produces a given response--rather than measuring the degree of response."[1]

In testing the subject's ability to discriminate, the reliability of the individual determination is not great. However, the mean of a number of determinations is, of course, much more reliable. "We treat these as a sample from an infinitely large population of such determinations and the sample mean gets smaller as the sample gets larger. Also making a number of independent determinations allows us to determine how variable they are and whether the probable error is large or small."[2]

A further consideration: the limen is not a single point, above which the stimulus is always effective, below which it is never effective. When careful determinations are made, a range of uncertainty is always found.[3]

What is the limen? One way of dealing with the problem is to take an average of two values. In an illustration of testing, Hebb defines the limen as the point at which 75 percent response is obtained instead of 50 percent, or 90 or 99 percent, depending on the purpose to which

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[1] D.O. Hebb, Textbook of Psychology (Philadelphia: W.B. Saunders Co., 1958), Pp. 243.

[2] Ibid. Pp. 244.

[3] Ibid. Pp. 244.

the determination is to be put.[1]

A stimulus has a good probability of affecting behaviour if it fits in with processes already going on in the brain. Hebb has made a distinction between two theoretically known events in awareness which are different in kind. These have been termed "sensation" and "perception." "Sensation" is defined by Hebb as "an activity of receptors and the resulting activity of different pathways up the cortical sensory area of the brain completely subject to environmental control." He defines a "perception" as the mediating processes to which sensation gives rise directly."[2]

This explanation is augmented by Hebb when he notes that "the process of perceiving is not instantaneous except with very familiar objects; and even here, there is reason to believe that it consists of events in the brain as shown by certain experimental data."[3]

In describing what perception is, Hebb explains as follows:

> Where behavior is under immediate sensory control no problem of perception need arise theoretically. There is no reason for example, to speak of an earthworm's perception of an obstacle it encounters in its path; sensory stimulation determines its responses directly. But in higher mammals, where mediating responses share in the control of response, a complex set of events may intervene between first contact with an object and the adequate response (the one that we usually call "the" response); the animal looks, touches, sniffs, before finally carrying off the object, eating it, copulating with it, paying no further attention to it, or running away from it. The mediating

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[1]D.O. Hebb, Textbook of Psychology (Philadelphia: W.B. Saunders Co., 1958), Pp. 245.

[2]Ibid. Pp. 179.

[3]Ibid. Pp. 179.

> processes that determine the final response must first be set up and adjusted, so to speak, and this preliminary adjustment is perception.[1]

In the perceptions of children, a response series may take only two or three seconds if the object is not unusual in the child's experience, but the overt behaviour is clearly necessary for perception. Hebb describes perception as essentially a preparation for the final response and preliminary or investigatory responses essentially contribute to it in most cases.[2] Visual perception (i.e., perceiving) in general, depends on complex eye movements.

ANIMAL EXPERIMENTS

Learning experiments are often found convenient and even necessary in studying the perception of animals and lower animal forms. By the use of discrimination and reward, animals are exposed to a situation where they must attempt to discriminate one stimulus from another. The information which is obtained from the repeated use of discrimination and reward is generally of interest to learning experiments but they may also demonstrate the minimal differences between the stimulus that can be discriminated, and thus also demonstrate something about the animal's perceptions.

Riesen (1947) reared chimpanzees in darkness to an age when the normal chimpanzee makes an effective use of vision. Hebb notes that Riesen's accounts fully confirm the conclusion that ordinary visual

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[1]D.O. Hebb, Textbook of Psychology (Philadelphia: W.B. Saunders Co., 1958), Pp. 179.

[2]Ibid. Pp. 179.

perception in higher mammals presupposes a long learning period. His observations concerning the almost complete visual incapacity of chimpanzees reared in darkness and the slowness of learning are of the greatest importance.[1]

Fantz (1958a, 1958b) found a preference in both an infant chimpanzee and a group of human infants for looking at a chessboard pattern rather than at a square of solid colours. These preferred patterns contain much more contour than the ones with which they were paired. An explanation of this preference has been given in neurological terms which claim that many of the so-called on-and-off receptors of the retina become active only when light begins or ceases to impinge upon them.[2]

In the hope of learning more about consciousness, comparisons have been made comparing human and subhuman reactions to given targets. S.H. Bartley discusses an experiment made by G. Révesz with hens in which they were presented with an illusion which was perceptually equal but really unequal according to measurement. Bartley states: "These animals without showing any ability to verbalize, react as do humans. They see the "illusion" with the same discrepancy from the metrical (measured) size of the presented geometrical forms. In this connection, the educability of the hen, although its original ability manifests certain marked limitations, has been brought out and this shows how perception may develop." Bartley's account of the experiment made

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[1] D.O. Hebb, Organization of Behaviour (New York, N.Y.: John Wiley and Sons, 1949), Pp. 18.

[2] D.E. Berlyne, Conflict, Arousal and Curiosity (New York, N.Y.: McGraw-Hill Book Co., 1960), Pp. 99.

by Révesz reads as follows:

"Révesz trained hens to discriminate between the smaller of two plane geometrical figures such as circles, triangles, rectangles and squares. After certain behavioural criteria had been reached in doing this, the investigation passed on to the use of a certain geometrical "illusion." The two portions of the target were placed in various positional relations to each other. For the hens, however, the two portions were made metrically unequal (unequal according to actual measurement). After this preliminary training series, in which the animal procured the grain from the proper one of the two target elements, the two target elements were made equal in size. The problem was to determine whether the hen would choose the perceptually smaller element. If so it would indicate that it was, in effect, subject to the illusion. The test turned out positive, and it was concluded that perceptions of the hen certainly did not tally with metrical size of the targets, but were something like those of the human in such situations."

By choosing the perceptually smaller of the two target elements (now metrically equal or equal according to measurement) the hen demonstrated that it was subject to the same illusion as man. The above experiment indicated that the hen was also capable of adaptation to change through learning based on the previous experiences provided in the exercise of judgments in discrimination learning received in relation to the various positional arrangements mentioned in the experiment.[1]

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[1]S.H. Bartley, Principles of Perception (New York, N.Y.: Harper and Brothers, 1958), Pp. 77.

GEOMETRICAL-OPTICAL ILLUSIONS

Hypotheses pertaining to illusions are generally lacking agreement. No simple theory can cover the vast range of illusions because there are so many factors involved. M. Luckiesh, a noted authority on visual illusions, discusses the special case of what may be termed "geometrical-optical illusions." In a review of two different theories, by Lipps and Wundt respectively, Luckiesh claims that most theories are variants of these two systematic "explanations" of illusions (in the restricted sense). He states:

> Lipps proposed the principles of mechanical-esthetic unity according to which we unconsciously give to every space-form a living personality and unconsciously consider certain mechanical forces acting. Our judgments are therefore modified by this anthromorphic attitude. According to Lipps' theory, the circle has a centripetal character and these radial forces toward the center, which apparently have overcome the tengential forces during the process of creating the circle, lead to an underestimation of its size as compared with a square of the same height and breadth. By drawing a circle and a square side by side, with the diameter of the former equal to the length of a side of the latter, this illusion is readily demonstrated. .....By experimenting with a series of pairs consisting of a circle and a square, varying in dimensions from equal heights to equal areas, an idea of the "shrinking" character of the circle becomes quite apparent.
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> Wundt does not attribute the illusion to a deception or error of judgment but to direct perception. According to his explanation, the laws of retinal image (fixation) and eye-movement are responsible. For example, vertical distances appear greater than horizontal ones because the effort or expenditure of energy is greater in raising the eyes than in turning them through an equal angle in a horizontal plane. Unconscious or involuntary eye-movements also appear to play a part in many linear or more accurately,

angular illusions.[1]

Luckiesh claims that Wundt's explanation does not suffice for all illusions although it may explain many geometrical illusions. Wundt's theory may be said to be of the "perceptive" class and Lipp's theory to be of the "judgment" or "higher-process" class. An illusion does not generally exist physically but it is difficult in some cases to explain the cause as there are many cases of errors in judgment. Luckiesh also explains that illusions can be entertaining, useful, deceiving or disastrous, depending upon one's viewpoint.

VISUAL ILLUSION IN THE PERCEPTION OF CHILDREN

Piaget (1961) has demonstrated that perception is often at the mercy of chance occurrences of the moment and subject to illusions. In his recent extensive studies of the perception of visual illusions by children of various ages and of their eye movements during perception, Piaget states:

> With the younger children there was a general tendency toward "centration" of regard upon one part of the visual field, with disregard of the remainder. Only when they had reached a certain age were the children able to explore the whole field systematically, comparing one part of it with another and thus perceiving accurately the inter-relationship of the parts .....The child's attention may become centrated on a particular feature of what is shown to him, and he may fail to examine other parts of it. Again, it seems probably that children are less able than are adults to guess what a shape is if it is complex or

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[1] M. Luckiesh, Visual Illusions (New York, N.Y.: Dover Publications, Inc., 1965), Pp. 10.

> incompletely shown. The children require more and clearer information to see things correctly and in detail. (The general structure of a rectangle is not reproduced until 11 years old.)[1]

Piaget and Vinh-Bang (1959) filmed eye movements while asking subjects to state which of two lines was longer. They allowed the subject to look at the figures for as long as they wished before making a judgment and found that the time occupied by eye movement was greater when the differences between the lines was smaller.[2] Children's perceptions of visual illusions are also described by M.D. Vernon who has noticed that below a certain age children are not capable of analyzing shapes correctly, giving due weight to the general structure and relating detail to it.[3] This lack of ability to isolate the parts of a figure from the whole and perceive them as such, which appears in perceiving visual illusions such as she experimented with, is more noticeable in children than in adults. In the early phases of the perceptual process, there is "a note of vagueness and uncertainty" followed by a trial of a succession of forms in order to find the appropriate one. She notes that at least in some conditions, subjects identify the general class to which a perceptual figure belongs and then gradually narrow down its specific nature and minor details.

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[1] J. Piaget, Les Mecanisms Perceptifs (Paris, France: Presses Universitaires de France, 1961).

[2] D.E. Berlyne, Conflict, Arousal and Curiosity (New York, N.Y.: Harper and Row, 1958), Pp. 103.

[3] M.D. Vernon, The Psychology of Perception (Baltimore, Maryland: Penguin Books, Inc., 1963), Pp. 45.

Vernon refers to the earliest phases of the perceptual process as a "figure-ground" experience which is apparently fundamental in perception when the shape of the objects in the field begins to emerge in consciousness. If the field of view is completely homogenous and no part of it is in any way different from the remainder, then the "figure-ground" experience is impossible. Distinction between "figure and ground" is also of fundamental importance in the perception of more complex visual material.

