The Relationship Between Visual Acuity and Conceptual Tempo

by

© Karen Mitchell

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Department of Educational Psychology
Memorial University of Newfoundland

St. John's Newfoundland

ABSTRACT

The purpose of this study was to examine the relationship between visual acuity and the two components of conceptual tempo, response accuracy and response latency. Subjects were chosen at random. Each subject was then administered a test of conceptual tempo, the Matching Familiar Figures Test (MFFT) and a test of visual acuity, the Snellen. The only significant relationship found was that between response accuracy and near visual acuity. Subjects with superior visual acuity made significantly fewer errors than did those with average or inferior acuity. It was concluded that visual acuity is an important determinant of MFFT performance. Based on these results, it was recommended that further research examine the relationship between visual acuity and other psychometric measures containing a visual component.

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CHAPTER 1

INTRODUCTION

The purpose of this study was to examine the relationship between visual acuity and conceptual tempo. It was hypothesized that visual acuity was a significant determinant of conceptual tempo. It was predicted that persons with normal and superior visual acuity were more accurate, that is, would make fewer errors than would those with inferior levels of visual acuity. It was also predicted that individuals with superior levels of visual acuity would exhibit faster response latencies than would individuals with inferior visual acuity.

Conceptual tempo as defined by Kagan (1965a), classifies stable individual differences in the degree to which an individual reflects upon alternative classifications of a stimulus or alternative solution hypotheses. It is a process of evaluation in a problem-solving sequence and it predicts the quality of response in situations that contain response uncertainty. Kagan uses the terms "reflection" and "impulsivity" to describe opposing ends of the tempo continuum.

The term "reflective" describes those individuals who typically take time to scan all the alternatives and reflect upon the validity of each before choosing a particular response. These individuals tend to respond slowly but commit few errors. The term "impulsive" describes the behaviour of those individuals who accept and report the first hypothesis that is printed on their screen of awareness without considering the validity or appropriateness of the response. These persons tend to work quickly and commit many errors.

Operationally defined, the construct involves two dimensions, response latency and error frequency. A dual-median split on these dimensions creates four possible categories of conceptual tempo: reflective, impulsive, fast-accurate, and slow-

inaccurate. Reflective persons score above the median in response latency and below the median in error frequency; impulsive tempo persons score below the median in response latency and above the median in error frequency; fast-accurate tempo persons score below both medians; while slow-inaccurate tempo persons score above both medians (see Table 1).

TABLE 1

Categories of Conceptual Tempo

		RESPONSE LATENCY	
		Fast	**Slow**
RESPONSE ACCURACY	**Accurate**	Fast-Accurate	Slow-Accurate (Reflective)
	Inaccurate	Fast-Inaccurate (Impulsive)	Slow-Inaccurate

Visual acuity describes that function of the eye that distinguishes the shape, or form of an object. Testing visual acuity is an important preliminary step in the evaluation of ocular function and involves a variety of complex processes. First the object is imaged on the retina. This causes a photochemical response which, in turn, produces a nerve impulse that results in a conscious perception. Visual acuity is expressed as a fraction, the numerator of which states the distance between the test object and the person. The denominator indicates the distance at which the test object subtends an angle of five minutes upon the retina of the eye. The Snellen chart, which has traditionally been the most common instrument for measuring visual acuity, describes acuity in less technical terms. According to Snellen a person having 20/20 vision is able to distinguish letters that the average

person can distinguish at 20 feet. A rating of 20/200 means that the person is able to distinguish letters at a distance of 20 feet what the average person could distinguish at 200 feet.

Significance

The results of this study may have significance for the psychometrician. If visual acuity is a significant factor in designating the categories of conceptual tempo, any measurement of tempo not preceded by a measure of visual acuity may be rendered invalid.

At the present time, most schools in Newfoundland screen children for long-distance, visual acuity prior to entering school. However, this screening does not continue in a routine manner, and is only available at the recommendation of the teacher or upon the request of the child. Thus, the schools may be unaware that many children may require some corrective measures to facilitate a normal level of visual acuity. It is also important to note, that the screening process involves testing only long-distance, visual acuity, while, it is near-distance visual acuity that appears to be most closely related to the requirements of the measure of conceptual tempo–and the majority of academic learning activities that occur in schools.

