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INTELLIGENCE QUOTIENT vs BRAIN ABILITY : A Correlational Study of the Brain's Perceptual Ability Through Three Different Sensory Modalities And Intelligence Quotient

Harold A. Wynn
Pittsburg State University

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A Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements for the Degree of Master of Science

By

Harold A. Wynn

PITTSBURG STATE UNIVERSITY

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CHAPTER I

INTRODUCTION

The purpose of this study was to investigate how an individual's ability to perceive various stimuli through the auditory, olfactory, and tactile sensory systems correlates with his/her ability to perform on the Wechsler standard intelligence test.

The primary objective of the scientific approach to psychological research, is to answer questions in a systematic, objective, and precise manner through observing and recording information. This objective holds true in the clinician's attempt to determine the uniqueness of each of his/her patients within the therapeutic context. Psychometric testing, which permits comparisons of the patient's performance with that of a reference group, is one such scientific approach.

An individual assessment, by use of the intelligence test, is a rare situation in that a highly able and skilled professional devotes his/her exclusive attention to one individual for a period ranging from one to several hours. This may never happen again. The examiner has the opportunity to gather valuable information about the individual that will be useful for assessment and intervention purposes.

In the past 15 years we have seen numerous attacks on the use of intelligence tests. Accusations have arisen from ethnic minority groups that standardization procedures are culturally biased. Other critics say that the intelligence test is misused. And still others insist that the intelligence test does not measure a broad enough spectrum of the brain's ability to perceive environmental stimuli. It is this last criticism that is the subject of this paper.

Need For the Study

The present method of intellectual testing is limited at best. Intelligent behavior is dependent on biological and genetically based components as well as culturally based education and environmental enrichment of the perceived stimuli (Sattler, 1988). The need for developing additional testing methods has been evident for sometime.

The form and purpose of intelligence tests of the future will be based more on the unique individual than they have been in the past. "My view...is that over the next 20 years we are likely to see evolution...changes in intelligence tests...We are likely to see tests that provide separate scores on a variety of abilities" (Turnbill, 1979, p.81). John Horn (1979) says that "...we can expect that intelligence tests of the future:...will contain subtests designed to indicate features of temporal integration of information, auditory organization, and elementary cognitive

processing of information" (p.239). "Realistic simulations of real-life problem situations might be used to supplement the usual psychological tests and thus to contribute to the database needed to develop a broader conception of intelligence" (Frederiksen, 1986, p.451).

Within the factor analytic theories of intelligence, several have asserted that there are many aspects of intelligence. Spearman (1927), Guilford (1967), Vernon (1950), and Horn (1967) all submit that there are many levels of intelligence which are each linked with individual skill, speed, intensity, and extent of a person's ability for intellectual output. Each of these theorists, in his own model, has developed a way of looking at one's cognitive abilities to perceive stimuli within the environment, process it, and reproduce it in some form of test.

Within the information-processing approaches to intelligence, Campione and Brown (1978), Sternberg (1986), Torgesen (1979), and Das (1972) focus on ways individuals mentally represent and process information. Information-processing models of cognitive activities categorize mental processes in terms of the different operations performed on the information after it is perceived by way of the sensory receptors. In these models, cognition is proposed to occur in several stages. The information is received through various sensory modalities. That information is processed at one stage and then passed on as input to the next stage for further processing.

Intellectual processing, then, is composed of certain cognitive activities or behaviors, "...which transform and manipulate information between the time it enters as a [sensory perceived] stimulus and the time a response to it is selected" (Torgesen, 1979, p.516).

These more modern approaches to intelligence seem to have in common a strong emphasis on innate and developmental influences. It appears that genetically determined cognitive ability is greatly modified by direct experience. It is noted that responses given by a subject are directly related to his/her unique historical learning experiences. It is also strongly suggested that the subject's attitude toward taking the test will directly affect the results (Roberts, 1985).

This investigation directly studied the individual's ability to perceive environmental stimuli through three different sensory modalities. The numerical results were then correlated with the Wechsler IQ test as evidence of each individual's unique ability to perceive stimuli differently. Whatever position a person adopts in a definition for discussing intelligence, it is important to recognize that the unique learning histories of each subject determine the way in which he/she uses the brain's ability to perceive environmental stimuli.

Purpose of the Study

Intelligence testing is intended to determine the intellectual capacity of the individual by using a psychometric instrument to measure and assign a number to that person's ability to perform well on the test. The purpose of this research is to give evidence that intelligence tests do not measure the individual's unique ability to perceive environmental stimuli.

Research Questions

This study examined the following questions:

1. Is there a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the Olfactory sensory system?
2. Is there a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the auditory sensory system?
3. Is there a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the tactile sensory system of the hands?
4. Is there a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the Olfactory sensory system?

5. Is there a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the auditory sensory system?

6. Is there a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the tactile sensory system of the hands?

7. Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the Olfactory sensory system?

8. Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the auditory sensory system?

9. Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the tactile sensory system of the hands?

Limitations

The study was limited to subjects from the ages of 10 60 years old. The age distribution is skewed to the early 20's and less representative of the older population. There was only one non-white subject. The majority of the subjects were of school age, college age, or in some way associated with continuing education. The lower IQ subjects were untrained laborers. The study was not well represented by the blue collar worker. The findings may not generalize to other populations.

Hypotheses

The hypotheses of the study were:

1. There is a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the Olfactory sensory system.
2. There is a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the auditory sensory system.
3. There is a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the tactile sensory system of the hands.
4. There is a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the Olfactory sensory system.
5. There is a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the auditory sensory system.
6. There is a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the tactile sensory system of the hands.
7. There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the Olfactory sensory system.
8. There is a significant correlation between an

individual's IQ and his/her ability to perform a stimulus matching test by way of the auditory sensory system.

9. There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the tactile sensory system of the hands.

CHAPTER II

A REVIEW OF THE LITERATURE

Currently published instruments that measure intelligence look at only a limited area of the brain's ability to perceive and process environmental stimuli. These tests are designed to look for a general intelligence of the individual and compare the results to a standardization sample. The tests fail to recognize each individual's unique ability in separate areas of cognitive functioning.

Theories of Intelligence

Cyril Burt (1955) tells us that the term intelligence derives from to intelligentia, which was introduced by Cicero. Spearman (1927) says that the "monarchic" view of the concept called intelligence became a popular idea as far back as the fifteenth century.

Herbert Spencer (1895) is given the credit by both Burt and Spencer in bringing the term "intelligence" into psychology. Spencer defined life as "...the continuous adjustment of internal relations to external relations." Spencer further proposed that the ability to adjust is achieved through the intelligence of humans and by virtue of instincts in the lower animals. Spencer defined

intelligence as the "...power of combining many separate impressions" (p.403). Spencer also tied the concept to the ideas of biological evolution in a way that was to set the pattern for psychologists for the coming years.

There continued to be many attempts to define intelligence, especially after the invention of a test that claimed to measure it. Numerous conferences were held on the problem, and many "intelligent" people were heard. The outcome was far from agreement. As Spearman (1927) put it, intelligence became a "...mere vocal sound, a word with so many meanings that finally it had none" (p.14). He further quoted J. S. Mill (Spearman, 1927) in a statement that described the search for a proper meaning of intelligence. The statement has the hint of a warning. "The tendency has always been strong to believe that whatever receives a name must be an entity of being, having an independent existence of its own. And if no real entity answering to the name could be found, men did not for that reason suppose that none existed, but imagined that it was something peculiarly obscure and mysterious" (p.14).

Attempts at giving intelligence an operational definition have also run into problems. A definition that satisfies the needs of understandable communication must contain ideas or concepts that are identifiable and reality based. David Wechsler (1958) offered a proposed operational definition when he said that, "...intelligence, operationally defined, is the aggregate or global capacity

of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (p.7). Wechsler does offer comment concerning the terms aggregate, global, purposefully, and rationally, but he does not supply empirical proof for these terms.

A more candid operational definition was given by E. G. Boring (1923), when he stated that "...intelligence as a measurable capacity must at the start be defined as the capacity to do well in an intelligence test" (p.35). It may appear to many, that Boring was being cynical, but he was actually demanding a careful look at the intelligence tests themselves, pointing out the obvious problem in measuring the brain's ability to function.

The French psychologist and educator, Alfred Binet, defined intelligence as "...the tendency to take and maintain a definite direction; the capacity to make adaptations for the purpose of attaining a desired end; and the power of autocriticism" (Terman, 1916, p.45). Another source from Binet & Simon (1916), states that intelligence is "...judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances. To judge well, to comprehend well, to reason well, these are the essential activities of intelligence" (pp. 42-43). Binet's emphasis focuses on thinking or problem-solving operations, in which he recognized three steps: direction (similar to the modern term "mental set"), adaptation (finding a means to reach an end), and

autocriticism (a form of self-evaluation). Binet (1909) later added a fourth step, comprehension. With the four steps of direction, comprehension, adaptation, and criticism, Binet's description of thinking or problem solving is quite congruent with recent theories.

Binet (1909) often remarked on the great complexity of intelligence. He also stated that "...the mental faculties of each subject are independent and unequal; with little memory there may be associated much judgment...Our mental tests, always special in their scope, are each appropriate to the analysis of a single faculty" (p.12).

The theories getting the most attention today are the factor analytic theories of intelligence. There are two primary theories within the factor analytic group. First there is the general-factor (g) theory of intelligence. The "g" factor is an index of general mental ability of intelligence and represents the "inventive" as contrasted with the "reproductive" aspect of mental ability (Jensen, 1979). Tests that have a high "g" loading require conscious and complex mental effort, such as is found in reasoning, comprehension, and hypothesis-testing tasks.

In contrast to the first, Thorndike (1927) and Thurstone (1938) have asserted in their theories that the intellect is composed of many separate faculties, such as mathematical, mechanical, and verbal faculties. Even though the disagreement between the factor analysts continues regarding how intelligence is organized, many of them accept

the theory of general intelligence (Urbach, 1974). Their general belief is that intelligent behavior is still multi-dimensional, with either a general unitary function or a composite of several somewhat independent abilities performed by the brain.

Spearman (1923) defined intelligence by saying, "...everything intellectual can be reduced to some special case...of reducing either relations or correlates" (p.300). Education of relation - "The mentally presenting of any two or more characters...tends to evoke immediately a knowing of relation between them" (p.63). Education of correlates - "The presenting of any character together with any relation tends to evoke immediately a knowing of the correlative character" (p.91).