GESTALT PSYCHOLOGY

The concept of "figure-ground" is today generally accepted in psychological literature. However, the Gestalt School of Psychology acknowledged this principle early in its history. Excerpts from Koffka in "Gestalt Psychology" indicate that Rubin explains that an area becomes solid when it has shape and is in this sense a "figure." He has called this area by the name "figure character" (Dingcharakter) and the looseness of the environment the "ground character" (Stoffcharakter). "The term "ground" is particularly appropriate because the figure seems nearer or protrudes in space as compared to the "ground." The unshaped environment is localized further backward and actually seems to extend behind the "figure" as a homogenous plane on which the "figure" lies." In general, contours are perceived as belonging to the figure.[1]

There is a shape-producing function in this process for perception and observing reversible figures, although each includes contour

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[1] W. Kohler, Gestalt Psychology (Toronto, Ontario: New American Library, 1947), Pp. 120.

common to both potential figures, the part that is functioning as figure at the moment will have a portion of the visual field that clings to it. The increasing reversal of stationary ambiguous figures under continued inspection might be attributed to a process of satiation, a term used when an observer seems unable to attend to more than one aspect at a time. There is some possibility that excitation and events in the central nervous system may be responsible for the effect as it does not seem to be due to any form of retinal fatigue. If one field is figured and the other plain, the former will dominate and the latter may be altogether suppressed. In general, Gestalt psychology would consider diffusion of excitation as evidence for tolerance for ambiguity.[1]

The Gestaltists also present the view that a pattern is responded to as a whole and it is wrong to ask which component of the pattern will determine the response. The "good" figure depends on how effectively it is preserved as a unit and fends off competing organizations. It is immune to distortion by memory and is unlikely to be misperceived by poor conditions of visibility. The "good" figure is dependent on such properties as (1) simplicity (2) closure (3) regularity (4) symmetry. Kohler, a Gestaltist, explains that inanimate nature, especially animal and vegetable forms, and even the soap bubble approximate the circle, straight line and other simple configurations more frequently than any particular irregular pattern.

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[1]W. Kohler, Gestalt Psychology (Toronto, Ontario: New American Library, 1947), Pp. 57.

Homogenous patterns in general, approximate the central tendencies of large classes of irregular pattern.

A well-publicized example of what has been interpreted as the application of Gestalt principles is demonstrated by the scribbling and drawing of the female chimpanzee who showed some conformity to human notions of aesthetic value as well as to Gestalt principles of perceptual organization. When given a piece of paper bearing a circle, for example, she tended to keep her drawing within the bounds of the circle showing some appreciation of figure-ground relations. The chimpanzee also scribbled in the vicinity of the gap in an incomplete circle, as if she were attempting to achieve "closure."[1]

The work of Gibson has contributed much to the study of perception and although not a Gestaltist in the full sense, his ideas are very close to their point of view. In his discussion of illusion, Gibson illustrates the possibility of a general theoretical approach to what he has called this difficult and confusing problem in perception. Gibson remarks that illusions, as the Latin root of the word suggests, "mock us." He reflects that the shadows of things, images in a pool of water and especially the making of pictures must have puzzled our ancestors as they pondered about the problems of appearances and reality.

In an effort to define and classify illusions, he notes that there are many kinds, some of which are difficult to explain. Like misper-

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[1] U. Neisser, Cognitive Psychology (New York, N.Y.: Appleton-Century-Crofts, 1967), Pp. 150.

ceptions, in general, they tend to fall into two major types: (1) objective, and (2) subjective. Mentioning seven classes of illusions, he suggests that objective illusions are caused by information from artificial sources, the deflecting of light rays, by contradictory information from pictorial sources and by obscure combinations of information in geometrical drawings. In discussing the illusions of the second type (subjective illusions) he describes them as being due to such factors as the after-effects of excitation, insufficient specialization of receptors and internal excitation of the nervous system. These seven classes of illusion are, he claims, not exhaustive.

Artificial sources, the commonest illusions of which are representations of what Gibson calls "reproducts" are exemplified in "the painting" the faithful picture, the wax flowers, the statue and "the model." The gadgets used in psychological laboratories to isolate, control and display are mistaken for "real" including the rectangular room and varieties of visual and auditory presentations.

In the varied images and experiences afforded by movies and television, children learn to span all available information, including that coming from outside the screen prior to viewing, as an important aspect of learning to distinguish illusion from reality.

In his discussion of "reality," Gibson states "we have no immediate access to the world around us or to any of its properties; what we do know is mediated not only by the organs of sense but by complex systems which interpret and reinterpret sensory information." For him, "reality is also very partially reflected in those private experiences

of seeing, hearing, imagining, and thinking, to which verbal experiences never do full justice." According to Gibson, our behaviour is an activity of the cognitive system integrated with muscles and glands.[1]

It is important to note that Gibson does not distinguish between the natural and the artificial sources of stimulation in this respect, the perceptions of which, he feels will be equivalent and related to the information that they convey. He indicates that the same structure will always afford the same perception.

In illusions, the puzzle of two or more reactions, seemingly caused by the same "stimulus" poses a difficult problem to explain. Gibson solves this seeming contradiction by saying that the same stimulus array coming to the eye will always afford the same perceptual experience insofar as it carries the same variables of structural information. If it carries different or contradictory variables of information it will afford different or contradictory perceptual experiences.

Rudolph Arnheim contributed much to the study of art and its dynamics. He interprets one of the basic tasks of man to be the scrutiny and understanding of the world in an attempt to find order and law outside and within himself. At the early stages of human development, such scrutiny is performed mainly by the senses and the conceptions of children and primitives point to early thinking as essentially visual thinking. In their art as well as man's reactions to all effigies whether they be in dreams, churches, movies, theatres, photograph

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[1] J.J. Gibson, The Senses Considered as Perceptual Systems (Boston, Mass.: Houghton Mifflin Co., 1966), Pp. 186.

albums or art museums, partial identification of the image with the real object is the rule rather than the exception. The term "illusion," is useful only when a difference arising between the physical and the psychological world makes us commit a mistake in dealing with physical things. For the artist, however, Arnheim notes that there is no danger because "in art what looks right is right."[1] He points out that one of the things the "man in the street" finds hardest to accept is that a picture may present a perfect likeness and yet be entirely incomprehensible visually and therefore devoid of artistic content. According to H. Kuhn, "illusionism" in the arts is found in the civilizations based on exploitation and consumption and that only in such a climate did it become possible to describe art as springing from a desire for reputation, power, fame, wealth, and the love of women, as Freud did in his lectures on psychoanalysis.[2]

Arnheim describes what he terms as the "artistic reality level" which may shift rapidly. As a rule in a given cultural context, the familiar style of pictorial representation is not perceived at all. In modern art, an "artistic reality level" occurs which makes us increasingly aware how deviant from realistic rendition modern work is and that a critic of today actually sees a different object than his colleague saw in 1890. For the artist themselves, there seems to be little doubt that they see in their works nothing but the exact

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[1] R. Arnheim, Art and Visual Perception (Berkeley, California: University of California Press, 1954), Pp. 8.

[2] Ibid. Pp. 114-115.

equivalent of the object. Style if thought of as a means of getting this result.[1]

Susanne K. Langer examines symbolic materials and calls them the "Gestalten" or fundamental perceptual forms that furnish the elementary abstractions in terms of which perceptual experience is understood.[2] She sees illusion as constituting a part of the intellectual vocabulary of contemporary aesthetics. The motif of "illusion" is generally coupled with its opposite, "reality."

Langer states that the work of art "detaches" itself from the rest of the world and even where the element of representation is absent, this air of illusion, of being sheer image, variously described as "strangeness," "semblance," "illusion" and "transparency" is a crucial factor indicative of the very nature of art.[3]

The illusion which constitutes the work of art is not a mere arrangement of given materials in an aesthetically pleasing pattern but is what results from the arrangement and is literally something the artist makes, not something he finds. It comes with his work and passes away in its destruction.[4] The parallel designs of art come from unrelated cultural products, periods and times. In looking for feeling,

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[1]R. Arnheim, Art and Visual Perception (Berkeley, California: University of California Press, 1954), Pp. 117.

[2]S.K. Langer, Philosophy in a New Key (New York, N.Y.: Penguin Books, Inc., 1941), Pp. 79.

[3]S.K. Langer, Feeling and Form (New York, N.Y.: Charles Scribner, 1953), Pp. 45-46.

[4]Ibid. Pp. 67.

the perceptual form is rediscovered as the truly essential factory, regardless of content or meaning.[1]

Langer explains Schiller's concept of "schein" or semblance as important for art because it liberates perception and thus the power of conception thereby allowing the mind to dwell on the sheer appearance of things. For Schiller, the function of artistic illusion was not "make-believe" as many philosophers and psychologists assume but was the very opposite. By the disengagement of belief and the contemplation of sensory qualities without their usual meanings and with no practical significance, attention is thus directed to appearance as such.[2]

According to E.H. Gombrich, "what is seen as reality depends on what we expect to see.....The effect of illusion is obtained when an image matches the preconceptions of the observer and made understandable only when the maker and beholder share the same set of conventions interpreted as individual reality."[3] His introduction includes a quotation from Max. J. Friedlander's article in "Von Kunst und Kennerschaft" which is pertinent to this paper. It reads:

> Art being a thing of the mind, it follows that any scientific study of the psychology of art will be psychology. It may be other things as well, but psychology it will always be.[4]

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[1] S.K. Langer, Feeling and Form (New York, N.Y.: Charles Scribner, 1953), Pp. 62.

[2] Ibid. Pp. 49.

[3] E.H. Gombrich, Art and Illusion (Princeton, N.J.: Princeton University Press, 1956), Pp. 5.

[4] Ibid. Pp. 60.

Although Gombrich has found it convenient to isolate the discussion of visual effects from the discussion of works of art, his study of the masters of the past who were both great artists and great "illusionists" reveals that the study of art and the study of illusion cannot always be kept apart. Artists use symbolism and images in their transference of ideas as they would use a language as yet not complicated by a knowledge of the linguistics of the visual world.

In discussing image reading, Gombrich elaborates on his explanations as follows: "In noticing relationships the mind registers tendencies."[1] The experience of art is not exempt from the general rule that involves the relationship between the expected and the experienced and a style, like a culture or climate of opinion, sets up a horizon of expectation, a mental set, which registers deviations and modifications with exaggerated sensitivity. "The history of art is full of reactions that can only be understood in this way."[2]

SUMMARY

Ambiguity and illusion have been explored in theory, idea and experimental evidence from various fields of knowledge. The result of this inquiry has been insights into how we perceive the world of objects and the nature of objective reality. The study of perception has also revealed the mind-body problem as basic to our understanding.

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[1]E.H. Gombrich, Art and Illusion (Princeton, N.J.: Princeton University Press, 1956), Pp. 60.

[2]Ibid. Pp. 60.

We are accustomed to receiving the same response from the same perceptual stimulus. However, we are not accustomed to receiving two or more different responses to the same perceptual stimulus. Ambiguity is represented by the two interpretations which are possible involving the same phenomenon, as in illusions. There are many approaches to this problem and the different responses which can occur to the same stimulus provide a basic challenge to theory and practice in perception, behaviour, art and learning.

Ambiguity has been shown as a functioning part of the process of learning and illusion described as a catalyst in the search for knowledge. The inquiry into what is innate and learned in our perception is not new and has been a central issue in psychology for some time. In this review, the work of the Gestaltists (e.g., Kohler, Koffka), Gibson, and the Behaviourists (e.g., Hebb, Gregory) illustrate this argument.

