

**A CLINICAL AND EXPERIMENTAL STUDY OF
PERCEPTION AS INFLUENCED BY MOTIVATION.**

Submitted in fulfilment of the
requirements for the degree of Ph.D. in the
Department of Psychology, University of Cape Town,

by

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Executed with the aid of a
National Council of Social Research Bursary.

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ACKNOWLEDGEMENTS

I wish to express my sincere thanks and appreciation for the guidance and assistance given me by Professor K.R.L. Hall, Dr. V.M. Grover, and Mr. J.C. Taylor of the University of Cape Town. I should like, in addition, to acknowledge my indebtedness to the N.C.S.R. for the bursary which made this research possible.

Finally, I wish to thank the principals of the schools and the children and parents concerned for their co-operation in the carrying out of this project.

INTRODUCTION

The question "Why do things appear as they do?" originally asked by Koffka (1) has evoked many answers from investigators of perception. Bartlett (2) found in a series of form-perception experiments significant individual differences in his subjects' perceptions of relatively simple designs and pictures. He found that "cautious" subjects reported few details while "confident" subjects reported more detail than was actually present and he concluded that temperament is an important factor in perception. Another factor that appeared to influence perception was experience or training; mathematicians, for example, perceived the designs as more "simple" while other individuals perceived the pictures as more "simple". The importance of experience was clearly demonstrated by the fact that the subjects perceived familiar objects in indefinite designs. Bartlett's answer to the above stated question is that subjects do not perceive alike though they may be faced by exactly the same external objects but that perception of these objects is characteristic of the individual, his interests and culture. Gibson (3) answers that all things seem to point to the general conclusion that each man learns the meaning of the world for himself, within the framework of his upbringing and the society in which he lives.

- 1) Koffka, K. 1935. Principles of gestalt psychology. New York : Harcourt.
- 2) Bartlett, Sir F.C. 1932. Remembering: a study in experimental and social psychology. Cambridge U.P.
- 3) Gibson, J.J. 1950. The perception of the visual world. Houghton Mifflin Co.

CHAPTER I

EXPERIMENTAL EVIDENCE FOR A MOTIVATIONAL THEORY OF PERCEPTION

Fairly recently the suspicion has developed in psychology that the traditional theories of perception are not adequate for the explanation of all the facts about perception. Some psychologists have come to the conclusion that motivational elements affect not only thinking and acting but also the way in which the individual perceives objects in his environment.

Many experiments have been carried out testing the hypothesis that value, need and other factors influence or determine perception. The investigators in these experiments, in contrast with the adherents to "formal" theories of perception, thought it their task not only to control these behavioural determinants such as needs, values, defenses and emotions, or "higher-level" processes, such as perception, but also to vary them as independent variables. In this way they sought information about their effect on perceptual organization.

In order to give behavioural determinants a chance to influence perception these experimenters found that they had to place perception under a disadvantage, in other words perception had to occur under "marginal" conditions. Thus objects to be perceived have been presented behind ground-glass screens, with dim illumination or tachistoscopically, etc. In this way motivational states had a better chance to show their influence.

In presenting the evidence on which the motivational or directive-state theory is based, use will be made mainly of Allport's classification of the material. The material can be classified under 7 headings dealing respectively with

- 1) the effect of bodily needs on what is perceived,
- 2) the effect of reward and punishment on perceptual content, and speed,
- 3) the influence of values on speed of object-recognition,
- 4) needs and values as affecting the dimensionality of the percept,
- 5) the effect of social values on what is perceived,
- 6) the effect on perception of the emotionally disturbing nature of the stimulus object, and
- 7) personality as a perceptual determinant.

1. The effect of bodily needs on what is perceived

Sanford (1) in 1936 was probably the first to demonstrate that the interpretation of photographs as indicating objects related to food was altered by periods of food deprivation.

He tested ten school children individually before and after a meal, with ambiguous pictures for interpretation, and found that more than twice as many food responses were given to the pictures before meals as after meals.

Levine, Chain and Murphy (2) tried to measure the relation between the intensity of food-interest and the amount of perceptual distortion. They used 80 cards, 40

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- 1) Sanford, R.N. 1937. The effects of abstinence from food upon imaginal processes: a preliminary experiment. J. Psychol. 3, 145-159.
 - 2) Levine, R., Chain, I. and Murphy G. 1942. The relation of the intensity of a need to the amount of perceptual distortion: a preliminary report. J. Psychol. 13, 282-293.

the factor of relative familiarity of the stimuli was not controlled in the Postman, Bruner and McGinnies study.

The average frequency of word usage was equalized as closely as possible from value to value by means of the Thorndike-Lorge "L" count. Within each value area a group of three relatively frequent and three relatively infrequent words was used.

The results revealed that relatively familiar words were recognized more rapidly than relatively unfamiliar words. This relationship applied to all value ranks except the theoretical one, for which low frequency words yielded lower thresholds than did high frequency words. For high frequency words there was no systematic relationship between value rank and duration thresholds but for low frequency words, duration thresholds did vary systematically with value rank; the higher the value rank, the lower the mean deviation threshold. There were no reversals. In an analysis of variance the interaction between frequency and value was found to be significant i.e. the effect of value rank on duration thresholds depended on the level of word-frequency. In general, their findings support the hypothesis that duration thresholds vary significantly as a function of both frequency and value rank, and they arrived at the conclusion that the processes mediating the effect of value rank do not operate independently of the familiarity of the stimulus and that these processes have an opportunity to manifest themselves if the recognition takes a certain amount of time to build up.

Solomon and Howes (1) in a repetition of the original Postman, Bruner and McGinnies study also found that

1) Solomon, R.L. and Howes, D.H. 1951. Word frequency, personal values, and visual duration thresholds. Psychol. Rev., 58, 256-270.

duration thresholds for frequently used words are significantly lower than for infrequently used words. There was a slight tendency for words of higher value ranks to have lower thresholds than words of low value ranks, but this was not a systematic tendency. This tendency was much more pronounced for infrequent words than for frequent ones.

These studies show that for frequently used words, value does not effect speed of recognition. For uncommon words the recognition thresholds seem to be influenced by value-rank, however, and Postman and Schneider explain this on the grounds that with a longer period required for recognition, selective sensitivity to different value areas has a chance to show itself. Solomon and Howes, on the other hand, maintain that subjects who are high in a certain value-area have probably used words relating to that area more often than subjects who are high in other value areas and therefore their duration thresholds will be lower.

It is therefore doubtful "that the influence of value and affect, if present, can be separated in these experiments from the effects of word-frequency or familiarity. Owing to individual differences in familiarization, this criticism may hold even for words that are infrequently used, and in cases where lists have been equated by standard word-frequency tables" - Allport (1, p. 338).

4) Needs and values as affecting the dimensionality of the percept.

This hypothesis also included the tendency for sought-after perceptual objects to become more vivid.

- 1) Allport, F.H. 1955. The theories of perception and the concept of structure. New York: John Wiley and Sons.

Bruner and Goodman (1) tested this hypothesis in 1947. Their subjects were ten year old children divided into three groups of ten each. These children estimated the sizes of coins by altering a circular spot of light so that its area seemed to them to be equal in size to the coin. To do this they turned a knob at the right hand side of the box which controlled, by means of an iris diaphragm, the size of the spot of light thrown from behind upon a ground-glass screen.

The first two groups of subjects were asked to estimate the sizes of coins from a penny to a halfdollar from memory. Four judgments were made for each coin : in ascending and descending order of value and from diaphragm open and closed. A third group followed a similar procedure but with the coin held in the left hand, and a control group used medium gray cardboard discs of identical size as the coins instead of the real coins.

The results showed that the coins were judged larger in size than the gray discs, and the greater the value of the coin, the greater was the deviation of apparent size from actual size. The halfdollar was an exception here; its overestimation fell off below that of a quarter. Bruner and Goodman explain this finding by assuming that it is because of its lesser reality-value for the ten year old. The graph these two experimenters plotted for the judgements of the coins and cardboard discs shows that for four out of the five cardboard discs the subjects underestimated the sizes.

The next hypothesis to be tested was that individual differences in value placed upon the coins should result in

1) Bruner, J.S. and Goodman, C.D. 1947. Value and need as organizing factors in perception. J. Abnorm. Soc. Psychol., 42, 33-44.

differences in perceptions. The assumption was made that poor children place greater value on coins than rich ones. It was found that on the average the poor group overestimated the size of every coin considerably more than did the rich group.

In the third experiment the "rich" and "poor" groups were asked to imagine the coins and then make the judgments. Here the "rich" group overestimated the sizes of the quarter and the halfdollar still more. The "poor" group, overestimated but for each coin the average judgments were brought down toward the actual size.

Carter and Schooler (1) repeated the Bruner-Goodman experiment. Rich and poor children made judgments regarding the size of coins from memory; when the coins were present; from aluminium discs and from cardboard discs. The rich and the poor children's judgments were found to be essentially the same with the exception that the poor children overestimated the size of the coins when judgments were made from memory. It was also found that there was a tendency for both the larger discs and larger coins to be overestimated and for the smaller coins to be underestimated, and a greater range of distortion (from 5% underestimation for the penny to 10% overestimation for the halfdollar) for coins than for other discs. When coins were present, although the differences were not statistically reliable, the judgments were in the expected direction, the "poor" overestimating coin sizes more than the "rich".

1) Carter, L.F. and Schooler, K. 1949. Value, need, and other factors in perception. Psychol. Rev., 56, 200-207.

Bruner and Rodrigues (1) investigated some of the factors which might have produced divergencies in the findings of the two experiments mentioned above. In this study the experimenters were interested in how the economic, social, or symbolic value of coins and discs affects their apparent size in a group of children of "middle income". Sixty subjects were given a penny, a nickel, and a quarter to judge; thirty subjects judged correspondingly sized nickel-coloured metal discs; thirty subjects judged gray cardboard discs.

Half of the subjects in each group were set to think of the buying power of money (The value group) and the other half to think about accuracy of size judgments of objects (The accuracy group). A third of the subjects used a variable six-chorded diaphragm for matching the sizes of the coins or discs, one third used a nine-chorded diaphragm, and the other third used a circular diaphragm.

The order of presentation of the sizes of coins and discs and the size of the diaphragm from which a match began, were varied. Half the "coin group" held the coin in their hands; the other half had it on the table. Thirty control subjects judged circles of light.

The experimenters found that there were a large number of factors influencing absolute apparent size, e.g. physical differences in texture, illumination, etc. Coins and metal discs, however, were judged significantly larger than cardboard discs. This finding the experimenters attributed to the fact that metal slugs are nearer in appearance to coins than are cardboard discs. They regarded as their most important finding the result that as the size and value of coins increase, the extent of over-estimation

1) Bruner, J.S. and Rodrigues, J.S. 1953. Some determinants of apparent size. J. Abnorm. Soc. Psychol., 48, 17-24.

increases significantly more markedly than in the case of metal or cardboard discs. This agrees with the Bruner-Goodman and Carter-Schoonler findings.

As regards the comparison of results obtained from the value group and the accuracy group, they found that accuracy set increases absolute overestimation of discs and coins, increases relative accentuation for valueless discs, and for coins a value set increases relative accentuation under certain conditions and has no effect under others.

A nine-ribbed diaphragm had a slight effect leading to overestimation of coins and underestimation of discs. This might have been responsible for the larger differences obtained by Bruner and Goodman.

On the basis of these results Bruner and Rodrigues concluded that the value of objects affects their phenomenal appearance, and that it should affect their apparent size in some instances, is probably a function of a pairing between value and size.

Lambert, Solomon and Watson (1) felt that since there are so many influences correlated with being rich and poor it would be better to study the determinants of size perception by experimentally controlling the life history of the subjects by taking an originally neutral object and giving it a value experimentally.

A neutral poker chip was associated with a sweet reward and later this association was extinguished by removal of the reward. The experimental subjects (children) turned a crank 18 times and then received a poker chip which, when put in a slot, led to the automatic delivery of a sweet.

1) Lambert, W.W., Solomon, R.L. and Watson, P.D. 1949. Reinforcement and extinction as factors in size estimation. J. Exp. Psychol., 39, 637-641.

The control subjects did the same but received sweets directly after work, without the mediation of a poker chip.

The Bruner and Goodman apparatus was used for making size estimates of the poker chips. These estimates were made before the experiment, after ten days of reward, after extinction had occurred i.e. when the reward was removed, and again after reward had been reinstated. Both experimental and control groups got the same treatment. The control group's results showed no significant changes under these different conditions. The experimental group showed an increase in apparent size of the token after the training with a reward, a decrease to the original level after the extinction and went back to overestimation when the reward was given again.

Bruner and Postman (1) used the same technique in an experiment with dollar discs, swastika discs and neutral discs. They found that dollar discs were judged largest, swastika discs (negative value discs) next in size, and neutral discs smallest. From this they deduced that value, whether positive or negative, leads to perceptual accentuation. A point that may prove important is that these experiments were carried out after the war and although the swastika discs were positively accentuated in the experiment it was ^{not} strikingly so.

In a repetition of the Bruner-Postman experiment Klein, Schlesinger and Meister (2) evaluated the accentuation influence of values on perception. Their stimuli were

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- 1) Bruner, J.S. and Postman, L. 1948. Symbolic value as an organizing factor in perception. J. Psychol., 27, 203-208.
 - 2) Klein, G.S., Schlesinger, and Meister, D.E. 1951. The effect of personal values on perception: an experimental critique. Psychol. Rev., 58, 96-112.

again dollar discs and swastika discs and their subjects German refugees and American born secretaries.

Their main findings were that differences in error among the groups could not be attributed only to the effect of value. The error magnitudes for value figures and for neutral figures for each group were not significantly different. They also found that the "more optimal conditions" seemed to favour underestimation while the "less optimal conditions" favoured overestimation. Another interesting finding was that subjects in both groups showed consistent tendencies either to over-estimate or under-estimate and these tendencies seemed to be independent of particular stimulus-figures. The Bruner and Postman conclusions that valued objects are subjectively enlarged is based on group averages which combine the data of those who consistently either overestimate or underestimate. No attention is given to the individual differences.

In the foregoing experiments objects which had a secondary value for the perceiver have been used but in a more recent experiment Beams (1) used objects valued for themselves. This study tested the effect of a child's liking or dislike for certain food objects upon his perception of the magnitude of these food objects.

Sixty children from ten to twelve years who were selected on the basis of likes and dislikes for certain food objects were used as subjects. Each subject was shown a food object which he either liked or disliked and was then required to estimate its size by adjusting a monochrome image of the food object by moving a sliding screen. This distance was measured and the difference was computed

1) Beams, H.L. 1954. Affectivity as a factor in the apparent size of pictured food objects. J. Exp. Psychol., 47, 3, 197-200

between the distance where the object appeared at life size and the subjects' adjustment distance. This procedure was followed for both liked and disliked objects and the difference between these two difference scores was obtained. "Liked" and "disliked" adjustment scores differed significantly; there was overestimation of the liked but not of the disliked object. A finding that was neglected in this study was that a small proportion of subjects adjusted the valued objects to smaller sizes and the objects of low valuation to larger sizes.

Gilchrist and Nesberg (1) in 1952 carried out an investigation in which they tested the effect of need on the adjustment of brightness of a need related object. The subjects who had gone without food or water for different periods of time were shown projector images of food or water at standard illuminances for 15 seconds. The light was then turned off for 10 seconds and then the image was again shown but this time at a different illumination from the standard. The subject was then required to adjust the illuminance so that it appeared to him to be exactly the same as under standard illuminance previously seen. They found that with increase of deprivation time there was an increase in illuminance adjustment of the need related object. Subjects who had food and liquids at normal intervals showed no such tendency in adjustment, and for pictures not related to the need there was no increase in illuminance.

The majority of experiments above described point in the same direction viz. that larger symbol sizes are selected for valued objects than for objects that have no value for the subject. Whether this indicates that valued

1) Gilchrist, J.C. and Nesberg, L.S. 1952. Need and perceptual change in need related objects. J. Exp. Psychol., 44, 369-376.

valued objects are perceived to be larger than non-valued objects is a point which will be discussed in/^are-examination of the role of preference in perception in a later chapter.

Allport criticises these experiments on the basis of the fact that when the subjects made their judgments they could not attend to the stimulus and variable object at the same time and in some cases the stimulus was not even present. The experiments are therefore rather of immediate memory than of perception.

Many critics of the experiments point out that the individual differences observed in the results should be examined, but so far no explanation has been attempted.

5) The effect of social values on what is perceived.

A great many experiments testing this hypothesis have been carried out some of which, for example, Bruner and Goodman's coin experiment, have already been described under another heading. To give a somewhat more complete picture a few other studies will be quoted.

Zillig (1) demonstrated the effect of social likes and dislikes on perception. She found among a group of school children some who were disliked by all and some who were liked by all. She then took an equal number of pupils from each group and had them stand up in front of the class and perform physical exercises. The "liked" children were previously instructed to make mistakes, while the "disliked" children were trained to do the exercises perfectly. At the end of the class the majority of children in the class said that the liked group did the exercises correctly. The

1) Zillig, W. / ^{1928.} *Einstellung und Aussage.*
F. Psychol., 106, 58-106.

experimenter interviewed the children afterwards and came to the conclusion that they actually perceived the differences between the two groups.

The effect on perception of dislike of those who are different from ourselves has been demonstrated in numerous investigations.

Razran (1) for example, demonstrated this effect. He showed the photographs of 30 girls to a group of college students and asked them to rate each photograph on a five-point scale, indicating general liking of the girl, her beauty, intelligence, character, ambition, and her "entertainingness". After two months he again showed them the photographs this time adding surnames to them; to some Jewish surnames, to some Italian, Irish, and to a final group old American surnames. The labelling of the photographs was shown to have a definite effect on the new ratings ascribed to the photographs. For those with Jewish and Italian surnames there was a general drop in liking and a smaller drop in beauty and character and a rise in the ratings for ambition especially for the Jewish surnames. Thus Razran concluded that stereotypes associated with ethnic groups had a definite effect on the perception of the photographs.

Allport and Kramer (2) found that those subjects who on an attitude questionnaire were shown to be anti-semitic, were also more successful in recognising the photographs of Jewish students from a number of photographs of

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- 1) Razran, G. 1950. Ethnic dislikes and stereotypes : a laboratory study. J. Abnorm. and Soc. Psychol., 45, 7-27.
 - 2) Allport, G.W., and Kramer, B.M. 1946. Some roots of prejudice. J. Psychol., 22, 9-39.

Jewish and non-Jewish students.

These few examples from among many serve to demonstrate the effect of social values on perception of what is perceived as well as the individual differences in perception of socially valued stimuli.

6) The effect on perception of the emotionally disturbing effect of the stimulus

In an experiment reported by McGinnies (1) in which he investigated this effect, the galvanic skin response was used as an index of autonomic response or emotionality to emotionally toned words. Seven emotionally toned or socially tabooed words were mixed with eleven neutral words and presented to the subject one at a time, tachistoscopically. The exposure times varied from .01 second upward. The discrimination thresholds for the words were determined by exposing the stimulus word once at .01 second, once at .02 second, etc., until the subjects reported the word correctly. There was a six second interval between the exposure and the time when the subject was allowed to report on his perception so that the experimenter could note the G.S.R. The G.S.R. as an index of emotionality was apparently significantly greater during the pre-recognition exposures for the taboo words than for the neutral words for the majority of subjects and the mean discrimination thresholds were greater for the critical than for the neutral stimulus words.

Lazarus and McCleary (2) demonstrated that a conditioned G.S.R. could be made to nonsense syllables presented

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- 1) McGinnies, E. 1949. Emotionality and perception defense. Psychol. Review, 56, 244-251.
 - 2) Lazarus, R.S. and McCleary, R.A. 1951. Autonomic discrimination without awareness: a study of subception. Psychol. Rev., 58, 113-122.

at exposure speeds too fast for verbal discrimination. Their stimulus words were presented on a beaded screen by means of a projection tachistoscope. Five different exposure speeds were selected for each subject so that the shortest exposure resulted in accuracy of discrimination which did not differ from chance and the longest resulted in accurate discrimination. So as to eliminate the factor of word familiarity, ten five-letter nonsense syllables were used as stimuli. The syllables were presented repeatedly in conjunction with an electric shock until they became conditioned to the galvanic response. In the final stage of the experiment all the stimulus words were presented tachistoscopically at five exposure speeds without accompanying shock. The G.S.R. was measured at each presentation and the G.S.R. measurements indicated that the subject was able to make an emotional discriminatory response to the stimulus words at exposure times below the verbal discrimination thresholds. There was no difference between the recognition thresholds for shocked and non-shocked syllables but the fact that an emotional discriminatory response could be made led the experimenters to think of a different level of perceptual activity which might have delayed recognition.

Cowan and Beier (1) re-examined the hypothesis "that psychological threat produces delayed perception", and at the same time studied the effect of "threat-expectancy" on perception. They presented their subjects with five neutral words and five threatening words printed in Carbon booklets. The typing in the booklets became clearer on successive pages and the experimenter first read the list of words to them so as to "alert" them to "threat".

1) Cowan, E.L. and Beier, E.G. 1956. The influence of "threat-expectancy" on perception. J. Personal., 19, 1, 65-94.

The subjects who did not receive warning required longer times and more trials for accurate verbal report of threat words than of neutral words. This difference disappeared with warning although the results were still in the same direction. At the same time they found that there was a significant increase in variance of perception of threat words when the subject was alerted to threat words, but not in the perception of neutral words.

An experiment dealing with this problem was designed in such a way by Singer (1) that should the results reveal differences in threshold they would have to be described in terms of "perceptual defense". Both neutral and emotional words in this study were in common use. Emotional and neutral words were mixed in random order and presented tachistoscopically twice; the second time after a fortnight.

For six of the twelve subjects the mean threshold for emotional words was higher than that for neutral words at both presentations, for two subjects the emotional words had lower thresholds both times, and for the other four subjects the thresholds were higher for emotional words on one presentation and for neutral words on the other. Thus the results follow the general trend.

The experiments showing higher discrimination thresholds for taboo words were criticized by Solomon and Howe in that perception of the words might have been at normal exposure times but that the presence of, for example, only a male experimenter inhibited the uttering of the word. Beier and Cowen tried to improve the experimental situation in this respect by using both male and female experimenter but even under these improved conditions taboo words required a longer discrimination time than neutral words. However,

1) Singer, B.R. 1956. An experimental enquiry into the concept of perceptual defence. Brit. J. Psychol., 47, 293-311.

some subjects might still have been reluctant to use the taboo words in polite company.

7) Personality as a perceptual determinant

The hypothesis that personality characteristics of the individual predispose him to perceive things in a manner consistent with those characteristics is strongly supported because in so many experiments dealing with perception individual differences are observed in the results. Therefore a description of experiments dealing with this hypothesis should perhaps include all the experiments already mentioned as well as investigations in which projective techniques have been used and the experiments specifically investigating the role played by individual differences in perception.

Investigations belonging to this last category are those of Witkin (1) in which he found individual differences in the perception of a tilted room, of the subjects own body when in a tilted position in the tilted room, and of an objectively upright rod surrounded by a tilted frame in the absence of other visual clues. He found that the subjects were consistent in their modes of perception in all three situations, and on a re-test after a year, and also that the perceptual features shown here were characteristic of the individual's perception in general. Subjects who had difficulty in detecting imbedded figures in a complex field also had difficulty in separating their own bodies from the total field of the tilted room so as to determine the position of their bodies with respect to the vertical.

1) Witkin, H.A. 1949-1950. The nature and importance of individual differences in perception. Perception and Personality: a symposium. Eds. Bruner, J.S. and Kroeckh, D.

Within and his collaborators (1) also found significant correlations between scores in perception tests such as the rod and frame and rotating room tests and Rorschach scores in certain areas, i.e. correlations between perception and personality patterns. Rorschach scores indicating active organising capacity were highly correlated with ability in the perceptual task of separating an item from its context. These results point to personality patterns associated with the different modes of perception.

Else Frenkel-Brunswick (2) in an experiment in which first the picture of a dog was shown followed by a series of pictures representing transitional stages leading to a final picture of a cat, found that a group of ethnically prejudiced children tended to hold longer to the original picture and to the changing pictures than did the non-prejudiced group.

Cattell and Wenig (3) in testing the hypothesis that some specific need, value, or interest has a direct influence on the content of the subject's perception, investigated their subjects' "projections" of personality traits revealed in their interpretations of thematic apperception pictures intended to express drives of dominance and sex. Measurements of the subject's sex and dominance drives on other personality tests were first obtained. The investigators found evidence to the effect that the amount of projections or "misperceptions" was proportional to the amount

1) Witkin, H.A., Lewis, H.B., Hertzman, M., Nechover, K., Bretnall, Meisner, P., and Wapner, S. 1954. Personality through perception. New York: Harper and Bros.

2) Frenkel-Brunswick, E. 1950. Intolerance of ambiguity as an emotional and perceptual personality variable. Perception and personality: a symposium. Eds. Bruner, J.S. and Krech, D. Duke Univ. Press.

3) Cattell, R.B. and Wenig, P.W. 1952. Dynamic and cognitive factors controlling misperception. J. Abnorm. Soc. Psychol., 47, 797-809.

of drive. The use of thematic apperception tests and Rorschach inkblots in the testing of motivational theory has however been criticized on the basis that the answers in these tests may not reveal pure perception but rather associations, imagery or interpretation.

SUMMARY

The experiments described here were executed to test the general hypothesis that the motivational state of an individual influences his perception. The methods and results of some of these experiments have been criticized by other experimenters but on the whole the results seem to be valid, whether they are regarded as confirming the motivational hypothesis about perception or not.

CHAPTER II

INTERPRETATIONS OF EXPERIMENTAL FINDINGS IN TERMS OF MOTIVATIONAL THEORY

In the experiments on the relation of the intensity of a need to the amount of perceptual distortion, the question, "How does intensity of a need influence what is perceived", is asked. The experimenters try to explain this influence in terms of an intervening process between motivation and the resulting perception. Levine, Chein and Murphy (1) use the term autism, first applied by Bleuler (2) and then used extensively by Bartlett (3), meaning "the organization of cognitive processes in the direction of drive-satisfaction". Sanford's (4) perceptual results after abstinence from food were also interpreted as showing that the perception of ambiguous figures is so organized as to be in the direction of need satisfaction.

"Autism" is also used by Froehensky and Murphy (5) and Schafer and Murphy (6) to show that reward and punishment

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- 1) Levine, R., Chein, I. and Murphy, G. 1942. The relation of the intensity of a need to the amount of perceptual distortion: a preliminary report. J. Psychol., 13, 282-293.
 - 2) Bleuler, E. 1924. Textbook of Psychiatry. New York: Macmillan.
 - 3) Bartlett, F.C. 1932. Remembering. Cambridge: Cambridge Univ. Press.
 - 4) Sanford, R.N. 1937. The effects of abstinence from food upon imaginal processes: a preliminary experiment. J. Psychol., 3, 145-159.
 - 5) Froehensky, H.M. and Murphy, G. 1942. The effects of reward and punishment on perception. J. Psychol., 13, 295-305.
 - 6) Schafer, R. and Murphy, G. 1943. The role of autism in visual figure-ground relationship. J. Exp. Psychol., 32, 335-343.

associated with certain percepts led to distortion in the direction of the rewarded percept. "The need for reward was effective in modifying perception; autism was active".

Van der Plas and Blake (1) explain their results about thresholds of value-relevant words in the field of auditory perception in a similar way by postulating that "experientially derived determinants such as values serve a centrally located integrative system which directly and differentially guides the recognition of certain kinds of auditory stimuli". (p.266)

Thus needs are assumed to have a direct influence on the percept through autism but for what happens during this process, no explanation is given.

Postman, Bruner and McGinnies (2) name three basic adaptive processes that operate in perception, viz. selection, accentuation, and fixation. Their experiments on the role of personal values as selective factors in perception focus on the mechanisms through which value orientation becomes a determinant of selection. They postulate three complementary selective mechanisms :

(1) selective sensitization, i.e. value-orientation lowers the threshold for acceptable stimulus objects,

(2) perceptual defense, i.e. it may raise thresholds for unacceptable objects, and

(3) value resonance, i.e. the perceiver will perceive more readily stimulus objects which lie within the same value area as his preferred presolution hypotheses and will keep on responding in terms of objects valuable to him even when they are not presented.