Spearman (1927) later suggested some statistical ways of testing the opposing views of theories of intelligence. He proposed a two-factor theory to account for the pattern of correlations seen with group tests of intelligence. He theorized that mental processes associated with "g" are education of relations (the relationship between ideas) and education of correlates (finding a second idea associated with a previously stated one).

Edward L. Thorndike (1927), whose ideas were based on a theoretical perspective, conceptualized intelligence as the product of a large number of interconnected but distinctly intellectual abilities (a multi-factor theory).

Louis L. Thurstone (1938) asserted that intelligence

could not be viewed as a unitary trait. Rather, there are secondary factors or abilities that may be related to "g." Thurstone maintained that human intelligence possesses a certain systematic organization, with a structure that can be inferred from a statistical analysis of the patterns of intercorrelations found in a group of tests.

Stoddard (1943) defined intelligence as "...the ability to undertake activities that are characterized by (1) difficulty, (2) complexity, (3) abstractness, (4) economy, (5) adaptiveness to a goal, (6) social value, and (7) the emergence of originality, and to maintain such activities under conditions that demand a concentration of energy and a resistance to emotional forces" (p.4).

Freeman (1955) presents intelligence as "...adjustment or adaptation of the individual to his total environment, or limited aspects thereof...the capacity to reorganize one's behavior patterns so as to act more effectively and more appropriately in novel situations...the ability to learn...the extent to which [a person] is educable...the ability to carry on abstract thinking...the effective use of concepts and symbols in dealing with...a problem to be solved" (p.60-61).

Philip E. Vernon (1965) believes that a general group factor (g) must be considered in any attempt to understand intelligence.

The most prominent multifactor theorist in the United States is J. P. Guilford (1967). He developed a model

called "Structure Of Intellect (SOI)." This is a three-dimensional model: one dimension represents operations (the kind of mental operation performed); the second dimension represents content (the type of content which the mental operation is performed); and the third dimension represent products (the resulting product of the process). These dimensions are broken down into many subcategories which are the topic of some recent changes in the SOI model (Guilford, 1988).

Raymond B. Cattell and John Horn (1967) took a different approach to explaining intelligence. Their theory holds that there are two types of intelligence: fluid intelligence which refers to essentially nonverbal mental efficiency which is more dependent upon physiological structures; and Crystallized intelligence which refers to acquired skills and knowledge which are dependent upon cultural assimilation.

John Horn (1985) maintains that current research does not allow a unitary theory to stand alone. He argues strongly against the concept of general intelligence. He sees intelligence as a composite of several abilities that the brain processes. This allows each individual to be distinctly different with his/her own combination of unique abilities. J. P. Das (1973) simply states that intelligence is "...the ability to plan and structure one's behavior with an end in view" (p.27).

L. G. Humphreys (1979) writes that intelligence is,

"...the resultant of the processes of acquiring, storing in memory, retrieving, combining, comparing, and using in new context information and conceptual skills; it is an abstraction" (p.115).

Howard Gardner (1983) alleges that humans have several or multiple intelligences. He writes that "...a human intellectual competence must entail a set of skills of problem solving - enabling the individual to resolve genuine problems or difficulties that he or she encounters, and, when appropriate, to create an effective product - and must also entail the potential for finding or creating problems - thereby laying the ground work for the acquisition of new knowledge" (p.60-61).

Jan-Eric Gustafsson (1984) proposes a three-level model of intelligence by using some of the above concepts. The three levels are: crystallized intelligence which deals with verbal information; fluid intelligence which deals with adaptive nonverbal abilities, and general visualization which deals with figurative information.

R. J. Sternberg (1986) asserts that intelligence is the "...mental activity involved in purposive adaptation to, shaping of, and selection of real-world environments relevant to one's life" (p.33).

Instruments Used to Determine IQ

The Wechsler Intelligence Scale for Children - Revised

(WISC-R) was used to determine the IQ of the subjects under 16 years old. "The WISC-R has been well received by those who use tests to evaluate children's intellectual ability. It has excellent standardization, reliability, and concurrent validity, and much care has been taken to provide useful administrative and scoring guidelines" (Sattler, 1988, p.143).

The WISC was originally developed by David Wechsler in 1949. It is currently published by The Psychological Corporation. The latest revised edition (WISC-R) was published in 1974. This revised edition, 25 years after the original WISC, retained 72 percent of the original items along with the original Coding subtest. The WISC-R is designed to test children from 6 years of age to 16 years 11 months and 30 days old.

The WISC-R (Wechsler, 1974) was designed to test the intellectual ability of children on an individual basis. Theoretically, it was designed to provide an individual test using a wide range of verbal and performance abilities. There are currently six verbal response subtests and six material manipulation (performance) subtests. These subtests yield a raw score which is converted to standard scores with a mean of 10 and a standard deviation of 3. The Verbal, Performance, and Full scale scores all have a mean of 100 and a standard deviation of 15.

The standardization of the age range was excellent and included 2,200 subjects. The sample was stratified by age,

sex, geographic region, urban/rural residence, occupation of the head of the household, and race (white and non-white). This sample was based on the 1970 U.S. census data (Sattler, 1988).

The WISC-R (Wechsler, 1974) has adequate concurrent validity with a variety of ability and achievement measures. This test has excellent reliability. Vernon (1984) writes, "Overall the reliability and stability of the Full scale scores are as high or higher than those of other tests of intelligence" (p.143). The internal consistency reliabilities of the WISC-R Full scale IQ's are extremely high with an average r=.96 and with standard errors of measurement of less than 5 points on the three scales.

The Wechsler Adult Intelligence Scale - Revised (WAIS-R) (Wechsler, 1981), was used in this investigation to determine the adult subjects Full scale IQ. The WAIS-R has retained 80 percent of the original items or slight modifications. The WAIS-R is designed to test adults from 16 years old to 74 years, 11 months of age.

The WAIS-R (Wechsler, 1981) is designed to test the intellectual ability of adults on an individual basis. The theoretical basis for this test is that the examiner could sample 11 types of ability and then generalize from the results. From this, the author of the test planned to examine intelligence which was defined as the global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his or her environment (Wechsler, 1958).

There are six verbal response subtests and five material manipulation (performance) subtests. These subtests yield a raw score which is converted to standard scores with a mean of 10 and a standard deviation of 3. The Verbal, Performance, and Full scale scores all have a mean of 100 and a standard deviation of 15.

The standardization of the age range was excellent and included 1,880 subjects. The sample was stratified by age, sex, geographic region, urban/rural residence, occupation of the head of the household, and race (white and non-white). This sample was selected to be representative of the U.S. late adolescent and adult populations during the 1970's.

The WAIS-R (Wechsler, 1981) has excellent subtest and Full scale reliability. "Reliabilities for the IQ associated with the Verbal, Performance, and Full Scale are extremely high for the standardization sample; average r= of .97, .93, and .97 respectively" (p.242). House, et al (1986), writes that the WAIS-R is "...consistent with the prior history of the Wechsler Scales...the reliabilities...for the WAIS-R are generally superior for psychometric instruments...there is no reason to doubt the WAIS-R is as valid as its two predecessors" (p.342). Also, it is noted that concurrent validity studies of the WAIS-R have been uniformly positive.

Current Research on Humans Perceptual Ability with the Olfactory, Auditory, and Tactile Senses

Three subtests were used to investigate perceptual ability within the three sensory modalities of olfaction, audition, and taction. The subtests included: Identification of the stimulus material; Short-Term Memory of the stimulus material associated with time; and a Stimulus Matching test also based on time. The reason for the similarities of the subtest within each sensory modality is that research shows that individuals adopt common strategies in dealing with similar tasks. Baron and Breck (1987) determined "...that common strategies were adopted [by subjects] for tasks with similar elements: the important consideration appeared to be the ability tapped by the task rather than the sensory modality in which the task was presented" (p.165).

Identification

The Identification subtests consisted of stimulus materials, presented one at a time. Each subject was asked to explain aloud exactly what the material was. Subject were then asked to identify all of the stimulus materials even if they were incorrect on many of the items. This subtest is a test of accumulated knowledge. The identification subtests of this research were intended to

exam a variety of cognition-related factors that include learning ability, fund of information, richness of ideas, memory, and sensory development.

"Odor identification is probably the most important information processing task in the olfactory domain. It entails cognitive, particularly memorial, skills, as well as sensory ability" (Murphy & Cain, 1986, p.179).

In the Olfactory Identification subtest, each subject was allowed as much time as was he/she needed to identify the odorant. This was done to allow older subjects opportunity to identify the odorant as it has been shown that odor thresholds tend to rise with age (Murphy, 1986; Doty et al. 1984; Schiffman, 1979). A marked loss of ability in the accuracy of odor identification tends to occur at higher thresholds with older people (Eskenazi, et al. 1986; Doty et al., 1984; Muphy, 1985; Schemper, Voss, & Cain, 1981; Schiffman, 1977). However, according to D. G. Laing (1986), only a single sniff would be needed to identify the odorant. "The most significant finding of this study [on identification of odors] is that humans obtain sufficient information from one sniff to identify a single odor at a concentration which is just above the recognition threshold. In other words, only a single sniff is necessary for the identification of an odorant over most of the concentration range used in studies of human olfaction" (p.169).

In the Auditory Identification subtest, each subject

was asked to identify some musical tunes. In describing an individual's ability to perceive musical information, Sternberg and Davidson (1985) point out that there is a domain-specificity of talent in the more gifted and "...hence do not see giftedness as having much to do with exceptionally high levels of IQ or any other single personal characteristic" (p.57). Like the Vocabulary and Information subtests of the Wechsler IQ tests, the Auditory Identification subtest taps memory and prior learning. However, it also requires substantial concentration and the active application of select skills to the new and unique experience as in the Arithmetic subtest of the Wechsler (Blatt & Allison, 1968).

In the Tactile Identification subtest, each subject was asked to identify objects that are commonly found in the average American household. The subjects were allowed to use right, left, or both hands as the research shows no difference between hands in performing a tactile recognition task (Manning-Melean et al. 1985; Varney & Benton, 1975; and Zoccolotti et al., 1979). Like the above identification subtests, Tactile Identification incorporates memory and prior learning. Success in properly identifying the items depends, in part, on the possession of particular tactile information plus the ability to draw on past experiences with the stimulus material in reaching solutions.