This document presents the view that there is a positive relationship between the perception of illusion on the one hand, and tolerance for ambiguity on the other. The need to overcome ambiguity results in differentiation and visual comprehension. The lack of differentiation in our perceptions leads to ambiguity. The problem of the interpretation of the stimuli which come to us from everyday life raises the need for stimulus discrimination which is important to our knowledge about the world we live in. This discrimination which is identified and examined by the investigations of the study is "tolerance for ambiguity" which has been described by the Gestaltists as

"diffusion of excitation" and Hebb (a Behaviourist) who has defined the term "threshold" or "limen" and the conceptions to which these refer as applicable to identifying mental processes. According to Hebb, the term "limen" refers to the point at which an excitation becomes capable of producing a reaction. A "stimulus" is generally described as an energy which excites a receptor, usually referred to as coming from outside the central nervous system.

Three important discriminations have been chosen for investigation in this study and information about them is included in the literature. They are: (1) equivocal, ambiguous figures, (2) figure-ground fluctuations, and (3) geometrical-optical illusions.

The selection of the "figure-ground" experience as a fundamental discrimination worthy of research has been confirmed by the importance given to this concept despite different terms of description by the various fields of study. It is considered the earliest phase of the perceptual process as described by Vernon.

This study presents the view that we must "learn" to discriminate through our "tolerance for ambiguity." The role of past experience has been shown as basic to learning and the knowledge derived from past experiences, past associations, expectation, motivations, set, internal conditions of the organism and other factors contribute significantly to our perceptions.

The ability to separate "illusion" from "reality" is the result of learning and experience. The various interpretations of "reality" are made by man in an effort to understand the world he lives in and

to find order and law both outside and within himself.

"We have no immediate access to the world around us" Gibson aptly stated. "What we do know is mediated not only by the organs of sense but by complex systems which interpret and reinterpret sensory information. Reality is also very partially reflected in those experiences of seeing, hearing and thinking to which verbal descriptions never do full justice."

The symbolic materials and images of art transfer ideas like a language which often offer parallel designs coming from unrelated cultural products, periods and times. The function of illusion in art is not make-believe but the disengagement of belief and the contemplation of sensory qualities, directing attention to appearance without their usual meanings.

DESIGN OF STUDY

INTRODUCTION

Visual illusions have been the subject of considerable study and the literature reflects the trends taken by the various schools of psychology in keeping with the prevalent spirit of inquiry of the times. Still controversial in the theoretical aspects of its status, today's perceptual theory sees the study of visual illusions as the path along which perceptual theory is to be sought. The Gestalt pioneers endeavoured to minimize the role of learning and experience but current research in physiology, neurology, psychiatry and related fields have profoundly affected present psychological theories and the direction of

their experimental practice and research.

The symbolic processes which are part of the thinking and reasoning capacities in man have influenced both our civilization and culture. The history of the arts have been linked closely with illusion and in the fine arts, picture-reading is classed by psychologists with the perception of symbolic material. The problem of ambiguity or the possibility of two interpretations of the same perceptual experience is discussed by Gombrich. Although defined in terms of the fine arts, his ideas have meaning for perception.[1] He makes the statement that "ambiguity is the key to the whole problem of image reading." Gombrich explains that ambiguity allows us to test the idea that an interpretation involves a tentative projection.....and in order to detach a projection once it has been made, we must switch to an alternative one.[2] The idea is expressed that ambiguities can never be seen as such and that we notice an ambiguity only by learning to switch from one reading to another and by realizing that both interpretations fit the image equally well. Inquiry into the "really real" involve the beholder's share in the reading and interpretation of the visual image. For perception and art, the suggestion of one reading rather than another of any arrangement of forms is of crucial importance and our inability to see ambiguity can be dangerous or block our pathway to further knowledge. Even the "pure" shapes of art, allow an infinity of special

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[1] E.H. Gombrich, Art and Illusion (Princeton, N.J.: Princeton University Press, 1956), Pp. 238.

[2] Ibid. Pp. 249, 258.

readings, as illustrated in the ambiguities presented by modern art. In the broadest sense, some paintings are themselves illusions, striving to represent the three dimensional world upon a two-dimensional canvas in an endeavour to catch the ever-changing relations of lines, forms and brightness within the limited range of the artist's palette, as opposed to nature's.

The ideas influencing the germination of the content and structure of this study have been represented in the choice and emphasis of the literature presented to the reader.

PROCEDURE

The reactions of children to visual illusions have been the subject of investigation in this pilot study and the hypothesis that there is a positive relation between illusion and tolerance for ambiguity has been confirmed as presenting a high correlation by the results of statistical analysis.

The study has endeavoured to research three categories of "readings" in perception and illusion, limited to the following:

(1) equivocal or ambiguous figures

(2) figure-ground fluctuations

(3) geometrical-optical illusions

Two tests were administered to the subjects participating in the study, as follows:

Test I: Perceptual Test

Nine visual illusions representing the three categories mentioned above, were presented in random order and the subjects asked to des-

cribe what they saw. The interviews were taped.

Test II: Attitude Test

Based on the perceptual test, a questionnaire was completed and accompanied by the exposure of three visual illusions already familiar. The results of the tests were analyzed statistically. Interpretations and conclusions were arrived at and reported in this study.

POPULATION

All the experimental subjects participating in the study were pupils attending the Saturday morning art classes held at Sir George Williams University in Montreal. A total of eighteen subjects were tested comprising two age groups, 10-12 years, and 7-9 years, respectively. In this study, the former is also referred to as Group I and the latter as Group II. Participation in the study was voluntary. The individuals who were taking part in the study were interviewed in the seminar room for the perceptual test. The separate groups met in their classrooms where group interviews and the attitude test took place.

An investigation into the heredity, social background, and history of the subjects was not within the scope of this inquiry. However, it might be added that the students seemed to be of middle-class origin, from urban populations and attending elementary schools.

Research into relative cultural levels and art expertness of the subjects was not included in this study.

GROUP INTERVIEWS

The examiner was introduced and the subjects acquainted with the purpose and procedures of the perceptual test. The subjects were told: "You are asked to participate in an experiment, the aim of which is to discover how people see things. There are no right answers and no wrong answers as each person sees in his or her own way." The subjects were also informed that they would be shown some pictures in another room and that conversations would be taped. The results of the study would be made available at a future date, if interest in them was shown. The group interviews were conducted for reasons of expediency and to gain "peer" co-operation and participation in the study.

PERCEPTUAL TEST: TEST I

The perceptual test was conducted in the seminar room of the Department of Fine Arts at Sir George Williams University. An effort was made to keep the room as free from distracting elements as possible. The table was bare, except for the materials needed in the test, the blackboard cleared and the door closed. A clock was used to time the individual interviews. The test extended over a period of six weeks and took place on consecutive Saturday mornings in sessions of approximately 15 minutes per interview. The subjects entered the seminar room unaccompanied except by the previous participant who acted as a guide to the location of the room. Classes were in session while the test was conducted. The examiner and the subject were seated side by side at a table and pictures of seven illusions, measuring 4" long by 5" wide were presented in random order. The examiner held up each illusion,

questions were asked and the interview taped. The tape was studied by the examiner and questions prepared for the attitude test. The purpose of Test I was to learn as much as possible from the testing situation. There was a possibility that nothing of interest would be discovered and to ensure that relevant information was being explored, structured questions were prepared which were used for direction. A total of six specific questions were asked, four relating to the immediate perceptual experience and two regarding the subject's interest in the test. The oral responses to these questions provided the information relative to the subject's reaction to visual illusion and his tolerance for ambiguity. These responses also provided information with regard to the subject's interest in the test. A copy of the perceptual test and pictures of the seven illusions employed have been placed in the appendix of this study.

PERCEPTUAL TEST: TEST I

The questions were adapted to the illusion figure that was being investigated. They were presented as follows:

Question:

(1) What do you see?

(2) Is there anything else you can tell me about the picture?

(3) Are there any differences between this and that?
i.e., "this line and that line?"
"this circle and that one?"

(4) What colour is the subject and what colour is the background?

(5) Did you like this test?

(6) Would you like to do it again?

A copy of the questions employed in the test appears in the appendix.

ATTITUDE TEST: TEST II

The questionnaire used in the attitude test was composed by the examiner based on the perceptual test. It was intended as an added support to the key measurement which was that of tolerance for ambiguity related to the perceptual test. Pictures of three illusions (Illusions I, II and V) apparently receiving the most responses in the perceptual test were exposed to eliminate the possibility that the subjects might have forgotten the illusion to be tested and/or avoid difficulties which might arise due to the necessity of verbal description and interpretation. The questionnaire was prepared in advance and mimeographed earlier in enough copies for distribution to both groups. A demonstration of procedure was made before beginning the test using the sample question: "Do you like milk?" Each question appearing on the questionnaire was repeated twice during the test and read aloud. The reading of the test question was followed by the exposure of the illusion and the relevant section of the questionnaire completed by the subjects, this procedure being followed until the test was finished. Pencils were used. A copy of the questionnaire has been placed in the appendix and figures of the illusions used for the attitude test have been so indicated.

ATTITUDE TEST: TEST II

The questions were read aloud twice for each of the three illusion figures, which were exposed (Illusions I, II and V). They were presented as follows:

Question: (1) How did you feel when you took the test?

Reply: (x) pleasant (xx) funny (xxx) strange

(2) How did you enjoy the test?

Reply: (x) I liked it very much

(xx) I liked it a little

(xxx) I didn't like it at all

(3) Did you feel strange?