Perhaps, a more profound implication for psychometricians may be a careful consideration of the generalizability of the function of visual acuity upon psychometric tests. If visual acuity significantly affects results on the conceptual tempo measure, it is reasonable to hypothesize that it will also have an effect upon other tests that require visualization of written materials and discrimination among various visual stimuli. Without correction of defective vision, the results of other tests,

such as, intelligence, achievement, and aptitude tests, also may be rendered inaccurate and invalid.

Within the school population, the impact of invalid test results would be greater for some individuals than for others. Grade and class placements are often based on the results of certain tests. Borderline decisions, predicated upon invalid results would do the student a serious injustice, the repercussions of which may be experienced for the whole of a student's school career and longer. Data that will increase the accuracy and validity of psychometric testing, would improve the quality of the educational decisions that are based upon psychometric tests.

CHAPTER 2

REVIEW OF THE LITERATURE

For this review, the tempo construct was researched extensively and it was found to be related to a large number of diverse variables. Some of these variables were of a general nature and were applicable to any study of the tempo construct, while others seemed explicitly related to the present study. An attempt was made to categorize and briefly outline the broad general class of variables that were related to tempo, and then to group more specifically and define those variables pertinent to the subject of this research, the relationship between visual acuity and conceptual tempo.

Many researchers postulated and supported a general theoretical outline of the tempo construct (Kagan, 1965b). The nature of the construct has been explored in detail and many hypotheses have been tendered to explain its subtle but complex composition. Although a large body of research has been cited to support the tempo construct, the construct has also received some criticism. The most notable criticisms claimed that response bias, speed-accuracy trade-offs and environmental effects were responsible for the phenomenon described as conceptual tempo.

The literature also cited research concerning the operationalization of the conceptual tempo construct. Several researchers cited conservative evidence that attested to the reliability, as well as the construct and convergent validity of the tempo measures. Some research also indicated that tempo measures were inadequate; therefore should be used sparingly and interpreted with caution (Becker, Bender & Morrison, 1978; Block, 1987; Block, Gjerde and Block, 1986).

Conceptual tempo has also been linked with certain demographic, developmental and personality correlates. Significant relationships were cited for age, sex, race

and culture (Cairns 1978; O'Brien, 1987). Connections were made between conceptual tempo and aspects of the individual's social and emotional make-up that related to depression, aggression, humorous affect, emotional stability, success, failure and anxiety (Brodzinsky 1977).

The research literature also suggested the existence of significant relationships between conceptual tempo and certain mental processes, such as, concept formation, creativity, convergent thinking, abstract thinking and intelligence. Although the nature of these relationships was not always clearly understood and by no means always linear, they were statistically significant (Broberg & Moran, 1987; Eska & Black 1971; Kotze, 1986; Smith, 1988).

Academic achievement was another important variable that seemed to be linked with tempo. General school achievement as well as performance in specific curriculum areas such as linguistics, reading and mathematics seemed to be a function of conceptual tempo (Margolis et al., 1982; Rinehart, 1988).

By far, the largest body of literature related to the modifiability of one's individual tempo. A great deal of evidence was put forward suggesting that various techniques were successful in effecting identifiable changes in an individual's cognitive style. These changes occurred under differing training and reinforcement conditions. Sometimes the changes were temporary and affected only one of the two tempo variables (Emihovich & Miller, 1988; Gow, Ward & Balla, 1986; Rivera & Omizo, 1980).

Pertinent to the present study, was a fairly extensive body of literature that cited inter-individual differences in style and technique as they related to the actual visual processes involved in the performance of tasks requiring visual discrimination. Related to conceptual tempo were a variety of visual variables; such as scanning strategies, focusing, auditory-visual integration, field dependence, visual-feature

analysis, vertical-horizontal eye movements, fixation patterns, color-form sorting and visual-perceptual abilities (Vurpillot 1969).