Short-Term Memory

Research concerning an individual's ability to remember and reproduce information has been going on for many years. Concerning attitudes and memory, Freud (1938) wrote, "The tendency to forget the disagreeable seems to be quite general; the capacity for it is naturally differently developed in different persons" (p.101). Later studies tend to confirm the notion that the factor of memory enters into all kinds of cognitive abilities. Memory has evolved into two major categories: of short-term and long-term memory which are both closely tied to so called intelligence.

> "When a child of normal intelligence and character proves to be seriously backward... the commonest [sic] causes is a weakness in mechanical memory. On the other hand, the cases of idiot savants demonstrate clearly that a person may possess an exceptional retentiveness for figures or words, and yet be highly deficient in general intelligence; and every university examiner can cite cases of dull students who nevertheless scrape through all their written examinations by dint of good memory" (Burt, 1967, p.200).

It is also noted that "Memory skills also vary in their adaptiveness and value in cultures in which different occupational or institutional demands are made on people's memory" (Mistry & Rogoff, 1985, p.136). The Short-Term

Memory area of research for this paper was intended to determine how people use their own past experiences in meeting the present challenge of memory ability.

The Olfactory Short-Term Memory subtest required the subjects to hold in memory a particular arrangement of stimulus material over varying lengths of time. Much like the Digit Span subtest of the Wechsler IQ test, Olfactory short-term memory looks at the ability of the subject to learn the order of the stimulus material, store it in memory and then reproduce by recall the correct order. There is some evidence presented by Eskenazi et al. (1986) that Olfactory recognition memory may operate somewhat independently of other perceptual abilities.

The Auditory Short-Term Memory subtest will be expected to correlate closely with the Digit Span, Coding, and/or Digit symbol subtest of the Wechsler IQ test. "The task [Digit Span] assesses the subjects ability to retain several elements that have no logical relationship to one another. Because auditory information must be recalled and repeated orally in proper sequence, the task has been described as a sequencing task" (Sattler, 1988, p.154). This subtest demands information processing of the stimulus tone. This involves discrimination, ability to adapt to the changing tones (Kemp, 1985), and memory of the auditory stimulus. Then the subject is required to repeat the tone identifying number aloud. The individuals auditory adaptation ability to the different tones is discussed by Weiler et al. (1987),

"...it appears that different methods produce different adaptation effects...The normal ear apparently shows several forms of adaptation, which reduces the perceptual strength of a continuing stimulus, in favor of an intermittent, less redundant one" (p.411).

The Tactile Short-Term Memory subtest also looks at the ability of the subject to learn the order of the stimulus material, store it in memory, and then reproduce by recall the correct order while being blindfolded. The inspection time allowed is critical in this and other subtests. According to research done by Mike Anderson (1988) on inspection time, information processing, and the development of intelligence, it was determined that "IT [inspection time] is related to IQ in development" (p.53). The subtest is also examining the subject's ability to retain information and recall it after a period of time.

Stimulus Matching

Stimulus Matching is a variation of magnitude estimation and magnitude matching (Stevens & Marks, 1980). In magnitude estimation, the subject assigns numbers to the strength of stimulus material (Stevens, 1975). Magnitude matching is similar except the subjects estimate the strengths of stimuli and are instructed to assign a position on a common scale of perceived strength (Stevens and Cain, 1987). The Stimulus Matching subtest used in this research

simply involves recognizing identical stimulus and arranging them in the proper order as quickly as possible.

In the Odor Stimulus Matching subtest, it was expected that older subjects will do less well as reported by Stevens & Cain (1985) in their studies on magnitude matching of odorants. A similar stimulus matching task was included by Eskenazi et al. (1986) in their research of olfactory aptitude.

In the Auditory Stimulus Matching test, two sensory modalities were in primary use: perception of the sound by way of audition and visual identification of the tone pipe making the sound, after some learning had occurred. According to Karma (1979), acoustic structuring ability and visual-spatial ability are analogous constructs. "Both are abilities to organize the elements of perception although the channel of information is different"(p.51). Also Hassler et al. (1985) confirm that there is "...a significant relationship between [auditory] musical talent and visualization" (p.102).

In Tactile Stimulus Matching, since the subjects were blindfolded, the acquisition of information was facilitated by relative movement of the hands or fingers over the stimulus object (Darian-Smith, 1982; Gibson, 1962; Krueger, 1970). In most cases, the objects were stationary and the subjects were asked to actively touch them. It has been found that "...when the relative movements are comparable, an observer [experimental subject] appreciates an object's

textural qualities in much the same way regardless of whether he uses 'active touch' (i.e., voluntary manual exploration) or 'passive touch' (i.e. movement of the object over the stationary skin)" (Essick & Whitsel, 1985, p.188).

Summary

The Olfactory, Auditory, and Tactile subtests were designed to examine the individual's intellectual competence at various perceptual levels. These subtest allowed the person to solve genuine environmental problems or difficulties by way of different sensory modalities.

It is expected that each individual will display his/her own unique skills to do well on some tests and poorly on others. Performance will depend upon his/her developmental history, genetic composition, and past learning.

CHAPTER III

METHOD

This chapter presents the design and methodology of the research study. The treatment of participants in this research project was in accordance with the ethical standards of the American Psychological Association as set forth in the publication "Ethical Principles of Psychologists - Revised" (American Psychological Association, 1981). The procedures utilized in this study were approved by the Pittsburg State Department of Psychology and Counseling and the University Rights of Human Subjects Committee.

Subjects

A total of 43 individuals participated in this research study. Twelve of the subjects were eliminated when it was determined that the data collected was not complete or was otherwise invalid. Thirty-one subjects provided data that was considered valid. All participants were volunteers and lived within a 100-mile radius of Pittsburg State University.

Apparatus

Each of the individuals participating in the study were

administered the Wechsler Adult Intelligence Scale Revised (WAIS-R) or the Wechsler Intelligence Scale for Children Revised (WISC-R). The WAIS-R and the WISC-R have good validity and high reliability ratings. "Each of the three IQ scales (of the WAIS-R) has an internal consistency reliability coefficient of .88 or above in the standardization group over the entire age range covered by the scale" (Sattler, 1988, p.220). The WISC-R has a .89 reliability coefficient. Both of these tests are well suited for the study (Sattler, 1988).

Testing For Olfactory Perception

In testing for olfactory perception, all of the stimuli used can be located in the average American household. In the olfactory identification subtest, the stimuli used consisted of: bubble gum, dried chopped onions, tea in bags, cedar wood shavings, pipe tobacco, vanilla extract, ivory soap, cinnamon stick, lemon peel, newspaper, roasted peanuts, and rubber bands. These items were placed inside red plastic squeeze bottles so that the subject could not see the item. The subjects would then squeeze, forcing the odorant out of the bottle so that they could smell the odorant molecules. The subjects were allowed as much time as they wished to smell the stimulus material and make a decision as to what it was.

D. G. Laing (1986, p.163) reports that "...no studies have described the duration that an odor must be sampled (sniffed) for identification to be achieved." However, it is

assumed that since perception of odor quality is necessary for identification in odor memory, varying amounts of odorant molecules are necessary for different individuals and odorants.

The stimuli used for the Olfactory Short-Term Memory subtest were scented candles made by the Flintlock Corporation of Houston, Texas. The scented candles used were: jade, strawberry, yellowrose, Chanel #5, clean air, lauren, pina colada, romance, country kitchen, french vanilla, mulberry, and cinnamon spice. These scented candles were also placed inside the plastic squeeze bottles to prevent visual associations.

The subjects were given the stimulus odorants in a particular order and asked to smell each of them for no more than two seconds each. The subjects was then asked to read a humorous article on behavior modification to prevent them from practicing any associations which he/she might have made with the odorants for graduated periods of time (Peterson & Peterson, 1959). After the appropriate time period had elapsed, the subjects were asked to position the odorants in the correct order by smelling them again.

The Olfactory Stimulus Matching subtest used the above mentioned scented candles as stimulus material. In this subtest, the subjects were asked to match a disorganized set of odorants to an organized, identically smelling set of odorants. This task was to be accomplished as quickly and accurately as possible. The subjects were told that more

points were given for faster responses and that no points would be given if there were incorrect responses.

Both the Short-Term Memory and Stimulus Matching subtests, along with the stimulus materials, were similar to those used by Eskenazi, Cain and Friend (1986) in their investigations of olfactory aptitude.

Testing for Auditory Perception

The Auditory Identification was tested by means of a cassette tape of songs which the subjects were to name. The tunes used were: Mary Had a Little Lamb, Jingle Bells, Row, Row, Row Your Boat; Alleutte; Kum-Ba-Ya; Oh Susanna; Swanee River; Amazing Grace; Camp Town Races; When the Saints Go Marching In; Streets of Laredo; and Jacob's Ladder. The subjects were asked to identify the song by name during the a second elapsed time between each song.

The Short-Term Memory subtest of this section was accomplished by the use of two identical seven tone xylophones. Each of the tones were numbered. The subjects were asked to reproduce the tone and identify it by number following the researcher's lead. After the subject had played the tones and become familiar with the tone placement and quality, the researcher would strike a tone or tones three times. The subjects was then asked to read a humorous article on behavior modification to prevent them from practicing any associations that he/she might have made with the auditory

stimulus, for graduated periods of time. After the appropriate time period had elapsed, the subjects were asked to reproduce the tone or tones in the correct sequence, and to announce the number of the tone or tones as was previously offered by the researcher.

The Auditory Stimulus Matching subtest used the above mentioned seven tone xylophones as stimulus material. In this subtest, the subjects were asked to match the exact combination of tones that the researcher presented and report aloud to the researcher in correct order the numbers corresponding to the tones. The researcher offered to repeat the tonal combinations as often as the subject asked. This task was to be accomplished as quickly and accurately as possible. The subjects were told that more points were given for faster responses and that no points would be given if there were incorrect responses.

Both the STM and Matching subtests are similar in concept to the subtests of the Wing Standardized Tests of Musical Intelligence (Wing, 1961).