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- 1) Van der Plas, J.M. and Blake, R.R. Selective sensitization in auditory perception. Perception and personality: a symposium. Eds. Bruner, J.S. and Krech, D. Durham: Duke Univ. Press.
 - 2) Postman, L., Bruner, J.S. and McGinnies, E. 1948. Personal values as selective factors in perception. J. abnormal Soc. Psychol., 43, 142-154.

The defense mechanism is regarded to be similar to repression by the authors, and manifestations of perceptual defense are that pre-solution responses to low-value words take the form of avoidance of meaning, e.g. responses are meaningless words or have the opposite meaning to the stimulus word. To the criticism that in order to "repress" the subject must first recognize the word, these authors have no answer.

Solomon and Howes (1) do away with the mechanisms of perceptual selectivity and perceptual defense by assuming that people who are slightly interested in a subject generally use words associated with that subject more often than people who have no special interest in the subject, in other words a high valuation of a given area of interest is associated with a positive deviation from the mean frequencies with which words in that area occur in general usage. In the Postman, Bruner and McGinnies experiment (2) it was found that words with high value-rank had shorter visual duration thresholds than words with low value-rank, and high value-rank is correlated with relatively frequent use of a word. Thus Solomon and Howes (1) regard "emotional factors" as playing an important role in the building of word frequencies in an individual's life history, and thus they are related to word frequency and, indirectly, to duration thresholds and they can find no evidence of emotional factors operating in the tachistoscopic situation independently of their effect upon word frequency.

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- 1) Solomon, R.L. and Howes, D.H. 1951. Word frequency, personal values, and visual duration thresholds. Psychol. Rev., 58, 256-270.
 - 2) Postman, L., Bruner, J.S., and McGinnies, E. 1948. Personal values as selective factors in perception. J. Abnorm. Soc. Psychol., 43, 142-154.

In theorizing about the role of value and need as organizing factors in perception, Bruner and Goodman (1) make a distinction between "autochthonous" and "behavioural" determinants of perception. Autochthonous determinants include the highly predictable properties of the nervous system which account for phenomena like simple pair formation, closure, contrast, tonal masking, paradoxical cold, flicker fusion, etc. They represent the innate endowment of the individual for the act of perceiving. (It is then also on the autochthonous determinants that the laws of perceptual organization of the Gestaltists are based).

"Behavioural" determinants include the active and adaptive functions of the organism such as the laws of learning and motivation, social needs and attitudes which lead to the control of "higher level functions" such as perception.

Thus according to Bruner and Goodman what the organism perceives in a world of more or less ambiguously organized sensory stimulation represents a compromise between what is presented by autochthonous processes and what is selected by behavioural processes. This selective process they refer to as perceptual hypothesis which stands for a systematic response tendency. The perceptual hypothesis may be activated by a need, by the requirements for learning of a task or by internally or externally imposed demands on the organism. If the hypothesis is rewarded it becomes fixated and perceptual objects which are habitually selected become more vivid, i.e. they have greater clarity or greater

1) Bruner, J.S. and Goodman, C.D. 1947. Value and need as organizing factors in perception. J. Abnorm. Soc. Psychol., 42, 33-44.

brightness or apparent size. In this way experimental results, indicating over-estimation of valued objects, are explained. Other concepts used in this theory are perceptual compromise between two hypotheses and ambiguity in the perceptual field which is supposed to offer more scope for behavioural factors in perception to operate.

Their experiments in which "poor" children chose larger tachistoscopically presented symbols for coins than did "rich" children, are supposed to prove the following general hypotheses :

- "1) The greater the social value of an object, the more will it be susceptible to organization by behavioural determinants. It will be selected perceptually from among alternative perceptual objects, will become fixated as a perceptual response tendency, and will become perceptually accentuated.
- 2) The greater the individual need for a socially valued object, the more marked will be the operation of behavioural determinants.
- 3) Perceptual equivocality will facilitate the operation of behavioural determinants only in so far as equivocality reduces the operation of autochthonous determinants without reducing the effectiveness of behavioural determinants".

On the basis of experiments in which subjects judged dollar discs largest, swastika discs next in size, and neutral discs smallest, Bruner and Postman (1) suggest that value, whether positive or negative leads to perceptual accentuation. If an object fulfills a need it becomes emphasized in perception through magnification and when a

1) Bruner, J.S. and Postman, L. 1948. Symbolic value as an organizing factor in perception. J. Soc. Psychol., 27, 203-208.

negative object alerts the organism to threat or danger it may also be positively accentuated, although no explanation is given of how this comes about. The authors also think it possible that certain kinds of negative symbols may lead to negative accentuation instead of to positive accentuation.

The hypothesis that value of an object as defined by changes in perceived size of the object, is a function of reinforcement, and punishment, was put forward by Lambert, Solomon and Watson (1) in the interpretation of their experiments in which children inserted a poker chip in a slot to get sweets. While a control group received sweets without the mediation of a poker chip. The experimental group showed an increase in the apparent size of the token after the training period while the control group showed no such change. From these results the experimenters deduce that "value" and "bigness" may be acquired equivalencies for children of this age and that the theory of reinforcement could solve many of the problems although they could give no explanation of the actual mechanism or structure responsible for overestimation following reinforcement.

Bruner and Rodrigues (2) in a re-examination of the Bruner-Goodman and Carter-Schooler results and from examining their own results in a similar experiment came to the conclusion that value of objects affects their phenomenal appearance. The fact that it sometimes affects apparent size is probably a function of the pairing of value and size in the environment !

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- 1) Lambert, W.W., Solomon, R.L. and Watson, P.D. 1949. Reinforcement and extinction as factors in size estimation. J. Exp. Psychol., 39, 637-641.
 - 2) Bruner, J.S. and Rodrigues, J.S. 1953. Some determinants of apparent size. J. Abnorm. Soc. Psychol., 46, 17-24.

McCurdy (1) finds no proof in the coin experiments for the Bruner-Goodman theory that perception itself is distorted directly by value and need. He observes that in these experiments the children produce a correct order of coins according to size, and exaggerate the differences between them. McCurdy thinks that the concept of "schema" used by Bartlett in connection with remembering could be usefully employed in the interpretation of the coin study results. He defines "schema" as some kind of cognitive disposition not in itself directly experienced but manifesting itself in imagining, remembering, perceiving, and acting. The "schema" is built up out of past experiences and is subject to change by organismic and environmental variations, and in some cases it may come to govern behaviour rigidly. Once a workable schema has been built up there is often no longer the necessity for close examination of objects, and this leads to the hypothesis that "accuracy of size estimation will be less for perceived objects belonging to a definite schema, unless the schema has been very carefully developed, than for perceived objects lacking such a schema.

He finds evidence for this hypothesis in the Carter-Schooler data where the subjects' size judgments based on the schema operating in memory are improved by inspection of the coins, but the estimates of the cardboard discs, which are supposed to be less schematized, are even more accurate.

The author criticises the Bruner-Goodman study for the reason that they assumed a need-state in their subjects, a stronger need for money in the poor than in the

1) McCurdy, H.G. 1956. Coin perception studies and the concept of schemata. Psychol. Rev., 63, 3. 160-168.

rich. This is also pointed out by Bruner and Rodriques who stated that there are too many factors in the life histories of the subjects to make inferences about need-state based on class membership. According to McGurdy "value" entered only in the Bruner-Goodman study in that the coins were presented in order of value. He sees a much stronger possibility for emotion to have played a role in the Lambert, Solomon and Watson experiment in which children were rewarded for using a poker chip and then later had to make size estimations of the poker chips, the rewarded subjects making larger estimations of the chip than unrewarded subjects. He assumes that in this case the reinforcing process generated a pleasant excitement and that this emotional condition might have helped along an expansive sort of inaccuracy in the presence of the stimulating poker chip. The positive error in judgment made by these children in the state of pleasant excitement may be an expression of an affective law for which the author finds evidence in the observations of body expansion and expansion of bodily gestures in sthenic states, variations in handwriting size with different moods, and so on. He arrives at the general conclusion that values and needs may influence perception but presumably more through schemata than directly and that if ever the hypothesis about the role of values and needs in perception is to be proved such proof will have to be founded on careful analysis of individual data. This theory does not, however, account for the minority cases in which smaller symbol sizes were chosen for valued objects.

In a repetition of the Bruner-Postman experiment Klein, Schlesinger and Meister (1) found interesting

1) Klein, G.S., Schlesinger, H.G. and Meister, D.E. 1951. The effect of personal values on perception: an experimental critique. Psychol. Rev., 58, 96-112.

individual differences. They found subjects who had stable tendencies either to overestimate or to underestimate. The Bruner and Postman interpretation that valued objects are overestimated was based entirely on group averages. These findings led Klein, Schlesinger and Meister to the conclusion that perceptual distortion is a function of individual variation, perceptual organization, and ego structure rather than of motivational factors only.

The mechanism of "perceptual defense" has previously been used in connection with the Postman, Bruner and McGinnies experiment in which nonsense responses, etc., were given to low value words. In a later experiment McGinnies (1) measured emotional, or autonomic reaction to tachistoscopically presented words during the period before recognition and found an increase in autonomic activity as measured by the G.S.R. during pre-recognition of taboo words. The subjects' reaction times were also longer for the taboo words and "defensive" verbal responses were given. The emotional activity was assumed to be an accompaniment to "perceptual defense". The author interprets perceptual defense as based upon "conditioned avoidance of unpleasant or dangerous stimulus objects". The stimulus words arouse unconscious anxiety which is revealed by the increase in autonomic response and further anxiety is avoided through perceptual defense against recognition of the threatening words, in other words, the threat words fail to be recognized.

1) McGinnies, E. 1949. Emotionality and perceptual defense. Psychol. Rev., 56, 244-251.

Howes and Solomon (1) claimed that it was not that the words were not perceived at normal exposure times but the presence of the experimenters in the experimental situation, i.e. the social aspect inhibited the subjects from uttering taboo words. But this explanation is not sufficient for all the aspects of perceptual defense. Lazarus and McCleary (2) found that their subjects were able to make emotional discriminatory responses to a stimulus even at exposure speeds too fast for verbal discrimination. This, according to the authors indicates a level of perceptual activity different from ordinary perception and the term "subception" was used for this perceptual level.

Singer presented emotional words in frequent use and neutral words to his subjects tachistoscopically, and again found that for six of twelve subjects the mean threshold for emotional words was higher than that for neutral words, for two subjects the emotional words had lower thresholds and for the remaining four the threshold was higher for emotional words in one part of the experiment and lower than for neutral words in the other part.

In his critique of the concept of defense Taylor (3) points out that defense implies the existence of a threat and that most people would assume that the threatening character of the situation must be perceived before defensive action is taken, but that according to perceptual defense theory, action is taken before threat is detected. He goes on to say: "Indeed the supposed danger is precisely that something should be perceived. The theory of perceptual defence implies that in certain cases the act of perception

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- 1) Howes, D.H. and Solomon, R.L. 1950. A note on McGinnies' "Emotionality and perceptual defense". Psychol. Rev., 57, 229-234.
 - 2) Lazarus, R.S. and McCleary, R.A. 1951. Autonomic discrimination without awareness: a study in subception. Psychol. Rev., 58, 113-122.
 - 3) Taylor, J.G. 1957. The indefensible concept of perceptual defence. (in press).

is itself dangerous, or at least uncomfortable. But in that case how does one defend oneself against such risk? The answer seems to be that in fact there is no defence". Taylor agrees with Solomon and Howes that the danger with taboo words is not that they be perceived but that they be uttered in a certain situation. He points out that this explanation is, however, not adequate for threshold differences such as found by Singer in which all the words were socially acceptable. In a later chapter we will see how Taylor's behavioural theory of perception disposes of concepts like perceptual defense and subception.

Klineberg (1) interprets experiments on the effect of social value on perception by stating that patterns of perception are acquired in the course of a person's social and personal experience. This takes place through the learning process, i.e. mainly through punishments and reinforcements. The link between perception and behaviour is recognised although not described.

A psychoanalytical hypothesis is put forward by Dollard (2). He states that the frustrations that are suffered by all members of an organised society during the process of growing up result in repression which shows itself in antagonism towards groups other than one's own. The supposed aggression shows itself in the form of projection of one's own aggression on the members of the other group, i.e. they are perceived as hostile.

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- 1) Klineberg, O. 1954. Social Psychology. New York: Henry Holt and Co.
 - 2) Dollard, J. 1949. Caste and class in a Southern Town. Harper.

Klineberg says that this interpretation involves a circular argument in that it takes for granted the phenomenon which it sets out to explain because if the Negro is indicated by society as a legitimate object of hostility, the hostility must be assumed to be there beforehand. Latent aggressiveness in the Whites cannot be used to explain prejudice while prejudice is assumed to exist to start with. The fundamental problem is to explain how the prejudice originated, and how it happened to be there as a "socially acceptable means of draining off the stored hostility".

Some theories have been developed to cover the findings of all the experiments supposed to support a motivational theory of perception.

In his investigation of affectivity as a motivational factor influencing perception Gardner Murphy (1) suggests that positive affect not only plays a vital role in the modification of perceptual responses but that it also serves as a clue to some forms of perceptual learning. It means that when two or more aspects of a perceptual whole are presented and one of these is repeatedly associated with positive affect then when these different aspects are simultaneously presented the dominant role will be taken by the aspect previously associated with positive affect.

Murphy assumes that in ambiguous situations such as when tachistoscopic presentations are made there are initial unstable perceptual structure and responses which permit modifications (this idea brings up the old problem of empiricism versus nativism again). During the momentary unstable periods a reward can exert its influence. The unstable perceptual response system can be modified either

1) Murphy, G. 1956. Affect and perceptual learning. Psychol. Rev., 63, 1, 1-15.

through changes in outer stimulation or through changes inside the organism. Stimulation from within the organism such as from neural and endocrine sources should regularly exert influence on perceptual processes. Although the structural properties of the environmental stimulus and the structural properties of the responding organism are important, "affectivity nevertheless appears to involve a continuous input of stimulation, resulting in facilitation or inhibition". (p.5)

Murphy next follows the evolutionary assumption that there is primitive movement towards or away from objects. Positive affect may appear during approach of an object and getting more and more contact with it. Thus he expects that in the long run there will be positive movement in the case of objects biologically good for the organism and positive affect will be the subjective aspect of approach behaviour. Through the learning process objects at first devoid of affect can become affectively toned, and perceptual responses to objects that are pleasant become dominant. From this it seems that the perceptual field is structured by the satisfactions of the social and cognitive worlds.

In the same way as in the case of positive affect, negative affect may have at its basis the biological process of escaping or shoving to one side and therefore in the perceptual field the figure is that which is being pursued and the ground that which is avoided.

It has been observed in some experiments, however, that there are instances when the unpleasant and not the pleasant plays the dominant role. Snyder (1) has asked the question : "How is an organism able to move away from a

1) Snyder, F. and Snyder, C. 1956. The effect of monetary reward and punishment on auditory perception. J. Psychol.

given object without that object's first becoming dominant in the perceptual field?" Murphy does not seem to have an adequate answer to this criticism except that the factor of sheer intensity of a stimulus must be taken into account. The unpleasant then sometimes becomes dominant as a result of sheer intensity and also because it may ultimately be a means to the pleasant. Set, which can either lower or raise a threshold may also play an important role in the perception of either pleasant or unpleasant as dominant.

The question of individual differences again arises in this theory. Murphy does not believe that affect operates in the same way in all people. He found that some of his subjects did not respond in the expected directions and ascribe this to the fact that rewards and punishments do not have the same meaning for all the subjects that it has for the experimenter. Even money did not evoke the same feelings in all subjects and also not the same tendencies in perception in Jackson's experiment (1). An interesting observation was that subjects whose perceptions were opposite to what was expected in some experiments showed the same tendency in other experiments to a degree greater than would be expected by chance alone.

To sum up the theory the author states that he suspects that "that garden variety of learning that offers the classical basis for our vast system of social rewards and punishments is a matter of instilling in the individual a new way of perceiving the environment". (p. 14)

Through the whole theory runs the theme that the perceptual field comes to take on a structure in which the acceptable, the good, the satisfying, tends to take the

1) Jackson, D.N. 1954. A further examination of the role of autism in a visual figure-ground relationship. J. Psychol., 38, 339-357.

dominant position. It is in this way that the role of physiological need in perception, the effect of rewards and punishments on what is perceived, the influence of values on perception, and other concepts of motivational theory are explained.

Another theory dealing with all the experimental findings described above is the Hypothesis-Theory of Bruner and Postman (1,2,3). This theory states that there are three stages in perception. In the first place there is an expectancy or "hypothesis" set up in the organism as a result of the arousal of central cognitive and motivational processes by a particular situation, then there is an input of information from the environment, i.e. the organism receives information regarding the stimulus characteristics through the sense organs. The information received by the organism either confirms or disproves the hypothesis. If an hypothesis is disproved a new one is developed.

An hypothesis is defined as "a highly generalized state of readiness to respond selectively to classes of events in the environment" (3 p.125). Thus we have mental set or perceptual hypotheses based on past experiences that tune the organism to certain aspects of the environment and the hypothesis may therefore be dependent on Tolman's "cognitive map" or Hull's habit hierarchies. The strength

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- 1) Bruner, J.S. and Postman, L. 1950. Perception, cognition and behavior. Perception and personality: a symposium. Eds. Bruner, J.S. and Kreeh, D. Durham: Duke Univ. Press.
 - 2) Allport, F.H. 1955. Theories of perception and concept of structure. New York: John Wiley and Sons.
 - 3) Bruner, J.S. 1951. Personality dynamics and the process of perceiving. In Perception - an approach to personality. Eds. Blake, R.E. and Ramsey, G.V. New York: Roland Press Co.

of a hypothesis depends on the frequency of past confirmation, the number of alternative responses, i.e. if the number of alternative responses is small, their strength will be greater; and the cognitive, motivational and social support accompanying circumstances. Three theorems are derived, dependent on the concept of hypothesis strength :

1. THE STRONGER AN HYPOTHESIS THE GREATER ITS LIKELIHOOD OF AROUSAL IN A GIVEN SITUATION.
2. THE GREATER THE STRENGTH OF AN HYPOTHESIS, THE LESS THE AMOUNT OF APPROPRIATE INFORMATION NECESSARY TO CONFIRM IT.
3. THE GREATER THE STRENGTH OF AN HYPOTHESIS, THE MORE THE AMOUNT OF INAPPROPRIATE OR CONTRADICTIONARY INFORMATION NECESSARY TO CONFIRM IT.

"Appropriate information" is intended to mean stimulus input which will either confirm or infirm an hypothesis. The cues of distance perception in confirming or infirming an hypothesis about the distance of an object, is used as an example of "appropriate information". In perception experiments it is the experimenter who decides what is appropriate or relevant information and what not and he then studies how the subjects make use of this information in perceiving. It is primarily when the subjects deal with "low grade" or ambiguous stimulus-information that one can get a clear picture of individual differences in hypotheses employed by different individuals. It is assumed that by using less than optimal methods of presentation the subjects have to make more use of motivational factors and past experience than of the actual characteristics of the stimulus object present. Bruner states that under these conditions one can discover "the extent to which hypotheses varying in strength would be able to utilise substandard information, assuming that the greater the strength, the greater would be the utilization". (p.133) There are, however, also limits imposed by stimulus factors which reduce

the effects of past experience and present needs almost to zero when the stimuli are simple, according to Bruner; but also that most complex perception, particularly in our social lives, is dependent on information of a far less reliable kind than that which is normally provided in the rapid exposure tachistoscopic presentations.

Individual differences in perceiving are ascribed by hypothesis-theory to differences in the kinds of hypotheses different individuals habitually employ, which in turn reflect differences in past history, personality structure, etc.

In a revision of the motivational theory, Allport states that according to this theory needs, values and motivational states no longer play a central role in perception but influence it indirectly through the hypotheses. Either veridical or non-veridical hypotheses can be confirmed. When the transformation of information is in the direction of a veridical hypothesis-object relationship Allport calls it stimulus-information and when the hypothesis is non-veridical with respect to the stimulus-object the stimulus input is distorted or changed to accord with the hypothesis, the term stimulus-deformation is used. Although the above mentioned concepts seem to be useful, it is difficult to imagine how the hypothesis transforms the stimulus input or how confirming or infirming of an hypothesis occurs.

Allport points out how the hypothesis-theory can explain the different types of motivational or directive-state experiments as he calls them. In the kind of experiment proving that bodily needs determine what is perceived, a hungry subject, for example, is supposed to have a "motivationally supported hypothesis" of the kind that what will be shown behind the groundglass screen will be food. In this situation there is little definite stimulus information and the motivationally supported hypothesis is free to change the stimulus-input so that it will confirm the non-

veridical food-hypothesis and thus determine perceptual organization.

The experiments dealing with the problem of how quickly an object is perceived, i.e. the experiments on duration thresholds for high value words and perceptual defense, is explained by the hypothesis-theory in the following way: the assumption that words of positive value have lower perceptual thresholds would in hypothesis theory mean that for recognition of those words only a small amount of stimulus-information is needed. But in some studies, for example, that of Postman and Leytham it has been found that for negative-value words the thresholds may either be raised or lowered. Hypothesis theory would explain this by assuming that any motivational support, whether positive or negative, reward or punishment, will strengthen an hypothesis so that it will be confirmed by a smaller amount of positively relevant stimulus-information. The arousal and confirmation of an hypothesis depend on the frequency with which it has been aroused and confirmed in the past whether emotional support has been positive or negative. Thus any kind of motivation plus frequency of past confirmation may both affect hypothesis strength. This argument takes care of frequency of word occurrence as a factor in word recognition.

In dealing with the concept of perceptual defense hypothesis-theory does away with a lot of mystery surrounding this concept. The higher recognition thresholds for taboo-words and misperceptions are according to hypothesis theory not due to repression but rather to the dominance of an alternative stronger "socially approved" hypothesis. In this case the dominant hypothesis is non-veridical and could have acquired its strength through frequent confirmations in past situations where they were veridical. Taboo words are usually not acceptable in society and are therefore less frequently seen or heard. The non-veridical hypothesis in

defense experiments are confirmed through stimulus deformation and result in misperceptions, i.e. a non-veridical word hypothesis through past confirmation is stronger than the taboored veridical hypothesis and is confirmed by less stimulus-information (in this case deformation) received under poor stimulus conditions and therefore the higher thresholds for veridical response to taboo words.

Another directive-state proposition deals with the relation between value and motivation on the one hand and exaggeration of size on the other. Bruner states that a subject in a size judgment experiment comes to the situation with two hypotheses, one about the size of the coin, for instance, and the other about its value. In the experimental situation information about size confirms both the size and value hypotheses. According to Bruner size increases as value increases and this linkage is wide spread in our culture and there is therefore a "joint maximization" of size cues with the result of accentuation of perceived size.

A last hypothesis in directive-state theory states that an individual's personality influence what is perceived and how it is perceived. Bruner insists "that a personality orientated theory of perception must have systematic means whereby it can account for individual differences in perceiving". (p. 135). Hypothesis-theory provides these means of accounting for individual differences in that differences in the kinds of hypotheses an individual habitually employs, and differences in the strength of these hypotheses, can be studied. As regards the study of personality factors in perception, Bruner's advice is to concentrate on the investigation of the environmental cues which are appropriate to the confirmation of hypotheses which reflect basic personality patterns. These are cues such as apparent coldness or warmth of people, apparent threateningness of situations, etc., which aid directly in interpersonal adjustment.

In this systematic way the hypothesis-theory deals with the main concepts of directive-state such as motivation, frequency, cognition, perceptual defense, etc. It brought out the role of the prevailing set of the organism on perception, an aspect of the theory which will be discussed.

The theory has been criticised for giving no clear statement of how the processes of "hypothesis-testing", stimulus information and transformation take place; in fact that they have not been very explicit about their intervening construct. Allport also points out that : "There is a gestalt emphasis upon the cognitive side, and, somewhat confusingly, a continuity learning-theory implication upon the side of motivational strengthening and confirmation through past trials". (p.404) This divides perceptual theory internally, perhaps unnecessarily as will later be pointed out.

It was mentioned earlier that hypothesis-theory is based on the older theory of mental set. Set is a state that is preparatory for, or facilitative of some specific act of behaviour, in this case a perception. The hypothesis used by Bruner and Postman is therefore a set. The set like the hypothesis is internal to the organism, it has various degrees of strength or energy. When stimulation by outer stimuli adds its energy to the set-energy it may rise above the threshold and result in overt action or perception in the same way as when an hypothesis has been confirmed.

Freeman (1,2,3) has supplied a physiological

- 1) Freeman, G.L. 1939. The problem of set. Amer. J. Psychol., 52, 16-30.
- 2) Freeman, G.L. 1948. The energetics of human behaviour. Ithaca: Cornell Univ. Press.
- 3) Freeman, G.L. 1948. Physiological Psychology. New York: Van Nostrand.

structure of set. The set according to him consists of tensions in the skeletal muscles that precede overt action of those muscles and the effects in the central nervous system of backlash from the proprioceptive stimulation attending these tensions. This backlash from the muscles to the central nervous system creates a "differential brain state" that further lowers the threshold of the motor pathways through which the ensuing response will occur. Freeman states that the basis of control expectancy or mental set "is backlash excitation from outlasting postural adjustments previously made to the stimulus anticipated".

The theory of set can now also be applied to the findings of the directive-state experiments. This has been done by Allport. According to him the perceiver in a perception experiment sits looking at the tachistoscope waiting for a stimulus to raise the energies of the perceptual set above the threshold for a fully conscious percept. If the stimulus object is appropriate to the set-structure the energies of the whole aggregate is raised. The dominating aggregate will be the one in which the summation of the set and the congruent input energies is the greatest. Sets for perceiving can be built up through training. Motivational strengthening of sets can be considered in one of two ways; The energies from need-states or emotional reactions can either be an aspect of the physiological aggregate of the set itself, or they can be the energies of "tangent" aggregates that are connected with and help to "energise the structure of the set".

Perceptual behaviour is facilitated, speeded up, or strengthened by the existence of a set. This explains results obtained in directive-state experiments such as the lowering of the threshold for letters that had been rewarded

on previous exposures, the tendency to perceive the part of the drawing as figure that has been rewarded and the part punished as ground or the accentuation of such perceived dimensions as size, brightness, etc. Sets to explain the above results could have been either a long or short time in building up.

The size accentuation of some preferred objects as well as the brightness accentuation of food objects of which subjects have been deprived can be explained in terms of the high energies of certain set-aggregates that have been further increased by the energies of their congruent stimulus objects. Perceptual defense explained by hypothesis-theory in terms of alternative hypotheses can likewise be explained in terms of antagonistic sets which detract from one another's energies and so lessen one another's probability of rising above the threshold and this is manifested through a longer stimulus-exposure required for the recognition of the related stimulus word.

In a perceptual defense experiment the subject has two sets: the first one represents the tendency to perceive in a socially acceptable manner and the second one to perceive in a veridical way. At fast tachistoscopic exposures there is not enough stimulus information for veridical perception of a word and therefore the first set has a chance to be activated and perception of a socially acceptable word results. With longer exposures more stimulus-information comes into play and the veridical set has a chance to rise above threshold as a percept of the real word.

Learning is assumed to play an important role in set building, the set is said to accumulate energies through past trials and in this way one set can become stronger than another. Again it is not clear whether the theory assumes a primitive set in the beginning or not.

Allport sums up the structural theory of set by saying that: "It is now no longer necessary to invoke the direct action of needs, motives or values upon perceptual organization, nor to invent mediating motivational mechanisms that communicate between percepts and traces or that select, organize, and mobilize the traces for specific recognitions and misperceivings. The set-structure as built up by past perceiving episodes is the trace; and into it may enter the energies of motivational states, but only as one set of factors among numerous others". (p.416) Thus the phenomena of directive-state are really phenomena of perceptual set in that they express the conditions of set formation and operation. Under ordinary conditions stimulus information is usually sufficient for quick accurate perception and the observer are not aware of set existing in the individual but under the conditions of the directive-state experiments marginal conditions reduced stimulus input and the existence of non-veridical sets, as already described in perceptual defense are revealed in the individuals perceptions.

SUMMARY AND CONCLUSIONS

Various theoretical interpretations of the findings of the experiments dealing with the role of motivational factors in perception have been put forward.

The theory that needs have a direct influence on perception through "autism" had a number of supporters. This "mannikin theory" used the term "autism" for the mechanism mediating between the motivating conditions and perception.