Reply: (x) very strange

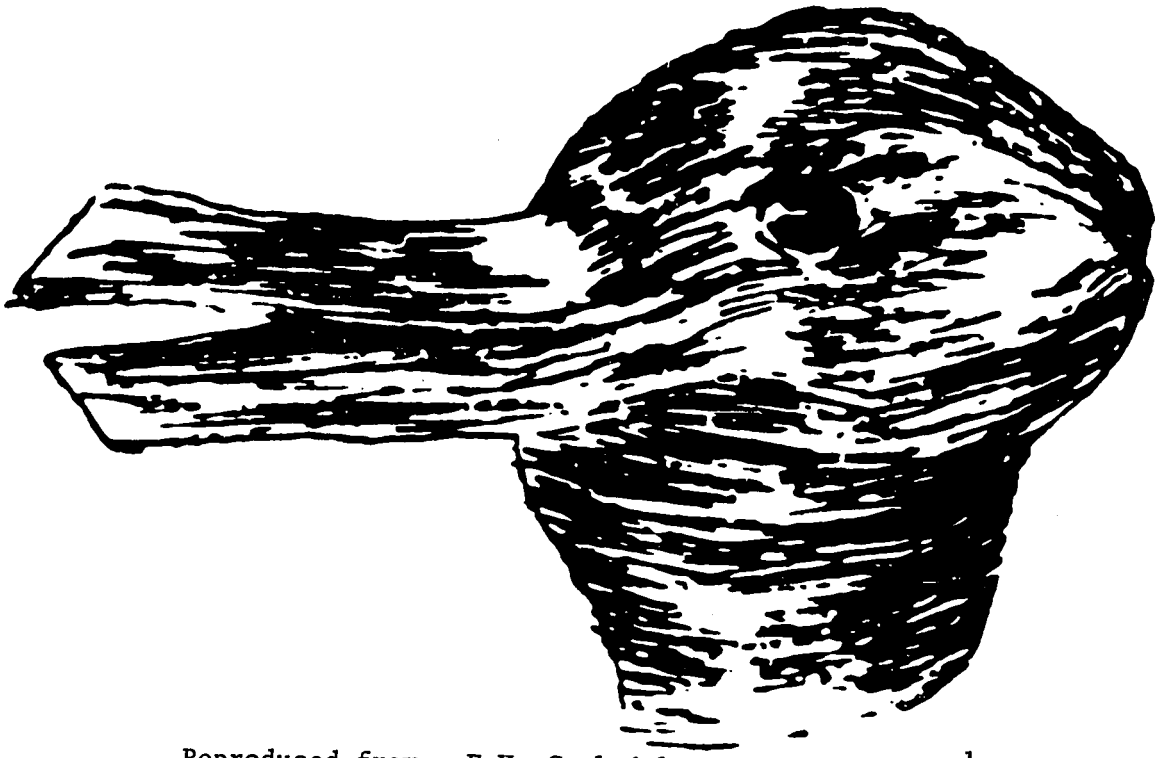
(xx) a little strange

(xxx) not strange at all

A copy of the questions employed in the attitude test also appear in the appendix.

VISUAL ILLUSION FIGURES EMPLOYED IN THIS STUDY

The seven visual illusions which were employed in the study are presented in the pages which follow, together with some explanations about them from authoritative texts. Illusion figures I, II and V are indicated as having been used in the attitude test. These particular visual illusions were chosen for investigation in this study because they were illustrative of the three categories of visual discrimination with which the study is concerned. They are as follows:



Reproduced from: E.H. Gombrich, Art and Illusion[1]

ILLUSION I - Ambiguous Figure (Duck or Rabbit?)

Gombrich explains that we cannot experience alternate readings at the same time. It is impossible to see the shape aside from its interpretation, the duck's beak becomes the rabbit's ears. He mentions that although we experience illusion, we cannot watch ourselves have one as we cannot hold two visions at the same time.[2] Gombrich classes this illusion as an ambiguous figure which involves projections and interpretations until the ambiguity is perceived.

This illusion figure was also employed in the attitude test.

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[1]E.H. Gombrich, Art and Illusion (Princeton, N.J.: Princeton University Press, 1956), Pp. 5

[2]Ibid. Pp. 6.

Reproduced from: William Dember, Psychology of Perception[1]

ILLUSION II - Ambiguous Figure (Wife - Mother-in-Law)

This illusion is based on a study by Leeper (1935) of an earlier ambiguous figure by Boring (1930). Leeper's (1935) experiment demonstrated a lasting control, by earlier experience of the particular perception that is made with Boring's ambiguous figure. Leeper was able to influence his subject's perception of this figure by a preliminary verbal description, but could easily do so by first showing a biased version of it. His experiment indicates the differences in perceptual and verbal instructions.

This illusion figure was also employed in the attitude test.

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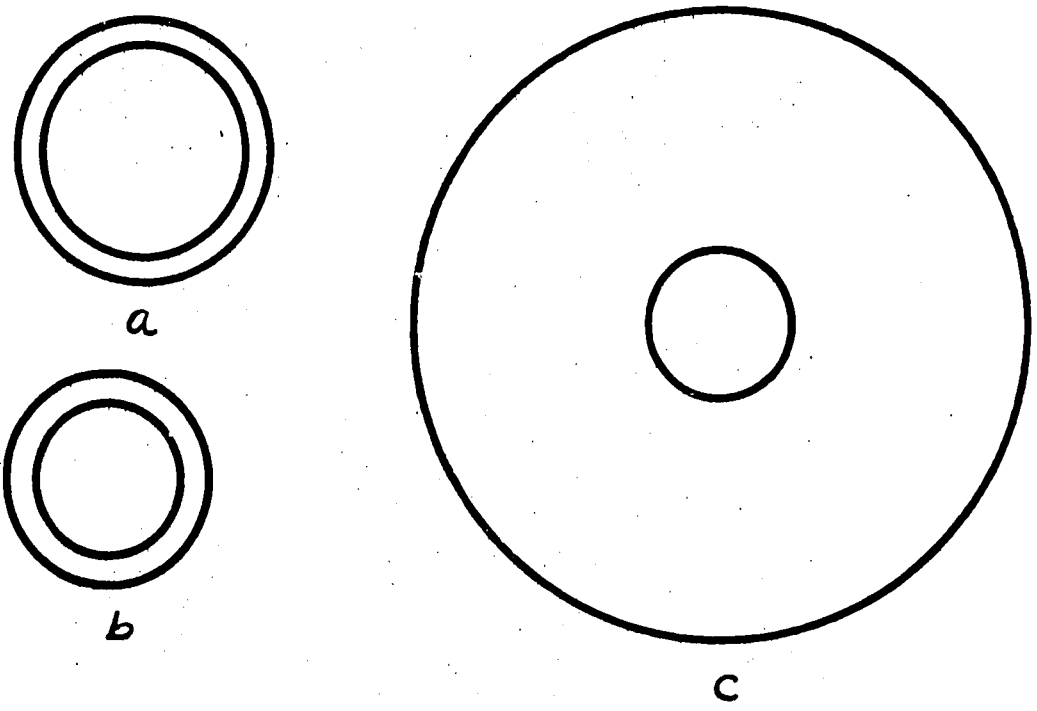
[1]William N. Dember, Psychology of Perception, (New York, N.Y.: Holt, Rinehart and Winston, 1960), Pp. 299.



Reproduced from: M. Luckiesh, Visual Illusions[1]

ILLUSION III - Geometrical-Optical Illusion of "Contrast"

This illusion is classified by Luckiesh as a geometrical illusion of a given type, although these types of illusions include other factors. He explains this illusion as being due to the phenomenon of "contrast" which usually refers to lines, angles and areas of different sizes in which the appearance of equal elements appear unequal. "Contrast" parts adjacent to large extents appear smaller and those adjacent to small extents appear larger, as a general rule. In the above illusion, equal circles appear unequal, the inner circles of "b" and "c" are equal but that of "b" appears the larger. The inner circle of "a" appears larger than the outer circle of "b" despite their actual equality.

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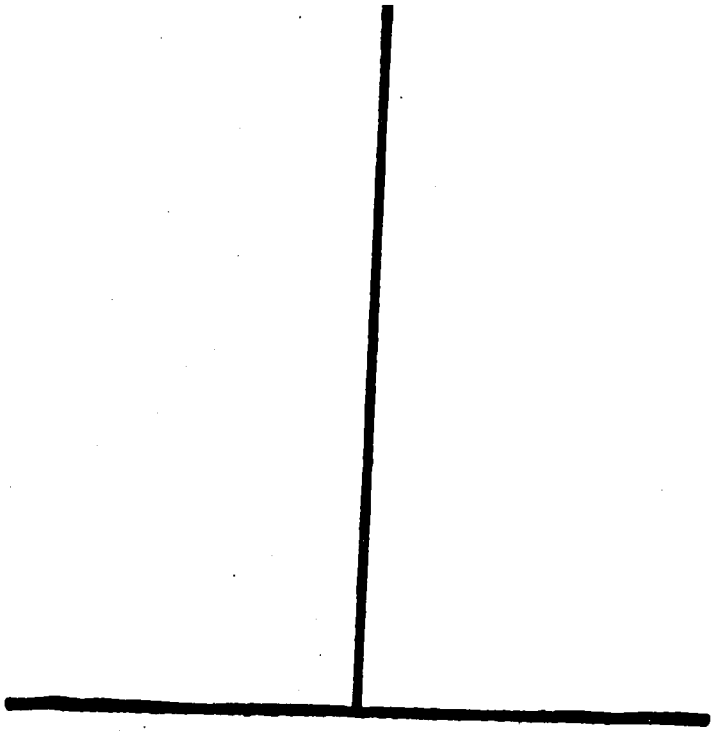
[1]M. Luckiesh, Visual Illusions (New York, N.Y.: Dover Publications, Inc., 1965), Pp. 56.



Reproduced from: M. Luckiesh, Visual Illusions[1]

ILLUSION IV - Geometrical-Optical Illusion of Effect of Location

Luckiesh discusses the effect of location on the visual field and notes that in this illusion the vertical line appears longer than the equal horizontal line. He reminds us that a pole or tree generally is thought longer when standing up than on the ground. Part of the illusion is due to the bisection of the horizontal by the vertical line. In his discussion of the effect of location on the visual field, Luckiesh points out that some accept the explanation that more effort is required to raise the eyes or point of sight, through a certain vertical distance than through an equal horizontal distance. It has also been demonstrated that images of objects lying near the periphery of the visual field

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[1] M. Luckiesh, Visual Illusions (New York, N.Y.: Dover Publications, Inc., 1965), Pp. 46.

are more or less distorted owing to the structure and defects of parts of the eye. In this complex field of physiological psychology, Luckiesh warns that questions may be not only annoying but disruptive. He states: "Perhaps unconsciously we appraise effort of this sort in terms of distance, but is it not logical to inquire why we have not, through experience, learned to sense the difference between the relation of effort to horizontal distance and that of effort to vertical distance through which the point of sight is moved?"[1] Luckiesh calls the above figure a geometrical illusion, and his remarks about geometrical illusions are, in general, also applicable to this figure.[2]

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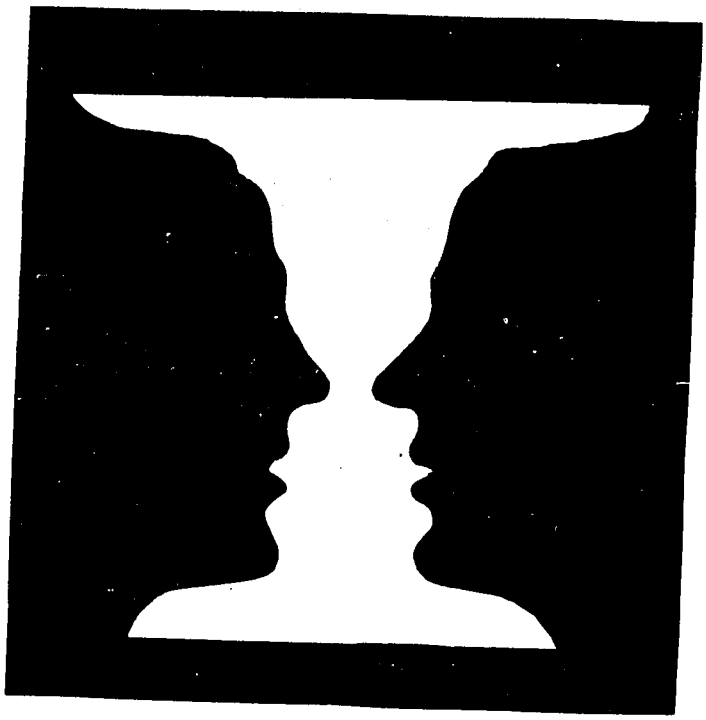
[1]M. Luckiesh, Visual Illusions (New York, N.Y.: Dover Publications, Inc., 1965), Pp. 46.