Testing for Tactile Perception

The Tactile Identification stimuli were: 2 wood screws, fishing line, wash cloth, a 5 inch by 7 inch piece of kitchen floor vinyl, lead pencil eraser, 3/8 inch by 3 inch by 3 inch carpet foam, a 4 inch by 4 inch piece of cut loop carpet, a AA-size battery, a lead pencil, a small rubber ball, a large

coat button, two band-aids in their wrappers, a house doorstop, a small block of wood, coins (the subjects were required to announce the value of the coins), a can of shoe polish, a 3 inch by 3 inch piece of leather, a folded one-dollar bill, a hair brush, and a ball of aluminum foil. The subjects were asked to identify each of the objects, one at a time, while wearing a blindfold. The subjects were discouraged from shaking, smelling or using any part of their body other than their hands to identify the items. A strict scoring method was used in that no credit was given for close answers. For example, a failure was recorded for the answer; "some type of brush" for the object hair brush.

The Short-Term Memory subtest required the subject to touch some cone shaped round stimulus blocks of wood with various material glued to the top. The stimulus material was: plain wood, plastic table cloth, wrinkled aluminum foil, raw cotton, plastic shower curtain, paper towel, 6 different grades of sand paper, and 6 different grades of carpet.

The subjects were presented the tactile stimulus blocks in a specified order from left to right. A slotted board was used to make it easier for the subjects to arrange the blocks in the correct order. The subjects were asked to touch the stimulus blocks for no more than two seconds each. Then, for graduated periods of time, the subjects were asked to repeat the humorous article on behavior modification which they had been reading on the previous two subtests. This was done to prevent the subject from practicing any associations they

might have made with the stimulus blocks. After the appropriate time period had elapsed, the subjects were asked to reposition the stimulus blocks in the correct order by touching them again.

The Tactile Stimulus Matching subtest required the subjects to simply discriminate between the above-described stimuli. In this subtest the subjects were asked to match a disorganized set of tactile stimuli to an organized set of stimuli which were identical to the organized set. This task was to be accomplished as quickly and accurately as possible. The subjects were told that more points were given for fast responses and that no points would be given if there were incorrect responses. The basic principles defined by Manning-Melean, Lilianne and Fernandez-Ballesteros, & Rocio (1985, p.503-506) in their investigations of perceptual tasks were used in organizing the tactile subtests.

Summary

The relationship between individual IQ and olfactory, auditory, and tactile perceptual ability was investigated. These sensory perceptors were studied in the areas of identification, short term memory, and stimulus matching. Pearson's correlational method was the statistical method used to study the 31 subjects' responses.

CHAPTER IV

RESULTS

The purpose of this study was to investigate how an individual's ability to perceive various stimuli through the auditory, olfactory, and tactile sensory systems correlates with his/her ability to perform on the age appropriate Wechsler standard intelligence test.

The research information was obtained from 16 female and 15 male volunteers. There was only one non-white subject in the sample. The age range was from 10 years old to 60 years old with a mean age of 32.7 years old. Sixteen of the subject have never been married, eight of them were married, and seven of them reported being divorced.

The volunteers reported the following occupations: Hospital mental health assistant (3), Trash collector (1), Secretary (2), Recreation Therapist (3), U.S. Army NCO (1), Counselor (1), Social Worker (1), Nurse (2), Laborer (4), Certified Public Accountant (1), Housekeeper (1), Bartender (1), Carpenter (1), School children under eighteen (6), Mechanic (2), and unemployed (1).

Measuring instruments included: the Wechsler Intelligence Scales for Children Revised; the Wechsler Adult Intelligence Scales Revised; an identification test for the olfactory, auditory and tactile senses; a short term memory test for the olfactory, auditory and tactile senses; and a

stimulus matching test for the olfactory, auditory and tactile senses.

TABLE 4.1

Test Results in Range, Mean, and Standard Deviation for the Subject Group: N = 31

Variable	Range	Mean	Standard Deviation
Full Scale IQ	69-138	103.97	22.04
Verbal IQ	91-143	105.74	16.93
Performance IQ	79-135	101.84	22.15
Olfactory ID.	0-10	4.61	2.43
Auditory ID.	2-12	6.58	2.68
Tactile ID.	2-20	15.06	4.54
Olfactory STM	0-17	8.35	5.17
Auditory STM	0-15	5.52	3.59
Tactile STM	1-20	10.39	5.40
Olfactory Match	14-30	22.26	5.25
Auditory Match	2-35	18.26	9.98
Tactile Match	5-35	23.65	5.95
Total ID	5-34	26.74	6.67
Total STM	3-39	24.00	8.56
Total Match	8-86	62.10	16.48
Total Olfactory	21-54	35.77	8.59
Total Auditory	6-49	31.58	12.26
Total Tactile	24-68	48.97	10.25

TABLE 4.2

Correlation Matrix

Of the IQ Scores and Other Subtests

	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.
a. Ver. IQ	.00	37(.58)	.13	.28	.01	.24	.35	.18	.02	.44	.11	
b. Per. IQ		.00(.91)	.03(.33)	.26	.07	.00	.10	.01	.20	.16		
c. Full Scale IQ		.00	.02(.37)	.20	.17	.07	.01	.03	.18	.12		
d. Tactile STM			.00	.03	.07	.20	.23	.44	.15	.03	.07	
e. Auditory STM				.00	.08	.07	.15	.11	.27	.19	.02	
f. Olfactory STM					.00	.16	.16	.04	.53	.20	.29	
g. Tactile Identification						.00	.19	.31	.03	.05	.30	
h. Auditory Identification							.00	.07	.23	.19	.28	
i. Olfactory Identification								.00	.02	.14	.31	
j. Tactile Stimulus Matching									.00	.10	.25	
k. Auditory Stimulus Matching										.00	.15	
l. Olfactory Stimulus Matching											.00	

p .05

(p .01

TABLE 4.3

Olfactory Identification

Correlations for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.1789	0.1774
Performance IQ	31	0.0971	0.3046
Full scale IQ	31	0.0108	0.4764

Question 1: Is there a significant correlation between an individual's IQ and their ability to identify environmental stimuli by way of the olfactory sensory system?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 1: There is a significant correlation between an individual's IQ and their ability to identify environmental stimuli by way of the olfactory sensory system.

As indicated in Table 4.3 there is no significant correlation between Verbal, Performance and Full scale IQ and the Olfactory Identification subtest. Hypothesis 1 was rejected based on these findings.

TABLE 4.4

Auditory Identification

Correlations for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.3457	0.0270 *
Performance IQ	31	0.0050	0.5000
Full Scale IQ	31	0.0658	0.3626

Question 2: Is there a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the auditory sensory system?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 2: There is a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the auditory sensory system.

As indicated in Table 4.4 there is a significant correlation (*) between Verbal IQ and Auditory Identification. However, no correlation exists for the Performance and Full scale IQ"s. Hypothesis 2 was rejected based on these findings.

TABLE 4.5

Tactile Identification

Correlation for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.2445	0.0910
Performance IQ	31	0.0717	0.3515
Full Scale IQ	31	0.1700	0.1873

Question 3: Is there a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the tactile sensory system of the hands?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 3: There is no significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the tactile sensory system of the hands.

As indicated in Table 4.5 there is no significant correlation between Verbal, Performance, and Full Scale IQ and the Tactile Identification subtest. Hypothesis 3 was rejected based on these findings.

TABLE 4.6

Olfactory Short-Term Memory

Correlation for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.0144	0.4684
Performance IQ	31	0.2617	0.0758
Full Scale IQ	31	0.2033	0.1361

Question 4: Is there a significant correlation between an individual's IQ and his/her ability to use short term memory by way of the olfactory sensory system?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 4: There is no significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the olfactory sensory system.

As indicated in Table 4.6 there is no significant correlation between Verbal, Performance, and Full Scale IQ and the Olfactory Short-Term Memory subtest. Hypothesis 4 was rejected based on these findings.

TABLE 4.7

Auditory Short-Term Memory

Correlation for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.2752	0.0653
Performance IQ	31	0.3292	0.0337 *
Full Scale IQ	31	0.3693	0.0193 *

Question 5: Is there a significant correlation between an individual's IQ and his/her ability to use short term memory by way of the auditory sensory system?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 5: There is a significant correlation between an individual's IQ and his/her aility to use short-term memory by way of the auditory sensory system.

As indicated in Table 4.7 there is a significant correlation (*) between the Performance and Full Scale IQ but not the Verbal scale IQ with the Auditory Short-Term Memory subtest. Hypothesis 5 was accepted based on these findings.

TABLE 4.8

Tactile Short-Term Memory

Correlation for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.1256	0.2538
Performance IQ	31	0.0329	0.4273
Full Scale IQ	31	0.0229	0.4492

Question 6: Is there a significant correlation between an individual's IQ and his/her ability to use short term memory by way of the tactile sensory system of the hands?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 6: There is no significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the tactile sensory system of the hands.

As indicated in Table 4.8 there is no significant correlation between the Verbal, Performance and Full Scale IQ with the Tactile Short-Term Memory subtest. Hypothesis 6 was accepted based on these findings.

TABLE 4.9

Olfactory Stimulus Matching

Correlation for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.1149	0.2726
Performance IQ	31	0.1607	0.1991
Full Scale IQ	31	0.1217	0.2604

Question 7: Is there a Significant Correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the olfactory sensory system?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 7: There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the olfactory sensory system.

As indicated in Table 4.9 there is no significant correlation between the Verbal, Performance and Full Scale IQ with the Olfactory Stimulus Matching subtest. Hypothesis 7 was rejected based on these findings.

TABLE 4.10

Auditory Stimulus Matching

Correlation for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.4364	0.0068 *
Performance IQ	31	0.2005	0.1396
Full Scale IQ	31	0.1838	0.1618

Question 8: Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the auditory sensory system?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 8: There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the auditoryy sensory system.

As indicated in Table 4.10 there is a correlation (*) between the Verbal scale IQ but not the Performance and Full Scale IQ with the Auditory Stimulus Matching subtest. Hypothesis 8 was not accepted.

TABLE 4.11

Tactile Stimulus Matching

Correlation for Variance

Variable	N	Correlation	Probability R=0
Verbal IQ	31	0.0221	0.4509
Performance IQ	31	0.0070	0.4845
Full Scale IQ	31	0.0311	0.4312

Question 9: Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the tactile sensory system of the hands?

In order to answer the question, the following hypothesis was tested using Pearson's correlation.

Hypothesis 9: There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the tactile sensory system of the hands.

As indicated in Table 4.11 there is no significant correlation between the Verbal, Performance and Full Scale IQ with the Tactile Stimulus Matching subtest. Hypothesis 9 was rejected based on these findings.

Summary

In this chapter nine research questions and nine hypotheses were presented and the findings were reported. Pearson's correlation was the statistical method utilized in the investigation of the questions.