Several other such mechanisms have been used. One of the most important of these is the psychoanalytic concept

of perceptual defense. This theory has been severely criticized for identifying repression with perceptual defense since to be able to 'repress' a response one must be able to recognize the object first. Solomon and Howes did pioneer work by giving a very reasonable explanation of the results of perceptual defense experiments in terms of behaviour theory. They explained that the high-value words for an individual are really high-frequency words and therefore require shorter recognition thresholds, and similarly low-value words are low-frequency words and require longer recognition thresholds. Another perceptual defense finding that taboo words are not perceived at normal exposure times was interpreted by Solomon and Howes in terms of the fact that the social aspect of the experimental situation i.e. the presence of the experimenters, inhibited the subjects from uttering the taboo words. It will later be shown that although this was a step forward in the right direction, it is not sufficient to explain all the aspects of perceptual defense.

Other interpretations of individual experiments make use of behaviour theory principles. Lambert, Solomon and Watson realized the importance of reinforcement in the estimation of the size of objects. McCurdy found the influence of past experience important but also used the rather indefinite mechanism "schema" which "functions as a kind of vague standard, arising out of past experience, and places any fresh experience in its appropriate context and relations" (1, p.254) The schema according to McCurdy may in some cases govern behaviour rigidly and this makes it

1) Dreyer, J. 1952. A dictionary of psychology. London: Hazell Watson and Viney Ltd.

difficult to find a place for it in a neural explanation of the events of perception. Klineberg gave an interpretation of the role of social motivation in perception in terms of learning of social behaviour. Dollard put forward a psychoanalytic theory of the same phenomena.

Gardner Murphy arrived at the useful conclusion that approach and withdrawal responses are at the basis of the appearance of affectivity or repulsion towards a stimulus object and the becoming dominant of that object but then he goes off at a tangent by suggesting that positive affect is the subjective aspect of approach. It seems that he did realize, however, that positive affect is part of a percept. Murphy finds the fact that the unpleasant is sometimes the dominant an unconquerable obstacle.

Bruner and Postman systematically interpreted all the findings of motivational experiments in terms of their hypothesis-theory based on the older concept of mental set. The theory assumes different stages in perception: first an "hypothesis" is set up in the organism as a result of the arousal of central cognitive and motivational processes by a particular situation, then there is an input of information from the environment regarding the characteristics of the stimulus, and this information either confirms or disproves the hypothesis. The theory has been criticized for not giving a clear statement of how hypothesis-testing takes place and for the use of both Gestalt and behavioural principles in describing perception.

Although hypothesis-theory showed that it could deal with all the findings of the "motivational experiments" the fact that it is an internally divided theory left us with the need for a unified and more parsimonious explanation of all the facts.

The other motivational-state interpretations utilizing numerous "mechanisms" have been found inadequate and

therefore the search for an adequate theory had to be directed elsewhere.

Here and there throughout the interpretations of the findings of the motivational experiments behaviour theory principles have been used. Solomon and Hovess especially had considerable success with their behavioural interpretation of the influence of value on the recognition thresholds of words. Past experience has often been invoked as influencing perception. These facts as well as the accent on individual differences has led the writer to the conclusion that an adequate explanation of all the facts brought to light by motivational theory can be found in a behavioural theory of perception and it was decided to test the power of such^a theory at first thoroughly in one part of the field of motivational-state experiments and then to apply its principles to all aspects of the field.

CHAPTER III

A BEHAVIOURAL THEORY OF PERCEPTION.

This theory put forward by J.G. Taylor (1, 2) goes out from the assumption that a perceptual event cannot be explained in terms of a single S-R bond, that it does not grow like an ordinary habit and that its occurrence is not associated in time with the evoking of any observable response; in other words that it is of an order different from ordinary behaviour. The fact that perception cannot be observed by experimenters, and that only the subject himself can report on his perception in the perceptual experiment makes it no less real because his reports on other aspects of the experimental situation which can be confirmed by observers are found to be correct, and accepted.

The term 'introspection' is used for the subjects observing and reporting on his private perceptual experiences. Introspection is here, however, not employed in its original meaning as used by the Wundtian school where the subjects were asked to turn their attention inwards and describe their conscious experiences, but the subject is merely asked to report immediately on what he perceives. Thus the subjects' introspection is accepted

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- 1) Taylor, J.G. The behavioural basis of perception (in preparation).
 - 2) Taylor, J.G. 1957. Towards a science of mind. Mind. (in press).

as a faithful but perhaps incomplete report of "private events induced - - by certain public events" (1, p.4). An important stipulation in connection with the use of the term introspection for reporting of perceptual events, is that it is not a complete description of the total perceptual experience to which it refers but it rather involves a selection of specific aspects at which the experimenter's questions are directed.

In his behavioural theory of perception the author deals with the statement, put forward by other schools of psychology and found so objectionable by behaviour scientists, viz. that conscious experience can serve as a means of initiating and controlling action. Complex activities are usually preceded by perceptual experiences of the goal, or path to be followed and thus the idea has arisen that the action is guided to the goal by the perception. The frequent conjunction of perception and behaviour in this relationship has to be explained, however, and since the idea that actions are caused by perceptual events cannot be accepted, and on the other hand no event can be the cause of an event that precedes it in time and therefore conscious events cannot be caused by the actions that follow them, another explanation must be found.

Taylor proposes that the way out of the dilemma is to postulate a third set of events as the cause of both the other sets. The set of events to fill this role is assumed to be events in the nervous system initiated

by stimulation of the receptors, events which are the immediate cause of effector activity and are modifiable by learning. The relationship between perceptual experience and behaviour can then be explained by the assumption that the same set of preceding neural activities is responsible for both, and the modifiability of the neural events explains both learned behaviour and perception. This theory does away with the psychophysical assumption that sensory experiences can be explained by events taking place in the afferent part of the nervous system, up to and including the sensory cortex, i.e., that part the structure and interconnections of which are determined by heredity and which is not often thought of as being modifiable by learning. According to Gestalt theory the structures up to and including the cortical projection areas perform the double function of (a) determining the perceptual experience and, (b) transmitting to other parts of the brain the impulses that evoke behaviour; and the structures beyond the projection areas can be modified so as to allow for learning but have nothing to do with perception. The insufficiency of psychophysical and Gestalt theory is shown up by the phenomena of hysterical anaesthesia, which prove that sensory experience can be abolished without physical or pathological interference with either the receptors or afferent tracts or the cortical projection area.

There is now, according to Taylor, a considerable amount of evidence (1) that perceptual experience can be changed experimentally by systematic redistribution of the stimuli acting on a receptor organ, provided the

1) Eriemann, I., and Kohler, I.

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experimental conditions are maintained for a sufficiently long time. Since the redistribution obviously cannot have an effect on the afferent tracts to the projection areas, a change in perception cannot be explained by changes in these neural structures.

In the experiments in which redistribution of stimuli has been effected it was found that not only perception changed but also behaviour. At first the responses to objects in the environment were misdirected, but this was changed relatively soon and new accurate responses were acquired. The interesting point is that these new responses to environmental objects were the same as those evoked by those objects before the experiment, but they were now evoked by differently ordered stimuli and neural events. Another point of importance is that the perceptual changes were only reported after the new responses were already established.

These facts suggest a single set of neural mechanisms mediating both learned responses and perception as postulated by Taylor, and on this his theory of perception is based. The set of neural mechanisms mediating learned responses are termed engrams, a term the definition of which implies no knowledge of the neurophysiological details of the structure. The symbol used for an engram is Hull's S_H^R which implies a relatively permanent neural structure mediating a specific response R to a specific stimulus S . Another property of Hull's S_H^R which also fits in with the concept of an engram is that the arousal of activity in the structure by afferent impulses resulting from S is a necessary but not sufficient condition for the

evocation of the response R, a further necessary condition being stimulation determined by the existence of a drive. The drive in Hull's system was physiological but Taylor also includes secondary or acquired drives. If there is no drive an engram may be activated by afferent impulses coming from S without evoking R, and similarly a large number of engrams may be simultaneously activated, even if the associated responses are mutually exclusive.

In the absence of direct neurological evidence that engrams can be activated without determining a response, Taylor supplies some indirect evidence. In experiments where the subjects are given an instruction, followed by a series of specific stimuli to which they have to make responses, we find that the responses are of the type required by the instruction right up to the end of the series. This seems to indicate that the neural activity mediating the choosing of a particular response rather than other available ones persists through out the session and the intervals between completion of one response and the presentation of the next stimulus. During the intervals there may be no observable behaviour disclosing the neural activity, the subject may even think of something else, but when the next stimulus is applied the appropriate response follows and thus indicates the existence of the mediating engram.

Perception is now defined as a function of a function of stimulation ($F(\phi(S))$), i.e., not as a direct function of stimulation as by the psychophysicists but rather as a function of certain engrams or habit structures

that have been built into the brain through the process of learning, i.e. $\pi = F(S^H R)$, where π denotes perception.

The form of the function F is explained in terms of three known properties of perception.

1. The fact that perception can occur in the absence of overt responses, i.e. although it is necessary that S be presented, it is not necessary that R be evoked leads to the specification that $F(S^H R)$ is simply the arousal of activity in the engram by the presentation of S .

2. Perception is normally a complex experience in which a large number of elements are presented simultaneously, and this enabled the author to state that the function F applies not to a single engram but to a set of engrams. The symbol $\underline{S}$ is used to represent the set of stimuli from the present environment, and $\underline{R}$ is used to represent the set of learned responses to the elements of $\underline{S}$. A one-to-one correspondence is assumed between $\underline{S}$ and $\underline{R}$, so that for every $S \in \underline{S}$ there is an $R \in \underline{R}$ which has been linked with it through a learning process. The symbol $\underline{S}^H \underline{R}$ therefore represents a set of engrams mediating all the acquired responses to the stimuli present in the environment and acting on the sense organs, and those stimuli present but not linked to a learned response are not included in $\underline{S}$. The perception hypothesis can thus be stated in the form $\pi = F(\underline{S}^H \underline{R})$.

3. The perceived environment remains constant despite continuous variation in the pattern of stimulation to which it gives rise. According to the perceptual hypothesis stated earlier the function of stimulation of which perception is a function is one that has been established by a learning process. The facts of perceptual constancy require that the functions of the several states of stimulation that can be aroused by an external object must all have identical values and this condition is satisfied if these several states of stimulation are all linked, by the learning process, to the same response R. This would not have been possible if the relevant states of stimulation were determined only by external stimulus energies from the external field since the stimulus energies from one object when the body is in a particular position may be the same as those from another object when the body is in a different position. But each position of the body determines a specific pattern of proprioceptive stimulation and therefore the energies from an external object acting on an exteroceptor together with the pattern of proprioceptive stimulation constitute a compound pattern of stimulation which is unique and can therefore be unambiguously conditioned to some specific response to the object. If the orientation of the organism is changed without change in the object, both exteroceptive and proprioceptive stimulation may be altered but the compound

stimulus pattern is again unique and can be conditioned to the same response to the object. It thus follows that in general each $S \in \underline{S}$ is a compound pattern of stimulation and involves two or more receptors, and no learned reaction is sufficiently determined by a single stimulus which implies that the engrams mediating such behaviour are complex structures which probably involve neurons in several different parts of the brain.

The theory goes on to state that each compound pattern of stimulation $S \in \underline{S}$ is at the same time an element of an equivalence class of stimulus compounds. The elements of this equivalence class are equivalent because each of them has been conditioned to the same response or set of responses, R . Thus if we say that $S_a, S_b \dots$ are elements of an equivalence class it also means that $\phi(S_a) = \phi(S_b)$. Therefore it is clear that each orderly aspect of nature that is capable of affecting the sense organs and which is at the same time directly or indirectly relevant to the needs of an organism must determine an equivalence class of stimulus compounds.

$\underline{S}$ is now defined as a set of stimulus patterns with elements $S_1, S_2 \dots S_n$, where each S is a unique compound stimulus that has been conditioned to a specific response, and each S is an element of an equivalence class of compound stimuli which have all been conditioned to the same response. Thus any change in the position of the organism will change some or all of the elements of $\underline{S}$, but each of the new elements is drawn from the same equivalence class as its predecessor, so that there is no change in the one-to-one correspondence between $\underline{S}$ and $\underline{R}$ and no change in the composition of $\underline{R}$ and no change in the perception.

The theory outlined above postulates "that when any set S^H_R of engrams is operated on by the function F , the organism is thereby put into a state of simultaneous readiness to respond appropriately to any aspect of the environment that may prove to be relevant to its needs and purposes" (1, p.16). This according to Taylor, is the essence of perception. Perception is thus a private experience and there are no measurable outward indications by which an observer can establish the existence of a compound state of readiness for a variety of responses all requiring the same effector organs in another person, although the person himself may be without any doubt as to his readiness for a variety of actions.

Summary and Conclusions

To sum up this behavioural theory of perception, perception is shown to be a function of learned behaviour. It is assumed that a very large number of habits relative to all features of the external environment that are capable of acting on the receptors and are relevant to the needs of the organism are acquired through learning starting at birth. The stimuli for these habits are compound and invoke exteroceptive, proprioceptive and interoceptive components in a variety of patterns which are organised into equivalence classes through being conditioned to the same response.

Through this learning a complex network of connecting links between afferent and efferent fibres, named engrams, are established. Every engram can be aroused to activity by the appropriate stimulus although

the relevant response need not be evoked. From this it follows that an individual's environment activates a selection of his engrams and thus puts him into a state of simultaneous readiness to respond appropriately to any feature of the environment. This simultaneous readiness for response is identified with perception. Thus if the experimenter knows the complete set of responses conditioned to a given set of compound stimuli he knows what perceptual experiences those stimuli will arouse. It is claimed by this theory that all perceptual phenomena can be exactly accounted for in terms of the habit structure of the subject.

To the question "why do things sometimes look differently from the way they are?" this theory would answer that because perception is shown to be a function of learned behaviour, how an object will be perceived or "how it will look" to the perceiver will be a function of his particular set of responses conditioned to the elements of the stimulus.

We shall now see how the theory can be applied to the results obtained in a certain type of directive-state experiment, viz. those experiments in which it is demonstrated that the value of objects to the individual tends to determine their perceived magnitudes. In a later chapter it will also be demonstrated how this theory explains the results of the other directive state experiments as well as the concept of set, and the part played by value and motivation in general in perception.

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- (2) FRANK, J. D. 2038. THE NEW AND OLD ORGANIZATIONS IN THE U.S.A.
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symbol in the form of a coloured photograph of the valued object. This photograph was projected on a screen, the distance of which could be adjusted by the S. himself, thus varying the size of the image.

In general the results show that the majority of Ss select symbol sizes that are substantially greater than the actual size of the objects that are highly valued and substantially smaller symbol sizes in the case of the objects that are given a low valuation. In some of the studies referred to a small proportion of the Ss chose smaller symbols for highly valued objects and larger symbols for objects of a low valuation.

Theorising^{about}/these results has been directed primarily to the majority responses and the investigators seem to be agreed that a selection of larger symbols implies that valued objects are perceived as being larger than life, while the selection of smaller symbols implies that objects with a low value are perceived as being smaller than their real size. So far no interpretation of the minority responses seems to have been attempted.

The interpretation of the majority reports looks plausible at first sight but in reality it is logically untenable. If an object A is perceived as larger than its true size, then it may be expected that a symbol A' representing A will similarly be perceived as larger than its true size; more

The study that is to be described now, was designed to test the following hypotheses based on Taylor's behavioural theory of perception (1, 2).

1. An object is likely to be perceived as smaller than its real size if the general response to it is to approach and consume and if the quantity presented is less than the amount required to satisfy the S's need. Conversely an object is likely to be perceived as larger than its real size if the normal response to it is avoidance or consumption of a very small quantity and if the quantity presented is larger than the amount that is normally consumed.
2. That the choice of values of A' in experiments such as that of Beers is a function of the habits acquired by the S in response to A . Thus habits of eager approach may be expected to result in the choice of larger values of A' while habits of avoidance or withdrawal will lead to the choice of smaller values.

As a corollary of the second hypothesis it can be predicted that Ss who placed a high value on A but have learnt to inhibit their eager approach, will select relatively small values of A' and similarly Ss who have learnt to inhibit an initial withdrawal response to a disliked object will select relatively higher values of A' .

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- 1) Taylor, J.C. 1957. Towards a Science of Mind. (in press).
 - 2) Taylor, J.C. The behavioural basis of perception (in preparation).

Pilot experiments were carried out

- 1) to obtain a list of foods that commonly evoke strong likes and dislikes among school children,
- 2) to determine at what age levels children are able to respond to the type of apparatus used, and
- 3) to find out whether colour influences size judgments.

The first pilot experiment yielded information on substances for which children commonly expressed strong liking or repugnance. As the technique to be used in the main experiment involved the comparison of a liked food object with a disliked food object with respect to size, it was necessary to select from among the foods considered a number of pairs that would satisfy the double requirement that one member of the pair was liked while the other was disliked, and that the two substances could be presented in identical form and size.

The procedure used in this experiment was the same as that used by Beams :

Printed sheets were prepared which contained a place for S's name and 7 straight lines, each one 7 in. long. The mid-point of each line was indicated by a small letter "o". Each S. was instructed to write the name of his favourite food or drink at the extreme right end of the top line and told this point would represent that food or drink. The extreme left end of the line was to represent the food or drink S. disliked most. He was then instructed to think of some food object which he liked only about half as much as his favourite

food and to let the small "o" represent this choice. This was each S's reference line against which he could check each of the food objects used as stimuli. The S's were asked to indicate their liking or dislike for each stimulus object separately by putting an "x" at that point of the line that represented their feeling for the specific food stimulus. Examples were given before the experimenter read the list of stimuli.

The following three pairs of food objects were then selected :

- 1) A slice of dry bread and a slice of chocolate cake.
- 2) A bowl of boiled spinach and a bowl of icecream.
- 3) A bottle of castor oil and a bottle of cold drink.

Some of the eight year old children tested, proved unable to follow the instructions and it was therefore decided to confine the main enquiry to children of nine, ten and eleven years.

Preliminary Experiment II

Purpose : To find out whether colour influences size judgment.

Apparatus : A masonite box $17\frac{1}{2}$ " x $12\frac{1}{2}$ " x 16" with a ground-glass screen in the front of the box ($14\frac{3}{4}$ " x $14\frac{3}{4}$ ") which was viewed monocularly through a round opening in the back of the box $\frac{1}{2}$ " in diameter. The pictures were projected on to the screen by a projector mounted on a sliding base to which a metre scale was attached. A pointer fixed to the projector enabled the E. to read the distance of the projector from the screen. The zero

end of the scale was 73 c.m. from the screen. At a pointer reading of 50 c.m. on the scale the stimulus object was presented at life size. A scale mounted on the lens enabled the E. to keep the picture in focus whenever the readings of the two scales were identical. A slide of a white block and one of a black block the same size were used as stimuli.

Subjects : 6 ten year old children.

Procedure : The white block was shown at normal size for 5 secs. Then E. changed over to the slide of the black block and moved it from the point nearest to the S. towards where the block was shown at normal size. S. stopped E. when in his opinion this block was the same size as the white one previously shown. The white block was then shown at normal size again, E. changed over to the black block and moved it towards normal from the point furthest away from S, i.e. it was made smaller. S. again had to indicate when it had reached normal size. This procedure was repeated 5 times in each direction for each block when the other one was held constant.

Results

(1) Black Constant

Average error

S1	-2.50
S2	1.65
S3	1.65
S4	-7.50
S5	-4.20
S6	0.00

(2) White Constant

	<u>Average error</u>
S1	-1.67
S2	-2.50
S3	-5.00
S4	.85
S5	-5.85
S6	3.35

This experiment showed that the judgment of size was not significantly effected by having the objects to be compared presented in different colours. (See Statistical Appendix I for application of t test to difference scores).

Experimental Design of Main Investigation

The design of the main experiment was in one respect similar to that of Beams in that the Ss were required to look at a test object that was invariant in size and then at a second object that could be varied in size and to indicate when in their judgment the second object was identical in size with the first one.

In the Beams study the test objects were a real food object whether liked or disliked and a photograph in colour of that same object projected on a screen in such a manner that the angle subtended at the S's eye could be varied.

In the present study the test objects were 2 photographs in colour of identical size. These were projected one at a time on a ground-glass screen forming one side of a box. The S. viewed the photograph through a peephole in the opposite side of the box. One

of the photographs was presented in a standard size and the other was then presented either in a smaller or larger size and adjusted until the S. reported it to be equal in size to the previously seen object.

The procedure differed from that adopted by Beams in the following respects :

- 1) The test objects were photographs of a liked and a disliked object.
- 2) In the Beams experiment the Ss themselves manipulated the apparatus to alter the size of the projected photograph; in the present study the apparatus was manipulated by the E. and the S. was merely required to report when the second photograph appeared to be equal in size to the previously presented one.
- 3) After the first seven Ss had been tested an additional procedure was adopted. The photographs of the liked and disliked objects were presented in rapid succession at the same size and the Ss were asked to report which of them appeared to them to be larger. This affords a direct test of the contention that liked objects are perceived as larger and disliked as smaller than their real size.

The hypotheses presented above imply that the responses of the Ss to the test situation are determined by the history of their behaviour in relation to food. As the most likely source of reliable information on this history was presumably the S's mother, the homes of all the Ss were visited by the E. with the object of obtain-

ing information about their present and past eating habits and any information about the mother's treatment of the child that might be relevant.

Stimuli, Subject and Apparatus

Three pairs of food objects were selected as stimuli :

- 1) A slice of dry bread and a slice of chocolate cake cut to the same size. Both slices were placed on saucers of the same size.
- 2) Equal quantities of icecream and boiled spinach placed separately in glass bowls of the same size.
- 3) A bottle of cold drink and a bottle of castor oil. Both the bottles and the labels on them were the same size.

A colour picture of each stimulus was taken against a common background, all at the same distance from the camera so as to be projected life size at the same distance from the viewer. These pictures were then developed into slides.

The apparatus used consisted of a masonite box $17\frac{1}{2}$ " high $12\frac{1}{2}$ " wide and 16" deep, with a ground-glass screen in the front of the box ($14\frac{3}{4}$ " x $14\frac{3}{4}$ ") which was viewed monocularly through a round opening in the back of the box $\frac{1}{2}$ " in diameter.

The pictures were thrown on the screen by a projector mounted on a sliding base to which a metre scale was attached. A pointer fixed to the projector enabled the E. to read the distance of the projector

from the screen. The zero end of the scale was 73 cm. from the screen, and a pointer reading of 50 cm. therefore indicated that the projector was 123 cm. from the screen. At this point the stimulus object was presented at life size. A scale mounted on the lens enabled the E. to keep the picture in focus whenever the readings on the two scales were identical.

The Ss were 35 children, 17 boys and 18 girls, ranging in age from 9 years 0 months to 11 years 5 months, in I.Q. from 95 to 133 (Individual Scale of the National Bureau of Educational Research) and in visual acuity from $7\frac{5}{6}$ to $\frac{6}{5}$ (Snellen Chart). These Ss were drawn from an original population of 200 Standard II, III and IV children in five government schools in Cape Town.

Procedure :

A. Beams' technique was used for the selection of Ss on the basis of their likes and dislikes for the stimulus objects. Sheets were prepared which contained a place for the S's name and 7 straight lines, each 7 " long. The mid-point of each line was indicated by a small letter "o". Each S. was instructed to write the name of his favourite food or drink at the extreme right-hand side of the top line and told that this point could represent that food object. The extreme left end of the line was to represent the food object which the S. disliked most. The small "o" at the mid-point of the line was to represent something which he liked about half as much as his favourite food or drink. This gave each S. a reference line against which to check each of the

food objects chosen as stimuli. The Ss indicated their like or dislike for each stimulus object separately by putting an "X" at that point on the line which represented their feeling for the specific stimulus. Several examples were given by the E. in order to demonstrate the importance of every inch of the line indicating like or dislike. The list of stimuli was then read by the E.

The scale was given on two consecutive days and then again after two days. Ss whose marks fell in either the first or last inch of the lines were chosen. Beams found this a reliable method for obtaining the Ss' likes and dislikes for the stimuli chosen.

35 Ss were found who consistently indicated a strong like for one object of each stimulus pair and a strong dislike for the other object of the pair.

Each S. was then shown in the box the liked or disliked object of one stimulus pair at life size, i.e. 123 cm. away from the screen for 5 secs. The E. then changed over immediately to the slide of the other stimulus of the pair and moved the projector to the point nearest to the screen and then more slowly towards the point on the scale where it was shown at life size, and the S. had to indicate when this stimulus image was the same size as the stimulus object previously shown at life size. The reading was taken in cm. when the S. indicated that the second stimulus was the same size as the first one.

Example

Spinach (disliked stimulus) is shown life size on the screen for 5 secs. The E. then changes over to icecream at its smallest size and moves it up the scale, i.e. it was made larger. The S. stops the E. when the image of the icecream is in his judgment as large as the spinach was. The reading is taken at this point. On the next trial the spinach is shown for 5 secs. The E. changes over to icecream and moves it to a point farthest away from the screen and then moves it more slowly towards the screen, i.e. he makes the image smaller. Again the S. stops him when the image of the icecream is in his opinion the same size as the spinach was. The process of changing over from one slide to the other and to a point near or far away from the screen takes approximately 3 secs.

Five readings were taken with spinach constant and icecream varied and again five readings with icecream constant and spinach varied. This procedure was repeated with each of the other stimulus pairs, and the order of presentation was systematically varied.

The average error of the 10 readings when the liked object was constant and the disliked object varied was then computed, and similarly for the 10 readings when the disliked object was constant and the liked object varied.

Procedure

B. Before and after part A of the experiment the photographs of the liked and disliked objects were

presented in rapid succession at the same size, i.e. life size and the Ss were asked to report which of the objects of a stimulus pair appeared to be larger. The order of presentation was varied systematically.

Results

A. From 29 of the 35 Ss positive difference scores were obtained for the first pair of stimuli, cake and bread, when bread was constant and cake varied, indicating that the S. had made a larger comparative image of the liked than of the disliked stimulus.

From 23 of the 35 Ss negative difference scores were obtained for the first pair of stimuli when cake ^{was} constant, indicating that the S. had made a smaller comparative image of the disliked stimulus than of the liked stimulus. The following are similar results for the second and third pairs.

TABLE I

<u>No.</u> <u>Subjects</u>	<u>No. pos.</u> <u>diff.scores</u>	<u>No.neg.</u> <u>diff.scores</u>	<u>Constant</u>	<u>Varied</u>
35	29	6	spinach	icecream
35	13	22	icecream	spinach
35	23	12	castor oil	cold drink
35	9	25	cold drink	castor oil

The mean difference between adjustments of liked and disliked objects for the first pair (cake and bread) was found to be 5.44 cm. indicating that the image of the liked object was made larger. Similarly for the second pair the mean difference was found to be 5.4 cm. and for the third pair 4.7 cm.

The t test showed that the difference between like and dislike scores was significant at less than the 1% level. (See Statistical Appendix I, No.III). No significant differences were found between the sexes and no significant correlation between the difference scores and intelligence, and no significant differences between the difference scores and age. (See Statistical Appendix I, Nos. IV, V, VI)..

B. The results of part B of the experiment are shown in the table below.

TABLE II

<u>stimuli</u>	<u>larger</u>	<u>smaller</u>	<u>equal</u>	<u>Total</u>
bread	19	2	7	28
spinach	19	4	5	28
castor oil	13	4	11	28

The differences between the average adjustment errors for the two stimuli of each stimulus pair were found and these results in combination with the results of experiment B are given in Table III.

TABLE III

The Combined Results of Experiments A and B.

Stimuli	Results of exp. A.	Results of exp. B.		
Cake and bread	28 L.L.	17 D.L.	1 D.L.	
	6 D.L.	4 e	2 e	1 e
	1 e	2 L.L.	1 L.L.	
	<u>35</u>	<u>5 n.t.</u>	<u>2 n.t.</u>	
Total	35	28	6	1 = 35
Ice cream and spinach	34 L.L.	19 D.L.		
	1 D.L.	5 e		
		3 L.L.	1 L.L.	
		<u>7 n.t.</u>		
Total	35	34	1	= 35
Cold drink and castor oil	31 L.L.	12 D.L.	1 D.L.	
	4 D.L.	10 e	1 e	
		2 L.L.	2 L.L.	
		<u>7 n.t.</u>		
Total	35	31	4	= 35

L.L. = liked object larger
 D.L. = disliked object larger
 e = equal in size
 n.t. = not tested

The results of part A of this experiment agree with those obtained by Beams in that the majority of subjects adjusted the photographs of the liked object to a larger size than the photographs of the disliked objects and a minority made the contrary adjustments.