[2]Ibid. Pp. 10.



Reproduced from: U. Neisser, Cognitive Psychology[1]

ILLUSION V - Rubin's Ambiguous Figure of Fluctuating Spatial Relations Called the "Peter-Paul Goblet"

Gregory explains this figure in terms of communication theory and describes the basic perceptual "decision" to be made in terms of the engineer's distinction between "signal" and "noise" basic to any system which handles information.[2] This figure alternates spontaneously so that sometimes it is seen as a pair of faces, sometimes as a white urn bounded by meaningless black areas--the faces.

Gibson describes the stimulus as the same for the two percepts.

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[1]U. Neisser, Cognitive Psychology (New York, N.Y.: Appleton-Century-Crofts, 1967), Pp. 90.

[2]R.L. Gregory, Eye and Brain (New York, N.Y.: McGraw-Hill Book Co., 1967), Pp. 11.

but the stimulus information as not being the same.[1] In the absence of texture and parallax, the information for edge-depth or superpositions has been arranged to specify two opposite directions of depth. There are two counterbalanced values of stimulus information in the same "stimulus." The perception is equivocal because what comes to the eye is equivocal. In such displays, the information for "one thing in front of another" must come from variables of the mutual contour at the optical function of the two things.

This illusion figure was also employed in the attitude test.

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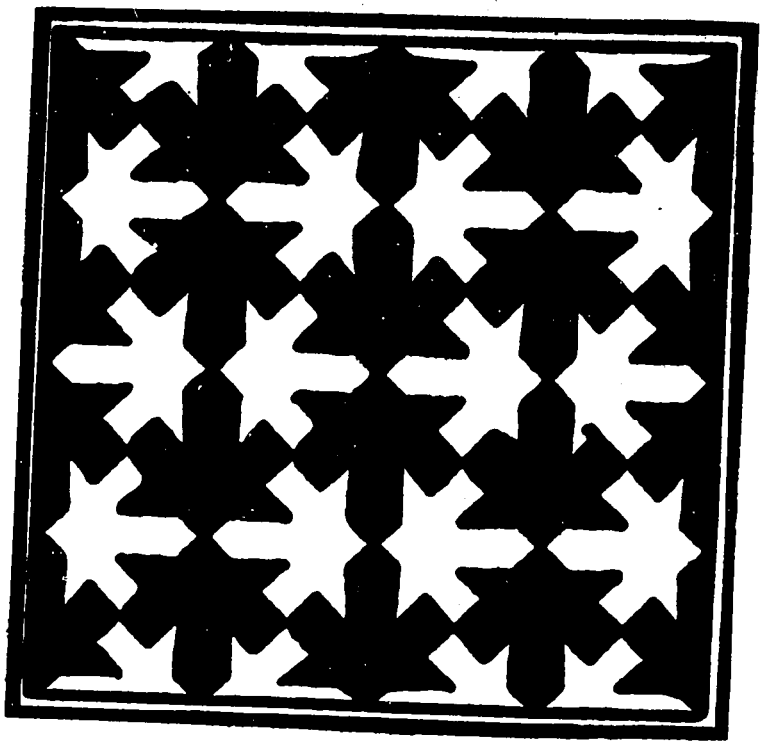
[1] J.J. Gibson, The Senses Considered as Perceptual Systems (Boston, Mass.: Houghton Mifflin Co., 1966), Pp. 246.



Reproduced from: M. Luckiesh, Visual Illusions[1]

ILLUSION VI - Figure-Ground Illusion Involving Fluctuating Spatial Relations

Luckiesh calls this illusion an equivocal figure and tells us that it is very interesting to watch the fluctuations of these figures and to note the various extraneous data which lead us to judge correctly.[2] Many figures apparently change in appearance due to fluctuations in attention and in associations. The figures which exhibit these illusions are obviously those which are capable of two or more spatial relations and the double interpretation is more readily accomplished by monocular than binocular vision. By gazing upon this particular illusion which consists of identical patterns in black and white, this

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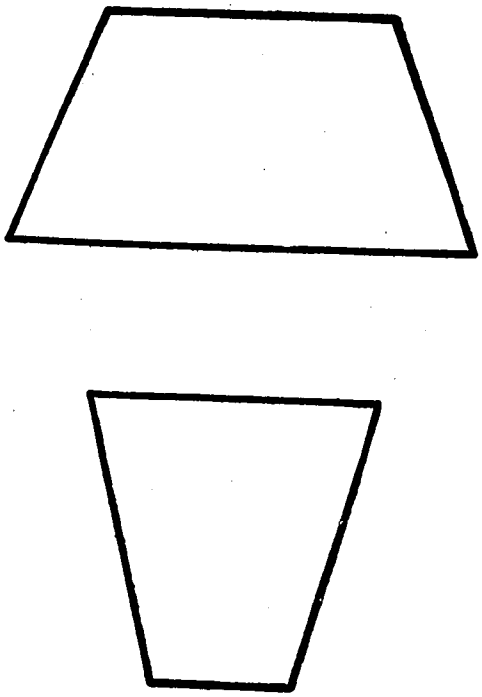
[1]M. Luckiesh, Visual Illusions (New York, N.Y.: Dover Publications, Inc., 1965), Pp. 65.

[2]Ibid. Pp. 65.

illusion will appear to fluctuate in appearance from a white pattern upon a black background to a black pattern upon a white background. Sometimes the fluctuation of attention apparently accounts for the change and in fact, this can be tested by wilfully altering the attention from a white pattern to a black one. Luckiesh calls attention to the fact that one investigator found that the maximum rate of fluctuation was approximately equal to the pulse rate, although no connection between the two was claimed. It has also been found that inversion is accompanied by a change in the refraction of the eye. Our perception is strongly associated with accustomed ways of seeing objects and Luckiesh reminds us how tenaciously we cling to our perception of the real shape of objects.



Reproduced from: M. Luckiesh, Visual Illusions[1]

ILLUSION VII - Geometrical-Optical Illusion of "Contour" and "Contrast"

Luckiesh considers this illusion as an illusion of contour but he also claims that it really is an illusion of contrast.[2] The length of the top horizontal line of the upper figure is due largely to contrasting the two figures. Also, it is difficult to believe that the maximum horizontal width of the lower figure is as great as the maximum height of the figure.

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[1]M. Luckiesh, Visual Illusions (New York, N.Y.: Dover Publications, Inc., 1965), Pp. 55.

[2]Ibid. Pp. 53.

Category I: Equivocal Illusions Involving Ambiguity (human and animal forms)

Illusion I: Rabbit - Duck

Illusion II: Wife - Mother-in-Law

Category II: Illusions Involving Figure-Ground Fluctuations

Illusion V: Urn - Faces (may also be classified as an ambiguous figure)

Illusion VI: Fluctuation spatial relations

Category III: Geometrical-Optical Illusions

Illusion III: Illusion of "contrast"

Illusion IV: Illusion of the "effect of location"

Illusion VII: Illusion of "contour" and "contrast"

METHOD

Owing to the absence of any measuring device which would span the gap between perception and objective reality, a general agreement among normal persons was necessary to determine the perception of an illusion. The widespread existence of illusions make visual perception the final judge. The verbal reports of the perceiver provided the responses which determined the structure of the measurements which were established especially for use in this study. Explanations are provided in this document. The key measurements employed in this study were as follows:

A: Measurement of stimulation

B: Measurement of tolerance for ambiguity.

The following were considered as added support for the measurement of tolerance for ambiguity:

C: Attitude test

D: Measurement of interest.

Two correlations were made for this study:

(a) the degree of stimulation with the degree of ambiguity for each age group (Group I, 10-12 years old, and Group II, 7-9 years old).

(b) f ratio test for both above mentioned age groups with a .01 level of significance on the degree of stimulation versus the degree of ambiguity.

Intended only as further information which might be of interest to the study, the following statistics were compiled:

(c) correlation between the level of interests indicated in the perceptual and attitude tests.

The responses of the two age groups were compared with regard to measurements A to D, inclusive, and an individual percentile record was made and scaled. An analysis was made of the responses to each illusion with regard to the two age groups and another analysis added in relation to each individual in accordance with the measurements, A to D, inclusive.

EXPLANATION OF STATISTICAL TECHNIQUES USED IN THE STUDY

A: MEASUREMENT OF STIMULATION

To obtain a measurement of stimulation, information was taken from the results of the responses to the perceptual interviews and a measurement arrived at based on a judgment of whether or not a response

was made by the experimental subject regardless of kind. For the measurement of stimulation, it was not necessary for the individual subject to have immediately reported two interpretations (or "two perceptions") of any given figure as in the tolerance for ambiguity measurement. Evidence of stimulation was accepted as including any type of response regardless of type, quality or number. The behaviour, comments and exclamations of the individual subject during the course of the interview were taken into consideration, and accepted as evidence of "stimulation." The values attributed to the responses were as follows:

(a) positive value - accepted as indicating excitement

(b) negative value - accepted as indicating frustration

A stimulation response in which a partial illusion was orally reported was rated as having a negative value. According to Hebb, it is customary to distinguish events which excite the neuron from outside the central nervous system as "stimulation." In this study, "stimulation" would refer to excitation of the visual receptors. Oral reports are usually accepted in perceptual discrimination studies.

B: MEASUREMENT OF TOLERANCE FOR AMBIGUITY

Tolerance for ambiguity is understood in this document in the sense of "limen" or "threshold" described by Hebb, and considered applicable to mental processes. It is understood as a point at which an excitation becomes capable of producing a reaction.[1]

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[1] D.O Hebb, Textbook for Psychology (Philadelphia: W.B. Saunders Co., 1958), Pp. 93.

In this study tolerance for ambiguity was investigated in relationship to the three categories of visual illusions represented by the discriminations involved in the following:

(a) equivocal, ambiguous figures

(b) figure-ground fluctuations

(c) geometrical-optical illusions

The measurement of tolerance for ambiguity as accepted in this document was based on the perceptual test. It was decided to adopt the following classifications:

(a) highly tolerant: those subjects who immediately perceived an illusion. Two interpretations (or two "perceptions") of any given stimulus figure must have been orally reported by the individual experimental subject.

(b) low in tolerance: those subjects who did not perceive it. There was a third or middle group who saw the illusion later, with help or otherwise. These were classified as "low in tolerance" for the purposes of this study. Included in this category were those who saw only part of an illusion figure. Subjects who saw versions other than the generally accepted one of the illusion figure were classified as "highly tolerant."