The findings for question one, three, four, five, seven, and nine were all similar. The findings indicates that there is a difference between an individual's IQ and his/her ability to perform various manipulations using the olfactory and tactile senses. This difference is assumed since no acceptable correlations were found.

The findings for question two are that there is a significant correlation (r = .3457, p .05) for the Verbal scale IQ and the subjects ability to perform and auditory identification test. However, none exists for the Performance and Full scale IQs. The findings for question five indicates that there is a significant correlation (r = .3292, p .05) for the Performance IQ and a significant correlation (r = .3693, p .05) for the Full scale IQ with the subjects ability to perform auditory short term memory tasks. The findings for question eight are that there is a significant correlation (r = .4364, p .01) between the Verbal IQ and the subjects ability to perform a stimulus matching task. However there is no acceptable correlation for the Performance and Full scale IQs.

7. Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the Olfactory sensory system?

8. Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the auditory sensory system?

9. Is there a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the tactile sensory system of the hands?

The research information was obtained from 16 female and 15 male volunteers. There was only one non-white subject in the sample. The age range was from 10 years old to 60 years old with a mean age of 32.7 years old. Sixteen of the subjects had never been married, eight of them were married, and seven them reported being divorced.

Measuring instruments included: the Wechsler Intelligence Scales for Children Revised; the Wechsler Adult Intelligence Scales Revised; an identification test for the olfactory, auditory and tactile senses; a short-term memory test for the olfactory, auditory and tactile senses; and a stimulus matching test for the olfactory, auditory and tactile senses. The tables in Chapter IV and the figures at the end of this chapter graphicaly display the results of these measuring instruments.

The data were statistically analyzed by utilizing Pearson's Correlation coefficients. This method was used to test the following nine hypotheses:

1. There is a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the Olfactory sensory system.

2. There is a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the auditory sensory system.

3. There is a significant correlation between an individual's IQ and his/her ability to identify environmental stimuli by way of the tactile sensory system of the hands.

4. There is a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the Olfactory sensory system.

5. There is a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the auditory sensory system.

6. There is a significant correlation between an individual's IQ and his/her ability to use short-term memory by way of the tactile sensory system of the hands.

7. There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the Olfactory sensory system.

8. There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the auditory sensory system.

9. There is a significant correlation between an individual's IQ and his/her ability to perform a stimulus matching test by way of the tactile sensory system of the hands.

The findings for question one, three, four, five, seven, and nine were all similar. The findings indicate that there is a difference between an individual's IQ and his/her ability to perform various manipulations using the olfactory and tactile senses. This difference is assumed since no acceptable correlations were found.

The findings for question two are that there is a correlation for the Verbal scale IQ and the subject's ability to perform and auditory identification test. However, none exists for the Performance and Full scale IQs.

The findings for question five indicate that there is a correlation for the Performance IQ score and the Full scale IQ score with the subjects ability to perform auditory short-term memory tasks. There was no acceptable correlation for the Verbal IQ score.

The findings for question eight are that there is a correlation between the Verbal IQ score and the subject's ability to perform a stimulus matching task. However, there is no acceptable correlation for the Performance and Full scale IQ scores.

Conclusions

The first major finding of this study indicates that there was a difference in the individual's ability to make an identification, perform a short-term memory task, and perform a matching task with various stimuli through the olfactory

sensory systems of the brain. In correlating the subject's IQ score with their scores on various subtests using this sensory modality, it was found that there was no adequate correlation. It was found that, in some cases, persons with lower IQ's performed as well as or better than individuals with a higher IQ. The assumption is made that the individuals brain has developed differently in the use of the olfactory system than in the areas that are specifically measured by the intelligence tests.

The second major finding of this study indicates that there was a difference in the individual's ability to make an identification, perform a short term memory task, and perform a matching task; with various stimuli through the tactile sensory systems of the brain. In correlating the subjects' IQ score with their scores on various subtests using this sensory modality, it was found that there was no adequate correlation. In some cases, it was found that persons with lower IQ's performed as well as or better than individuals with a higher IQ. The assumption could be made that the individual's brain has developed differently in the use of the tactile system than in the areas that are specifically measured by the intelligence tests.

The third major finding of this study indicates that there is a relationship in the individual's ability to make an identification, perform a short term memory task, and perform a matching task with various stimuli through the auditory systems of the brain. In correlating the subjects' IQ score with their

scores on various subtests using this sensory modality, it was found that there was a significant correlation in some cases. Specifically, the significant correlations occurred in these cases: Verbal IQ score and the Auditory Identification subtest score; Performance IQ score and the Short Term Memory subtest score; Full Scale IQ score and the Short Term Memory subtest score; and the Verbal IQ score and the Stimulus Matching subtest score. The assumption could be that since a major part of the intelligence test requires the auditory perception of the test administrator's vocal instructions and questions, the auditory subtests used in this research measured many of the same auditory sensory systems as the intelligence test.

These findings support the notion that there are many levels of intelligence which are each linked with individual skill, speed, intensity, and extent of a person's ability for intellectual output. Each of the sensory subtests given to the subjects is a way of looking at his/her cognitive abilities to perceive stimuli within the environment, process it, and reproduce it. These cognitive abilities, as recorded by the test results, are directly related to the subject's unique historical learning and developmental experiences.

Recommendations

The findings from this study suggested the following recommendations:

1. Further research should be done to investigate how an

individual's ability to perceive various stimuli through all of the sensory systems correlates with his/her ability to perform on the age appropriate Wechsler standard intelligence test.

2. Since the study was limited to a small number of subjects with a limited number of occupations, it is suggested that a similar study be conducted with a larger group of more varied socioeconomic level to attempt to obtain similar results.

3. Other demographic variables as well as other individual variables should be studied in an attempt to obtain similar results.

4. Since the study was limited to a small geographical area, it is recommended that similar studies be conducted in other areas to attempt to obtain similar results.

5. It is recommended that other subtests be developed to look at perceptual abilities in all of the senses and that these abilities be compared to the current definition of intelligence.