Part B of the experiment however directly contradicts the inference drawn by Beams from these results, viz. that a liked object is perceived as being larger than its real size and a disliked object smaller. These findings are in general agreement with the hypotheses stated above but complete confirmation was dependent on the information given by the mothers of the Ss.

C. The mothers of the Ss were asked the following questions :

- 1) Which foods does the S. like very much?
- 2) Which does the S. dislike?
- 3) What does S. do when a dislike object is placed before him, e.g. does he leave it on his plate, hide it, push it away or eat it?
- 4) Is the S. sometimes made to eat the disliked objects?
- 5) Does he get punishment or reward for eating or not eating it?
What kind of tactics does the S. employ to obtain objects he likes when they are not available?
- 6) The mother's view of the Ss' feeling for and behaviour towards the 6 stimuli chosen.

Results

The reports obtained from the mothers gave further confirmation of the hypotheses. It was found that in general the Ss showed strong tendencies to obtain and approach the liked objects with enthusiasm whereas they tended to leave the disliked object on the plate, push it away, hide it under something else, to take only small helpings or to refuse to take it at all.

Examples

SV

In Experiment A the liked object was made larger than the disliked object each time (mean difference = 5.67 cm.). In Experiment B the S. reported that the three disliked objects appeared to be larger than the liked one. The mother of the subject reported that the subject leaves the disliked foods on her plate, she has tried to make her eat it but with no success. The subject has tasted castor oil but refuses to take it. In general the subject is a small eater, has strong preferences and refuses to eat disliked foods.

SII

In Experiment A the liked objects were all three adjusted to a larger size than the disliked objects (mean difference = 11.67 cm.). In Experiment B the subject reported that the three disliked objects appeared to be larger than the liked ones. The subject's mother reported that the subject is very fond of cake and would leave bread strictly alone when cake

is available; he dislikes spinach intensely, pushes it away when put on his plate, and he eats a lot of icecream; he cries and tries to escape when he has to take castor oil, cold drinks are liked very much. In general the subject has a good appetite, he has strong preferences which are reflected in the big average difference results, and when he wants something he goes on nagging until he gets it.

SXXV

All three liked objects were adjusted to larger sizes than the disliked objects in Experiment A (average difference = 9.17 cm.). In Experiment B the S. reported that the three disliked objects were larger than the three liked objects. In the mother's report we find that the subject eats no bread, only toast, but likes cake. She refuses to eat spinach and just leaves it on her plate, and castor oil is also refused while she loves ice cream and cold drinks. In general the subject has a small appetite and strong likes and dislikes. She just quietly refuses to eat disliked foods and no amount of argument will persuade her to eat it. When she is not allowed something, she grumbles.

A detailed description of each individual case is given in Appendix A.

The Minority Responses

An attempt was made in this study to find an explanation for the minority responses obtained, showing larger adjustments for the reported disliked objects than for the reported liked objects, and

similarly perceptions of the liked object as larger than the disliked object.

It was found that although the S. had reported dislike for a food object, the mother reported that the S. actually ate that food object. This seems to be in agreement with Taylor's interpretations (1) of the results obtained in the spectacle experiments of Eriksen and Kohler at Innsbruck (2), that verbal habits are not as subject to extinction as overt habits and that verbal habits may also be divorced from other habits.

The reversals obtained by Beane may therefore be explained in the following way. The overt habits of the Ss had changed but their verbal habits descriptive of their earlier likes and dislikes had persisted. Their selection as Ss was determined by the persisting verbal habits but their response to the test situation, i.e. their size perceptions depended mainly on their existing overt habits.

Examples

SIV

In Experiment A bread (disliked object) was adjusted to a larger size than cake (average difference = 1.5 cm., which is a relatively small difference). In Experiment B bread and cake were reported to be the same size. The subject's mother reports that the subject eats both quite willingly.

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- 1) Taylor, J.G. The behavioural basis of perception. (in preparation).
 - 2) Kohler, I. 1951. Über Aufbau und Wandlungen der Wahrnehmungswelt. Vienna : Österreichische Akademie der Wissenschaften.

SXXI

Cake and bread were adjusted to the same average size in Experiment A. In Experiment B they were also reported to be equal in size. The subject's mother reported that he did not at first want to eat bread but now eats both willingly.

SVI

Gold drink (liked object) was adjusted to a larger size than castor oil (average difference = 2.0 cm., again a fairly small difference). The two stimulus objects were reported to be equal in size in Experiment B. The subject's mother reported that the subject does not get castor oil any longer.

SXVII

In part A of the experiment cake (liked object) was adjusted to a smaller size than bread (mean difference = 6 cm.). In part B cake was perceived as larger than bread. The mother stated that the S. eats both bread and cake, but that she is not allowed to eat cake often or too much of it, since it does not agree with her.

In this case the approach responses to cake are rapidly extinguished by the mother while there is a delay in the extinguishing of the verbal responses. This seems to explain the adjustment scores obtained from the S. and confirms the prediction stated as a corollary to the second hypothesis. The verbal responses have presumably not been changed as can be seen from the ratings the S. ascribed to the two stimuli.

SIX

When bread was constant and cake adjusted an error of +16 cm. was obtained. With cake constant and bread varied an error of +18 cm. was obtained. Both these errors were in a positive direction, therefore both objects were probably seen as too small and thus made larger. That bread was made slightly bigger than cake was probably due to chance. A social report shows that the S. is from a very poor family and there is probably a strong need for carbohydrates. Furthermore, the child eats both quite readily and therefore only approach and no withdrawal responses are present in this situation.

The Special Case of Castor Oil

The comparison between castor oil and cold drink affords an interesting confirmation of the hypothesis since castor oil is not often administered in practice although it is not infrequently talked about. Even children who have never tasted castor oil have been fully acquainted with its unpleasant characteristics. In this case consequently there are verbal habits without any corresponding overt habits.

When the stimuli cold drink and castor oil were presented in rapid succession 12 Ss out of 28 perceived the disliked castor oil as larger than the liked cold drink. This proportion of the responses is considerably smaller than those obtained for the other two sets of stimuli.

The two stimuli were reported as being equal in size by 11 Ss. Five of these have never had castor

oil, 4 perhaps once when they were much younger, and 2 received rewards for taking it. Thus the behaviour of the first 9 Ss in relation to castor oil included only verbal habits. Since there were no overt avoidance habits, no actual difference in the size perceptions was found. The difference scores obtained in part A of the experiment were relatively small, ranging from 0.5 cms. to 5.0 cms. which is below average.

The 2 Ss who perceived castor oil and cold drink as being equal in size and who received rewards for taking castor oil, again received reinforcement of their overt responses to castor oil as is the case with their responses to cold drink, i.e. the responses are essentially the same and therefore no significant difference in the size perceptions can be expected. The different rating ascribed to the 2 stimuli can again be explained by the fact that no punishment or reward of the verbal responses of like or dislike was given. The adjustment differences obtained in part A of the experiment were again small (2.5 cm. and 3.5 cm.).

General Eating Habits

To throw more light on the differences in individual scores obtained in part A of the experiment it was decided to compute the sums of the errors as well as the differences between the errors for each stimulus pair for each subject, for example, S3 cold drink constant, castor oil adjusted, error = -6.5 cm.; castor oil constant, cold drink adjusted, error = -3.0 cm.; the sum of the errors = -9.5 cm.; and the difference between the errors = 3.5 cm. The means and standard deviations of the sums for each stimulus pair and of the differences for each stimulus pair were

calculated, as well as the means and standard deviations of the average sums of errors and differences of errors for the three pairs of stimulus objects.

When for a subject an average sum of errors greater than $+1\sigma$ was obtained, it was assumed that the subject is a hearty eater, in other words he made the food objects on the average larger than their true size and therefore in terms of Hypothesis I it is assumed that he approaches food more vigorously than the subject whose sum of errors is below -1σ and who is assumed to be a small eater. When a subject's average difference scores were larger than plus or minus one standard deviation, his preferences were assumed to be strong. The reports obtained from the mothers confirm these assumptions to a large degree.

Subjects XIII, XVII, XXIX and XXXV gave difference scores larger than 1σ for the stimulus pair cold drink and castor oil and were reported to have a strong preference for one object of the pair. Large differences between bread and cake were reflected by the results of subjects I, II, X, XII, XXIII, XXIV, and XXVI and similar large differences between icecream and spinach were found in the results of subjects II, VI and XXV.

An average sum of errors larger than the mean plus one standard deviation, or approximately one standard deviation larger than the mean has been obtained from subjects IX, XIX, XXI, XXIV and XXVII. These subjects were reported to be hearty eaters and one of them was a child living in poor economic circumstances

who would naturally approach food eagerly. (See Appendix I and Statistical Appendix I, No. VII and VIII).

The bi-serial correlation between the sums of the errors and appetite (good eaters and poor eaters) is $r_{bis} = .7$ (Statistical Appendix I, No. X)). This correlation led to the expectation that there would be a significant correlation between the sum of the errors obtained for one pair of stimuli and the sum of errors obtained for another pair. This expectation was confirmed. The correlations were $r_{12} = .48$, $r_{13} = .35$, and $r_{23} = .47$, where subscripts 1, 2 and 3 refer to the three pairs of stimuli. For a sample of this size the usual formula for the standard error of correlation coefficients yields values that are too small. The two values may be obtained from Pearsons Table 32 (distributions of correlation coefficients in small groups) (1). See also Statistical Appendix I, No. XI.

No significant correlations between the difference scores for the three pairs of stimuli were obtained, which is in accordance with individual preferences. The correlations were as follows: $r_{12} = .1$, $r_{13} = .04$, $r_{23} = .2$. (See Statistical Appendix I, No. XI).

Summary and Conclusions

The purpose of this investigation was to re-examine the hypothesis that value affects the perceived magnitude of an object. Defects in interpretation of the results yielded by experiments supporting this hypothesis have been found and the

(1) Pearsons Tables for Statisticians and Biometricians. Part II.

alternative general hypothesis, that perceptual size distortions, and the adjustment and selection of symbols representative of valued objects are functions of the habits acquired by the subject in response to these objects, has been put forward. Evidence in support of this hypothesis has been obtained in two experiments on size perception and adjustment, and from an investigation of individual case histories regarding the subjects' behaviour towards the stimuli chosen for the experiments. Other relevant predictions about the eating habits of the subjects, based on their size judgments have also been confirmed by the reports about their individual behaviour patterns.

CHAPTER V

A FURTHER APPLICATION OF BEHAVIOURAL THEORY TO EXPERIMENTS ON THE ROLE OF PREFERENCE IN PERCEPTION OF SIZE.

INVESTIGATION II

In the previous two experiments it was established that an object is perceived as smaller than its real size if the general response it evokes, is approach and if the quantity presented is less than the amount required to satisfy the subject's need and that an object is perceived as larger than its real size if the usual response to it is avoidance and the quantity presented is larger than the amount that is normally accepted.

It was also found that the choice of values of a symbol representing an object is a function of the habits acquired by S. in response to the object.

These results led to a further study, now to be described, designed to test certain predictions about the behaviour of Ss in a variety of experimental conditions. The field chosen for this extension of the investigation was children's likes and dislikes for certain school subjects and their perceptions of objects representing these subjects. A necessary requirement of the experimental procedure was that S. should have a strong like for one subject of a pair, and a strong dislike for the other one, or vice versa. A preliminary investigation yielded the information that the school subjects Reading and Arithmetic most

frequently evoke either a strong like and dislike or vice versa in the same subject.

The design of the experiments used in this part of the investigation was in many respects similar to that previously quoted. In Experiment A the photographs of a book representing a liked subject and of a book representing a disliked subject were presented in rapid succession at the same size and Ss were asked to report which of them appeared to be larger.

In this study the photographs were of an arithmetic book and a reading book of the same size. One object of the pair was liked and the other disliked.

The subjects in Experiment B were required to look at a photograph A, representing one of the books mentioned, that was invariant in size, and then at a second photograph B, representing the other book of the pair, that could be varied in size, and to report when in their judgment the second photograph was identical in size with the first one. Both these experiments were carried out under 3 different sets of conditions.

In situation I the experiments were carried out without giving the subjects any further instructions, while in situation II they were asked questions about homework and generally prepared for the homework situation, stress was laid on the doing of the disliked subject; and in situation III the subjects were put at ease and prepared for free time in which they would be allowed to do the subject that they preferred.

These experiments were executed to test the following deductions from the main hypotheses : Liking and disliking of objects are reflections of behaviour, i.e. overt approaching and avoiding plus verbal behaviour and autonomic ^{response}. The liked object is the one that is sought after and the disliked object the one that is avoided. This also implies that the avoided object will tend to be perceived as larger than the sought after object, but this result will be subject to variation determined by the specific behaviours of Ss. Thus a docile child who works at a disliked subject under pressure and does not actively avoid it, will perceive a smaller difference between the liked and disliked objects than a more aggressive child who actively avoids the disliked subject.

The technique in Experiment A does not permit of any quantitative measurements of relative size but we can deduce that the probability that the disliked object is perceived as larger is greater in the case of aggressive than of timid children and hence the proportion of judgments in the predicted direction would be larger in the former group. In behavioural terms, if we assume that the degree of perceptual expansion of the disliked object is an increasing function of $S_1^E R - S_2^E R$, where S_1 represents the liked object, S_2 the disliked object, and R is the response of approaching the object, then the probability that the disliked object is perceived as larger is also an increasing function of $S_1^E R - S_2^E R$.

The effect of putting the subject into the homework situation is that $S_2^E R$ tends to increase in case of willing (or timid or docile) subjects, but not so much in more aggressive subjects. The increase of $S_2^E R$ may be assumed to be a continuous variable, ranging

from a small negative value in very obstinate subjects to a value exceeding the free value of $S_1^E R$ in the case of the most docile subjects. This leads to the prediction that the docile subjects will now perceive the disliked objects as smaller and there will be no change in the obstinate subjects.

Under the III set of conditions the results may be similar to those of Condition I except that the habits brought into play in Condition II may persist in Condition III in some cases, because Situation II had to follow Situation III after a relatively short time. The reason for this was that the time allowed for working in the schools was limited.

In Experiment B the subject is presented with a pair of pictures of objects to which he habitually reacts in different ways. The first one is presented in life size and the second either much larger or much smaller. He is invited to adjust the size of the second picture so as to equate it to the first one. It is postulated that in this situation the subject's response will reflect his habitual overt behaviour towards the objects represented by the pictures. Thus if he is in the habit of establishing closer contact with one of the pair and rejecting the other, he will make the picture of the former larger than real size and that of the latter smaller.

R = response of approaching.

In case of a liked object, $S_1, S_1^E R > 0$
neutral " $S_2, S_2^E R = 0$
disliked " $S_3, S_3^E R < 0$

Condition I

$S_1^E R > S_3^E R$ and the subject will adjust S_1 to a larger size than S_3 .

Condition II

$S_3^E R$ ranges from a negative value in obstinate subjects to a larger positive value than $S_1^E R$ in most docile subjects.

Therefore $S_1^E R > S_3^E R$ (obstinate subjects)

$S_3^E R > S_1^E R$ (docile subjects).

i.e. docile subjects will adjust the disliked object to a larger size than the liked object in the homework situation and obstinate subjects will respond in the same way as under Condition I.

Condition III

The adjustments will reflect the same overt behaviour as in free Situation I.

Stimuli, Subjects, and Apparatus.

An open arithmetic book and an open reading book of the same size were selected as stimuli. A black and white photograph of each stimulus was taken against a neutral background, both at the same distance from the camera so as to be projected life size at the same distance from the observer. These pictures were developed into slides.

The apparatus consisted of a masonite box 2' 1 1/2" high, 2' 1 1/2" wide and 15 1/2" deep, with a ground-glass screen in the front part of the box (23" x 23") which was viewed monocularly through a round opening 1" in diameter in the back of the box. The interior of the box was painted black.

The pictures were projected onto the screen by an Aldis 35 mm. projector mounted on a sliding base to which a metric scale was attached. A pointer fixed to the projector enabled the E. to read the distance of the projector from the screen. The zero end of the scale was 64 cm. therefore indicated that the projector was 11 cm. from the screen at the point where the stimulus object was presented at life size. A scale mounted on the lens enabled the E. to keep the picture in focus whenever the readings on the two scales were identical.

The Ss were 28 children, 14 girls and 14 boys, ranging in age from 9 years 0 months to 11 years 9 months, in I.Q. from 94 to 128 (Individual Scale of the National Bureau of Educational Research) and in visual acuity from 7.5/6 to 6/5 (Snellen Chart). These Ss were drawn

from an original population of 280 Standard II, III and IV children in 4 government schools in Cape Town.

Procedure

The Ss were selected on the basis of their likes and dislikes for Arithmetic and Reading.

The teachers were asked to select Ss who in their opinion had either a strong like for reading and a dislike for arithmetic or vice versa. These Ss were then interviewed individually by the E. and when the judgment of the E. and the teacher coincided, the S. was chosen. These judgments were also checked with the mothers.

28 Ss were chosen who indicated a strong like for one subject of the stimulus pair and a strong dislike for the other subject.

Experiment A

The photographs of the liked and disliked books were presented in rapid succession at the same size, i.e. life size and the Ss were asked to report which of them appeared to be larger. This was repeated 3 times, varying the order of presentation.

Experiment B

Each S. was shown in the box a picture of one object of the stimulus pair at life size, i.e. 11½ cm. from the screen for 5 seconds. E. then changed over immediately to the slide of the other stimulus of the pair and moved the projector to the point nearest to the

screen and then more slowly towards the point where it showed life size, and S. had to indicate when this stimulus image was the same size as the stimulus image, previously shown at life size. The reading was taken in cm. when S. indicated that the second stimulus was the same size as the first one.

Example

Arithmetic book (dialiked stimulus in this case) is shown at life size for 5 secs. E. then changes over to the reading book at its smallest size and moves it up the scale, i.e. makes it larger. S. stops E. when the image of the reading book is in his judgment as large as the arithmetic book was. The reading on the scale is taken at this point.

On the next trial the arithmetic book is again shown for 5 secs. E. then changes over to the reading book and moves it to the point farthest away from the screen and then moves it towards the screen, i.e. it is made smaller. S. stops E. again when the image of the reading book is according to his judgment the same size as the arithmetic book was. The process of changing over from one slide to the other and to a point near or far away from the screen took approximately 3 secs. Because this experiment was repeated three times the number of readings taken with each stimulus constant and the other one varied, were reduced to 3 in each direction. The order of presentation was systematically varied.

The plan of the experiment is shown in the table below.

TABLE A

Constant stimulus	Variable stimulus	
	Ascending	Descending
Liked	3	3
Disliked	3	3

The average error for the 6 readings when the liked object was constant and the disliked object varied, was calculated, and similarly for the 6 readings when the disliked object was constant and the liked object varied.

The results are summarised in Table B.

TABLE B.

<u>Experiment</u>		<u>Experiment</u>	
Conditions	A	B	
I	23 D.L. 3 L.L. 2 e Total 28	1 D.L. 1 D.L. 1 D.L. 19 L.L. 2 L.L. 1 L.L. 3 e 23 3 2 = 28	
II	9 D.L. 2 D.L. 1 D.L. 12 L.L. 1 L.L. 2 e 1 e 23 3 2 = 28	12 D.L. 1 D.L. 9 L.L. 2 L.L. 2 L.L. 2 e 23 3 2 = 28	
III	17 D.L. 2 D.L. 2 D.L. 4 L.L. 1 L.L. 2 e 1 e 23 3 2	6 D.L. 17 L.L. 2 L.L. 2 L.L. 1 e 23 3 2 = 28	

D.L. = disliked object larger

L.L. = liked object larger

e = equal size

Condition I (Free choice situation)

On presentation of the photographs of the liked and disliked objects 25 of the 28 perceived the disliked object as larger than the liked one, 2 perceived the two objects as equal in size and 3 the liked object as larger. 22 of the 28 Ss chose larger average values of the liked object than of the disliked object, 3 chose the same average values of the 2 objects, and 3 chose smaller average values of the liked object than of the disliked object.

Condition II (Instructed and prepared for homework)

4 Ss perceived the disliked object as larger than the liked object and chose larger values of the liked object in Experiment B. These results correspond with those obtained for the same Ss under Condition I, but the difference scores in Experiment B were reduced by 2 of those Ss.

7 Ss reversed both the results, i.e. perceived the reported liked object as larger than the disliked one and chose larger values of the disliked object than of the liked one. The rest of the subjects either reversed one result or one result indicated that the objects were equal in size. 8 of these Ss reduced the difference between the two stimulus objects in Experiment B.

Condition III (Instructed and prepared for free time)

16 Ss in Experiment A perceived the disliked object as larger than the liked one, and the same 16 in Experiment B chose larger values for the liked object. These results correspond with their results under Condition I. 7 of these increased the difference between the liked and disliked object.

2 Ss again reversed both the results, i.e. perceived the liked object as larger than the disliked object and chose smaller values of the liked than of the disliked object. 3 perceived the liked object as larger in Experiment A but also chose larger values of the liked object in Experiment B, while 3 others perceived the disliked object as larger but again chose larger values of the disliked object in Experiment B. 2 Ss perceived the two objects as being equal in size but in Experiment B made the liked object larger, one perceived the two objects as equal in size but made the disliked object larger in Experiment B, and one subject perceived the disliked object as larger and chose the same average sizes for the two objects in Experiment B.

The χ^2 test showed that the differences between the dislike and like scores obtained in Experiment B, Condition I were significant at less than the 1% level. There were no significant differences between intelligence scores and the difference scores, and no significant differences between the difference scores of the sexes and of the 3 age groups. (See Statistical Appendix II).

Since the predictions implied that the responses the Ss made in the test situations were closely linked with the history of their behaviour to the stimuli in similar circumstances this history was obtained from the teachers and mothers of the Ss. Before these experiments were started the teachers supplied the B.

with reports on the S's behaviour in relation to these stimulus objects and the mothers were later interviewed individually. Some of the Ss were Child Guidance Clinic cases and in these cases their clinic files yielded the necessary information.

The mothers and teachers were asked the following type of questions :

- 1) Does the S. like arithmetic?
- 2) Does the S. like reading?
- 3) Which of these subjects does the S. like best?
- 4) Does the S. get homework?
Does he do it willingly, or has he to be persuaded to do it, or does he refuse to do it?
- 5) How does S. behave in the homework situation?
Does he tackle the disliked or liked subject first?
Does he loose interest soon or persevere once started?
- 6) Does the S. read a lot in free time?

Discussion and Analysis of Results

In Condition I, a free choice situation, revealing the subjects' ordinary behaviour in such a situation we find that 19 of the 28 subjects perceived the disliked object as larger than the liked object and chose larger values for the liked than for the disliked object. This result is similar to results obtained in the previous experiments and in accordance with the prediction made. The information supplied by the teachers and mothers confirms the prediction in that they report that these children do not hesitate to approach the liked object and avoid the disliked object if given a choice.

Examples

81

This S. likes reading much better than arithmetic. He reads when he gets the chance and belongs to the public library. He avoids doing arithmetic when possible. The arithmetic book was perceived as larger than the reading book and in Experiment B the reading book was made larger (average difference = 8.2 cm.).

82

S is very fond of reading. He has not many playmates and so reads a lot. Arithmetic is certainly not his best subject at school and he is not very interested in it. In Experiment A arithmetic is seen as larger than reading in Experiment B he chooses larger values of the liked reading book, the difference between the two average adjustments being 11.6 cm.

83

The S. is a stammerer and slow at reading. He particularly does not like reading aloud although he reads well enough. He prefers doing arithmetic any time. Reading was seen as larger in Experiment A and arithmetic made larger in Experiment B (mean difference = 4.1 cm.)

For descriptions of the individual cases see Appendix B.

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From the results given above, it can be seen that some Ss gave results not in keeping with those obtained from the majority. An attempt will be made to explain these where possible.

S16 reported like for reading and dislike for arithmetic and perceived the reading book as larger in comparison with the arithmetic book, while in Experiment B she chose larger values of the arithmetic book. This girl was reported by the mother and teacher to be conscientious and obedient. These experiments were done in school where the S. normally displays general disciplinary behaviour and part of this behaviour is probably the avoidance of story books.

Ss 7, 12, 28, perceived the disliked object as larger in the comparison experiment but chose the same average values for the arithmetic book and the reading book in Experiment B. The mothers and teachers reported that one of these boys seldom does these subjects out of school, and that the other two do both subjects quite willingly when told to do so.

If perception includes all behaviour then preference will probably come out in the comparison of the 2 objects. The choice of values of an object reflects overt behaviour, in this case that of drawing nearer or pushing away and it is therefore here that willingness to approach the object or avoidance are reflected.

Other controversial results were obtained from subjects 4, 8, 21, 24, and 25.

84

The arithmetic book, representing the disliked subject, was perceived as larger than the reading book, and in Experiment B the arithmetic book was again made larger (average difference = -.8 cm.). The report obtained from the mother and teacher states that the subject likes reading better but does not read often, this fact is reflected in the adjustment in Experiment B where the difference between the two objects was small.

88

The arithmetic book, representing the liked subject was perceived as larger than the reading book and again made larger in Experiment B. The mother and teacher report that the subject would rather do arithmetic than reading. (See Appendix for description of case.) The result in this first experiment could have been due to the fact that the experiment was carried out in school and the subject probably did not realise at first that he had a choice.

821

The reading and arithmetic books were perceived to be equal in size in Experiment A but in Experiment B the liked arithmetic book was made larger. The parent-teacher report in this case is not very clear but it seems that when overt behaviour is required the S. would rather do arithmetic than reading which agrees with the result of Experiment B.

S24 and S25.

These two subjects' results were as follows :

S24 Experiment A, arithmetic book perceived as larger
Experiment B, arithmetic book made larger.

S25 Experiment A, the reading and arithmetic books were perceived to be equal in size.

Experiment B, the disliked reading book was adjusted to a larger size than the arithmetic book.

Both these subjects were remedial reading cases who reported that they like arithmetic better than reading. They were both unable to read the arithmetic problems in the book used as a stimulus. They were both reported to be weak in both the subjects and their behaviour towards the two subjects were reported to be irregular. The results for this part of the investigation were therefore not treated as valuable but their inclusion as subjects will be shown to be justified in a later discussion of the remedial cases.

In Condition II the Ss were asked questions about homework and then prepared for the homework situation in which they had to do the disliked subject. The perception of the objects in this situation should therefore reflect the behaviour in the homework situation where the S. is required to do the disliked subject. This situation is quite independent of Situation I as can be seen from the significant differences between the results of Conditions I and II. (See Statistical Appendix, II).

7 Ss reversed both results in this situation, i.e. they perceived the liked object as larger than the disliked object and chose larger values of the disliked object.

The histories confirm the predictions in that these cases without exception were reported by the mothers and teachers to be timid or co-operative and to do homework willingly.

Examples

S5

Condition I

Experiment A. The reading book (disliked object) was perceived as larger than the arithmetic book.

Experiment B. The arithmetic book (liked object) was made larger than the reading book (average difference = 8.2 cm.)

Condition II

Experiment A. The arithmetic book (liked object) was perceived as larger than the reading book.

Experiment B. The reading book (disliked object) was made larger than the arithmetic book (average difference = 8.4 cm.)

The mother and teacher of the subject reported that the subject is very obedient and does what he is told to do. There is no difficulty about doing homework.

613

Condition I

Experiment A. The arithmetic book (disliked object) was perceived as larger than the reading book.

Experiment B. The reading book was made larger than the arithmetic book (average difference = .9 cm.)

Condition II

Experiment A. The reading book (liked object) was perceived as larger than the arithmetic book.

Experiment B. The arithmetic book was made larger than the reading book (average difference = -5.8 cm.)

Again the subject was reported to be a timid, obedient girl who does her homework willingly.

Other examples of complete reversals can be found in the descriptions of cases 14, 18, 23, 27 and 28 in the Appendix. } leave out

4 Ss gave the same results as in Situation I, i.e. they perceived the disliked object as larger than the liked one and chose larger values of the liked object in Experiment B. The histories here again confirm the prediction in that these cases were reported to have strong likes and dislikes for the stimulus objects and avoid doing the subject represented by the disliked object whenever possible. These Ss seem to cause a lot of trouble in the homework situation and in some cases there was a lack of supervision of the homework so that the disliked work was simply not done.

81

Condition I

Experiment A. The arithmetic book (disliked object) was perceived as larger than the reading book.

Experiment B. The reading book (liked object) was made larger than the arithmetic book (average difference = 8.2 cm.)