Instrument Evaluation

The development of any highly abstract construct presented the theorist with the very difficult task of operationalizing and quantifying that construct. Even though the concept of reflection-impulsivity was widely supported, evaluators of the instruments used in its measurement were critical of the acceptance and further development of the construct. Several researchers have provided evidence to attest to the reliability and validity of the instruments used to measure conceptual tempo. While the Matching Familiar Figures Test, (MFFT), Design Recall Test (DRT) and Haptic Visual Matching Test (HVM) were the three most commonly used instruments, the majority of the research focussed on the MFFT which was the original instrument developed by Kagan. Evidence supporting the construct validity of the MFFT was cited by Cairns (1978); Kagan (1964); Lorr and Wunderlich (1985); and Stein and Prindaville (1976). These authors concluded that the MFFT was a valid measure of the construct of reflection-impulsivity. Margolis, Leonard, Brannigan and Heverley (1980) developed a longer version of the MFFT known as Form F which they also determined to be a valid indicator of reflection-impulsivity.

Evidence was also put forth supporting the reliability of the MFFT. Re-test intervals ranged in time from 3 weeks to a year. Adams (1973); Epstein, Cullinan and Lloyd (1977); Kagan (1965a), (1965b); Siegleman (1969); and Yando and Kagan (1968) reported that the MFFT appeared to be a stable instrument over varying periods of time.

All the research concerning the reliability and validity of the tests has not been totally favorable and many researchers have concluded that the MFFT is only

moderately reliable and valid and should be used cautiously and discretely. Becker, Bender and Morrison (1978) reviewed existing research concerning the reliability and validity of the MFFT. Although they did cite the favorable conclusion of Epstein et al. (1977) that the MFFT was a valuable tool to use when assessing children, they cited several researchers who had arrived at less favorable conclusions concerning the MFFT. Block et al., (1986); Block, Block, and Harrington (1974); and Weiner (1975) all warned against over-enthusiasm regarding the MFFT due to low test-retest reliabilities and low correlations between response times and errors. Block, Gjerde and Block (1986) found an absence of construct validity in the MFFT in their work with preadolescents. Kagan (1986) responded to this research alleging flaws in their logic and inferences. Kagan's article received a response from Block (1987) who discounted many of the arguments and evidence addressed by Kagan and further reaffirmed his earlier criticism of the validity of the MFFT. Block et al., (1974) also found that errors rather than time accounted for the majority of the variance in performance. Lack of normative data was a further criticism offered by these researchers. Becker, Bender and Morrison (1978) reported that while there was some evidence of concurrent validity, the relationship between the MFFT and school achievement measures yielded significant but relatively low correlations. Low test-retest correlations also raised some doubt as to the reliability of the MFFT. The authors concluded that while the construct of reflection-impulsivity was highly relevant and appropriate particularly when dealing with children who were classified as learning disabled or educationally handicapped, the measurement instrument, the MFFT, needed research and examination. At present, it is concluded that MFFT results should be interpreted with caution and supplemented with data from other educational measures when they are used for making important decisions.

Block, Block and Harrington (1974) suggested that any one test of conceptual tempo may be inadequate to measure the construct as outlined by Kagan (1964). In their study, 50 boys and 50 girls were administered the MFFT in conjunction with the California Child Q sort, which was used to assess personality attributes. Separate contributions of latency and accuracy were measured. It was found that accuracy had important personality concommitants whereas latency was inconsequential. Fast-inaccurate children were anxious, hypersensitive, vulnerable and structure seeking; they were not impulsive, minimally concerned and unanxious as conjectured by Kagan. The authors thus contended that conceptual tempo as measured by the MFFT may be more a function of differences in basic personality factors. Due to the broad scope of conceptual tempo, they suggested that one measure such as the MFFT, was inadequate and should be used in conjunction with a number of other measures in order to achieve overall construct validity.

Cairns and Cammock (1978) attempted to improve the reliability of the MFFT by adding to its length. Twenty items were selected as a result of item analysis of 38 MFFT type items. These items were then administered in two subsequent studies to a group of 11 year old boys. The split-half correlations for the new MFFT over a two-week period were r = .91 for latency and r = .89 for errors. Test-retest correlations over 5 weeks were calculated at r = .85 for errors and r = .77 for latency. These results prompted the authors to suggest that the revised version of the MFFT known as the MFFT 20, might be suitable for use with children ranging from 7 - 11 years of age. Loper and Hallahan (1980) compared the new MFFT 20 with the original MFFT and discovered significantly higher reliablity coefficients for both latency and error on the MFFT 20. Grush et al., (1983) developed a new self-report measure of impulsivity that provided group administration and economy of scoring. Reliability and validity measures prompted the authors

to conclude that the New Impulsivity Scale had sufficient psychometric properties and practical advantages to warrant its use in educational and research settings. Oas (1984) found that both the Draw-a-Person and Bender Gestalt Tests were valid measures of impulsivity among adolescents.