6. This study should be replicated to determine if the findings of this study will generalize to a larger sample.

FIGURE 5.1

Olfactory Identification scores

In relation to the individual's Full scale IQ score

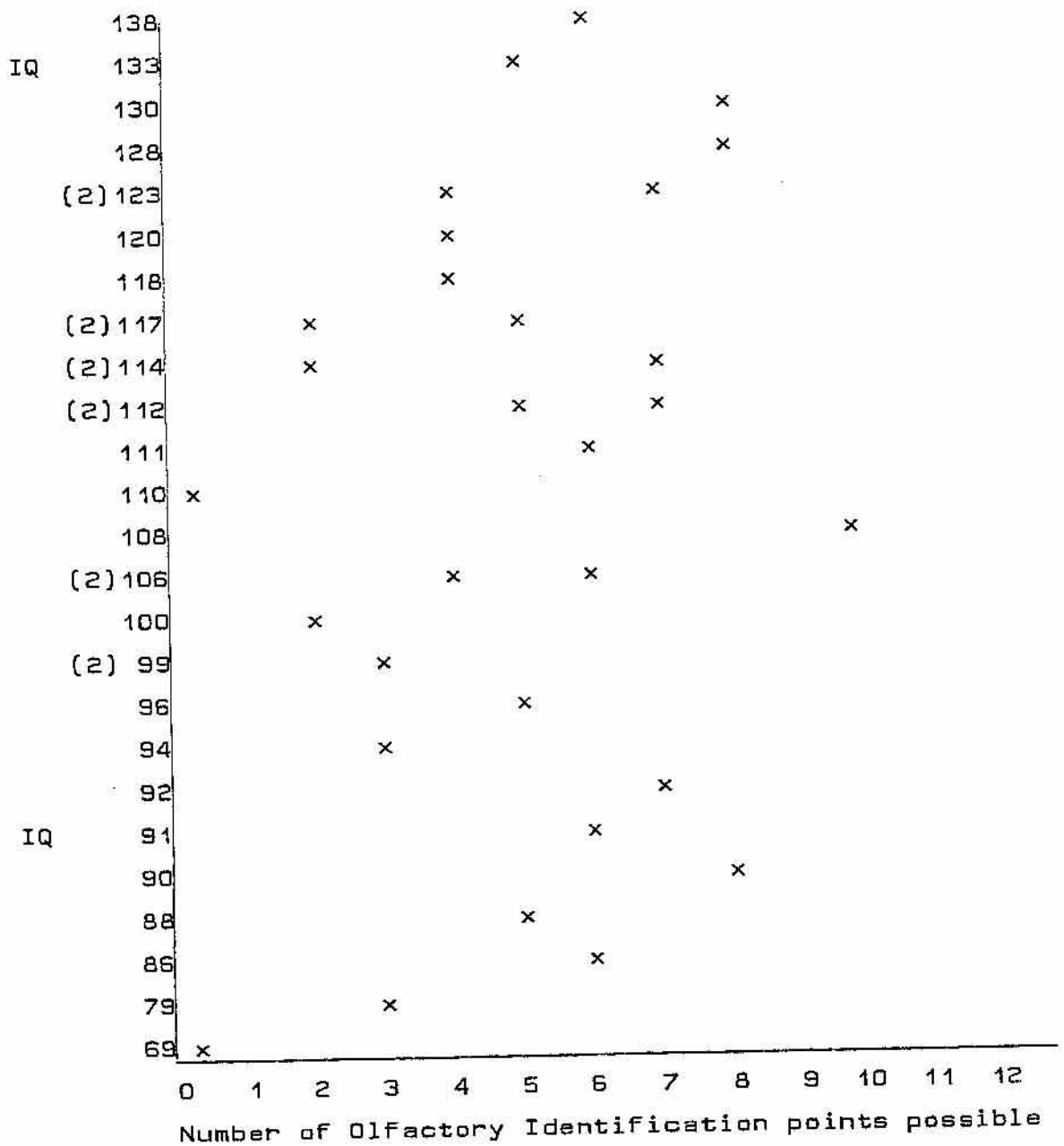


FIGURE 5.2

Auditory Identification scores

In relation to the individual's Full scare IQ score

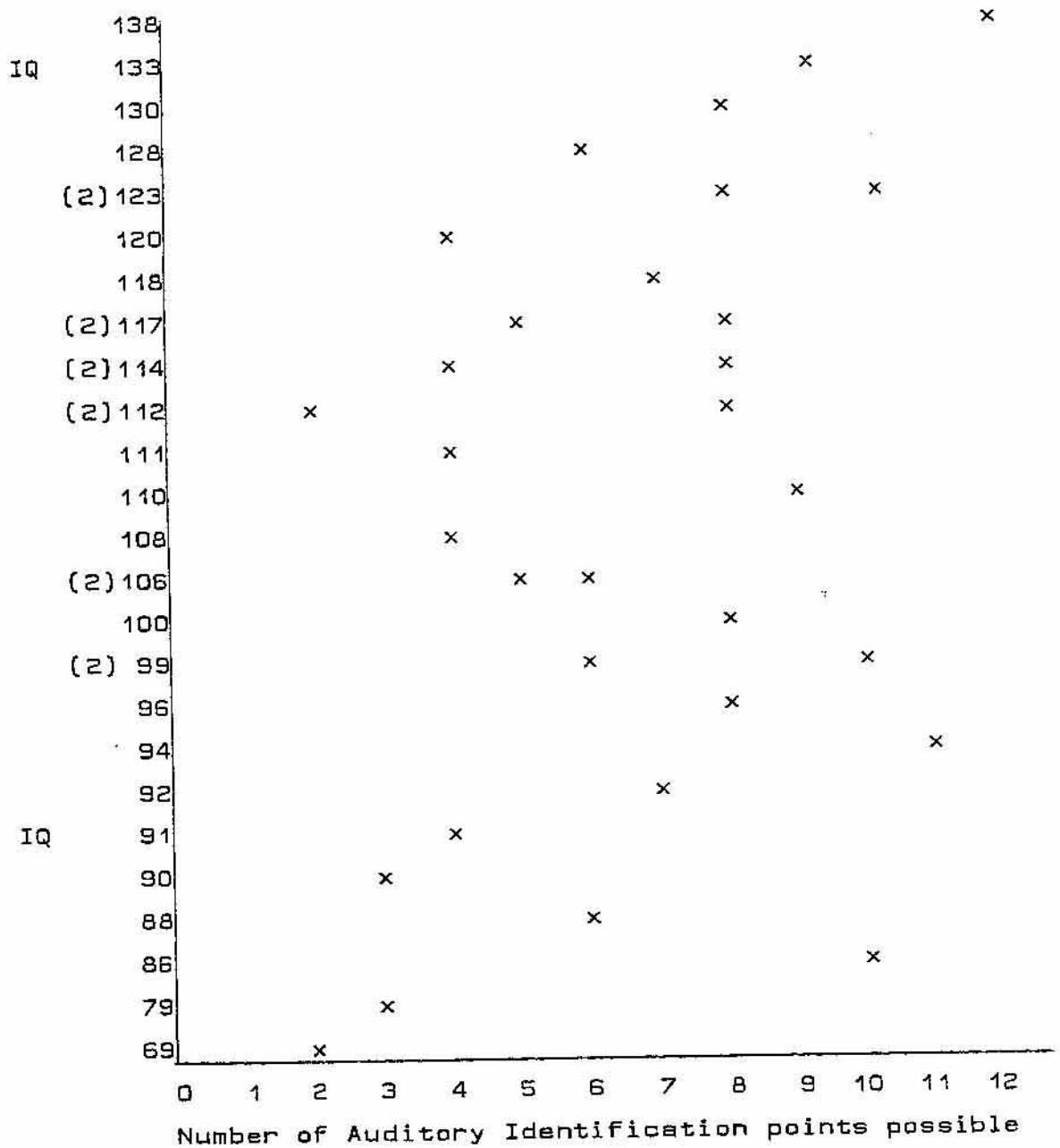


FIGURE 5.3

Tactile Identification scores

In relation to the individual's Full scall IQ score