Condition II

Experiment A. The arithmetic book was again perceived as larger than the reading book.

Experiment B. The reading book was again made larger (average difference = 2.7 cm.)

The subject was reported to be very unwilling to do the disliked subject in the homework situation.

810

Condition I

Experiment A. The arithmetic book (disliked object) was perceived as larger than the reading book.

Experiment B. The reading book (liked object) was made larger than the arithmetic book (average difference = 2.5 cm.)

Condition II

Experiment A. The arithmetic book was again perceived as larger than the reading book.

Experiment B. The reading book was again made larger (average difference = .8 cm.)

The S's mother and teacher reported that she "loathes arithmetic". She is also very unwilling to do arithmetic for homework.

Other similar cases described in the Appendix are numbers 15 and 20.

The rest of the subjects either reversed one result or gave one "equal" response.

- (1) Some still perceived the disliked object as larger in Experiment A but in Experiment B also chose larger values of the disliked object. (For examples see numbers 7, 17, 19, 26 in Appendix B.)
- (2) Some perceived the liked object as larger but still adjusted it to a larger size in Experiment B. (For examples see numbers 3, 9, 22 in the Appendix.)
- (3) Some perceived the two objects as being equal in size but still chose larger values of the liked object in Experiment B. (See numbers 2, 6, and 21 in Appendix B.)

There was evidence in the histories to the effect that those subjects who chose larger values of the disliked object in Experiment B and perceived the disliked object as larger in Experiment A, have to be persuaded to start their homework but once started, work well at it. Those who perceived the liked object as larger in Experiment A, but still chose larger values of the liked object in Experiment B are according to their histories quite willing to do homework but become restless and are easily distractable. Some reports revealed nothing significant.

By looking at these results in combination with the histories it seems that results in Condition II are based on a continuum of behaviour in the homework situation. The extremes of this continuum are

Remedial Cases

4 subjects from the University of Cape Town Child Guidance remedial reading centre were given the size perception tests on entering the classes. These subjects all reported that they like arithmetic better than reading.

sl.8

In Situation I, Experiment A, the reading book was perceived as larger than the arithmetic book and in Experiment B larger volume of the arithmetic book was chosen. (Average difference between arithmetic and reading = 5.8 cm.)

In Situation II, Experiment A, the arithmetic book was perceived as larger and in Experiment B the reading book was made larger (average difference between reading and arithmetic = -2.5 cm.)

In Situation III the reading book was again perceived as larger in Experiment A and the arithmetic book was made larger in Experiment B (average difference between reading and arithmetic book = .8 cm.)

When this test was given both the mother and teacher of the subject reported that the S. finds reading very difficult and likes arithmetic better. She does not read in free time. The S. is however a 'weak' personality and when told to do reading for homework, she does it without grumbling. This behaviour is reflected in her size perceptions of the stimuli.

82/4

In Situation I, Experiment A, the arithmetic book was perceived as larger than the reading book and in Experiment B the arithmetic book was also made larger than the reading book (difference = 9.2 cm.)

In Situation II, Experiment A, the arithmetic book was again perceived as larger than the reading book and in Experiment B it was also made larger (difference = 11.6 cm.)

In Situation III, the same result was obtained as above, the difference in Experiment B between the arithmetic and reading book was 15.6 cm.

The mother and teacher reported that the subject is very reluctant to do reading but does arithmetic more willingly. He is a stubborn child. Since overt behaviour is assumed to be reflected in Experiment B our expectations regarding his behaviour are confirmed. The sum of errors made in adjustment by this subject is negative and this result is a reflection of his general reluctance to do either of the subjects.

82/5

In Situation I, Experiment A, the subject perceived the reading and arithmetic books as being equal in size and in Experiment B made the reading book larger (difference = -11.5 cm.)

In Situation II, Experiment A, the reading book was perceived as larger and in Experiment B the arithmetic book was made larger (difference = 9.2 cm.)

In Situation III, Experiment A, the reading book was perceived larger and in Experiment B the arithmetic book was made larger (difference = 2.5 cm.)

The mother and teacher both report that the S's performance in both reading and arithmetic is poor, his reading however is worse than arithmetic. This behaviour is reflected in Situations II and III. In Situation I which was done at school the S. was most probably not at ease and therefore did not respond in a characteristic manner. The subject is reported to resist doing homework and to avoid schoolwork in general, a result which is reflected by the fact that his average sum of errors is a negative quantity.

The irregular results of the two cases described above could also have been due to the fact that their behaviour to the reported liked subject was not consistent.

S26

Situation I

Experiment A. reading book perceived as larger.

Experiment B. arithmetic book made larger (average difference = .50 cm.)

Situation II

Experiment A, reading book perceived as larger.

Experiment B, reading book made larger
(average difference = -1.5 cm.)

Situation III

Experiment A, reading book perceived as larger.

Experiment B, reading book made larger
(average difference = -.3 cm.)

Mother and Teacher's Reports

The S. is backward in both reading and arithmetic but is better at arithmetic. He has no interest in reading books and is sometimes punished for not wanting to read.

The reading book is throughout the series of experiments perceived as larger than the arithmetic book which is in accordance with expectations.

In Situations II and III, Experiments B, the reading book was made slightly larger than the arithmetic book. Since results in Experiment B are assumed to reflect overt behaviour it can be expected that the S. will approach the disliked subject in the homework situation, i.e. Situation II. The result of Situation III may be a carry-over from II.

The experiments under Condition I were repeated with subjects 18, 24 and 26 after three months of remedial training and with subject 25 after two weeks of remedial training.

The first three subjects now all perceived the arithmetic book as larger than the reading book in Experiment A and made the reading book larger in Experiment B. They all reported that they now like reading much better than arithmetic. The mothers' and teachers' reports confirmed this in that they state that these subjects are now very keen on reading since they can read stories for pleasure for the first time. Their approach responses to reading books are much stronger than to arithmetic books and this behaviour is reflected by the results. (See Appendix B.)

S25 still gave controversial results for the two experiments. The remedial teacher reported that the subject has just started remedial classes and still has a great struggle with the reading of simple words. The S. himself, reports that he still likes arithmetic better. His second set of results is as follows :

Experiment A. the reading book was perceived as larger than the arithmetic book.

Experiment B. the reading book was also made larger than the arithmetic book.

These few remedial cases show clearly that a change in behaviour results in a change of perception and therefore confirms the behavioural theory hypothesis, that perception is a function of behaviour, in a striking manner.

Summary and Conclusions.

In this investigation certain predictions about the subjects' behaviour and perception based on the postulate that size perception is a function of specific habits acquired by the subject, were tested in experiments with objects representing school subjects.

The predictions were as follows :

1. a) A liked object is one that is sought after and a disliked object, one that is avoided. This implies that the avoided object will be perceived as larger than the sought after object in a free choice situation, but this result will be subject to variation determined by the specific behaviours of the subjects, i.e. the probability that the disliked object will be perceived as larger, is greater in the case of aggressive than of timid children.

b) The effect of putting the subjects in the homework situation will lead to an increase in reaction potential of the approach response to the disliked object in docile subjects but not in aggressive subjects, i.e. docile subjects will now perceive the disliked objects as smaller and there will be no change in obstinate subjects.

2. In an experiment in which the subject is presented with a pair of pictures of objects to which he habitually reacts in different ways and he has to adjust the size of one which is presented as very large or very small to the size of the other one shown in life size, his adjustment will reflect his overt behaviour towards the objects represented by the pictures. Thus if R is the response of approaching, in the case of a liked object, S_1 , $S_1^E R > 0$, for a neutral object S_2 , $S_2^E R = 0$, and for a disliked object S_3 , $S_3^E R < 0$.

a) Therefore in a free choice situation $S_1^E R > S_3^E R$ and the subject will adjust S_1 to a larger size than S_3 .

b) In a homework situation for obstinate subjects $S_1^E R > S_3^E R$ and for docile subjects $S_3^E R > S_1^E R$.

X These predictions were tested in the situations described above. X || Experiments using school books, representing liked or disliked school subjects, as stimuli were carried out, as well as investigations of the subjects' behaviour in the different situations as reported by the mothers and the teachers. These investigations largely confirmed the predictions and brought out other interesting points. It was found, for instance that the results in the homework situation could be related to a continuum of behaviour. The most significant finding was perhaps the change in perception of the remedial cases after a change in behaviour through training has been achieved.

We can therefore conclude that adjustment of size as described in this particular kind of experiment and size perception of the stimulus objects used are based on rather complex, but specific patterns of behaviour towards the stimuli in specific situations.

CHAPTER VI

A DISCUSSION OF THE ROLE OF MOTIVATION IN PERCEPTION.

In the behavioural explanation of perception a primary role is assigned to motivation in the linking of a response to a stimulus element. For any response to be linked to a stimulus element through the process of learning there must exist a drive in the organism. These drives are originally physiological, but in later life social drives may be derived from them. Thus motivation is vital for the building of engrams the arousal of which constitutes the basis of perception. At a later stage we find in our investigations of perception that motivation, whether physiological or social, is still necessary, in conjunction with a stimulation, for the arousal of an engram mediating a learned response; for what is perceived in a particular situation is based on the activity of engrams.

In perception experiments where instructions are given to the subject, motivation exists in that anybody brought up in human society will be socially motivated by the instructions of the experimenter to make a response which will reflect his perception. Motivation does therefore not influence perception directly but only indirectly because it is necessary for the activation of engrams whereon perception depends.

To illustrate that motivation does not directly influence what is perceived, let us consider the role of physiological need for food on what is perceived. The physiological need for food is, at the beginning, the same for all foods but in the course of life differential conditioning to differently appearing food objects takes place and therefore when they are subsequently presented they are perceived differently. In this way the direct influence of physiological motivation on perception falls away.

In the experiments dealing with the role of motivation in perception much attention has been given to the role of value. Value was assumed to be a motivating factor influencing perception. In the process of learning to respond appropriately to a stimulus, the subject's overt approach response to a food object, for example, may result in punishment of some form. The punishment has the result that the stimulus which evoked the overt approach response now becomes conditioned to inhibition of the response and to an autonomic response which creates a drive which may be diminished by a consequent avoidance response. The autonomic response, however, does not cease to exist while the subject may still receive punishment for approaching the object. The perception of the object is thus dependent on the arousal of engrams mediating an overt response, perhaps a verbal response, and an autonomic response, and the element of perception corresponding to the autonomic response is thus value, or like, or dislike.

We can now go over to a discussion of the experiments in support of the role a "directive state" of the organism plays in perception, in the light of the behavior theory.

It has already been pointed out that the direct influence of physiological motivation on perception falls away since originally the need for food was the same for all food objects. The perception of a food object as liked or disliked, small or larger, is based on differential conditioning to the different appearances of food objects. In the experiments where the subjects had been deprived of food for a certain number of hours the subjects were presented with ambiguous pictures for interpretation. These stimuli could have had properties resembling those of food objects and these properties together with the physiological need were responsible for the activation of certain engrams appropriate to responses to food, and the activation of these engrams constituted a readiness to respond, which is perception.

A second "directive state" hypothesis deals with the effect of reward and punishment on perceptual content, magnitude and speed. The subjects in the Prochansky and Murphy (1) experiment received punishment in conjunction with short lines and rewards in conjunction with long lines. Afterwards short lines were overestimated. The responses to short and long lines in this

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- 1) Prochansky, H.M., and Murphy, G. 1942.
The effects of reward and punishment on perception.
J. Psychol., 13, 295-305.

experiment were probably the subvocal responses "short" and "long". We can assume that punishment caused a certain amount of inhibition of the subvocal response "short" on the presentation of short lines. This means that inhibition of engrams mediating the response "short" will take place but no inhibition of the engrams mediating the response "long". This amount of inhibition was probably sufficient for the line to be perceived as long when intermediate lines were presented.

In the Schafer-Murphy experiment (1) one caricatured face was always accompanied by punishment while the other one was rewarded. On presentation of the two together the rewarded one was perceived by the majority of subjects. We do not know in this case what the exact behaviour towards the two faces was but again we can assume that the amount of inhibition or even extinction of the responses to the punished face resulted in the perception of the rewarded face when the two were presented simultaneously.

The same kind of reasoning applies to the other figure-ground experiments and also to the results obtained by Rigby and Rigby (2) in an experiment in which shorter tachistoscopic times were found necessary for the recognition of rewarded capital letters. The reward caused an increase in strength of the engrams responsible for the perception of the rewarded letters while no such increase occurred in the strength of the engrams for the non-rewarded letters.

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- 1) Schafer, R., and Murphy, G. 1943. The role of autism in visual figure-ground relationship. *J. Exp. Psychol.*, 32, 335-343.
 - 2) Rigby, M.K. and Rigby, W.K. 1952. Perceptual thresholds as a function of reinforcement and frequency. *Amer. Psychol.*, 7, 321.

The hypothesis that personal values influence the speed of object-recognition as put forward by Postman, Bruner, McGinnies and others (1,2), has already been attacked by Solomon and Howes (3) from a behavioural point of view. These investigators in a repetition of the Postman, Bruner and McGinnies investigation found that the exposure time required for correct recognition of a word is an approximately linear decreasing function of the frequency of usage of the word. Luchins' criticism (4), that the Thorndike-Lorge word-count is not a satisfactory independent variable because we cannot take it as a certainty that the frequency of a word in these counts means frequency of the subject's use of the word, was eliminated by Solomon and Howes. They did this by establishing differential frequencies in the laboratory and then observing the effects of the established frequencies on the perceptual thresholds of the words when exposed tachistoscopically. They again arrived at the conclusion that the duration thresholds indicate the degree of strength of the stimulus-response connections for the words. Motivational factors are assigned a role

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- 1) Postman, L., Bruner, J.S., and McGinnies, E. 1948. Personal values as selective factors in perception. *J.Abnorm.Soc.Psychol.*, 43, 142-154.
 - 2) Postman, L. and Schneider, B.H. 1951. Personal values, visual recognition, and recall. *Psychol.Rev.* 58, 271-284.
 - 3) Solomon, R.L. and Howes, D.H. 1951. Word frequency, personal values, and visual duration thresholds. *Psychol.Rev.*, 58, 256-270.
 - 4) Luchins, A.A. 1950. On an approach to social perception. *J.Person.*, 19, 1, 64-84.

in the building of frequency of particular words in the life history of an individual and thus they play no direct part in the recognition of words exposed tachistoscopically. No distinction, however, is made by Colomon and Hovco, between perception and the linguistic response.

Up to, but not including, this point Taylor's behavioural theory of perception (1) agrees with Colomon and Hovco. It states that habit strength of uttering an unfamiliar word is substantially below the maximum value of frequently encountered words and from this it can be deduced that the reaction latency for unfamiliar words is longer than for common words and that therefore a longer exposure is necessary for the response of pronouncing the word. Since perception of the word and its utterance are dependent on the same exposure, when a relatively unfamiliar word is exposed tachistoscopically "perception requires a longer exposure than in the case of common words even when no vocal response is called for". Thus the verbal response is not assumed to be identical with the perception.

"The behavioural theory of perception postulates that each distinguishable feature of a perceptual experience is related to some specific mode of behaviour". On this postulate can be based the investigation of the effects of needs and values on the discriminability of the percept as described in this study.

1) Taylor, J.C. 1957. The indefensible concept of perceptual defence. (in press).

Investigators such as Bruner, Goodman, Postman, Beams, and others (1,2,3), as a result of their experimental findings, came to the conclusion that objects on which the subject places a high value are perceived as larger than they really are and objects of neutral and low value are perceived as they are and smaller than they are. In some studies, however, they found that a small proportion of their subjects chose smaller symbols for highly valued objects and larger symbols for objects of low valuation. The conclusion stated above was based on the majority of cases while no interpretation of the minority responses seems to have been attempted. A logical error was found in the interpretation of the majority responses, viz., that if an object is perceived as larger than its true size, it may be expected that a symbol representing the object will similarly be perceived as larger than its true size in which case the object and its symbol will be perceived as identical in size. The subjects in these experiments were, however, not required to make a comparison of the sizes of the object and the symbol but to examine the object and then select from among a number of available symbols one that most nearly resembles the object. Thus they had no real evidence of perceptual distortion of the stimulus object in the absence of direct comparisons of the stimulus object and objects of different values.

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- 1) Bruner, J.S., and Goodman, C.D. 1947. Value and need as organizing factors in perception. J.Abnorm.Soc.Psychol., 42, 33-44
 - 2) Bruner, J.S., and Postman, L. 1948. Symbolic value as an organizing factor in perception. J.Soc.Psychol., 27, 203-208
 - 3) Beams, H.L. 1954. Affectivity as a factor in the apparent size of pictured food objects. J.Exp.Psychol., 47, 3, 194-200

This defect in the experimental procedure was eliminated in two experiments dealing with the problem which has been described. Two hypotheses derived from the behavioural theory were confirmed by the first experiment. It was found : (i) that a food object is perceived as smaller than its real size if the general response it evokes is to approach and consume and if the quantity presented is less than the amount required to satisfy the subject's need, and that an object is likely to be perceived as larger than its real size if the normal response to it is avoidance or consumption of a small quantity and if the quantity presented is larger than the amount that is normally consumed; and (ii) that the choice of values of a symbol representing an object is a function of the habits acquired by the subject in response to the object.

In the second part of the investigation predictions based on the main hypotheses were tested and it was found that all the responses that can be evoked by the stimulus can be related to some feature of the perceptual experience and that a change of these responses will result in a change in the perception.

The engrams activated for size perception of a liked or disliked object are those mediating the overt responses of approach and avoidance, language responses, and autonomic responses. The perceptual element related to the autonomic response is then value and thus the influence of value on perception of size falls away.

Several experiments have been carried out to examine the directive-state hypothesis that the emotionally disturbing effect of a stimulus has some effect on ^{perception of} the stimulus. The usual procedure in such experiments is to expose the words tachistoscopically at different levels of illumination or at different exposure times and the subject is required to report what he has seen. The level of illumination or the exposure time at which the correct response occurs is taken as the threshold. In general the investigators found significant differences between the thresholds for neutral and emotionally toned words. The thresholds for emotionally toned words were higher than those for neutral words for some subjects but lower for others. The first finding was interpreted in terms of "perceptual defence" and the second in terms of a higher level of sensitivity to disturbing words, presumably due to learning.

Taylor (1) provides us with a behavioural interpretation of the findings of "perceptual defence" experiments. This interpretation starts out from the point that if we have a set of stimuli S , conditioned positively or negatively to the response R of uttering a specific word, S includes $S_1 + S_2$, where S_2 is the printed word and S_1 all the other stimuli. S_1 includes sequences of words already spoken, social stimuli, etc. The social stimuli are important because in some social

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- 1) Taylor, J.O. 1957. The indefensible concept of perceptual defence. (in press).

situations the uttering of a taboo word is accepted while in others it is punished. The first set of social stimuli are positively conditioned to $\bar{R}$ and the latter are conditioned to inhibition of $\bar{R}$. The social history, which varies from subject to subject, determines the strength of these opposing reaction tendencies. It is assumed that inhibition operated in most individuals when S_1 included a person who is not usually included in the subject's social environment and that it varies with the person's sex, social status, etc. Thus with Solomon and Hower, Taylor assumed "that the probability that a taboo word will be uttered is a decreasing function of the proportion of such persons who are in the subject's presence".

In the McGinnies (1) experiment the social situation with two experimenters present, was such as to evoke maximum inhibition of uttering a taboo word for most subjects. The set of stimuli S now consisted of S_1 to which an element has been added, viz., the invitation to utter the word, and S_2 the tachistoscopically exposed word. Thus when neutral words ^{were} exposed the response was uninhibited but on the exposure of taboo words the reaction potential for $\bar{R}$ was markedly reduced and a stronger stimulus S_2 was required to overcome the inhibitory effect of S_1 and to raise the effective reaction potential above the reaction threshold.

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- 1) McGinnies, E. 1949. Emotionality and perceptual defense. Psychol. Rev., 56, 244-251.

The finding by McGinnies that the subject reports irrelevant words to taboo words but not to neutral words when the exposures are such that he can no longer ignore the demand for verbal response is explained in terms of Hull's principle of unlearned responses (1), because the situation in which the correct response is inhibited is the same as that in which an appropriate response has not yet been acquired.

The fact that a longer tachistoscopic exposure is necessary for the recognition of a word than for the perception of a single letter invalidates the defense hypothesis still further since this would mean that the subject is defending himself against the perception of words. Supporters of the perceptual defense hypothesis have argued that the higher thresholds for taboo words are caused by autonomic response. Lazarus and McCleary (2) found, however, that recognition thresholds for shocked syllables were no higher than for non-shocked syllables.

Lazarus and McCleary demonstrated that a conditioned G.S.R. could be made to nonsense syllables presented at exposure speeds too fast for verbal discrimination. This led the experimenters to postulate a

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- 1) Hull, C.L. 1943. Principles of Behaviour. N.Y.: Appleton-Century-Crofts, Inc.
 - 2) Lazarus, R.S. and McCleary, R.A. 1951. Autonomic discrimination without awareness: a study of subception. Psychol. Rev., 58, 113-122

different level of perceptual activity which might have delayed recognition, which they called subception. The behavioural theory accounts for this finding in terms of the hierarchy of thresholds. The autonomic response was the same to all the shocked syllables, i.e. no discriminatory autonomic responses had to be made to the syllables whereas discriminatory verbal responses had to be made and therefore in the latter case the relevant neural structure was more complicated and a stronger stimulus was necessary for its activation. The interpretation that there was no perception now turns out to be false because the subject did perceive something most probably having an unpleasant quality.

Singer (1) in his study of the effect of emotionality on perceptual threshold used only neutral and emotional words that were in common use. He found again that for some subjects the emotional words had higher thresholds than for neutral words while for others they had lower thresholds. The words used in this study were selected from a longer list to which reaction times of free association responses were measured. The words to which association responses with long reaction times were obtained, were selected. The reason for long times in the free association situation could have been that 1) the stimulus word was part of a situation which caused vocal inhibition which will cause increase in reaction time and then perhaps a response completely

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- 1) Singer, B.R. 1956. An experimental inquiry into the concept of perceptual defence. Brit.J.Psychol., 47, 298-311.

unrelated to the stimulus word; 2) the stimulus word may be a stimulus for the response of saying a taboo word which in the experiment is inhibited and the subject must therefore find another word. The fact that high thresholds to emotionally toned words were found in the tachistoscope experiments can be explained by assuming that usually not only one word is present in a situation which results in inhibition of verbal response but most of the words with long reaction times could be related to the same experience and therefore the stimulus words and the words associated with them may have high discrimination thresholds and long association reaction times. But Singer also found that words with long reaction times had low reaction thresholds. Again behavioural theory finds several possible explanations such as 1) in the free association test a subject may want to make a witty response but since this is out of place there is inhibition and he has to find another response; 2) or, he may want to make a longer response but since only one word is required the reaction time is increased while he selects a verbal response. In the tachistoscopic situation again, the uttering of the stimulus word associated with a witty response is not inhibited, its habit strength will most probably be higher than that of a neutral word and therefore recognition thresholds will be lower. Taylor has thus shown how all the phenomena of perceptual defense can be accounted for in terms of the subject's habit structure.

As far as the influence of social determinants on perception is concerned, there are no social determinants apart from behavioural determinants of perception. What a subject perceives in a particular environment is dependent on his behaviour built up through the particular set of rewards and punishments in that environment.

Reinforcement in the social situation is frequently of an indirect nature, i.e. reinforcement may come from expressions of approval or disapproval not from the people towards whom the behaviour is directed, but from other members of one's own social group. Young children, for example, make no social distinctions between their playmates but the parents often point out certain characteristics of the playmates which should be reacted to by refusal to play and the punishment or reward comes from the parent. Thus the use of certain descriptions of particular social groups are reinforced by approval of one's own groups and this kind of training is responsible for the phenomenon of stereotypes.

The investigation of personality as a perceptual determinant is mainly concerned with individual differences in perception. Witkin, Else Frenkel-Brunswick and others (1,2,3) found that subjects were

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- 1) Witkin, H.A. 1949-1950. The nature and importance of individual differences in perception. Perception and Personality : a symposium. Eds. Bruner, J.S. and Krech, D.
 - 2) Frenkel-Brunswick, E. 1950. Intolerance of ambiguity as an emotional and perceptual personality variable. Perception and Personality : a symposium. Eds. Bruner, J.S. and Krech, D.
 - 3) Cattell, R.B., and Wenig, P.W. 1952. Dynamic and cognitive factors controlling misperception. J.Abnorm.Soc.Psychol., 47, 797-809.

consistent in their modes of perception in different test situations. According to behavioural theory personality is revealed in perception because the most important ingredients of personality are the habits acquired by a person to the objects in his environment through the learning process. The activation of these same habit structures constitute the basis of the individual's perception of his environment.

We have now seen how the behavioural theory of perception can deal with the results of all the different classes of motivational experiments. One important concept of motivational theory remains to be explained, i.e. the concept of perceptual set. Set as defined in motivational theory is a state that is preparatory for, or facilitative of some specific act of behaviour, in this case a perception. Behavioural theory states, briefly, that perception has an area of maximum detail which is deducible from behaviour principles, for example, when the eyes are focussed on an object the rest of the environment is vague. In the area of maximum detail the engrams are stronger and more differentiated, therefore objects acting on the fovea, for example, are perceived more clearly than stimuli acting on the periphery. In the experimental situation the instructions of the experimenter result in the direction of the area of maximum detail to some aspect of the environment. Set is therefore part of perception.

SUMMARY

In this study the investigator looked for an answer to the problem of why objects appear the way they do, in a behavioural theory of perception. Perception was defined by this theory as a state of simultaneous readiness for response to all the features of the environment to which the subject has learnt to react in the course of his life. It was shown how perceptual phenomena dealt with by motivational theory can be accounted for in terms of the subject's habit structures. The motivational theory hypothesis, that needs and values affect the dimensionality of the percept, has been examined in detail. Logical errors in reasoning have been found and the hypothesis has been rejected. Hypotheses about size perception, based on the behavioural theory of perception, were tested and confirmed by experiments. These hypotheses state that size perception is based on particular habits the subject has acquired towards the objects concerned and therefore take care of both usual and unusual results. The importance of the subjects' personal histories for the confirmation of the hypotheses about the perceptual results was realised and they were examined in detail. In a second investigation deductions from the main hypotheses about perception of size of books representing school subjects in specific situations were tested and confirmed. An interesting confirmation of the hypothesis was obtained from remedial reading cases whose perceptions changed completely after a period of intensive training.

The explanatory power of the theory is shown in its application to all the different classes of experiments executed in support of motivational theory, a procedure which has not been attempted before. The advantage of the behavioural theory above other motivational theories lies mainly in the fact that it does away with mechanisms like "hypotheses", "outlet", "perceptual defense", and others, and deals with behaviour which is concrete, and reaction potential which is something tangible.

It is believed that further confirmation of the hypotheses put forward in this study will be obtained from a more intensive investigation of larger numbers of remedial cases in which even the methods developed in this study may be found useful diagnostic tools in the future. In another clinical field experiments using faces of the members of a family or particular group, as stimuli, and brightness as the dependent variable much information may be gained as regards the social relationships existing within the group. Again using similar techniques interesting studies of cultural differences as reflected by size perceptions, for instance, could be undertaken. It is the writer's hope that the power of the behavioural theory of perception put forward by Taylor will be tested to the full in all its implications.

APPENDIX A

INVESTIGATION I : INDIVIDUAL CASES.

APPENDIX A

INVESTIGATION I : INDIVIDUAL CASES

S I

(a) Experiment A

Difference between average adjustment errors for cake and bread = 12.0 cm. (cake adjusted to a larger size than bread in experiment A).

Experiment B

Bread perceived as larger than cake.

Mother's report

S prefers cake to bread and sometimes has to be persuaded to eat bread.

(b) Experiment A

Difference between average adjustment errors for spinach and icecream = 2.5 cm. (icecream adjusted to a larger size).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S leaves spinach on his plate. Eats a lot of icecream.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 2.5 cm. (cold drink adjusted to a larger size than castor oil).

(c) contd.

Experiment B

Cold drink perceived as larger than castor oil.

Mother's report

S drinks both although he reports that he does not like castor oil. He receives rewards for drinking castor oil.

Average sum of errors = -1.7 cm.

Mother's report on general eating habits

S is a small eater. When he does not like something he leaves it on his plate. He has been forced to eat disliked foods.

S II

(a) Experiment A

Difference between average adjustment errors for cake and bread = 11.0 cm. (cake adjusted to a larger size than bread).