C: ATTITUDE TEST

The questions appearing on the questionnaire were used as an index of the experimental subject's attitudes towards ambiguity. This test was considered as an added support for the measurement of tolerance for ambiguity.

D: MEASUREMENT OF INTEREST

To obtain a measurement of the level of interest, the verbal responses to questions 5 and 6 in the perceptual test were examined and the responses placed into two categories as follows:

Question: "Did you like this test?"

Reply: "positive interest" - yes

"negative interest" - no

Question: "Would you like to do it again?"

Reply: "positive interest" - yes

"negative interest" - no

E: The responses of the two age groups (Group I and Group II) were compared with regard to each of the above measurements: "A," "B," "C," and "D."

F: A percentile record was compiled referring to the individual's standing with reference to his age group and this record was scaled.

G: An analysis was made as to the responses to each illusion with regard to the two age groups in order to determine how many subjects saw each illusion immediately, how many saw the illusion with assistance and how many did not see it. The deviant responses were also included in the analysis along with those subjects who saw other illusions or part of an illusion figure.

H: An analysis was made with regard to the viewing of each illusion by

each individual using the measurementsm "A," "B," "C," and "D."

I: The results of the level of interests were correlated and the following correlations were made:

(a) the degree of stimulation with the degree of ambiguity for each group using the perceptual test to see whether or not responses for each group were consistent in both tests.

(b) the correlation between the level of interest shown in the responses to the perceptual test with the responses to each question asked for each illusion in the attitude test.

(c) F ratio test for both groups with a .01 level of significance was conducted on the degree of stimulation versus the degree of ambiguity.

STATISTICAL ANALYSIS OF STUDY[1]

INTRODUCTION

As it was felt by the author that statistical analysis would add considerably to the understanding of this study, the assistance of Douglas Paron, Jr., was requested. As artist and art educator, the author was unfamiliar with the techniques of statistical analysis.

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[1]Statistical analysis done by: Douglas Paron, Jr., B.Sc., McGill University.

The following results were orally dictated by Douglas Paron:

1. Correlation between the degrees of responses of the stimulation test with the degree of responses with the ambiguity test: both groups had a very high correlation (.92 and .85 consecutively for Group I and Group II). This shows that each group was consistent in their responses to both tests.

2. Correlation between the attitudes towards the three illusions presented in the attitude test (written) with the attitudes expressed in the perceptual test (verbal interview) to seven visual illusions:

   Group I: Of the three illusions only one question (number 1) of Illusion V was significant (.79). The other correlations were either non-significant (.6 to -.6) and fell within the above mentioned range. The mean for the significant result (i.e., attitude test - written) was 1.52; the other mean for the perceptual test (verbal interview) was 3.14. The perceptual test was on a scale of 1 to 4 and the attitude test was on a scale of 1 to 3. In looking at the mean of the perceptual test and comparing it with the mean of the attitude test, the former mean showed that the group attitude was "slightly positive." In the latter case, the group attitude was rated as close to "pleasant" as indicated by Illusion V (urn-faces illusion) Question 1: "How did you feel when you took the test?" of the attitude test.

   Group II: The results were similar in Group II. There were two significant results for the correlations of two different

questions in two different illusions in the attitude test, Illusion II, question 1 and Illusion V, question 2. The scales were the same as in Group I. The mean for question 1, Illusion II was 2.7 and the mean for question 2, Illusion V was 1.87. The former mean, according to the scale was interpreted as being "strange" (question 1, Illusion II). The latter mean was interpreted as being "funny" (question 2, Illusion V). The overall trends of correlations for Group II (the perceptual test with the attitude test) were positively correlated but in Illusion I for Group II the response to the total questions compared to the other two illusions were least significant.

THE F RATIO TEST

Group I. In doing statistical analysis of the responses from the stimulation test and the degree of ambiguity (perceptual test) the f ratio test using a .01 level of significance and also a .05 level of significance showed that there was no difference in the variances between the two but in noting the dispersion of the variances, the degree of ambiguity was half that of the degree of stimulation. This seemed to indicate that with help, the individuals of this group approach the mean of the group (3.1). Without help, the mean has been interpreted as 2.8.

Group II. For Group II there was no indication of marked improvement between the two tests. The mean was 4.8 for the stimulation test and 5 for the ambiguity test.

CONCLUSIONS

This document presents a pilot study of children's reactions to visual illusion and the hypothesis that there is a positive relationship between stimulation and tolerance for ambiguity.

The conclusions which are here presented are limited to the children who participated in this study. They are tentative, pending further investigation under more controlled conditions and are as follows:

I The influence of learning and change has been revealed as significant factors operating in the perceptions of all the children who participated in this investigation.

Statistical analysis employing the f ratio with a .01 and .05 level of significance correlated the following: (a) stimulation test, and (b) the degree of ambiguity. The analysis of the responses showed that for the children 10-12 years, there were no differences in the variances between the two tests.

In noting the dispersions of the variances, however, it was discovered that the degree of ambiguity was half that of the degree of stimulation. This result was interpreted as indicating that with help, the individuals of this age group approach the mean of the group (3.1). Without help, the mean was interpreted as 2.8,

This result points to an improvement in the performance of the group. It also shows that a change took place and the dispersions became smaller. The individuals lessened their tolerance for ambiguity as they approached the mean of the group and as a whole

the group range of responses narrowed.

II The f ratio test showed that more change and learning had occurred in the older children, 10-12 years, than in the younger children, 7-9 years. In the younger age group, there was no indication of marked improvement between the two tests. The mean was 4.8 for the stimulation test and 5 for the degree of ambiguity.

As a speculation, this trend is probably due to the immaturity of the nervous system and the egocentric attitudes of the younger children, 7-9 years, in comparison with the older children, 10-12 years. The results might be interpreted as subject to the effects of "centration" observed by Piaget which might also account for the rigidity in the perceptual responses noted in the younger children. As a group, they showed more individuality and fantasy as well as variety in the test results. As a group, these children had limited experience, learning skills, and were less susceptible to the socializing influences of society as compared to the older children. They were, obviously, at a different stage in growth and maturity. These combination of factors, among others, might account for the large dispersion for the younger group.

These results clarify the nature of learning and show the effect of experience.

III The original hypothesis made by this study was confirmed by statistical evidence. It was found that there was a very high cor-

relation between the children's ability to perceive visual illusions and their tolerance for ambiguity. The statistical results indicate .92 for the older group, 10-12 years, and .85 for the younger group, 7-9 years.

This study has found that not all children perceived visual illusions, some saw them with help and others did not see them at all. A part of an illusion figure was also orally reported by some children.

The results are interpreted as evidence of the differences in discrimination displayed by the children with reference to the three categories of visual illusions which are investigated in this study and are as follows: (1) equivocal, ambiguous figures, (2) figure-ground fluctuations, and (3) geometrical-optical illusions. The measurement of tolerance for ambiguity was based on the perceptual test and it was decided to adopt the following classifications:

(a) highly tolerant: those subjects who immediately perceived the illusion.

(b) low in tolerance: those subjects who did not perceive the illusion.

To qualify as "highly tolerant" a subject must have orally reported two interpretations (or "two perceptions") of any given stimulus figure. "Tolerance for ambiguity" is understood in the sense of "threshold" of "limen" defined by Hebb and considered here as applicable to mental processes. It is understood as a

point at which an excitation becomes capable of producing a reaction.

IV The results of this study show that high excitement occurred in all subjects as indicated in the highly positive value displayed by the relationship between the following variables:

(a) positive value - indicating high excitement.

(b) negative value - indicating frustration.

The results of the statistical correlation of the variables of stimulation and tolerance for ambiguity have been already quoted as .92 and .85 for the children, 10-12 years and 7-9 years, respectively and are related to the above mentioned excitement values.

V To obtain a measurement of the level of interest, the verbal responses to questions 5 and 6 in the perceptual test were examined and placed into two categories as follows:

(1) Question: "Did you like this test?"

Reply: "positive interest" - yes

"negative interest" - no

(2) Question: "Would you like to do the test again?"

Reply: "positive interest" - yes

"negative interest" - no

A statistical analysis was made of the relationship between the following variables:

(a) perceptual test (stimulation): oral responses in relation

to interest in the investigation of seven illusions, visually presented (Illusions: I-VII).

(b) attitude test: written responses to a prepared questionnaire with reference to interest in three illusions perceived in the perceptual test (Illusions: I, II, V).

The purpose of the analysis was to determine whether the time factor of an interval of six weeks, between the two tests involved a change in the attitudes of the subjects and to learn which attitude was retained.

The results showed that for the older children, 10-12 years, only one question in the attitude test was significant with a statistical result of .79 (Illusion V) "how did you feel about the test?" The other correlations were non-significant (.6 to -.6) and fell within the above mentioned range. The group attitude was "slightly positive" and a comparison of the means of the perceptual and attitude test showed the group attitude as "pleasant."

For the younger children, ages 7-9 years, the positive correlations of means for the perceptual and attitude tests indicated favourable attitude to both tests. There were two significant results for the correlations of two different questions shown in the attitude test (Illusions: V, II). The means displayed a result of 1.87 and 2.7 respectively and were interpreted as "funny" and "strange" in the questions taken from the attitude test which were "how did you enjoy the test?" and "how did

you feel when you took the test?" Only Illusion II had predictive value (knowing the mean values predicted that it would be the same for the individual).

There is no way of determining the future development of the subjects and there was no real basis for correlation as Illusion II had no correlative or predictive value in relation to the degree of interest which was correlated in the perceptual and attitude tests.

It would be debatable whether the six week interval in time and the variations in individual waiting time influenced the direction of the results. There were a great many variables involved which were unexplored and these factors also affected results in other correlations in this study.

INTERPRETATION OF THE STUDY

UNKNOWN VARIABLES

In order to learn as much as possible an "open attitude" was adopted toward events which developed as the investigation progressed. Information was obtained with regard to children's reactions to visual illusions and the nature of the phenomena which were being studied became better understood gradually forming the basis for future research.

This study was limited by many factors. Intended as a pilot study, only a small group of children were involved and it might be claimed that the number was a limited and biased sampling of the

available school population. The age, sex, stage of maturity and the internal conditions of the participating experimental subjects were not previously investigated and might have affected the results of the study. Little is known about the subjects' school activities, families, economic and social positions. The individual subject might have been influenced by his attitudes towards his teachers, the art classes in progress or his peer group. The attitude of the examiner conducting the tests might inadvertantly have affected the proceedings. There was an interval of six weeks between tests, a period of time which varied with the individual and group participating and which might have contributed to some of the results regarding interest in the test. The duration of time allowed for testing each individual also varied.

This study is no exception in the respect that chance factors might have been operative. The nature of the illusions might have influenced the individual subject and the subject's responses might have been controlled by the presence of a whole complex of factors. It is always possible that behaviour was dominated by only a small part of the stimulus situation and that subjects performed in that particular manner in response to a selection of very specific phenomena. The experimental situation was made more complex by the necessity of functioning in the "natural environment" of the available facilities of the Art Department.

There are many possible variables which might be examined in the future and it may be that a chance combination of co-incidental factors might have influenced the result of the study.