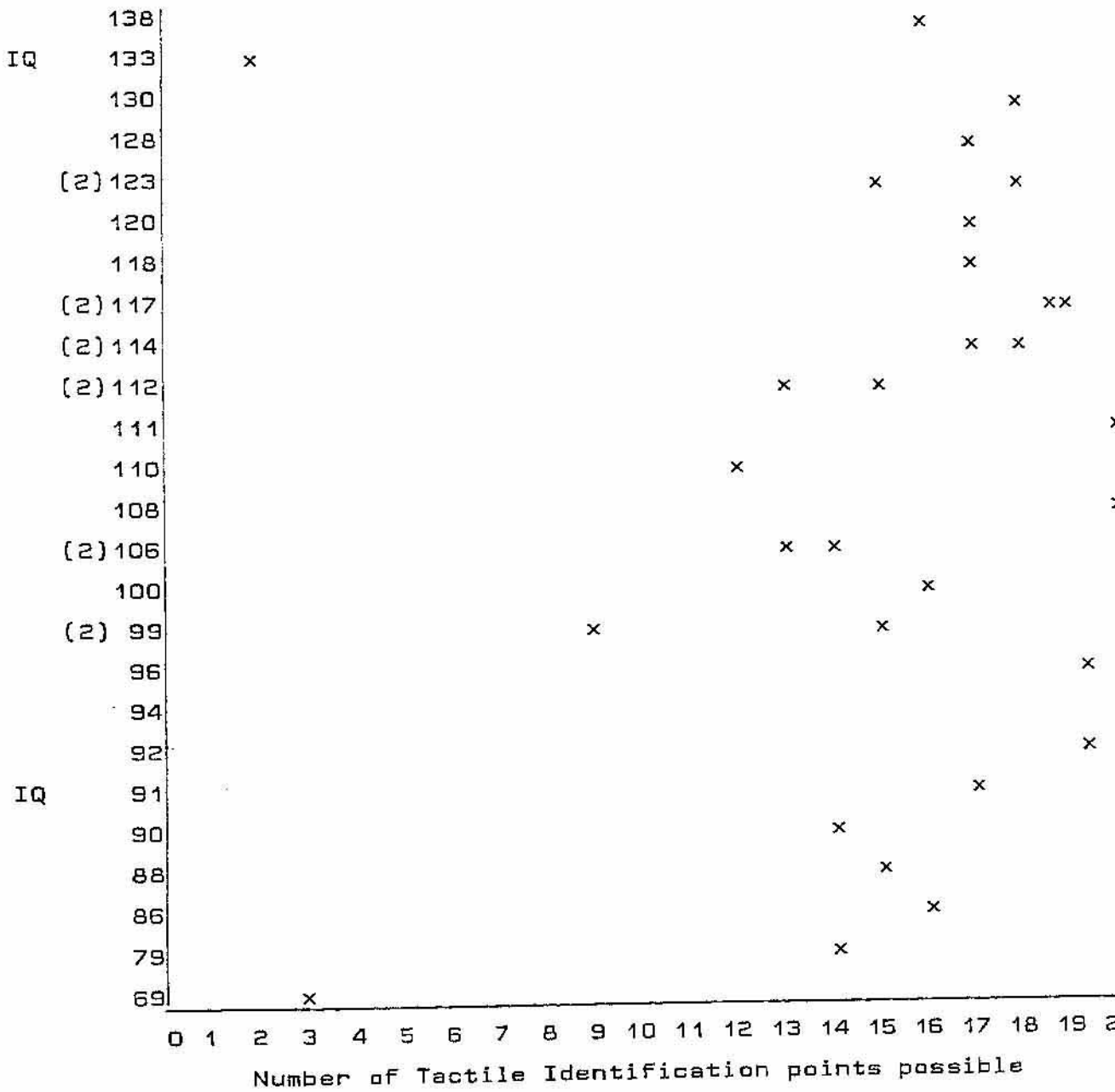


FIGURE 5.4

Olfactory Short-Term Memory scores

In relation to the individual's Full scale IQ score

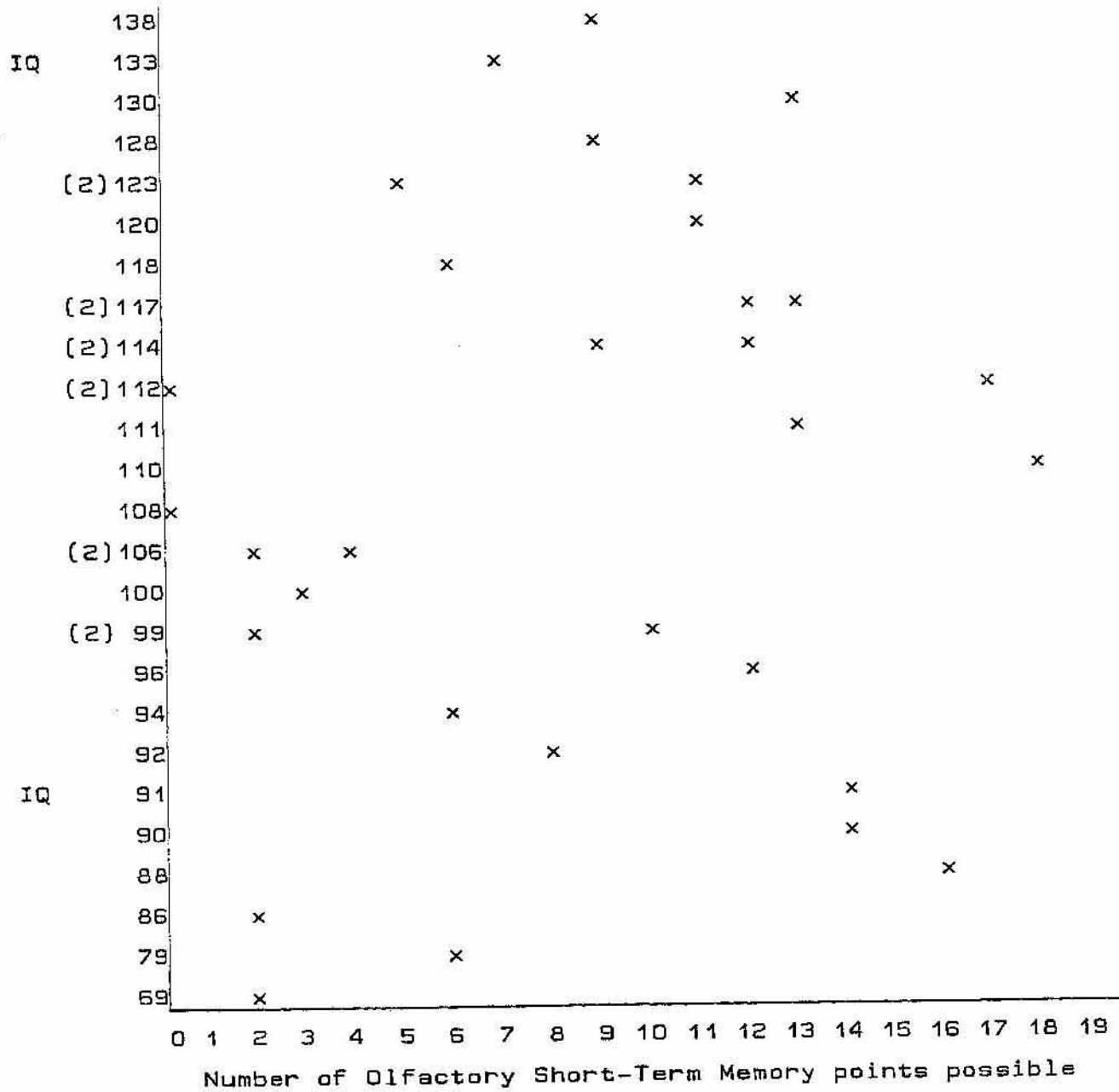


FIGURE 5.5

Auditory Short-Term Memory scores

In relation to the individual's Full scale IQ score

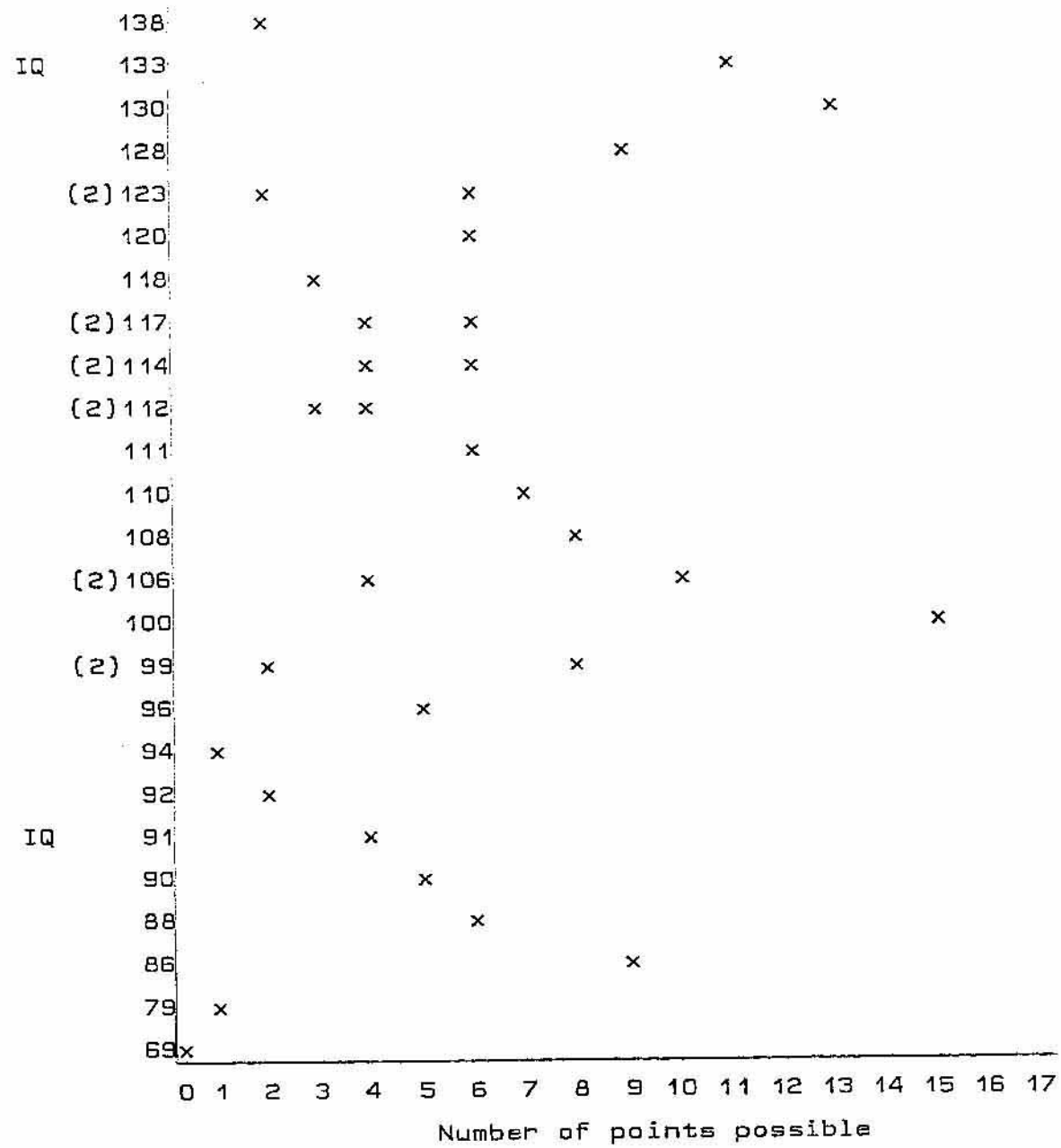


FIGURE 5.6

Tactile Short-Term Memory scores

In relation to the individual's Full scale IQ score

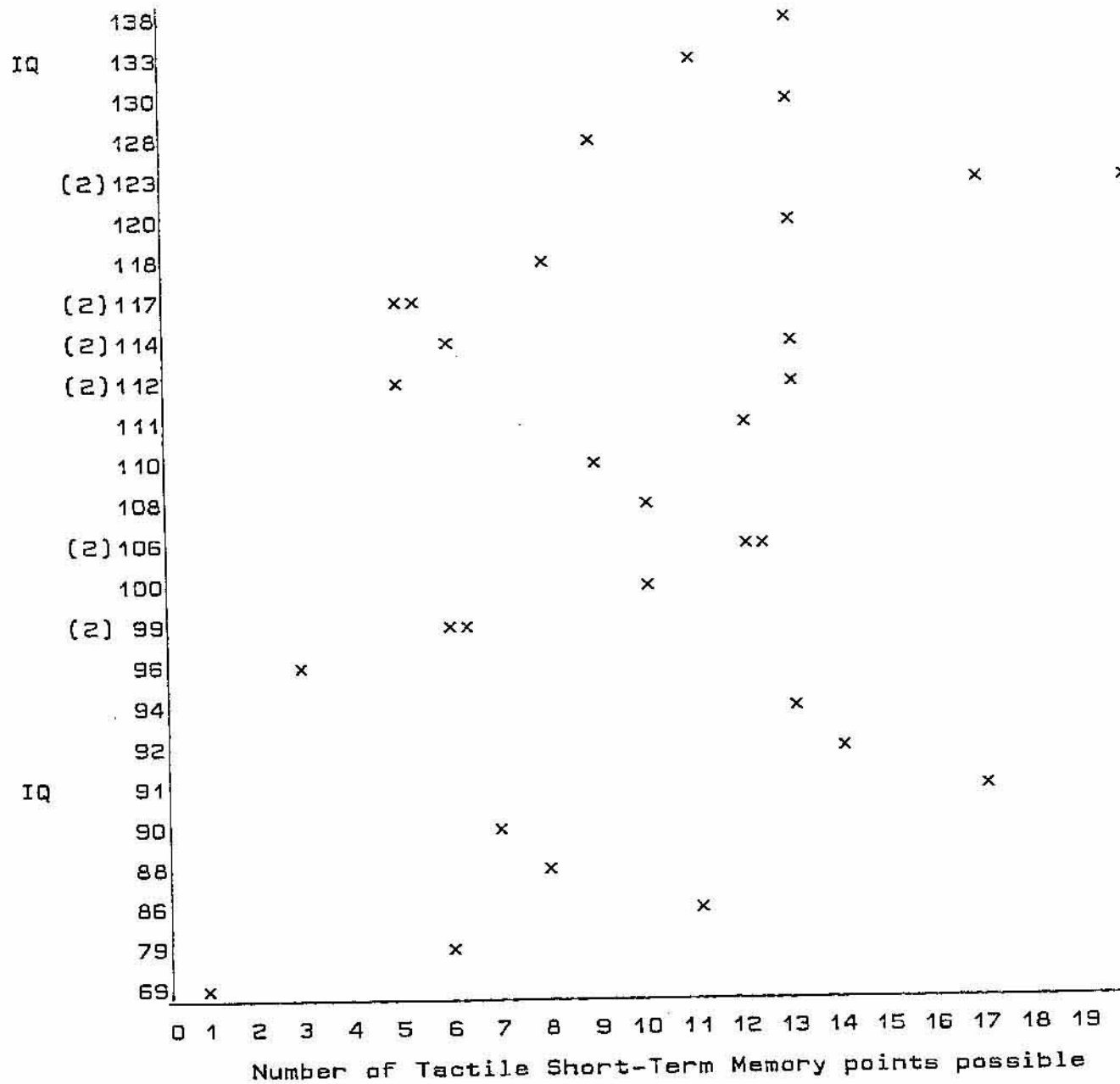