Demographic Variables

Data were also discovered relating tempo to certain demographic variables such as age, sex, race and socio-economic status. Studies to date have confirmed the hypotheses that error rate decreased with age and response latency increased with age. Achenbach and Weisz (1975); Brown and Quay (1981); Cairns (1978); Campbell and Douglas (1972); Kagan (1966a); Katz (1971); O'Brien (1988); and Schleifer and Douglas (1973) cited evidence attesting to the developmental nature of tempo. Reflection tends to increase with age, with older subjects exhibiting a significant increase in latency and decrease in error rate.

Draguns and Multari (1961) offered an alternative explanation of the age factor. Their study indicated that an increased tendency toward reflectivity corresponded with a general disposition toward caution with an increase in age. Ambiguous pictures were shown to children in grade I, II, V, and VII. Gradually clues were added to decrease ambiguity. Older children proceeded cautiously, generating and rejecting a larger number of alternative hypotheses in an effort to increase the accuracy of their responses. This process was reflected in the results. In contrast, the error rate of the younger children was considerably higher than that of the older children.

In contrast, Souch (1970) conducted a cross-sectional investigation involving 495 subjects in grades one through six and found no evidence to support a positive relationship between age and conceptual tempo.

Massari and Massari (1973) cited evidence of sex differences in the relationship between cognitive style and intellectual functioning in disadvantaged preschool children. They found that accuracy measures of reflection-impulsivity were positively related to measures of intelligence for girls but not for boys. This evidence suggested that at the pre-school age level, the reflection-impulsivity dimensions were not functionally equivalent for both sexes and should be treated accordingly.

Lewis, Rausch, Goldberg, and Dodd (1968) attempted to define sex differences in the cognitive style of preschool children. Response latency and error rate on a matching figures task were measured as well as intelligence. The results indicated that important sex differences in cognitive style did exist. Boys' errors were significantly correlated only with response speed. Faster response times produced more errors. Girls' errors were only significantly correlated with intelligence scores. Girls with high IQ's made significantly few errors. The authors suggested that the results obtained in this study argued against pooling data across sex.

Zucker and Stricker (1968) found the individual differences in conceptual tempo may in part be a function of socio-economic status. When lower and middle class groups of children were compared, the results showed that lower class children made decisions significantly faster than did middle class children. Also, lower class children made significantly more errors than did middle class children. In short, middle class children were significantly, more reflective than were lower class children.

Salkind, Kojima and Zelniker (1978) examined cross cultural differences in cognitive tempo that emerged from MFFT data gathered from over 5000 American, Japanese and Israeli Children. Significant main effects were found for age, sex and nationality. Younger Japanese children made fewer errors than did their American and Israeli counterparts up to the age of 8, at which point their accuracy level

approximated that of 10 - 12 year old American and Israeli children. The latency performance of Japanese children peaked at 8 years of age, while American and Israeli children continued to increase in latency up to the age of 20, eventually becoming slower than their Japanese counterparts. All three cultures reflected the same developmental trend, impulsivity at an early age to increased reflectivity with age.

Ayabe and Santo (1972) studied conceptual tempo in Japanese, Chinese and American children. Their results showed that although Japanese and Chinese children did not differ significantly on the latency variable, they did produce significantly fewer errors than did other children when told to "go as fast as you can." These results supported the hypothesis that traditional Japanese and Chinese values of perseverance and reservation would manifest themselves in the production of fewer errors and extended latencies and that certain cultures exhibit greater tendencies toward reflectivity than do others.

Social and Emotional Behaviours

Limited research was also available suggesting that cognitive style was related to the child's social and emotional makeup. Emotional variables such as depression, aggression, humorous affect, success and failure were linked with tempo.