IMPLICATIONS OF THE STUDY

This is an investigation into a fundamental problem. The implications are cross-disciplinary. In its scope, it reaches deeply into the perceptual functioning of the individual which determines his behaviour, personality and even some psychological states. The perception of both the artist and the viewer are significant in art and in the subject-object relationships, generalized to other disciplines.

Much of current literature related to learning is based on verbal structure. This study contributes to the understanding of the non-linguistic forms of learning basic to human development.

The inquiry into what is innate and learned in our perceptions has been a central issue in psychology for some time and presents a framework for the understanding of the importance of the conclusions presented by this investigation.

The conclusions of this study have demonstrated that the influence of learning and change are significant factors operating in the perceptions of all the children who participated in it. More learning took place in the older children than in the younger ones. The results of the study clarify the nature of learning and show the effects of experience. The original hypothesis of the study has been confirmed showing a high correlation between the ability to perceive visual illusions on the one hand, and tolerance for ambiguity on the other. The nature of the discriminations made by children in their perceptions have been illustrated by their ability to perceive visual illusions. Tolerance for ambiguity was assumed by the interpretation of statistical analysis as well as by observation of high excitement. These re-

sults were evident for all the children who participated in the study.

This inquiry into illusions or ambiguous figures demonstrates that perception goes beyond sensation and illustrates how the same pattern of stimulation at the eye can give rise to different and sometimes misleading perceptions. The different responses which can occur to the same stimulus provide a basic challenge to theory and practice in perception, behaviour, learning, and art.

The knowledge that has been gleaned from the sources of both science and art seem to justify the artist's belief in the truth of his vision. We are impressed by things as perceived not with things as they are and the connection between the material and the mental, is still incomprehensible. Even the simplest perception, it has been shown, is quite complex in its many manifestations.

The problem of the interpretation of the stimuli which come to us from everyday life demonstrate the need for stimulus discrimination which is essential to our knowledge about the world we live in.

The conclusions of this study identify the factor of tolerance for ambiguity as fundamental in learning and diffusion of excitement as inherent in it. Ambiguity is also presented in this document as the key to our knowledge about perception and art.

Tolerance for ambiguity is considered by this study to operate in the sense of "limen" or "threshold" defined by Hebb. The need to overcome ambiguity results in the necessity for differentiation and visual comprehension in perception. The lack of differentiation leads to ambiguity.

The earliest phase of the perceptual process has been described

by Vernon and other psychologists, as the "figure-ground" experience which has been explored and clarified in this study. The basic discriminations which are involved in "figure-ground" clarifications have been traced in the sources of the various disciplines, provided by the literature, experimental evidence and ideas, in an effort to identify a common search for differentiation and meaning. The nature of illusions, as demonstrated by the investigation of equivocal, ambiguous figures and geometrical-optical illusions have also proved essential to discrimination. Ambiguity has been shown as a functioning part of the process of learning and illusion described as a catalyst in the search for knowledge.

This study presents the view that we must learn to discriminate through our "tolerance for ambiguity." The role of past experience has been shown as basic to learning and the knowledge derived from past experiences, past associations, expectations, motivations, set, internal conditions of the organism and other factors contribute significantly to our perceptions.

The ability to separate "illusion" from "reality" is the result of learning and experience. The various interpretations of "reality" are made by man in an effort to understand the world he lives in and to find order and law both outside and within himself. In noticing relationships between the "expected" and the "experienced" both psychology and art are involved in "image-reading." Ambiguity has been shown as an important key to our knowledge in both science and art.

APPENDIX

TEST I: PERCEPTUAL TEST

The questions were adapted to the illusion being investigated.

Questions:

(1) What do you see?

(2) Is there anything else you can tell me about the picture?

(3) Are there any differences between this and that?
i.e., "this line and that line?"
"this circle and that one?"

(4) What colour is the subject and what colour is the background?

(5) Did you like this test?

(6) Would you like to do it again?

TEST II: ATTITUDE TEST

The questions were read aloud twice for each of the three illusions presented.

Questions:

(1) How did you feel when you took the test?

Reply: (x) pleasant (xx) funny (xxx) strange

(2) How did you enjoy the test?

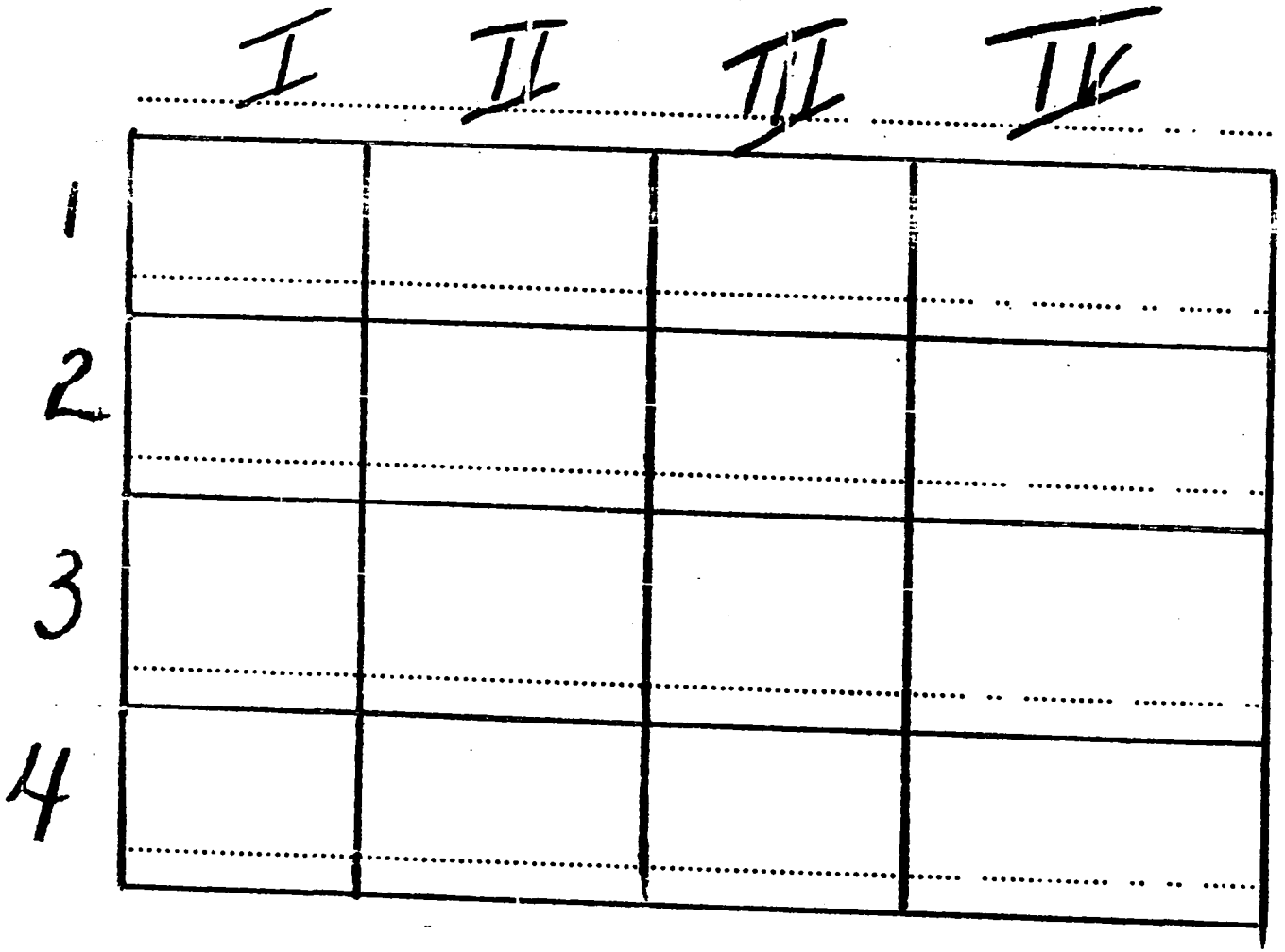
Reply: (x) I liked it very much
(xx) I liked it a little
(xxx) I didn't like it at all

(3) Did you feel strange?

Reply: (x) very strange
(xx) a little strange
(xxx) not strange at all

NAME..... AGE.... GRADE.....

QUESTIONNAIRE



Scaling of Positive and Negative Verbal Responses

Verbal Response of Perceptual Test (Scaling '1-4')

Group I: 10-12 years
Mean = 3.14

1	4
2	4
3	2
4	3
5	3
6	3
7	3

Group II: 7-9 years
Mean = 2.7

1	1
2	2.5
3	4
4	3
5	2.5
6	4
7	2 5
8	2

Questions: (1) Did you like the test?

(2) Would you like to do this test again?

Table of Responses (Group I: 10-12 yrs.)

Degrees of Stimulation

Subjects	I	II	III	IV	V	VI	VII	Total	%	Scale
1				+	+	+		3	43	3
2	+	+		+	+			4	57	4
3					+	+	+	3	43	3
4			+					1	14	1
5					+	+		2	28	2
6				+	+	+	+	4	57	4
7				+			+	2	28	2
8			+	+	+		+	4	57	4

Degree of Ambiguity

Subjects	I	II	III	IV	V	VI	VII	Total	%	Scale
1				+	+	+		3	43	2
2	+	+		+	+			4	57	3
3					+	+	+	3	43	2
4				+	+			2	28	1
5					+	+		2	28	1
6				+	+	+	+	4	57	3
7				+	+		+	3	43	2
8			+	+	+		+	4	57	3