Experiment B

Bread perceived as larger than cake.

Mother's report

S is very fond of cake. Eats it whenever he can get it, but is not too keen on bread.

(b) Experiment A

Difference between average adjustment errors for spinach and icecream = 18.5 cm (icecream adjusted to a larger size than spinach)

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S dislikes spinach intensely, pushes it away when put on his plate. He eats a lot of icecream.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 5.5 cm (cold drink adjusted to a larger size than castor oil).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

Cries and tries to escape when he has to take castor oil. Likes cold drinks very much.

Average sum of errors = 1.7 cm.

Mother's report on general eating habits

S is a good eater. When he wants something he keeps on asking for it. He has strong likes and dislikes.

S III

(a) Experiment A

Difference between average adjustment errors for bread and cake = 9.0 cm. (cake made larger than bread).

Experiment B

Bread perceived as larger than cake.

Mother's report

S is very much more keen to eat cake than to eat bread.

(b) Experiment A

Difference between average adjustment errors for spinach and icecream = 8.0 cm. (icecream made larger than spinach).

Experiment B

Spinach perceived larger than icecream.

Mother's report

S does not eat spinach, leaves it on the plate; she loves icecream.

(c) Experiment A

Difference between average adjustment errors for cold drink and castor oil = 3.5 cm. (cold drink made larger than castor oil).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S likes cold drinks very much but has to be persuaded to take castor oil, tries to get out of taking it.

Average sum of errors = -3.8 cm.

Mother's report on general eating habits

S is a good eater. Foods that she dislikes she leaves on the plate but used to push it away when she was younger. When she wants something she keeps on asking for it till she gets it.

S IV

(a) Experiment A

Difference between average adjustment errors for cake and bread = -1.5 cm. (i.e. bread made larger than cake).

Experiment B

Bread and cake perceived the same size.

Mother's report

S. eats both quite willingly.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 6.0 cm. (i.e. icecream made larger than spinach).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

Eats only small helpings of spinach and will eat icecream whenever he can get hold of it.

(c) Experiment A

Difference between average adjustment errors for cold drink and castor oil = -1 cm. (castor oil made larger)

Experiment B

Castor perceived as larger than cold drink.

Mother's report

S loves cold drink and is forced to drink castor oil which he now takes quite easily.

Average sum of errors = .2 cm.

Mother's report on general eating habits

S used to push away disliked foods and was sometimes made to eat it but not any longer. He keeps on asking for something he wants until he gets it. S. is a fairly good eater.

S V

(a) Experiment A

Difference between average adjustment errors for cake and bread = 7.5 cm. (cake made larger)

Experiment B

bread perceived as larger than cake.

Mother's report

S eats cake when she can get it but does not always want to eat bread.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 7.5 cm. (icecream made larger than spinach).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S does not eat spinach, it must not be put in front of her.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 2.0 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S does not take castor oil.

Average sum of errors = -5.0 cm.

Mother's report on general eating habits

S is a small eater. She has strong preferences and refuses to eat disliked foods; she is satisfied when something she wants is not available.

S VI

(a) Experiment A

Difference between average adjustment errors for cake and bread = 4.0 cm. (cake made larger)

Experiment B

Bread perceived as larger than cake.

Mother's report

Child likes to eat cake but does not eat a lot of bread.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 20.5 cm. (icecream made larger).

Experiment B

?? Icecream perceived as larger than spinach.

Mother's report

S does not eat spinach, she leaves it on her plate.

(c) Experiment A

Difference between average adjustment errors for cold drink and castor oil = 2.0 cm. (cold drink made larger).

Experiment B

Cold drink and castor oil perceived to be the same size.

Mother's report

S does not get castor oil any longer. S drinks cold drinks often.

Average sum of errors = 1.2 cm.

Mother's report on general eating habits

When S does not like something she just leaves it on her plate, she is never forced to eat disliked foods. If she is not allowed something she lets the matter rest. S is a good eater.

S VII

(a) Experiment A

Difference between average adjustment errors for cake and bread = 5.9 cm. (cake made larger).

Experiment B

Not carried out.

Mother's report

S would rather eat cake than bread.

(b) Experiment A

Difference between average adjustment errors for spinach and icecream = 1.5 cm. (icecream made larger).

Experiment B

Not carried out.

Mother's report

When S was younger, used to push spinach away but now eats a small helping.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 4.5 cm. (cold drink made larger).

Experiment B

Not carried out.

Mother's report

S drinks lots of cold drinks and had castor oil only when he was in hospital.

Average sum of errors = 6.17 cm.

Mother's report on general eating habits

S is a small eater. S used to push away disliked foods but was in hospital where he was forced to eat it.

S VIII

(a) Experiment A

Difference between average adjustment errors for cake and bread = 5.0 cm (cake was made larger).

Experiment B

Not carried out.

Mother's report

S is fond of cake but eats only small quantities of bread.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 4.5 cm. (icecream made larger).

Experiment B

Not carried out.

Mother's report

S does not eat spinach.

(c) Experiment A

Difference between average adjustment errors for custer oil and cold drink = 0.0 cm. (cold drink made larger).

Experiment B

Not carried out.

Mother's report

S does not get custer oil any longer, was very unwilling to take it.

Average cum of errors = 4.2 cm.

Mother's report on general eating habits

S does not make a fuss about food but definitely refuses to take something that she does not like. She is a smallish eater.

S IX

(a) Experiment A

Difference between average adjustment errors for Cake and bread = -2.0 cm. (bread made larger).

Experiment B

Not carried out.

Mother's report

S likes cake very much but does not get it often, she eats bread every day. (Those are poor people).

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 4.0 cm. (icecream made larger)

Experiment B

Not carried out.

Mother's report

S does not eat spinach, she hides it under knife and fork. She loves icecream.

(c) Experiment A

Difference between average adjustment errors for caster oil and cold drink = 6.0 cm. (cold drink made larger).

Experiment B

Not carried out.

Mother's report

S gets sick when she sees caster oil.

Average sum of errors = 14.3 cm.

Mother's report on general eating habits

S is a good eater but has strong likes and dislikes, she used to push away disliked foods but is now made to eat it.

S X

(a) Experiment A

Difference between average adjustment errors for cake and bread = 20 cm. (cake made larger).

Experiment B

Not carried out.

Mother's report

Mother bakes cake frequently and S loves it. She does not always want to eat bread.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 1.5 cm. (icecream made larger).

Experiment B

Not carried out.

Mother's report

S does not eat spinach. She asks permission to leave it.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 4.0 cm. (cold drink made larger).

Experiment B

Not carried out.

Mother's report

S has had castor oil, is very unwilling to take it and therefore does not get it any longer.

Average sum of errors = $-.8$ cm.

Mother's report on general eating habits

S is not a good eater, when she does not like something she asks for permission to leave it. She is not too persistent if something she wants is not available.

S XI

(a) Experiment A

Difference between average adjustment errors for cake and bread = -10.0 cm. (bread made larger).

Experiment B

Not carried out.

Mother's report

S eats bread and eats only certain kinds of cake, not the kind that was used as a stimulus.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 6.0 cm. (icecream made larger).

Experiment B

Not carried out.

Mother's report

S does not want to eat spinach, he leaves it on his plate.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 6.5 cm. (cold drink made larger).

Experiment B

Not carried out.

Mother's report

S pushes castor oil away, refuses to drink it.

Average sum of errors = -4.8 cm.

Mother's report on general eating habits

S is not a big eater. He pushes away foods that he dislikes, especially castor oil and sulks when he cannot get something that he wants.

S XII

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 14.5 cm. (cake made larger).

Experiment B

Not carried out.

Mother's report

S is not fond of bread but eats cake whenever he can get it.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 6.0 cm. (icecream made larger).

Experiment B

Not carried out.

Mother's report

S leaves spinach on his plate, sometimes pushes it away.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 6.0 cm (cold drink made larger).

Experiment B

Not carried out.

Mother's report

S refuses to take castor oil.

Average sum of errors = -5.0 cm.

Mother's report on general eating habits

S is not a big eater. Foods that he dislikes he leaves on his plate and sometimes pushes away the plate. When he cannot get something he wants he is sometimes understanding but at other times keeps on asking for it.

S XIII

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 8.0 cm (cake made larger).

Experiment B

Not carried out.

Mother's report

S loves cake. He once cried and refused to go to a party because his father said he should not eat more than 2 pieces of cake. S does not always want to eat bread.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 2.0 cm. (icecream made larger).

Experiment B

Not carried out.

Mother's report

S does not eat spinach, he leaves it on his plate.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 12.0 cm. (cold drink made larger).

Experiment B

Not carried out.

Mother's report

S would never drink castor oil willingly.

Average sum of errors = 2.7 cm.

Mother's report on general eating habits

S is a difficult and fairly small eater. Foods that he dislikes he just leaves. He has strong likes and dislikes and is very dissatisfied when he cannot get something he wants.

S XIV

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 3.5cm (cake made larger).

Experiment B

Bread perceived as larger than cake.

Mother's report

S likes eating cake but is not keen on bread.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 2.5 cm. (icecream made larger).

Experiment B

icecream perceived as larger than spinach.

Mother's report

S eats both.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 7.5 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S drinks cold drinks often, she dislikes castor oil and does not get it any longer.

Average sum of errors = 6.8 cm.

Mother's report on general eating habits

S is a good eater. She refuses to drink castor oil but is otherwise not difficult. She earns money to buy desired objects like cold drinks.

S XV

(a) Experiment A

Difference between average adjustment errors for cake and bread = 4.0 cm. (cake made larger).

Experiment B

Cake and bread were perceived to be the same size.

Mother's report

S eats both but is not too keen on either.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 5.9 cm. (icecream made larger)

Experiment B

Spinach perceived larger than icecream.

Mother's report

S gets only a small helping of spinach but she hides it under her fork and thus leaves it on the plate.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drinks = 2.5 cm. (cold drink made larger).

Experiment B

Castor oil and cold drink were perceived to be the same size.

Mother's report

S has not had castor oil.

Average sum of errors = 4.5 cm.

Mother's report on general eating habits

S is a small eater. She gets only small helpings of disliked foods. When she is not allowed something that she likes, she is quite reasonable.

S XVI

(a) Experiment A

Difference between the average adjustment errors for cake and bread = -1.0 cm. (bread made larger).

Experiment B

Bread perceived as larger than cake.

Mother's report

S eats both with difficulty.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 9.0 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

"S would rather die than eat spinach".

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 4.5 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

Mother has heard that castor oil is bad and therefore does not give it to S.

Average sum of errors = -4.8 cm.

Mother's report on general eating habits

S is a problem eater as well as a small eater. When disliked food is put on her plate, she covers it up or just pushes it about. Mother has difficulty in getting her to eat something.

S XVII

(a) Experiment A

Difference between the average adjustment errors for cake and bread = -6.0 cm. (bread made larger)

Experiment B

Bread perceived as larger than cake.

Mother's report

S is not allowed to eat too much cake or too often. She eats bread willingly.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 5.0 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S does not eat spinach but is sometimes forced to eat it.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 11.0 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S takes castor oil with great difficulty but does not get it often.

Average sum of errors = 2.0 cm.

Mother's report on general eating habits

S is an average eater. Mother is strict and does not allow S to eat cake and sweets too often, and she sometimes forces S to eat disliked foods.

S XVIII

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 6.5 cm. (cake made larger).

Experiment B

Bread perceived as larger than cake.

Mother's report

S eats cake but mother has great difficulty to get her to eat bread.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 4.5 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S refuses to eat spinach.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 3.0 cm. (cold drink made larger)

Experiment B

Castor oil and cold drink perceived to be the same size.

Mother's report

S loves cold drinks and does not get castor oil.

Average sum of errors = 6.0 cm.

Mother's report on general eating habits

S is a small eater but has definite likes and dislikes. She gets only small quantities of disliked foods, she either pushes her plate away or plays with the food when it is disliked. When she is not allowed to have something she is not terribly persistent.

S XIX

(a) Experiment A

Difference between average adjustment errors for cake and bread = 7.5 cm. (cake made larger)

Experiment B

Bread perceived as larger than cake.

Mother's report

S eats only small quantities of bread, but eats cake when it is available.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 6.0 cm. (icecream made larger)

Experiment B

Icecream and spinach perceived to be the same size.

Mother's report

S does not get spinach.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 6.0 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

Child gets castor oil no longer, he dislikes it very much.

Average sum of errors = 8.5 cm

Mother's report on general eating habits

S is a good eater, he tells his mother beforehand when he does not want something then she does not insist on his eating it.

S. XI

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 3.5 cm. (cake made larger).

Experiment B

Cake and bread perceived to be the same size.

Mother's report

S would rather eat cake than bread.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 2.5 cm. (icecream made larger).

Experiment B

Icecream and spinach perceived to be the same size.

Mother's report

S. does not get spinach.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 3.5 cm. (cold drink made larger)

Experiment B

Castor oil and cold drink perceived to be the same size.

Mother's report

S drinks castor oil with difficulty but gets rewards for drinking it.

Average sum of errors = -1.8 cm.

Mother's report on general eating habits

S is not a big eater. He gets the things he wants and when disliked foods are placed on his plate he scolds the servant. He is not too fond of any of the above named sweets and would rather buy marbles with his pocket money.

S XXI

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 0.0 cm.

Experiment B

Cake and bread perceived to be the same size.

Mother's report

S eats both cake and bread without difficulty.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 6.5 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S does not allow mother to put spinach on his plate.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 6.5 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S hates castor oil, has had it once or twice but now refuses to take it.

Average sum of errors = 10.3 cm.

Mother's report on general eating habits

S is a good eater. Disliked foods must be left off his plate. When he wants something he keeps on asking till he gets it.

B XXII

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 2.5 cm. (cake made larger).

Experiment B

Cake perceived as larger than bread.

Mother's report

S eats both but likes only plain cake (cake shown had chocolate icing).

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 4.5 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S cannot bear to look at spinach; mother not allowed to dish it up for him.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 2.0 cm. (Cold drink larger).

Experiment B

Cold drink perceived as larger than castor oil.

Mother's report

S has not had castor oil.

Average sum of errors = -2.3

Mother's report on general eating habits

S is a small eater and he has definite likes and dislikes. When something he dislikes is placed in front of him he leaves the table.

S XXIII

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 14.5 cm. (cake made larger).

Experiment B

bread perceived as larger than cake.

Mother's report

S loves cake, does not want to eat bread.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 2.0 cm. (icecream made larger).

Experiment B

Icecream and spinach perceived to be the same size.

Mother's report

S does not get spinach.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 5.0 cm. (cold drink made larger).

Experiment B

Caster oil and cold drink perceived to be the same size.

Mother's report

S is forced to take caster oil. He takes it very unwillingly.

Average sum of errors = 7.8 cm.

Mother's report on general eating habits

S is a good eater and has to eat most things. He is quite satisfied when not allowed to have something.

S XXIV

(a) Experiment A

Difference between average adjustment errors for cake and bread = 12.0 cm. (cake made larger).

Experiment B

Bread perceived as larger than cake.

Mother's report

Child eats cake often and bread only with something nice on it.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 5.5 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S does not eat spinach, he just pushes it around on his plate.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drinks = -4.5 cm. (castor oil made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S has never had castor oil.

Average sum of errors = 18.0 cm.

Mother's report on general eating habits

S is a good eater.

S XXV

(a) Experiment A

Difference between average adjustment errors for cake and bread = 5.0 cm. (cake made larger)

Experiment B

Bread perceived as larger than cake.

Mother's report

S eats cake but no bread, only toast.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 15.5 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S refuses to eat spinach, she just leaves it on her plate.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 7.0 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S refuses to drink castor oil.

Average sum of errors = -6.7 cm.

Mother's report on general eating habits

S is a small and difficult eater, she has strong likes and dislikes. She just quietly refuses to eat disliked foods and no amount of argument will help. When she is not allowed something, she grumbles.

S XXVI

(a) Experiment A

Difference between average adjustment errors for cake and bread = 11.0 cm. (cake made larger).

Experiment B

Bread perceived as larger than cake.

Mother's report

S eats cake often, but eats bread only with jam on it.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 6.5 cm. (icecream made larger).

Experiment B

spinach perceived as larger than icecream.

Mother's report

S refuses to eat spinach, leaves it on her plate.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 4.5 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S refuses to drink castor oil.

Average sum of errors = -13.7 cm.

Mother's report on general eating habits

S is an average eater. She has strong likes and dislikes. If she is forced to eat a disliked object she gets sick.

S XXVII

(a) Experiment A

Difference between average adjustment errors for cake and bread = 4.0 cm. (cake made larger).

Experiment B

Cake perceived as larger than bread.

Mother's report

S eats both but would rather eat cake.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 3.0 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S does not have to eat spinach.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 3.5 cm. (cold drink made larger).

Experiment B

Castor oil and cold drink perceived to be the same size.

Mother's report

Mother does not give the S castor oil.

Average sum of errors = .2 cm.

Mother's report on general eating habits

S is not a big eater. What he does not like he leaves on his plate.

S XXVIII

(a) Experiment A

Difference between average adjustment errors for cake and bread = 9.5 cm. (cake made larger).

Experiment B

Bread was perceived as larger than cake.

Mother's report

S refuses to eat plain bread but loves cake.

(b) Experiment A

Difference between average adjustment errors for icecream and opinech = 1.0 cm. (icecream made larger)

Experiment B

Icecream perceived as larger than opinech.

Mother's report

Mother never gives the S opinech.

(a) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 4.5 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger.

Mother's report

S took castor oil once or twice but spat it out.

Average sum of errors = 4.0 cm.

Mother's report on general eating habits

S is a small, difficult eater. Disliked food is just left on her plate. When she is not allowed to have something she tries to get round her father.

S XXIX

(a) Experiment A

Difference between average adjustment errors for cake and bread = 5.0 cm. (cake made larger)

Experiment B

Bread perceived as larger than cake.

Mother's report

S would not eat bread without something on it, but will always eat cake.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = -4.0 cm. (spinach made larger).

Experiment B

Icecream perceived as larger than spinach.

Mother's report

Subject eats both.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 10.0 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S refuses to take castor oil.

Average sum of errors = -11.3 cm.

Mother's report on general eating habits

S is not a big eater, but also not a difficult eater, i.e. she has not many likes and dislikes. When she wants something, she means until she gets it.

S XXX

(a) Experiment A

Difference between the average adjustment errors for cake and bread = -3.5 cm. (bread made larger).

Experiment B

Cake and bread perceived to be the same size.

Mother's report

S eats both cake and bread.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 9.5 cm. (icecream made larger).

Experiment B

Icecream and spinach perceived to be the same size.

Mother's report

S does not willingly eat spinach.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 5.0 cm. (cold drink made larger).

Experiment B

Castor oil and cold drink perceived to be the same size.

Mother's report

S has only had castor oil once but dislikes it intensely and would not take it willingly.

Average sum of errors = -5.3 cm.

Mother's report on general eating habits

S is an average eater. He leaves disliked food on his plate and is not forced to eat it. When he wants things like cold drinks and icecream he uses his pocket money,

S XXXI

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 6.5 cm. (cake made larger).

Experiment B

Bread perceived as larger than cake.

Mother's report

S would much rather eat cake than bread, and does not eat dry bread.

(b) Experiment A

Difference between the average adjustment errors between icecream and spinach = 5.5 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S used to push plate away when it had spinach on it but now is forced to eat small helpings.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 7.0 cm.

?

(cold drink made larger)

Experiment B

Castor oil and cold drink perceived to be the same size.

Mother's report

S takes castor oil with reluctance.

Average sum of errors = 3.3 cm.

Mother's report on general eating habits

S is a good eater, she gets only small helpings of disliked foods and is more or less forced to eat everything.

S XXXII

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 3.0 cm. (cake made larger).

Experiment B

Bread perceived as larger than cake.

Mother's report

S does not eat bread without something nice on it.

(b) Experiment A

Difference between average adjustment errors for icecream and spinach = 2.0 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S does not eat spinach, mother does not dish it up for her any longer.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = -2.5 cm. (castor oil made larger.)

Experiment B

Cold drink perceived as larger than castor oil.

Mother's report

The subject does not get castor oil.

Average sum of errors = 16.8 cm.

Mother's report on general eating habits

S is a good eater and has not many strong likes and dislikes.

S XXXIII

(a) Experiment A

Difference between average adjustment errors for cake and bread = 6.0 cm. (cake made larger).

Experiment B

Cake and bread perceived to be the same size.

Mother's report

S eats both cake and bread.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 3.0 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S leaves spinach on his plate.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = -0.5 cm. (castor oil made larger).

Experiment B

Castor oil and cold drink perceived to be the same size.

Mother's report

S does not get castor oil.

Average sum of errors = -1.8 cm.

Mother's report on general eating habits

S is a small eater and has never been made to eat disliked foods. When he wants something he asks for it and usually gets it.

B XXXIV

(a) Experiment A

Difference between average adjustment errors for cake and bread = 8.5 cm. (cake made larger)

Experiment B

Bread perceived as larger than cake.

Mother's report

S eats bread only with something nice on it.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 1.5 cm. (icecream made larger).

Experiment B

Spinach perceived as larger than icecream.

Mother's report

S does not eat spinach.

(c) Experiment A

Difference between average adjustment errors for castor oil and cold drink = 5.0 cm. (cold drink made larger).

Experiment B

Cold drink and castor oil perceived to be the same size.

Mother's report

S has had castor oil only once or twice when younger.

Average sum of errors = 7.5 cm.

Mother's report on general eating habits

S is a good eater, she just leaves disliked foods on her plate. When she wants something she usually gets it.

S XXXV

(a) Experiment A

Difference between the average adjustment errors for cake and bread = 5.5 cm. (cake made larger).

Experiment B

Bread perceived to be larger than cake.

Mother's report

S eats bread only with something nice on it; he loves cake.

(b) Experiment A

Difference between the average adjustment errors for icecream and spinach = 4.0 cm. (icecream made larger).

Experiment B

Icecream and spinach perceived to be the same size.

Mother's report

Although S dislikes spinach he eats both spinach and icecream.

(c) Experiment A

Difference between the average adjustment errors for castor oil and cold drink = 9.0 cm. (cold drink made larger).

Experiment B

Castor oil perceived as larger than cold drink.

Mother's report

S refuses to take castor oil.

Average sum of errors = 3.5 cm.

Mother's report on general eating habits

S is a good eater and has not many strong likes and dislikes. He takes his pocket money to buy icecream and cold drinks when there are not any in the house.

APPENDIX B

INVESTIGATION II : INDIVIDUAL CASES.

APPENDIX B.

Experiment II : Individual Cases.

S1

Condition I

Experiment A. The Arithmetic book (representing the disliked subject) was perceived as larger than the reading book.

Experiment B. The Reading book (representing the liked subject) was made larger than the arithmetic book (average difference = 8.2 c.m.)

Condition II

Experiment A. The Arithmetic book was again perceived as larger than the reading book.

Experiment B. The Reading book was made larger (average difference = 2.7 c.m.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger (average difference = 9.1 c.m.)

Report obtained from Mother and Teacher.

The S likes reading much better than arithmetic. He reads when he gets the chance and belongs to the public library. He avoids doing arithmetic when possible and is unwilling to do homework.

General Remarks

In the homework situation (Condition II) there is a decrease in the average difference and in the free situation an increase. This result seems to be a fair reflection of behaviour in these situations.

82

Condition I

Experiment A. The Arithmetic book, representing the disliked subject, was perceived as larger than the reading book.

Experiment B. The Reading book, representing the liked subject, was made larger than the arithmetic book (average difference = 11.6 g.m.)

Condition II

Experiment A. The Arithmetic and reading books were perceived to be equal in size.

Experiment B. The Reading book was again made larger than the arithmetic book (average difference = .8 cm.)

Condition III

Experiment A. The Reading book (liked object) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book (disliked object) was made larger than the reading book. (average difference = -.8 cm.)

Report obtained from Mother and Teacher

S is very fond of reading and arithmetic is his worst subject. The mother is widowed and they live in a mixed area where S is not allowed to play much with the

children and thus he spends a fair amount of time on reading. He is however not too unwilling to do his homework (and this behaviour is reflected in the results in Condition II).

General Remarks

The controversial results obtained in Condition III may be a reflection of a carry over of behaviour patterns active in Condition II.

S3

Condition I

Experiment A. The Reading book, representing the disliked subject, was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book, representing the liked subject, was made larger than the reading book (average difference = 4.1 cm.)

Condition II

Experiment A. The Arithmetic book was now perceived as larger than the reading book.

Experiment B. The Arithmetic book was again made larger than the reading book (average difference = 2.1 cm)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = .8 cm.)

Report obtained from Mother and Teacher

The S. dislikes reading, he is a stutterer and slow at reading. He would rather do arithmetic than

reading when he has a choice. He is however not unwilling to do his homework.

General Remarks

The S's willingness to attempt the disliked subject in the homework situation is reflected in the results of Experiment A, Condition II. The controversial result of Condition III may be a carry over from Condition II, especially since this is an obedient S.

S4

Condition I

Experiment A. The Arithmetic book, representing the disliked subject, was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -.8 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic and Reading books were made the same average size.

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -3.3 cm.)

Report obtained from Mother and Teacher

S prefers reading but does not read often.
He does both reading and arithmetic without argument.

General Remarks.

Experiment A reflects all behaviour and here the disliked arithmetic book was perceived as larger, while the result in Experiment B reflects overt behaviour. The average differences are small and behaviour is reported to be the same under all circumstances.

85

Condition I

Experiment A. The Reading book, representing the disliked subject was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book, representing the liked subject, was made larger than the reading book (average difference = 8.2 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 8.4 cm.)

Condition III

Experiment A. The two books were perceived as equal in size.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 7.8 cm.)

Report obtained from Mother and Teacher

If there is a choice S. would rather do arithmetic but is not too interested in either of the two subjects. In the homework situation he does what he is told to do. He is a 'weak' kind of person.

General Remarks.

Obedience in the homework situation is reflected in the results obtained under Condition II. Results under Condition III may again reflect a carry over of habits activated under Condition II.

86

Condition I

Experiment A. The Arithmetic book, representing the disliked subject was perceived as larger.

Experiment B. The Reading book (liked) was made larger than the arithmetic book (average difference = 5.8 cm.)

Condition II

Experiment A. The two books were perceived as being equal in size.

Experiment B. The reading book was made larger than the arithmetic book (average difference = 5.4 cm.)

Condition III

Experiment A. The two books were perceived as being equal in size.

Experiment B. The reading book was made larger than the arithmetic book (average difference = 8.5 cm.)

Report obtained from Mother and Teacher

S. would rather read than do arithmetic when he has the choice. He starts doing his homework well but gets bored after a while.

General Remarks.

His behaviour in the homework situation is reflected by the results of Condition II where he initially perceives the two books as equal in size but then makes the reading book larger again. The behaviour of Condition II was carried over into Condition III.

97

Condition I

Experiment A. The disliked Reading book was perceived as larger than the arithmetic book.

Experiment B. The two books were made equal in size.

Condition II

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = .9 cm.)

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 10.8 cm.)

Report obtained from Mother and Teacher

S. when given a choice would rather do arithmetic. He is only beginning to read fluently. Although not always willing to start homework, he does settle down to it. In school he does both when told to do so.

General Remarks.

The different patterns of behaviour described above are reflected in the experimental results. The fact that the S. made the two books equal in size under Condition I may be due to the fact that the experiment was carried out in the school where overt behaviour to both subjects is approach, and to the fact that no instructions were given.

S8

Condition I

Experiment A. The Arithmetic book (liked) was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger (average difference = 2.4 cm.)

Condition II

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 4.2 cm.)

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 10.8 cm.)

Report obtained from Mother and Teacher.

S. would rather do arithmetic than reading under all circumstances, also in the homework situation where he is very unwilling to do the disliked subject.

General Remarks.

The behaviour described above is reflected in the results. The result obtained under Condition I, Experiment A could have been due to the fact that the experiment was carried out in school.

89

Condition I

Experiment A. The Reading book (disliked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 1.7 cm.)

Condition II

Experiment A. The Arithmetic book (liked) was perceived as larger than the reading book.

Experiment B. The Arithmetic book was still made larger than the reading book (average difference = 1.7 cm.)

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 7.7 cm.)

Report obtained from the mother and teacher

S. is better at arithmetic than reading. He does not read often and does not read in free time. Mother helps him to start homework but has difficulty in getting him to finish it.

General Remarks

The reported behaviour is reflected by the results.

Slo.