Anxiety was one emotional variable that appeared to be related to tempo. Messer (1970); Messer and Kagan (1969); and Weiner and Adams (1974) provided evidence to support the hypothesis that situationally-induced anxiety led to an increase in response latencies and a decrease in the number of errors. Anxiety as a result of fear of failure prompted a tendency toward reflectivity. In contrast to the previously mentioned research, Reali and Hall (1970) were not able to

differentiate reflective children from impulsive children on the basis of expectancy for success or fear of failure.

Research also linked tempo with humorous affect in children. Brodzinsky, Tew and Palkovitz (1979); Brodzinsky (1977); and Brodzinsky (1975) reported that impulsive children displayed the greatest spontaneous mirth. Reflective children displayed a higher level of comprehension and a greater appreciation of all forms of humor according to Brodzinsky (1975).

Some researchers attempted to relate tempo to aggression and depression in children. In terms of aggression Messer and Brodzinsky (1979) found that impulsive children had less control over aggressive thoughts and exhibited more aggression in terms of classroom behaviours than did reflective children. Fuhrman and Kendell (1986) found impulsivity related to hyperactivity but not aggression, delinquency or depression. Bombe et al. (1987) produced research suggesting no significant relationships between personality correlates and tempo.

Research has also indicated that reflective and impulsive children exhibit distinctive individual differences in the types of social and classroom behaviours that they exhibit. Peters and Bernfield (1982) found impulsive children to be more yielding in social situations than their reflective counterparts who were more assertive and direct in a social situation. Blumenthall, McKee, William and Haney (1981) found that one specific component of Type A behaviour, speed and impatience, was significantly and positively related to increased impulsivity. Susman, Huston-Stein, and Friedrich-Color (1980) found that impulsive children were less likely to engage in social helping behaviours such as cooperation and sharing. Brown and Quay (1981) found that error rate was significantly higher for behaviourally-disordered children than for normal children. McKinney (1975) rated impulsive boys as less task-oriented and considerate than reflective children of

either sex. Kagan (1965a) found data that indicated that there were individual differences between the personality-behaviour correlates of impulsive and reflective children. Reflective children demonstrated greater persistence, chose more difficult tasks, and tended to avoid peer group interaction and physically dangerous activities. Oas (1985) found that impulsivity was related to delinquent behaviour among incarcerated adolescents.

Some researchers have attempted but have not been able to define clearly distinctive behavioral components of the tempo construct. Bjorkland and Butler (1973) attempted to document some general behavioral correlates of reflection-impulsivity. Their results led the authors to conclude that preferred individual cognitive styles did not appear to be a part of any general, global pattern of behaviour.

Special Sub-Groups

A small body of literature defined tempo differences between average children and certain special subgroups within the normal population. These groups included the emotionally disturbed, the learning disabled and the retarded. Within these special groups, data were also available which was consistent with tempo data from normal samples.

A small body of research among emotionally disturbed children revealed individual and distinctive differences in cognitive style that were compatible with tempo research among a norm sample. Tempo differences correlated highly with variables; such as, need for achievement, locus of control, fear of failure, and mental age. Evidence of tempo differences between the emotionally disturbed and normal children was also discovered. Finch, Spirito and Brophy (1982) found that emotionally-disturbed children demonstrated a high positive correlation between

reflectivity and performance on standardized measures of intelligence. Zern, Kennedy and Kvaraceus (1977) found that emotionally-disturbed children were significantly more impulsive than their reflective counterparts. Finch, Jr., Crandell and Deardoff (1976) found that reflective emotionally-disturbed children indicated a higher need for achievement than did impulsive children. Nelson III, Finch, Jr. and Hooke (1975) found that 'fear of failure' influenced tempo. As with normal children, emotionally disturbed children demonstrated a tendency toward reflectivity as the fear of failure increased. Finch, Pezzuti, Montgomery and Kemp (1974) found that reflective emotionally-disturbed children had a significantly higher grade level placement than did the impulsive children. Rohrbeck and Twentyman (1986) found that pre-school children who had been abused and neglected by their mothers were significantly more impulsive than were their peers.