FIGURE 5.7

Olfactory Stimulus Matching scores

In relation to the individual's Full scale IQ score

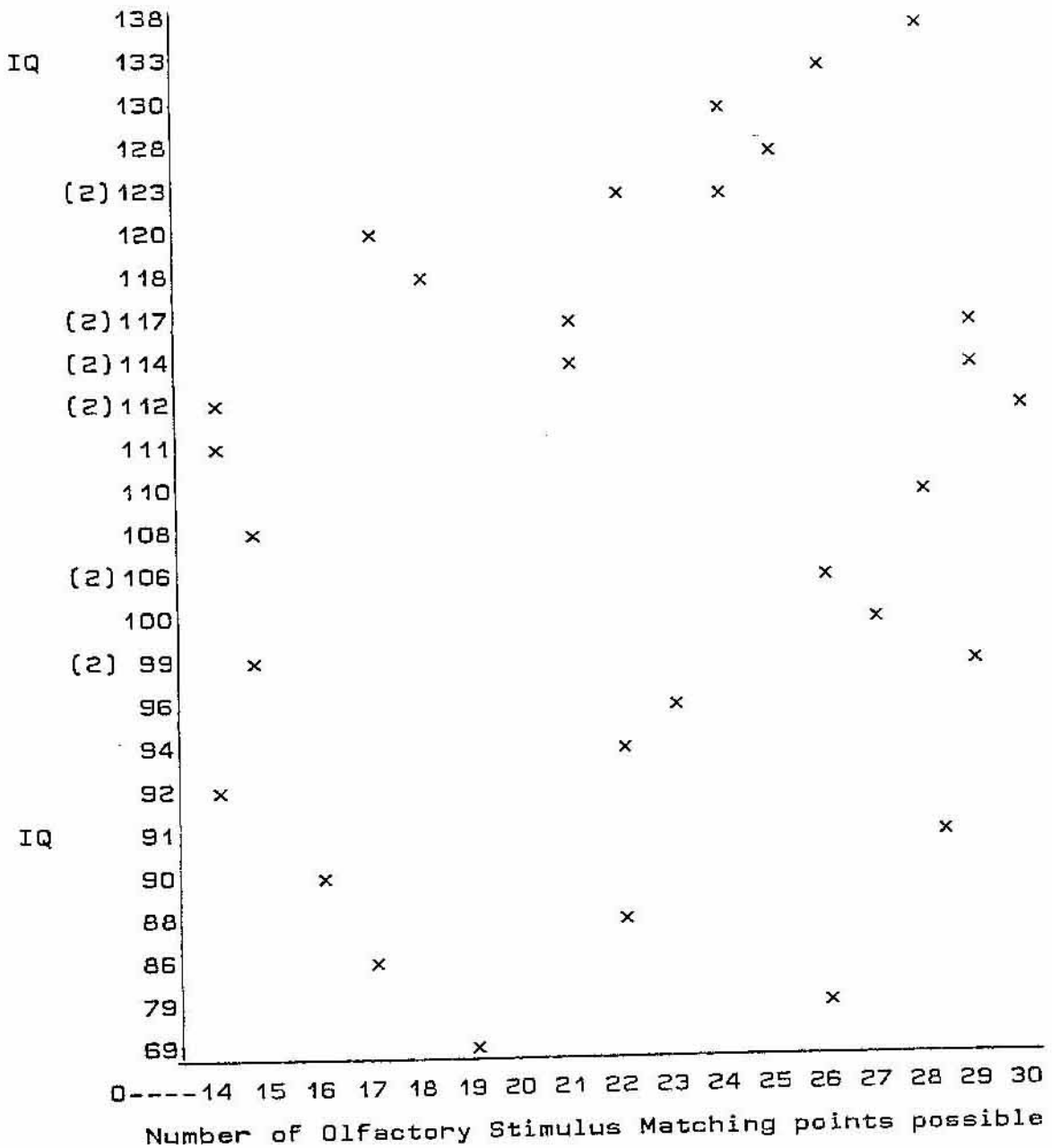


FIGURE 5.8

Auditory Stimulus Matching scores

In relation to the individual's Full scale IQ score

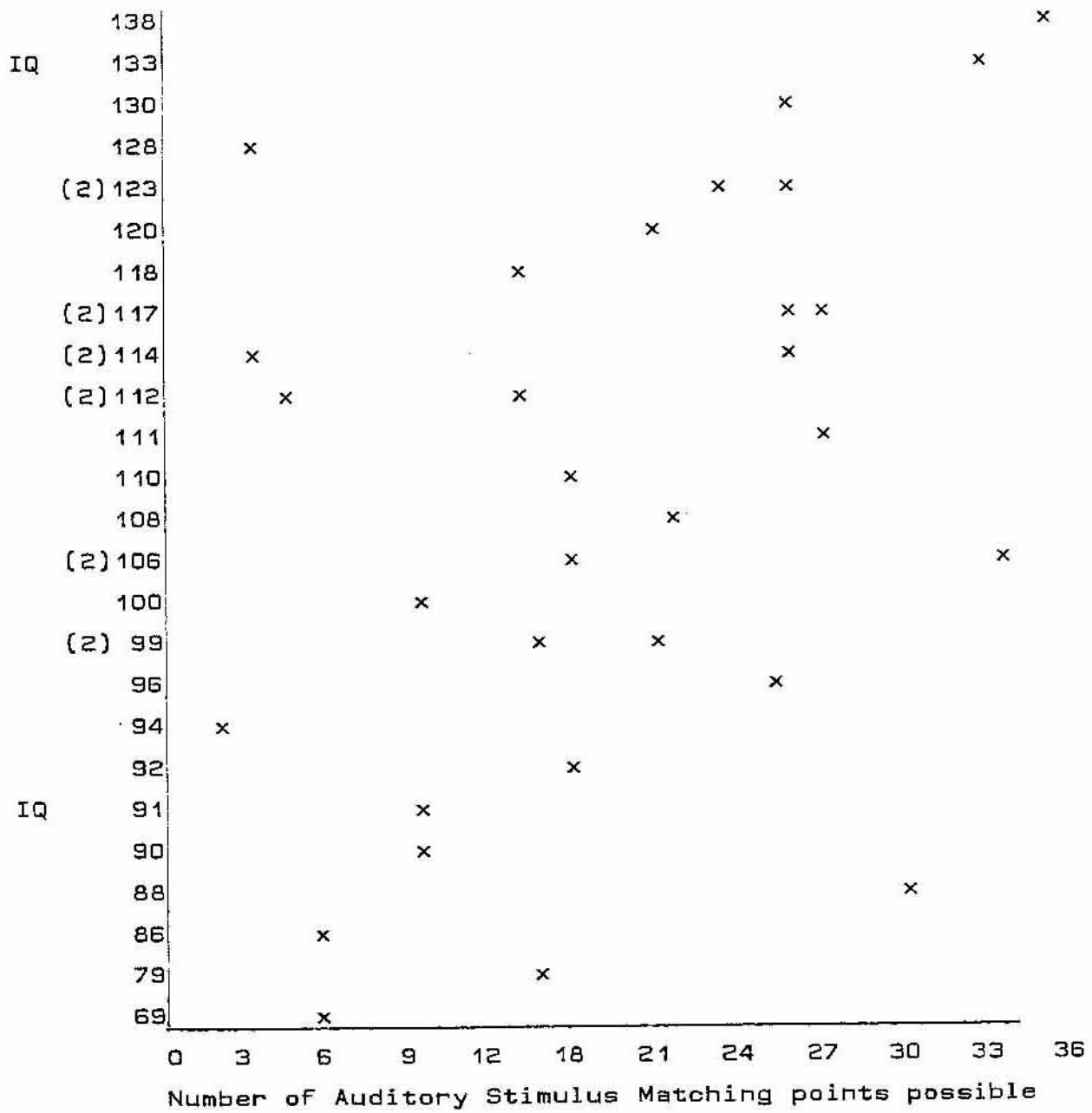
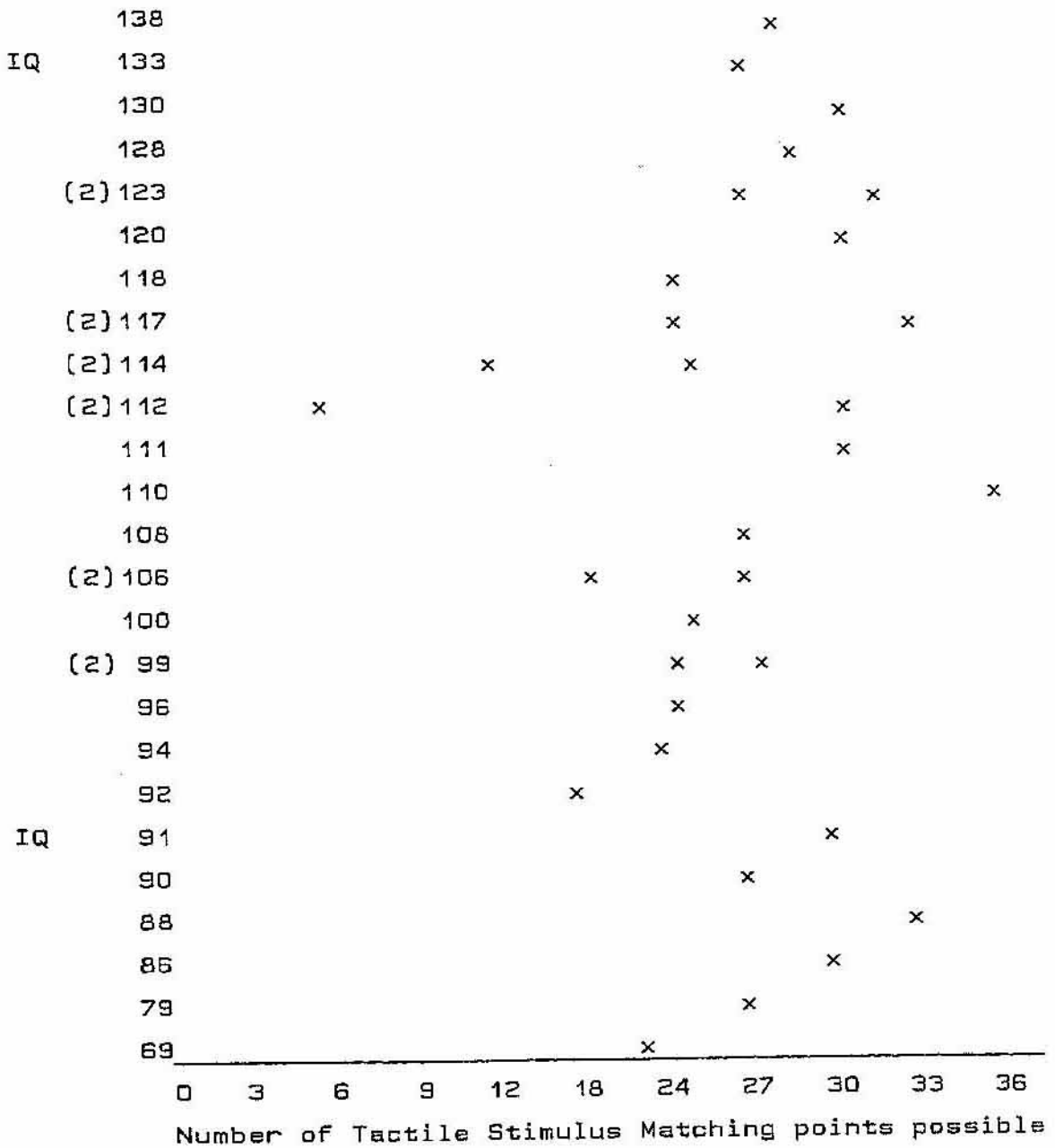


FIGURE 5.9

Tactile Stimulus Matching scores
In relation to the individual's Full scale IQ score



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