Condition I

Experiment A. The Arithmetic book (disliked)
was perceived as larger than the reading book.

Experiment B. The Reading book was made larger
than the arithmetic book (average difference = 2.5 cm.)

Condition II

Experiment A. The Arithmetic book was perceived
as larger than the reading book.

Experiment B. The Reading book was made larger
than the arithmetic book (average difference = .8 cm.)

Condition III

Experiment A. The Arithmetic book was perceived
as larger than the reading book.

Experiment B. The Reading book was made larger
than the arithmetic book (average difference = 1.7 cm.)

Report obtained from Mother and Teacher.

S. is fond of reading and reads a lot. She
is very unwilling to do arithmetic. "She loathes it".

General Remarks

The experimental results reflect the reported
behaviour.

811

Condition I

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 7.5 cm.)

Condition II

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The two books were made equal in size.

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 3.3 cm.)

Report obtained from Mother and Teacher

The S. would rather read than do arithmetic when she has the choice. She is obedient and does her homework when told to do so.

General Remarks.

The experimental results reflect this behaviour. The result in Condition III, Experiment A was probably a carry over from Condition II.

S12

Condition I

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The two books were made the same average size.

Condition II

Experiment A. The Reading book (liked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -5.9 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -2.5 cm.)

Report obtained from Mother and Teacher.

S. likes reading better than arithmetic but does not do either out of school often. She is usually quite willing to do homework, she never refuses anything the mother asks her to do.

General Remarks.

The S's behaviour, as described above, is reflected in the experimental results. The result obtained in Condition III, experiment B may be the result of carry over of habits evoked in Condition II.

913

Condition I

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = .9 cm.)

Condition II

Experiment A. The Reading book (liked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -5.8 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = .9 cm.)

Report obtained from Mother and Teacher.

When given a choice the S. would rather do reading than arithmetic. She is a timid, obedient girl and does what she is told to do.

General Remarks.

The results reflect the behaviour described above.

514

Condition I

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 4.1 cm.)

Condition II

Experiment A. The Reading book (liked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -3.3 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = .8 cm.)

Report obtained from Mother and Teacher.

S. reads a lot and does not do arithmetic if she has a choice. She is, however, a quiet, good girl and does what she is told to do willingly also homework.

General Remarks.

The results reflect the behaviour described.

815

Condition I

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 4.2 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 6.7 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = .8 cm.)

Report obtained from Mother and Teacher.

S. is fond of reading, she reads a lot in her free time. She is very unwilling to do arithmetic at any time.

General Remarks.

The results obtained reflect the reported behaviour in that the same results were obtained under all three sets of conditions.

816

Condition I

Experiment A. The Reading book (liked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -8.3 cm.)

Condition II

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -3.4 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The two books were made equal in size.

Report obtained from Mother and Teacher.

S. reads a lot and does not do arithmetic when she can get out of doing it. The mother has difficulty in getting her to start her homework but once started, she gets on with it.

General Remarks.

The results obtained in Condition I could have been influenced by the fact that the experiment was carried out in the school and that $S^E R$ for dutiful behaviour was greater than that for free time behaviour. The results of Condition II reflect the behaviour in the homework situation and those of Condition III are also as expected.

sl7

Condition I

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = .8 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = -2.0 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 1.7 cm.)

Report obtained from Mother and Teacher.

This S. is fond of reading and would always when given a choice much rather read than do arithmetic. She is weak at arithmetic. The mother has difficulty in getting her to start homework, e.g. sums, but once started she gets on with it to get it done.

General Remarks.

The results reflect the behaviour described.

818

Condition I

Experiment A. The Reading book (disliked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 5.8 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = -2.5 cm.)

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = .8 cm.)

Report obtained from Mother and Teacher.

The S. finds reading very difficult and would much rather do arithmetic. She is, however, very timid and does what she is told to do. When this test was given the S. had just entered the remedial reading centre.

General Remarks.

The experimental results are a perfect reflection of the behaviour.

819

Condition I

Experiment A. The Reading book (disliked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 3.3 cm.)

Condition II

Experiment A. The Reading book was again perceived as larger than the arithmetic book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = -5.0 cm.)

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 5.0 cm.)

Report obtained from Mother and Teacher.

S. would rather do arithmetic than reading when given a choice. S. can be stubborn at times and then the mother has trouble in getting her to start homework.

General Remarks.

The results reflect the behaviour.

820

Condition I

Experiment A. The Arithmetic book (disliked) was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 4.2 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 2.5 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = 3.3 cm.)

Report obtained from Mother and Teacher.

S. would rather read than do arithmetic under all circumstances. The S. is disinclined to do homework and since there is no supervision of homework the disliked subject is simply not done.

General Remarks.

The results reflect the reported behaviour.

821

Condition I.

Experiment A. The reading and arithmetic books were perceived to be equal in size.

Experiment B. The Arithmetic book (liked) was made larger than the reading book (average difference = 4.2 cm)

Condition II

Experiment A. The two books were perceived as equal in size.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 5.0 cm.)

Condition III

Experiment A. The two books were perceived as equal in size.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 2.5 cm.)

Report obtained from Mother and Teacher.

The teacher reports that S. would rather do arithmetic than reading, she does not read too fluently. She would however, not do arithmetic if not necessary. The mother reports that the S. would rather read than do arithmetic.

General Remarks.

The description of behaviour in this case is not clear enough to explain the results.

822

Condition I

Experiment A. The Reading book (dialiked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 4.5 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 5.0 cm.)

Condition III

Experiment A. The Reading Book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 1.6 cm.)

Report obtained from the Mother and Teacher.

The teacher reports that the S. is weak in reading and spelling but better at arithmetic and she would rather do arithmetic than reading. No satisfactory report could be obtained from the mother.

General Remarks.

The results correspond with the S's general behaviour towards the two subjects.

S23

Condition I

Experiment A. The Reading book (disliked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 6.6 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Reading book was made larger than the arithmetic book (average difference = -5.0 cm.)

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 4.9 cm.)

Report obtained from Mother and Teacher.

S's arithmetic is better than reading. She hates reading and would rather do arithmetic. The S's mother reports that there are daily fights over homework, she gets started but then starts daydreaming and refuses to go on.

General Remarks.

The results reflect behaviour perfectly.

824

Condition I

Experiment A. The Arithmetic book (liked) was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 9.2 cm.)

Condition II

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 11.6 cm.)

Condition III

Experiment A. The Arithmetic book was perceived as larger than the reading book.

Experiment B. The Arithmetic book was made larger than the reading book (average difference = 15.0 cm.)

Report obtained from Mother and Teacher

B. is very reluctant to do reading but does arithmetic more willingly. He is a stubborn child.

General Remarks

Experiment B seems to reflect the reported overt behaviour.

S25

Condition I

Experiment A. The Reading and Arithmetic books were perceived as being equal in size.

Experiment B. The Reading book (disliked) was made larger (average difference = -11.5 cm.)

Condition II

Experiment A. The reading book was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger (average difference = 9.2 cm.)

Condition III

Experiment A. The Reading book was perceived as larger than the arithmetic book.

Experiment B. The arithmetic book was made larger (average difference = 2.5 cm.)

Report obtained from Mother and Teacher

S's performance in both reading and arithmetic is poor, reading is worse however.

General Remarks

The reported behaviour is reflected in the results obtained under Conditions II and III. The results of Condition I could perhaps be attributed to the fact that the experiment was done in school.

S26

Condition I

Experiment A. The Reading book (disliked) was perceived as larger than the arithmetic book.

Experiment B. The Arithmetic book was made larger (average difference = .50 cm.)

Condition II

Experiment A. The Reading book was perceived as larger.

Experiment B. The Reading book was made larger (average difference = -1.5 cm.)

Condition III

Experiment A. The Reading book was perceived as larger.

Experiment B. The Reading book was made larger (average difference = -.8 cm.)

Report obtained for Mother and Teacher

S. is backward in both reading and arithmetic but is better at arithmetic.

General Remarks

The reading book is throughout the series of experiments perceived as larger than the arithmetic book which is in accordance with expectations.

128

Condition I

Experiment 1. The Arithmetic book (distorted) was perceived as larger than the reading book.

Experiment 2. The Reading book was made equal in size to the arithmetic book.

Condition II

Experiment 1. The Reading book was perceived as larger than the arithmetic book.

Experiment 2. The Arithmetic book was made larger than the reading book (average difference = +.6 cm.)

Condition III

Experiment 1. The Reading book was perceived as larger than the arithmetic book.

Experiment 2. The Arithmetic book was made larger than the reading book (average difference = +4.9 cm.)

Report obtained from Father and Teacher.

Tim C. is in an orphanage and the report was therefore obtained from the staff. He would rather read than do arithmetic, and during lessons time has to do arithmetic when he gets it for homework.

General Remarks.

The results in general reflect the reported behaviour. The results obtained in Condition III might have been due to carry over of habits from Condition II.

STATISTICAL APPENDIX TO INVESTIGATION I.

STATISTICAL APPENDIX TO INVESTIGATION I

I t test applied to the average differences between
'black' and 'white' errors.

<u>Black</u>	<u>White</u>			
<u>X</u>	<u>Y</u>	<u>D</u>	<u>d</u>	<u>d²</u>
-2.50	-1.67	.83	.817	.667
1.65	-2.50	-4.25	-4.163	17.331
1.65	-5.00	-6.65	-6.663	44.396
-7.50	.85	8.35	8.337	69.506
-4.20	-5.85	-1.65	-1.663	2.766
0.00	3.35	3.35	3.337	11.136
<u>-10.90</u>	<u>-10.82</u>	<u>.08</u>		<u>145.802</u>

$\bar{D} = -1.82$ $\bar{d} = -1.80$ Average = .013

$$t = \frac{\bar{D}_1 - \bar{D}_2}{\sqrt{\frac{\sum d^2}{n(n-1)}}$$

$$= \frac{.02}{\sqrt{\frac{145.802}{6(5)}}}$$

$$t = .639$$

$$d.f. = 5$$

$$P > .9$$

II Subjects in Experiment I

9 year olds	total 13	I.Q. 101 - 133
10 year olds	total 12	I.Q. 99 - 124
11 year olds	total 10	I.Q. 95 - 128

XII t test applied to the average like and dislike errors

Av. like errors	Av. dislike errors	$\bar{x}$	$\bar{y}$	$\bar{z}$
2.00	-3.67	-5.67	-3.51	.2601
6.67	-5.00	-11.67	-6.51	42.3001
1.50	-5.33	-6.83	-1.67	2.7009
.67	-5.50	-1.17	3.50	15.9201
.33	-5.17	-5.50	-1.51	.1156
5.00	-3.83	-8.83	-3.67	13.4609
5.00	1.17	-3.83	1.33	1.7609
5.00	-3.00	-5.00	-1.67	.4409
8.50	5.33	-2.67	2.49	6.2001
3.00	-4.67	-8.50	-5.51	11.1556
-2.00	-2.83	-0.83	4.33	10.7409
2.33	-7.17	-9.50	-4.51	10.0956
5.00	-2.33	-7.33	-2.17	4.7009
3.67	1.17	-4.50	.66	.4356
2.67	-1.17	-5.21	1.32	1.7424
-3.33	-4.50	-4.17	1.50	.9001
2.67	-5.67	-3.33	1.82	3.3124
5.33	.67	-4.66	.50	.2500
7.50	1.00	-6.50	-1.51	1.7956
.67	-2.50	-3.17	1.33	3.9601
7.33	3.00	-4.33	.83	.6809
.33	-2.67	-1.00	2.16	4.6656
7.33	.17	-7.16	-2.80	7.8400
0.17	1.83	-4.21	.62	.6724
2.33	-7.83	-9.16	-4.85	16.0000
-3.50	-14.67	-7.21	-8.20	4.7524
1.00	-1.67	-1.50	1.66	2.7556
4.50	-3.50	-3.00	.16	.0056
-3.00	-7.50	-5.67	1.40	2.2001
-3.00	-4.50	-3.67	1.40	2.2001
4.00	-1.50	-6.50	-1.17	1.3609
0.00	0.00	-8.00	4.33	10.7409
.50	-2.50	-2.00	2.33	5.4289
6.50	1.33	-5.50	.16	.0056
4.33	-1.33	-6.16	-1.60	2.5600
110.16	-64.50	-250.66	$\Sigma \bar{z}^2 = 213.2100$	

$$E_1 = 3.32$$

$$E_2 = -1.24$$

$$E = -5.16$$

$$t = \frac{E_1 - E_2}{\sqrt{\frac{\Sigma \bar{z}^2}{n(n-1)}}}$$

$$= \frac{5.16}{\sqrt{\frac{213.2100}{25(25-1)}}}$$

$$C.R. = 24$$

$$= 12.3$$

IV. t test of difference in male and female average differences
scored

M	d	d ²	M	d	d ²
9.67	.69	.4761	6.89	1.51	2.2801
11.67	6.69	44.7561	5.67	.35	.1225
1.17	-9.01	81.1801	0.83	9.51	12.3201
3.03	-1.15	1.3225	9.83	.51	.2601
.89	-4.15	17.2225	2.67	-2.65	7.0225
9.50	4.92	24.2064	8.50	3.10	10.1125
7.33	2.55	6.5025	4.50	-.82	.6724
6.50	1.52	2.3104	9.03	-.43	.1849
3.17	-1.01	1.0201	4.17	-1.15	1.3225
4.33	-.65	.4225	9.33	-1.99	3.9601
3.00	-1.90	3.6100	4.67	-.65	.4225
7.17	2.19	4.7961	9.17	3.65	13.3225
4.33	-.65	.4225	7.33	2.01	4.0401
3.50	-1.40	1.9600	5.00	-.32	.1024
3.67	-1.31	1.7161	5.67	-1.69	2.8761
2.83	-2.15	4.6225	6.33	1.01	1.0201
6.17	1.19	1.4161	.63	4.49	20.1601
<u>64.67</u>	$\sum d_2^2 = 129.3593$		<u>4.67</u>	.65	.4225
			<u>95.83</u>	$\sum d_1^2 = 82.6255$	
$\bar{M} = 4.90$			$\bar{M}_1 = 9.32$		

$$t = \frac{\bar{M}_1 - \bar{M}_2}{\sqrt{\frac{\sum d_1^2 + \sum d_2^2}{(n_1 + n_2 - 2)} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

$$= \frac{.5}{\sqrt{\frac{82.6255 + 129.3593}{10 + 17 - 2} \left(\frac{1}{18} + \frac{1}{17} \right)}}$$

$$= .5 \quad d.f. = (n_1 - 1) + (n_2 - 1)$$

$$= 25$$

$$P = .6$$

V. t test applied to the average difference scores of the 3 age groups

9	d	d ²	10	d	d ²
5.67	.16	.0256	11.67	6.46	41.9904
6.83	1.32	1.7424	5.67	.48	.2304
8.83	3.32	11.0224	5.83	.64	.4096
3.83	-1.68	2.8224	2.67	-2.52	6.3504
4.50	-1.01	1.0201	9.50	4.31	18.5761
3.83	-1.68	2.8224	4.67	-.52	.2704
4.17	-1.34	1.7956	3.17	-2.02	4.0804
3.33	-2.18	4.7524	4.33	-.86	.7396
6.50	.99	.9801	3.00	-2.19	4.7961
7.17	1.66	2.7556	7.33	2.14	4.5796
4.33	-1.18	1.3924	3.67	-1.52	2.3104
9.17	3.66	13.3956	.83	-4.36	19.0096
3.50	-2.01	4.0401			
<u>71.66</u>		<u>48.5671</u>	<u>62.34</u>		<u>103.3430</u>

N = 5.51

N = 5.19

d.f. = 23

9 + 10

$$t = \frac{M_1 - M_2}{\sqrt{\frac{\sum d_1^2 + \sum d_2^2}{(n_1 + n_2 - 2) \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

$$= \frac{.32}{\sqrt{\frac{151.9101(.16)}{23}}}$$

$$= .3$$

$$P = .7$$

<u>11</u>	<u>A</u>	<u>σ^2</u>
1.17	-3.46	12.1104
6.50	3.85	14.8225
.83	-3.82	14.5924
7.33	2.68	7.1824
5.00	.35	.1225
3.67	-.98	.9604
6.33	1.68	2.8224
2.83	-1.82	3.3124
4.67	-.02	.0004
6.17	1.32	2.3104
<u>46.50</u>		<u>58.2362</u>

$$\bar{x} = 4.65$$

$$\underline{9 + 11}$$

$$t = \frac{.86}{\sqrt{\frac{106.8033}{13 + 10 - 2}} (.18)}$$

$$= .9 \quad \text{d.f.} = 21$$

$$P = \text{between .4 and .3}$$

$$\underline{10 + 11}$$

$$t = \frac{.54}{\sqrt{\frac{161.5792}{12 + 10 - 2}} (.18)}$$

$$= .4 \quad \text{d.f.} = 20$$

$$P = \text{between .7 and .6}$$

VI Correlation between intelligence and average difference scores

Int.	Diff scores			
<u>X</u>	<u>Y</u>	<u>XY</u>	<u>X²</u>	<u>Y²</u>
104	5.67	589.68	10816	32.1489
105	11.67	1225.35	11025	136.1889
104	6.83	710.32	10816	46.6489
95	1.17	111.15	9025	1.3689
103	5.67	584.01	10609	32.1489
115	8.83	1015.45	13225	77.9689
113	3.83	432.79	12769	14.6689
115	5.83	670.45	13225	33.9889
100	2.67	267.00	10000	7.1289
116	8.50	986.00	13456	72.2500
109	.83	160.47	11881	.6889
107	9.50	1016.50	11449	90.2500
121	7.33	886.93	14641	53.7289
120	4.50	540.00	14400	20.2500
115	3.83	440.45	13225	14.6689
115	4.17	479.55	13225	17.3889
119	3.33	396.27	14161	11.0889
105	4.67	490.35	11025	21.8089
133	6.50	864.50	17689	42.2500
124	3.17	393.08	15376	10.0489
121	4.33	523.93	14641	18.7489
124	3.00	372.00	15376	9.0000
101	7.17	724.17	10201	51.4089
120	4.33	519.60	14400	18.7489
118	9.17	1082.06	13924	84.0889
112	7.33	820.96	12544	53.7289
99	3.50	346.50	9801	12.2500
104	5.00	520.00	10816	25.0000
113	3.67	414.71	12769	13.4689
118	3.67	433.06	13924	13.4689
114	6.33	721.62	12996	40.0689
118	.83	97.94	13924	.6889
98	2.83	277.34	9604	8.0089
123	4.67	574.41	15129	21.8089
128	6.17	789.76	16384	38.0689
<u>3949</u>	<u>180.50</u>	<u>20478.36</u>	<u>448471</u>	<u>1145.2392</u>

VI (Cont.)

$$r^2 = \frac{\left[xy - \frac{(\sum x)(\sum y)}{n} \right]^2}{\left[y^2 - \frac{(\sum y)^2}{n} \right] \left[x^2 - \frac{(\sum x)^2}{n} \right]}$$

$$= \frac{20478.36 - \frac{(3949)(180.50)}{35}}{\left[1145.2392 - \frac{(180.50)^2}{35} \right] \left[148471 - \frac{(3949)^2}{35} \right]}$$

$$r^2 = .02$$

$$r = .14$$

VII Sums of errors and differences between errors for each stimulus pair

<u>Subjects</u>	<u>Castor oil</u> <u>Constant</u>	<u>Cold drink</u> <u>Constant</u>	<u>Sum</u>	<u>difference</u>
1	0.0	-2.5	-2.5	2.5
2	5.5	0.0	5.5	5.5
3	-3.0	-6.5	-9.5	3.5
4	-2.0	-1.0	-3.0	-1.0
5	-3.5	-5.5	-9.0	2.0
6	-1.5	-3.5	-5.0	2.0
7	2.5	-2.0	.5	4.5
8	8.5	.5	9.0	8.0
9	6.5	.5	7.0	6.0
10	-1.5	-5.5	-7.0	4.0
11	-1.0	-7.5	-8.5	6.5
12	2.5	-5.5	-3.5	8.0
13	6.0	-6.0	0.0	12.0
14	3.5	-4.0	-.5	7.5
15	.5	-2.0	-1.5	2.5
16	-3.5	-8.0	-11.5	4.5
17	7.5	-3.5	4.0	11.0
18	6.5	3.5	10.0	3.0
19	4.5	-1.5	3.0	6.0
20	2.0	-1.5	.5	3.5
21	7.0	.5	7.5	6.5
22	-2.0	-4.0	-6.0	2.0
23	5.5	.5	6.0	5.0
24	3.0	7.5	10.5	-4.5
25	-2.5	-9.5	-12.0	7.0
26	-1.0	-5.5	-6.0	4.5
27	2.0	-1.5	.5	3.5
28	3.5	-1.0	2.5	4.5
29	5.0	-5.0	0.0	10.5
30	-2.5	-7.5	-10.0	5.0
31	7.5	.5	8.0	7.0
32	7.0	9.5	16.5	-2.5
33	-1.0	-1.5	-1.5	-1.5
34	7.5	2.5	10.5	5.0
35	6.5	-2.5	4.0	9.0

<u>Subjects</u>	<u>Bread Constant</u>	<u>Cake Constant</u>	<u>Sum</u>	<u>difference.</u>
1	2.5	-9.5	-7.0	12.0
2	11.0	0.0	11.0	11.0
3	7.5	-1.5	6.0	9.0
4	1.5	3.0	4.5	-1.5
5	2.0	-5.5	-3.5	7.5
6	3.5	-0.5	3.0	4.0
7	9.0	3.5	12.5	5.5
8	3.5	-1.5	2.0	5.0
9	16.0	10.0	26.0	-2.0
10	13.0	-7.0	6.0	20.0
11	12.5	1.5	-7.0	-10.0
12	8.0	-6.5	1.5	14.5
13	6.5	-1.5	5.0	8.0
14	3.0	-0.5	2.5	5.5
15	2.5	1.5	1.0	4.0
16	-1.5	0.0	-2.0	-1.0
17	-4.0	2.0	-2.0	-6.0
18	4.5	2.0	2.5	6.5
19	20.0	2.0	12.0	7.5
20	0.0	1.5	-3.5	0.5
21	6.0	0.0	12.0	0.0
22	3.0	2.0	7.5	2.0
23	11.0	5.5	7.5	14.5
24	7.5	1.5	3.0	12.0
25	0.5	1.5	-6.0	12.5
26	1.5	0.0	0.0	11.0
27	4.0	0.0	4.0	4.0
28	7.5	2.0	5.5	9.5
29	0.5	1.5	6.0	0.0
30	11.0	2.0	1.5	1.5
31	10.0	0.0	17.0	0.0
32	11.0	0.0	14.0	0.0
33	0.0	0.0	7.5	0.0
34	0.0	0.0	4.5	0.0
35	0.0	0.0	4.5	0.0

<u>Subjects</u>	<u>Spinach Constant</u>	<u>Icecream Constant</u>	<u>Sum</u>	<u>Difference</u>
1	3.5	1.0	4.5	2.5
2	3.5	-15.0	-11.5	18.5
3	0.0	-8.0	-8.0	8.0
4	2.5	-3.5	-1.0	6.0
5	2.5	-2.5	-2.5	7.5
6	13.0	-7.5	5.5	20.5
7	3.5	2.0	3.5	1.5
8	3.0	-1.5	1.5	4.5
9	3.0	-1.0	2.0	4.0
10	0.0	-1.5	-1.5	1.5
11	3.5	-2.5	1.0	6.0
12	-3.5	-9.5	-13.0	6.0
13	2.5	.5	3.0	2.0
14	10.5	8.0	18.5	2.5
15	5.0	0.0	5.0	5.0
16	4.0	-5.0	-1.0	9.0
17	4.5	-0.5	4.0	5.0
18	5.0	.5	5.5	4.5
19	8.0	2.0	10.0	6.0
20	0.0	-2.5	-2.5	2.5
21	9.0	2.5	11.5	6.5
22	-2.0	-6.5	-8.5	4.5
23	5.5	3.5	10.0	2.0
24	14.0	8.5	22.5	5.5
25	7.0	-8.5	-1.5	15.5
26	-10.5	-17.0	-27.0	6.5
27	-0.5	-3.5	-4.0	3.0
28	2.5	1.5	4.0	1.0
29	-16.5	-12.0	-28.0	-4.0
30	1.0	-8.5	-7.5	9.5
31	3.5	-2.0	1.5	5.5
32	9.5	7.5	17.0	2.0
33	1.5	-1.5	0.0	3.0
34	3.5	2.0	5.5	1.5
35	3.0	-1.0	2.0	4.0

VIII.

Standard Deviations and Means of Sums of Errors
and of Differences between Errors.