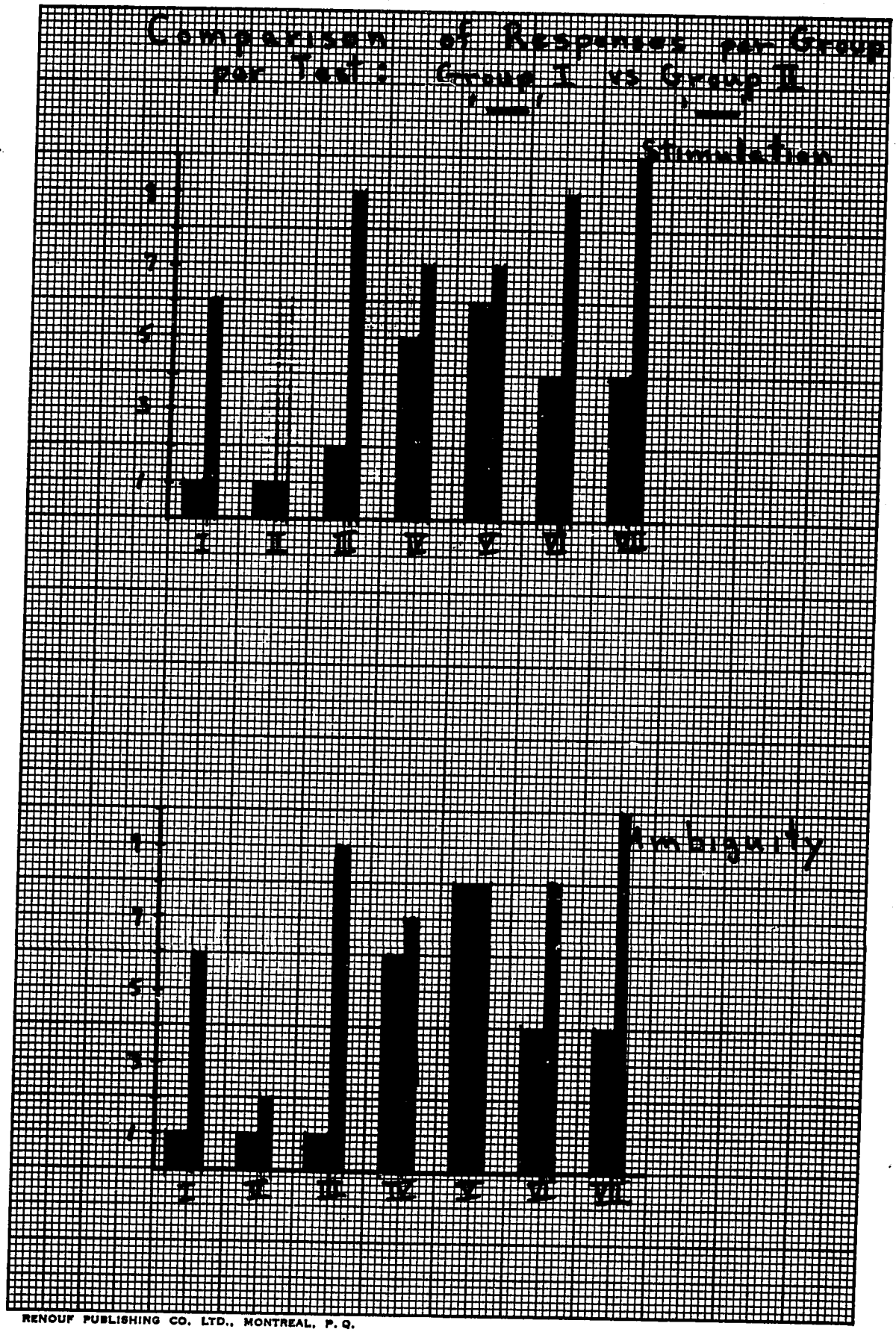
Table of Responses (Group II: 6-9 yrs.)

Degree of Stimulation

Subjects	I	II	III	IV	V	VI	VII	Total	%	Scale
1	+		+	+	+	+	+	6	86	4
2	+		+	+		+	+	5	20	3
3			+	+	+	+	+	5	70	3
4			+	+			+	3	43	1
5	+		+		+	+	+	5	70	3
6			+		+	+	+	4	57	2
7	+		+	+	+	+	+	6	86	4
8	+		+				+	3	43	1
9				+	+	+	+	4	57	2
10	+	+	+	+	+	+	+	7	100	5

Degree of Ambiguity

Subjects	I	II	III	IV	V	VI	VII	Total	%	Scale
1			+	+	+	+	+	5	70	3
2	+		+	+	+	+	+	6	86	4
3	+	+	+	+	+	+	+	7	100	5
4			+	+			+	3	43	1
5	+		+		+	+	+	5	70	3
6			+		+	+	+	4	57	2
7	+		+	+	+	+	+	6	86	4
8	+		+				+	3	43	1
9					+	+	+	4	57	2
10	+	+	+	+	+	+	+	7	100	5



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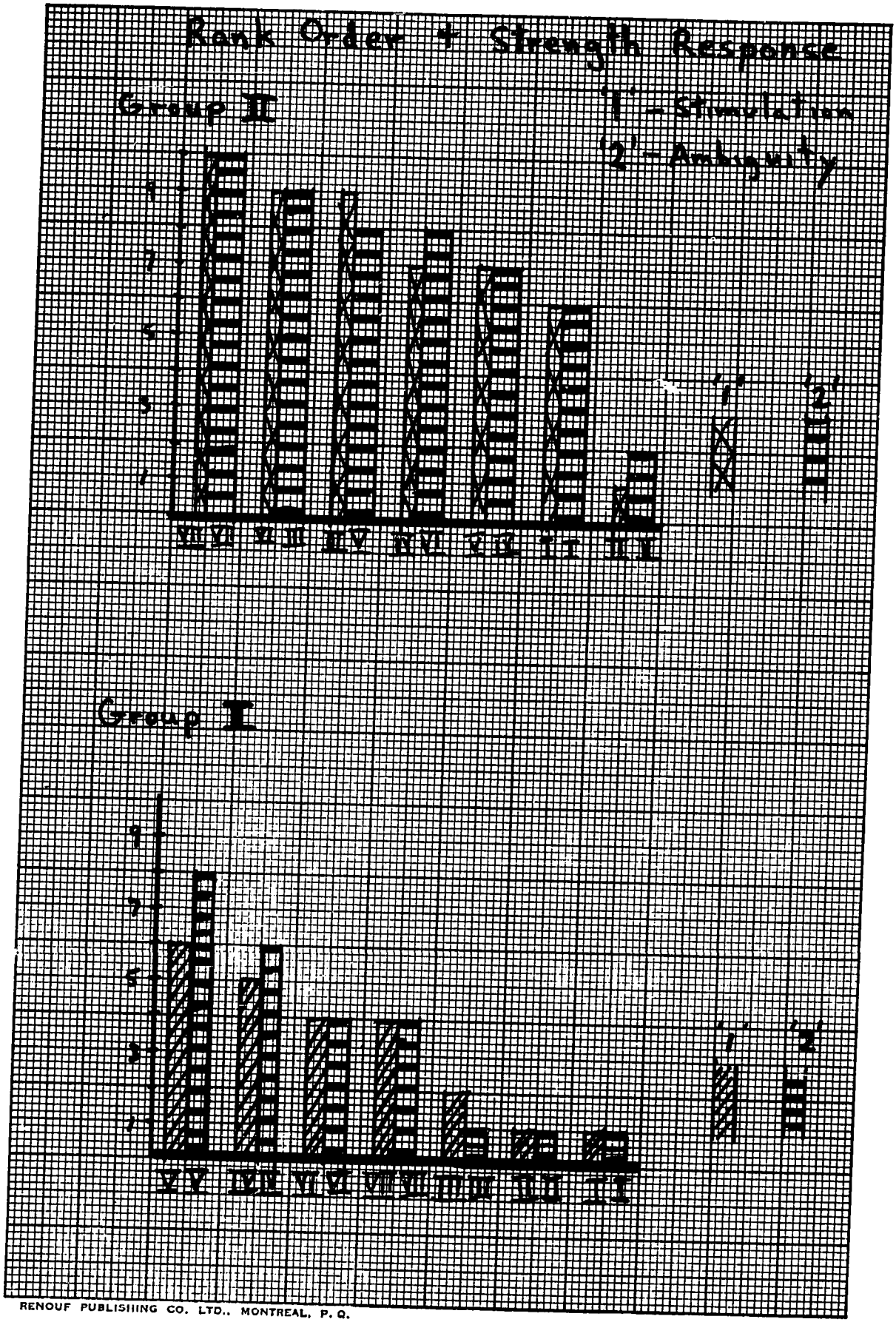
Rank Order + Strength Response
'1' - Stimulation
'2' - Ambiguity
Group II
Group I
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BIBLIOGRAPHY

Arnheim, R. Art and Visual Perception. Berkeley, California: University of California Press, 1954.

Arnheim, R. Toward a Psychology of Art. Berkeley, California: University of California Press, 1966.

Bartley, S.H. Principles of Perception. New York, N.Y.: Harper and Row, 1958.

Berlyne, D.E. Conflict, Arousal and Curiosity. New York, N.Y.: McGraw-Hill Book Co., 1960.

Chennakesavan, S. Perception. New York, N.Y.: Asia Publishing House, 1966.

Dember, W.N. Psychology of Perception. New York, N.Y.: Holt, Rinehart and Winston, 1960.

Feldman, E.B. Art as Image and Idea. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.

Gibson, J.J. The Senses Considered as Perceptual Systems. Boston, Mass.: Houghton Mifflin, Co., 1966.

Gombrich, E.H. Art and Illusion. Princeton, N.J.: Princeton University Press, 1956.

Gregory, R.L. Eye and Brain. New York, N.Y.: McGraw-Hill Book Co., 1967.

Hebb, D.O. Organization of Behaviour. New York, N.Y.: John Wiley and Sons, 1949.

Hebb, D.O. A Textbook of Psychology. Philadelphia: W.B. Saunders Co., 1958.

Hillway, T. Introduction to Research. Boston, Mass.: Houghton Mifflin Co., 1964.

King, R. Readings for an Introduction to Psychology. Toronto, Ontario: McGraw-Hill Book Co., 1966.

Koestler, A. The Act of Creation. New York, N.Y.: Macmillan and Co., 1964.

Kohler, W. Gestalt Psychology. Toronto, Ontario: New American Library, 1947.

Kohler, W. Dynamics in Psychology. Toronto, Ontario: McClelland & Stewart Ltd., 1949.

Langer, S.K. Philosophy in a New Key. New York, N.Y.: Penguin Books Inc., 1941.

Langer, S.K. Feeling and Form. New York, N.Y.: Charles Scribner and Sons, 1953.

Luckiesh, M. Visual Illusions. New York, N.Y.: Dover Publications, Inc., 1965.

Neisser, U. Cognitive Psychology. New York, N.Y.: Appleton-Century-Crofts, 1967.

Piaget, J. and Inhelder, B. The Child's Conception of Space. London, England: Routledge & Kegan Paul, Broadway House, 1967.

Read, H. Icon and Idea. London, England: Faber and Faber Ltd., 1955.

Vernon, M.D. The Psychology of Perception. Baltimore, Md.: Penguin Books, Inc., 1963.

GLOSSARY FOR TERMS

Ambiguity	is described in the Dictionary of Psychological terms, by James Drever, as "capable of two interpretations, as in the case of ambiguous figures."
Contour	circumference, folds or outlines.
Contrast	an effect of intensification of differences produced by the juxtaposition of two stimuli and sensations of the same modality but differing markedly in quality or intensity.
Equivocal	Ambiguous, having double meaning, dubious.
Figure-ground	a general characteristic of all perceptual experience especially manifested in the visual field, in virtue of which the field is organized from the beginning, the object as it were segregated from the ground, and standing out almost as if in relief, the phenomena are well illustrated by reversing figures, puzzle picture phenomena when the objects concealed is suddenly revealed.
Geometrical illusion	usually applied to a group of optical illusions of which illusions of distance and directions are the chief.
Optical illusion	an illusion of vision; usually refers to an illusion affecting spatial relations, especially of the group designated geometrical illusions.
Percept	the mental product of the act of perceiving; the mental modification which comes into existence when we perceive; must not be confused with the thing perceived.
Perception	Perception, according to Rock (1966), is described as being involved with the way things look, with sensory appearances. The process of becoming immediately aware of something; usually employed of sense perception when the thing of which we become immediately aware is the object affecting a sense organ.