Sums		Bread and Cake			
	f	x	x^2	fx	
-8-6	5	-3	-15	45	
-5-3	3	-2	-6	12	
-2 0	2	-1	-2	2	
1 3	9	0	0	0	
4 6	7	1	1	7	
7 9	3	2	4	12	
10 12	4	3	9	36	
13 15	0	4	16	0	
16 18	1	5	25	25	
19 21	0	6	36	0	
22 24	0	7	49	0	
25 27	0	8	64	0	
28 30	0	9	81	0	
31 33	0	10	100	0	
34 36	1	11	121	121	
	<u>35</u>		<u>41</u>	<u>260</u>	
			<u>-23</u>		
			<u>18</u>		

$$C = .514$$

$$C^2 = .264$$

$$\sum fx^2 = (260 - 35 \times .264)9$$

$$= 2256.84$$

$$s = \sqrt{\frac{2256.84}{35}}$$

$$= 8.03$$

$$H = H_1 + 1 \frac{\sum fx}{N}$$

$$= 2 + 1.54$$

$$= 3.54$$

Differences

	f	x_1	x_2	x_1^2	x_2^2
-11-9	1	-5	-3	25	9
-8-6	1	-4	-2	16	4
-5-3	1	-3	-1	9	1
-2 0	4	-2	0	16	0
1 3	4	-1	1	4	1
4 6	11	0	2	0	4
7 9	6	1	3	1	9
10 12	4	2	4	4	16
13 15	2	3	5	9	25
16 18	0	4	6	16	36
19 21	1	5	7	25	49
				<u>25</u>	<u>135</u>
				<u>-24</u>	
				<u>1</u>	

$$C = .029$$

$$C^2 = .001$$

$$\sum fx^2 = (135 - 35 \times .001)9$$

$$= 1214.685$$

$$s = \sqrt{\frac{1214.685}{35}}$$

$$= 5.89$$

$$H = 5.53$$

Sums

Cold drink and Castor Oil

	f	x_1	fx_1	fx_1^2
-12-10	4	-3	-12	36
-9-7	3	-2	-6	12
-6-4	4	-1	-4	4
-3-1	6	0	-22	0
0 2	5	1	5	5
3 5	4	2	8	16
6 8	4	3	12	36
9 11	4	4	16	64
12 14	0	5	0	0
15 17	1	6	6	36
	<u>35</u>		<u>47</u>	<u>209</u>
			<u>-22</u>	
			<u>25</u>	

$$\begin{aligned}
 c &= .71 \\
 c^2 &= .5 \\
 \sum fx^2 &= (209 - 17.5)9 \\
 s &= \sqrt{\frac{1732.5}{35}} \\
 &= 7.02 \\
 M &= -2 + \frac{25}{35} \\
 &= .13
 \end{aligned}$$

Differences

	f	x_1	fx_1	fx_1^2
-6-4	1	-3	-3	9
-3-1	3	-2	-6	12
0 2	3	-1	-3	3
3 5	14	0	-12	0
6 8	10	1	10	10
9 11	3	2	6	12
12 14	1	3	3	9
	<u>35</u>		<u>19</u>	<u>55</u>
			<u>-12</u>	
			<u>7</u>	

$$\begin{aligned}
 c &= .2 \\
 c^2 &= .4 \\
 \sum fx^2 &= (55 - 35 \times .4)9 \\
 &= 369 \\
 s &= \sqrt{\frac{369}{35}} \\
 M &= 5.8 \\
 &= 3.2
 \end{aligned}$$

SumApproach and Increase

	x	x^1	x^1	x^{1^2}
-30-28	1	-10	-10	100
-27-25	1	-9	-9	81
-24-22	0	-8	0	0
-21-19	0	-7	0	0
-18-16	0	-6	0	0
-15-13	1	-5	-5	25
-12-10	1	-4	-4	16
-9-7	3	-3	-9	27
-6-4	1	-2	-2	4
-3-1	6	-1	-6	6
0 2	6	0	-12	0
3 5	5	1	-5	5
6 8	4	2	8	16
9 11	2	3	6	18
12 14	1	4	4	16
15 17	1	5	5	25
18 20	1	6	6	36
21 23	1	7	7	49
	<u>35</u>		<u>42</u>	<u>424</u>
			-45	
			-4	

$$c = .114$$

$$c^2 = .013$$

$$\Sigma fx^2 = (424 - 35 \times .013)9$$

$$= 3811.91$$

$$\sqrt{\frac{3811.91}{35}}$$

$$= 10.4$$

$$H = 1 + 3 \cdot \frac{4}{35}$$

$$= .6$$

Differences

	x	x^1	x^1	x^{1^2}
-6-4	1	-3	-3	9
-3-1	0	-2	0	0
0 2	10	-1	-10	10
3 5	11	0	-13	0
6 8	8	1	8	8
9 11	2	2	4	8
12 14	0	3	0	0
15 17	1	4	4	16
18 20	2	5	10	50
	<u>35</u>		<u>26</u>	<u>101</u>
			-13	
			13	

$$c = .37$$

$$c^2 = .137$$

$$\Sigma fx^2 = (101 - 35 \times .137)9$$

$$= 874.845$$

$$\sqrt{\frac{874.845}{35}}$$

$$= 4.9$$

$$H = 4 + 3 \cdot \frac{13}{35}$$

$$= 5.1$$

IX. Standard Deviation and Mean of average sum of errors

-15	-13	1	-5	-5	25
-12	-10	1	-4	-4	16
-9	-7	1	-3	-3	9
-6	-4	6	-2	-12	24
-3	-1	5	-1	-5	5
0	2	6	0	-22	0
3	5	1	1	9	9
6	8	6	2	12	24
9	11	1	3	3	9
12	14	1	4	4	16
15	17	1	5	5	25
18	20	<u>1</u>	6	<u>6</u>	36
		35		35	
				-22	
				<u>6</u>	

$$C = .17$$

$$C^2 = .019$$

$$\begin{aligned} \sum fx^2 &= (194 - 35 \times .019)9 \\ &= 1740.015 \end{aligned}$$

$$\sigma = \sqrt{\frac{1740.015}{35}}$$

$$= 7.05$$

$$M = 1 + 3 \times .17$$

$$= 1.51$$

X. Bistrial correlation between average sums of errors and appetite.

Scores	x	x^1	fx^1	fx^{12}
-15-13	1	1	1	25
-12-10	1	1	1	16
-9-7	1	1	1	9
-6-4	0	0	0	0
-3-1	0	0	0	0
0 2	0	0	0	0
3 5	0	0	0	0
6 8	0	0	0	0
9 11	1	1	1	25
12 14	1	1	1	16
15 17	1	1	1	25
18 20	1	1	1	36
	<u>35</u>		<u>6</u>	<u>194</u>

Small Meters

x	x^1	fx^1	fx^{12}
0	4	0	0
1	3	3	9
1	2	2	4
4	1	4	4
5	0	0	0
2	1	2	2
3	2	6	12
1	3	3	9
0	4	0	0
0	5	0	0
0	6	0	0
0	7	0	0
<u>17</u>		<u>11</u>	<u>40</u>
		<u>2</u>	

$$M = -2 + 3\left(\frac{2}{17}\right) = 1.64$$

$$\Sigma fx^2 = (40 - .24)9$$

$$s = \sqrt{\frac{357.84}{17}} = 4.6$$

Big Meters

x	x^1	fx^1	fx^{12}
1	7	7	49
0	6	0	0
0	5	0	0
2	4	8	32
0	3	0	0
4	2	8	16
2	1	2	2
3	0	3	0
1	1	1	1
1	2	2	4
1	3	3	9
<u>1</u>	<u>4</u>	<u>10</u>	<u>129</u>
		<u>-25</u>	
		<u>-15</u>	

$$M = 7 + 3\left(\frac{-15}{18}\right) = 4.51$$

X (Cont.)

$$x_{018} = \left\{ \frac{H_p - H_c}{b} \right\} \left\{ \frac{2}{y} \right\}$$

$$= \left\{ \frac{4.51 - 1.64}{4.6} \right\} (.51)$$

$$= .7$$

XI. Correlations between Sums of Errors and Differences for each stimulus pair.

Cake and Bread differences and Cold Drink and Castor Oil differences.

X	Y	XY	X^2	Y^2
12.0	2.5	30.00	144.00	6.25
11.0	5.5	60.50	121.00	30.25
9.0	3.5	31.50	81.00	12.25
-1.5	-1.0	1.50	2.25	1.00
7.5	2.0	15.00	56.25	4.00
4.0	2.0	8.00	16.00	4.00
5.5	4.5	24.75	30.25	20.25
5.0	8.0	40.00	25.00	64.00
-2.0	6.0	-12.00	4.00	36.00
20.0	4.0	80.00	400.00	16.00
-10.0	6.5	-65.00	100.00	42.25
14.5	8.0	116.00	210.25	64.00
8.0	12.0	96.00	64.00	144.00
3.5	7.5	26.25	12.25	56.25
4.0	2.5	10.00	16.00	6.25
-1.0	4.5	-4.50	1.00	20.25
-6.0	11.0	-66.00	36.00	121.00
6.5	3.0	19.50	42.25	9.00
7.5	6.0	45.00	56.25	36.00
3.5	3.5	12.25	12.25	12.25
0.0	6.5	0.00	0.00	42.25
2.5	2.0	5.00	6.25	4.00
14.5	5.0	72.50	210.25	25.00
12.0	-4.5	-54.00	144.00	20.25
5.0	7.0	35.00	25.00	49.00
11.0	4.5	49.50	121.00	20.25
4.0	3.5	14.00	16.00	12.25
9.5	4.5	42.75	90.25	20.25
5.0	10.0	50.00	25.00	100.00
-3.5	5.0	-17.50	12.00	25.00
6.5	7.0	45.50	42.25	49.00
3.0	-2.5	-7.50	9.00	6.25
6.0	-1.5	-9.00	36.00	2.25
6.5	5.0	32.50	42.25	25.00
5.5	9.0	49.50	30.25	81.00
190.5	163.0	302.85	2269.75	1185.00

Cake and bread crumbs and Castor oil and Cold drink crumbs.

X	Y	XY	X^2	Y^2
-2.5	-7.0	17.50	6.25	49.00
5.5	11.0	60.50	30.25	121.00
-9.5	6.0	-57.00	90.25	36.00
-3.0	4.5	-13.50	9.00	20.25
-9.0	-3.5	31.50	81.00	12.25
-5.0	3.0	-15.00	25.00	9.00
.5	12.5	6.25	.25	156.25
9.0	2.0	18.00	81.00	4.00
7.0	34.0	238.00	49.00	1156.00
-7.0	6.0	-42.00	49.00	36.00
-8.5	-7.0	59.50	72.25	49.00
-3.5	1.5	-5.25	12.25	2.25
0.0	5.0	0.00	0.00	25.00
-.5	2.5	-1.25	.25	6.25
-1.5	1.0	-1.50	2.25	1.00
-11.5	-2.0	23.00	132.25	4.00
4.0	-2.0	-8.00	16.00	4.00
10.0	2.5	25.00	100.00	6.25
3.0	12.5	37.50	9.00	156.25
.5	-3.5	-1.75	.25	12.25
7.5	12.0	90.00	56.25	144.00
-6.0	7.5	-45.00	36.00	56.25
6.0	7.5	45.00	36.00	56.25
10.5	3.0	31.50	110.25	9.00
-12.0	-6.0	72.00	144.00	36.00
-6.0	-8.0	48.00	36.00	64.00
.5	4.0	2.00	.25	16.00
2.5	5.5	13.75	6.25	30.25
0.0	-6.0	0.00	0.00	36.00
-10.0	1.5	-15.00	100.00	2.25
8.0	0.5	4.00	64.00	.25
16.5	17.0	280.50	272.25	289.00
-1.5	-4.0	6.00	2.25	16.00
10.5	7.5	78.75	110.25	56.25
4.0	4.5	18.00	16.00	20.25
8.5	125.5	1001.00	1755.25	2697.75

Differences Gake and Breed, Cold drink and Oaster oil

$$r^2 = \frac{\left[795 - \frac{(190.5)(163)}{35} \right]^2}{\left[1185 - \frac{(163)^2}{35} \right] \left[2269.75 - \frac{(190.5)^2}{35} \right]}$$

$$= \frac{5871.76}{567604.52}$$

$$r^2 = .0016$$

$$r = .04$$

Sumo

$$r^2 = \frac{\left[1001 - \frac{(0.5)(125.5)}{35} \right]^2}{\left[2697.75 - \frac{(125.5)^2}{35} \right] \left[1755.25 - \frac{(8.5)^2}{35} \right]}$$

$$= \frac{941909.1}{3940732.8}$$

$$r^2 = .239$$

$$r = .48$$

Correlations between the Differences for
Icecream and Spinach and Castor Oil and Cold drink

x	y	xy	x^2	y^2
2.5	2.5	6.25	6.25	6.25
5.5	18.5	101.75	30.25	342.25
3.5	8.0	28.00	12.25	64.00
-1.0	6.0	-6.00	1.00	36.00
2.0	7.5	15.00	4.00	56.25
2.0	20.5	41.00	4.00	420.25
4.5	1.5	6.75	20.25	2.25
8.0	4.5	36.00	64.00	20.25
6.0	4.0	24.00	36.00	16.00
4.0	1.5	6.00	16.00	2.25
6.5	6.0	39.00	42.25	36.00
8.0	6.0	48.00	64.00	36.00
12.0	2.0	24.00	144.00	4.00
7.5	2.5	18.75	56.25	6.25
2.5	5.0	12.50	6.25	25.00
4.5	9.0	40.50	20.25	81.00
11.0	5.0	55.00	121.00	25.00
3.0	4.5	13.50	9.00	20.25
6.0	6.0	36.00	36.00	36.00
3.5	2.5	8.75	12.25	6.25
6.5	6.5	42.25	42.25	42.25
2.0	4.5	9.00	4.00	20.25
5.0	2.0	10.00	25.00	4.00
-4.5	5.5	-24.75	20.25	30.25
7.0	15.5	108.50	49.00	240.25
4.5	6.5	29.25	20.25	42.25
3.5	3.0	10.50	12.25	9.00
4.5	1.0	4.50	20.25	1.00
10.0	-4.0	-40.00	100.00	16.00
5.0	9.5	47.50	25.00	90.25
7.0	5.5	38.50	49.00	30.25
-2.5	2.0	-5.00	6.25	4.00
-1.5	3.0	-4.50	2.25	9.00
5.0	1.5	7.50	25.00	2.25
9.0	4.0	36.00	81.00	16.00
163.0	189.0	827.00	1185.00	1793.50

Suma

<u>X</u>	<u>Y</u>	<u>XY</u>	<u>X²</u>	<u>Y²</u>
4.5	-2.5	-11.25	20.25	6.25
-11.5	3.5	-63.25	132.25	30.25
-8.0	-9.5	76.00	64.00	90.25
-1.0	-3.0	3.00	1.00	9.00
-2.5	-9.0	22.50	6.25	81.00
5.5	-5.0	-27.50	30.25	25.00
5.5	.5	2.75	30.25	.25
1.5	9.0	13.50	2.25	81.00
2.0	7.0	14.00	4.00	49.00
-1.5	-7.0	10.50	2.25	49.00
1.0	-8.5	-8.50	1.00	72.25
-13.0	-3.5	45.50	169.00	12.25
3.0	0.0	0.00	9.00	0.00
18.5	-.5	-9.25	342.25	.25
5.0	-1.5	-7.50	25.00	2.25
-1.0	-11.5	11.50	1.00	132.25
4.0	4.0	16.00	16.00	16.00
5.5	10.0	55.00	30.25	100.00
10.0	3.0	30.00	100.00	9.00
-2.5	.5	-1.25	6.25	.25
11.5	7.5	86.25	132.25	56.25
-8.5	-6.0	51.00	72.25	36.00
10.0	6.0	60.00	100.00	36.00
22.5	10.5	236.25	506.25	110.25
-1.5	-12.0	18.00	2.25	144.00
-27.0	-6.0	162.00	729.00	36.00
-4.0	.5	-2.00	16.00	.25
4.0	2.5	10.00	16.00	6.25
-28.0	0.0	0.00	784.00	0.00
-7.5	-10.0	75.00	56.25	100.00
1.5	8.0	12.00	2.25	64.00
17.0	16.5	280.50	289.00	272.25
0.0	-1.5	0.00	0.00	2.25
5.5	10.5	57.75	30.25	110.25
2.0	4.0	8.00	4.00	16.00
<u>22.5</u>	<u>8.5</u>	<u>1226.50</u>	<u>3732.25</u>	<u>1755.25</u>

Correlation between the Sums

$$\begin{aligned}
 r^2 &= \frac{\left[xy - \frac{(\sum x)(\sum y)}{n} \right]^2}{\left[y^2 - \frac{(\sum y)^2}{n} \right] \left[x^2 - \frac{(\sum x)^2}{n} \right]} \\
 &= \frac{\left[1226.5 - \frac{(22.5)(8.5)}{35} \right]^2}{\left[1755.25 - \frac{(8.5)^2}{35} \right] \left[3732.25 - \frac{(22.5)^2}{35} \right]} \\
 &= \frac{1490958.6816}{6517992.25} \\
 r^2 &= .23 \\
 r &= .47
 \end{aligned}$$

Correlation between the Differences

$$\begin{aligned}
 r^2 &= \frac{\left[827.0 - \frac{(163)(139)}{35} \right]^2}{\left[1798.5 - \frac{(139)^2}{35} \right] \left[1185 - \frac{(163)^2}{35} \right]} \\
 &= \frac{2830.24}{722496.76} \\
 r^2 &= .04 \\
 r &= .2
 \end{aligned}$$

Correlations between the Sums of Errors for Cake
and bread and Icecream and spinach.

X	Y	XY	X^2	Y^2
-7.0	4.5	-31.50	49.00	20.25
11.0	-11.5	-126.50	121.00	132.25
6.0	-8.0	-48.00	36.00	64.00
4.5	-1.0	-4.50	20.25	1.00
-3.5	-2.5	8.75	12.25	6.25
3.0	5.5	16.50	9.00	30.00
12.5	5.5	68.75	156.25	30.25
2.0	1.5	3.00	4.00	2.25
34.0	2.0	68.00	1156.00	4.00
6.0	-1.5	-9.00	36.00	2.25
-7.0	2.0	-7.00	49.00	1.00
1.5	-13.0	-19.50	2.25	169.00
5.0	3.0	15.00	25.00	9.00
2.5	18.5	46.25	6.25	342.25
1.0	5.0	5.00	1.00	25.00
-2.0	-1.0	2.00	4.00	1.00
-2.0	4.0	-8.00	4.00	16.00
2.5	5.5	13.75	6.25	30.25
12.5	10.0	125.00	156.25	100.00
-3.5	-2.5	8.75	12.25	6.25
12.0	11.5	138.00	144.00	132.25
7.5	-8.5	-63.75	56.25	72.25
7.5	10.0	75.00	56.25	100.00
5.0	22.5	67.50	9.00	506.25
-6.0	-1.5	9.00	36.00	2.25
-8.0	-27.0	216.00	64.00	729.00
4.0	-4.0	-16.00	16.00	16.00
5.5	4.0	22.00	30.25	16.00
-6.0	-28.0	168.00	36.00	784.00
1.5	-7.5	-10.50	2.25	56.25
0.5	1.5	.75	.25	2.25
17.0	17.0	289.00	289.00	289.00
-4.0	0.0	0.00	16.00	0.00
7.5	5.5	41.25	56.25	30.25
4.5	2.0	9.00	20.25	4.00
125.5	22.5	1072.00	2697.75	3732.25

Differences

X	Y	XY	X^2	Y^2
2.5	12.0	30.00	6.25	144.00
18.5	11.0	203.50	342.25	121.00
8.6	9.0	72.00	64.00	81.00
6.0	-1.5	-9.00	36.00	2.25
7.5	7.5	56.25	56.25	56.25
20.5	4.0	82.00	420.25	16.00
1.5	5.5	8.25	2.25	30.25
4.5	5.0	22.50	20.25	25.00
4.0	-2.0	-8.00	16.00	4.00
1.5	20.0	30.00	2.25	400.00
6.0	-10.0	-60.00	36.00	100.00
6.0	14.5	87.00	36.00	210.25
2.0	8.0	16.00	4.00	64.00
2.5	3.5	8.05	6.25	12.25
5.0	4.0	20.00	25.00	16.00
9.0	-1.0	-9.00	81.00	1.00
5.0	-6.0	-30.00	25.00	36.00
4.5	6.5	29.25	20.25	42.25
6.0	7.5	45.00	36.00	56.25
2.5	3.5	8.75	6.25	12.25
6.5	0.0	0.00	42.25	0.00
4.5	2.5	11.25	20.25	6.25
2.0	14.5	29.00	4.00	210.25
5.5	12.0	66.00	30.25	144.00
15.5	5.0	77.50	240.25	25.00
6.5	11.0	71.50	42.25	121.00
3.0	4.0	12.00	9.00	16.00
1.0	9.5	9.50	1.00	90.25
-4.0	5.0	-20.00	16.00	25.00
9.5	-3.5	-33.25	90.25	12.25
5.5	6.5	35.75	30.25	42.25
2.0	3.0	6.00	4.00	9.00
3.0	6.0	18.00	9.00	36.00
1.5	8.5	12.75	2.25	72.25
4.0	5.5	22.00	16.00	30.25
<u>189.0</u>	<u>190.5</u>	<u>920.55</u>	<u>1798.50</u>	<u>2269.75</u>

Correlation between the Sums for Cake and Bread, Ice cream and Spinach

$$\begin{aligned}
 r^2 &= \frac{\left[xy - \frac{(\sum x)(\sum y)}{n} \right]^2}{\left[y^2 - \frac{(\sum y)^2}{n} \right] \left[x^2 - \frac{(\sum x)^2}{n} \right]} \\
 &= \frac{\left[1072 - \frac{(125.5)(225)}{35} \right]^2}{\left[3732.25 - \frac{(22.5)^2}{35} \right] \left[2697.75 - \frac{(125.5)^2}{35} \right]} \\
 &= \frac{982715.3424}{8356602.8172} \\
 r^2 &= .127 \\
 r &= .35
 \end{aligned}$$

Correlation between the Differences

$$\begin{aligned}
 r^2 &= \frac{\left[920.55 - \frac{(189.5)(190.5)}{35} \right]^2}{\left[2269.75 - \frac{(190.5)^2}{35} \right] \left[1798.50 - \frac{(189.0)^2}{35} \right]} \\
 &= \frac{12292.1569}{959065.1310} \\
 &= .01 \\
 r &= .1
 \end{aligned}$$

STATISTICAL APPENDIX TO INVESTIGATION II.

STATISTICAL APPENDIX TO INVESTIGATION II.

I. t test applied to difference between 'like' and 'dislike' errors obtained under Condition I

<u>Like errors</u>	<u>Dislike errors</u>	<u>D</u>	<u>d</u>	<u>d²</u>
-6.0	-14.2	-8.2	-5.1	26.01
8.3	-3.3	-11.6	-8.5	72.25
3.3	-0.8	-4.1	-1.0	1.00
-0.8	0.0	0.8	3.9	15.21
4.1	-4.1	-8.2	-5.1	26.01
2.5	-3.3	-5.8	-2.7	7.29
-3.3	-3.3	0.0	3.1	9.61
0.8	-1.6	-2.4	.7	.49
-2.5	-4.2	-1.7	1.4	1.96
2.5	0.0	-2.5	.6	.36
6.7	-0.8	-7.5	-4.4	19.36
1.7	1.7	0.0	3.1	9.61
1.7	0.8	-0.9	2.2	4.84
6.6	2.5	-4.1	-1.0	1.00
8.3	4.2	-4.1	-1.0	1.00
-5.8	2.5	8.3	-11.4	129.96
-2.5	-3.3	-0.8	2.3	5.29
0.8	-5.0	-5.8	-2.7	7.29
7.5	4.2	-3.3	-0.2	.04
-5.0	-8.2	-4.2	-1.1	1.21
-5.0	-9.2	-4.2	-1.1	1.21
3.3	-1.2	-4.5	-1.4	1.96
-2.5	-9.1	-6.6	-3.5	12.25
-3.3	-12.5	-9.2	-6.1	37.21
-8.3	4.2	12.5	15.6	243.36
6.6	1.6	-5.0	-1.9	3.61
1.6	-2.5	-4.1	-1.0	1.00
-6.6	-6.6	0.0	3.1	9.61
<u>14.7</u>	<u>-72.5</u>	<u>-87.2</u>		<u>650.00</u>
$H = .525$	$H = -2.589$	$H = -3.11$		

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sum d^2}{N(N-1)}}$$

$$= 3.4$$

$$\text{d.f.} = 27$$

$$P = .01$$

II. t test applied to the difference scores of the three groups based on intelligence obtained under Condition I.

Low I.Q.

94 - 110	<u>d</u>	<u>d²</u>
8.2	2.5	6.25
4.1	-1.6	2.56
-0.8	-6.5	42.25
8.2	2.5	6.25
5.8	0.1	.01
5.8	0.1	.01
9.2	3.5	12.25
5.0	-0.7	.49
<u>45.5</u>		<u>70.07</u>

$$M_1 = 5.7$$

Medium I.Q.

112 - 121	<u>d</u>	<u>d²</u>
111.6	9.7	94.09
1.7	-.2	.04
4.2	2.3	5.29
4.2	2.3	5.29
0.0	-1.9	3.61
2.4	.5	.25
4.2	2.3	5.29
-12.5	-14.4	207.36
0.0	-1.9	3.61
<u>3.3</u>	<u>1.4</u>	<u>1.96</u>
19.1		326.79

$$M_2 = 1.9$$

Low and Medium I.Q.

$$t = \frac{M_1 - M_2}{\sqrt{\frac{\sum d_1^2 + \sum d_2^2}{(n_1 + n_2 - 2) \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

$$= \frac{3.8}{\sqrt{\frac{70.07 + 326.79}{(8 + 10 - 2) \left(\frac{1}{8} + \frac{1}{10} \right)}}$$

$$= \frac{3.8}{2.39} = 1.6 \quad \text{d.f.} = 16$$

P = between .1 and .2

II (Cont.)

High I.Q.

122 - 128	<u>d</u>	<u>d²</u>
0.0	-2.3	5.29
2.5	.2	.04
7.5	5.2	27.04
0.9	-1.4	1.96
4.1	1.8	3.24
-8.3	-10.6	112.36
0.8	-1.5	2.25
4.5	2.2	4.84
6.6	4.3	18.49
4.1	1.8	3.24
<u>22.7</u>		<u>178.75</u>

$M = 2.3$

High and Low I.Q.

$$t = \frac{3.4}{\sqrt{\frac{248.82(.225)}{16}}}$$

$t = 1.8 \quad \text{d.f.} = 16$

$P = \text{between .1 and .05}$

Medium and High I.Q.

$$t = \frac{.4}{\sqrt{\frac{505.54(.2)}{18}}}$$

$t = .16 \quad \text{d.f.} = 18$

$P = \text{between .9 and .8}$

III. t test applied to the difference scores obtained for the 3 age groups under Condition I

<u>9</u>	<u>d</u>	<u>d²</u>	<u>10</u>	<u>d</u>	<u>d²</u>
8.2	4.7	22.09	-0.8	-4.63	21.4369
11.6	8.1	65.61	8.2	4.37	19.0969
1.7	-1.8	3.24	5.8	1.97	3.8809
0.9	-2.6	6.76	0.0	-3.83	14.6689
0.8	-2.7	7.29	2.5	-1.33	1.7689
3.3	-0.2	0.04	7.5	3.67	13.4689
6.6	3.1	9.61	0.0	-3.83	14.6689
9.2	5.7	32.49	4.1	.27	.0729
-12.5	-16.0	256.00	4.2	.37	.1369
5.0	1.5	2.25	5.8	1.97	3.8809
4.1	.6	.36	4.2	.37	.1369
<u>38.9</u>		<u>405.74</u>	<u>4.5</u>	<u>.67</u>	<u>.4489</u>
M = 3.5			46.0		93.6668

$$M = 3.83$$

$$\frac{9 + 10}{2}$$

$$t = \frac{.33}{\sqrt{\frac{498.4068}{21} (.173)}}$$

$$d.f. = 21$$

$$= .16$$

$$P = \text{between .9 and .8}$$

<u>11</u>	<u>d</u>	<u>d²</u>
4.1	3.62	13.1044
2.4	1.92	3.6864
-8.3	-8.78	77.0884
4.2	3.72	13.8384
0.0	-0.48	.2304
<u>2.4</u>		<u>107.9480</u>

$$N = .48$$

$$\underline{9 + 11}$$

$$t = \frac{3.02}{\sqrt{\frac{513.69(-.29)}{14}}}$$

$$= .9 \quad \text{d.f.} = 14$$

$$P = \text{between .3 and .4}$$

$$\underline{10 + 11}$$

$$t = \frac{3.35}{\sqrt{\frac{231.618(-.28)}{15}}}$$

$$= 1.7 \quad \text{d.f.} = 15$$

$$P = \text{between .2 and .1}$$

IV. t test applied to male and female scores of Condition I

$\bar{X}$	d	d^2	$\bar{X}$	d	d^2
-8.2	-10.3	106.09	4.2	1.22	1.4884
11.6	9.5	90.25	4.2	1.22	1.4884
4.1	2.0	4.00	2.1	-.58	.7744
.8	-1.3	1.69	-6.6	-9.58	91.7764
0.0	-2.1	4.41	.8	-2.18	4.7524
5.8	3.7	13.69	6.2	3.22	10.3684
0.0	-2.1	4.41	3.3	.32	.1024
2.4	.3	.09	2.5	-.48	.2304
1.7	-.4	.16	7.5	4.92	20.4304
-9.2	-11.3	127.69	0.0	-2.98	8.8804
11.5	9.4	88.36	8.3	5.32	28.3024
5.0	2.9	8.41	.9	-2.08	4.3264
4.1	2.0	4.00	4.2	1.22	1.4884
0.0	-2.1	4.41	4.1	1.12	1.2544
29.6		457.66	41.7		175.6636

$\bar{M} = 2.1$

$M = 2.98$

$$t = \frac{88}{\sqrt{\frac{633.3236(-.143)}{26}}}$$

$n = 47$

$d.f. = 26$

$P =$ between .7 and .6

V. t test applied to difference scores of Conditions I and II.

I	II	D	d	d ²
8.2	2.7	-5.5	-2.7	7.29
11.6	0.8	-10.8	-8.0	64.00
4.1	2.1	-2.0	0.8	06.64
-0.8	0.0	0.8	3.6	12.96
8.2	-8.4	-16.6	-13.8	190.44
5.8	5.4	-0.4	2.4	5.76
0.0	-0.9	-0.9	1.9	3.61
2.4	4.2	1.8	1.0	1.00
1.7	1.7	0.0	2.8	7.84
2.5	0.8	-1.7	1.1	1.21
7.5	0.0	-7.5	-4.7	22.09
0.0	-5.9	-5.9	-3.1	9.61
0.9	-5.8	-6.7	-3.9	15.21
4.1	-3.5	-7.4	-4.8	21.16
4.2	6.7	2.5	5.3	28.09
-8.3	-3.4	4.9	7.7	59.29
0.8	-2.0	-2.8	0.8	0.64
9.8	-2.5	-8.3	-5.5	30.25
3.3	-5.0	-8.3	-5.5	30.25
4.2	2.5	-1.7	1.1	1.21
4.2	5.0	0.8	3.6	12.96
4.5	5.0	0.5	3.3	10.89
6.6	-5.0	-11.6	-8.8	77.44
9.2	11.6	2.4	5.2	27.04
-12.5	9.2	21.7	24.5	600.25
5.0	-1.5	-6.5	-3.7	13.69
4.1	-3.9	-16.0	-7.2	51.84
0.0	-0.8	-0.8	2.0	4.00
<u>87.3</u>	<u>7.5</u>	<u>-50.0</u>		<u>1310.02</u>

$\bar{X} = 3.12$

$\bar{X} = .26$

$\bar{X} = -2.8$

d.f. = 27

$$\begin{aligned}
 t &= \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sum d^2}{n(n-1)}}} \\
 &= \frac{2.86}{\sqrt{\frac{1310.2}{28(28-1)}}} \\
 &= 2.2
 \end{aligned}$$

P = between .05 and .02

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