Several researchers worked with groups of mentally retarded and learning disabled children. Gow and Ward (1982) found that tempo performance was not a good indicator of general intelligence within a mentally handicapped group of adolescents. Gow and Ward (1980); Lee and Cottreau (1979); Lowry and Ross (1975); and Peters and Davies (1981) found that training significantly increased reflectivity among the mentally handicapped. Jackson and Haines (1983) found that retarded adolescents were significantly more impulsive than normal adolescents. Kotze (1986) found that deficits in the problem-solving ability of learning disabled children were significantly related with impulsivity. However, Borys and Spitz (1978) found evidence to refute claims that impulsivity was a factor that contributed to inferior performance by EMR children on certain problem-solving tasks.

Learning disabled children were also found to differ from other children in terms of cognitive style. Two investigations, Epstein, Cullinan and Sternberg (1977), and Nagle and Thwaite (1979), concluded that groups of both mildly and

severely, learning-disabled children were significantly more impulsive than were groups of normal peers. Research among the learning disabled and the mentally handicapped indicated that these two groups do differ significantly from the norm in terms of cognitive style, but that within their own group, tempo followed much the same trend as it did within the normal population. Walker (1985) critically reviewed the literature on learning-disabled children and while agreeing that there is evidence of an impulsivity-learning disability link, he suggests that the connection is clouded by past methodological inconsistencies.

Mental Processes

Tempo has also been related to certain mental processes such as problem-solving, convergent thinking, central learning, non-animistic reasoning, concept formation, abstract thinking, inductive reasoning and creativity. In studying some of the mental processes, it was found that reflective children were more effective detectors of referentially ambiguous items than were impulsive children. Pratt and Wickens (1983), Walker (1982) reported that reflective children were better time-estimators than were impulsive children. Ault (1973); Cameron (1984); Klein, Blockovitch, Buchalter and Huggle (1976); Kotze (1986); Lawry (1983); McKinney (1973); and Walker (1982) found that reflective children were better problem-solvers than were their impulsive counterparts. They also appeared to develop a larger number of more efficient strategies than did the impulsive children. Cathcart and Liedtke (1973) and Juliano (1977) also provided evidence which suggested that reflective children performed better than did impulsive children on tasks that measure abstract concept formation. Creativity was another variable that researchers attempted to link with conceptual tempo. Broberg and Moran (1987), Fuqua, Bartsch and Phye (1975) found that reflective children scored significantly higher

than impulsive children on all areas of creativity. Reflectivity was also positively correlated with non-animistic reasoning (Berzonsky, 1974) and a tendency toward inductive reasoning (Kagan, 1966a). Goldman and Everett (1985) also found that reflective subjects have more highly developed time concepts than do impulsive subjects, and Smith (1988) reported that impulsive children were more holistic reasoners than were reflective children.

Some researchers could not find evidence that would link tempo with certain mental processes. Rosenfield, Houtz and Steffero (1977) could not provide data to support the relationship between tempo and creativity or tempo and problem-solving. Wolfe, Egelston and Powers (1972) found no evidence linking tempo with abstract or concrete thinking.

In summary, the research indicated that tempo appeared to be linked with certain mental processes such as problem-solving, reasoning, creativity and concept formation, and that reflectivity was a desirable trait to encourage in the facilitation of the development of other mental processes.

Intelligence

The relationship between conceptual tempo and measured intelligence noted in the literature is not really clear, and it appears to be much more than a straight linear relationship. Eska and Black (1971) conducted an extensive study, measuring intelligence as the primary variable. The results of this study indicated that MFFT response latency appeared to be positively correlated with nonverbal measures of intelligence, and that the significant negative correlations between error and IQ suggested an inverse relationship between error and measured intelligence. It was also found that response latency was not as important as response accuracy in determining the relationship between tempo and intelligence.

Eska and Black (1971) also noted the intercorrelations among IQ, MFFT latency and MFFT error as reported by several investigators. These results appear in Table 2. It was important to note that although nonsignificant IQ-latency correlations cited in several of the studies did support the traditional position that response latency was relatively orthogonal to measured IQ scores, eleven of the twelve studies reported positive correlations between latency and IQ, and seven of the twelve reported that the correlations were significant for either males, females, or both.

TABLE 2

Correlations Between MFFT Errors, MFFT Latencies, and IQ in Selected Studies

Study No.	N		Grade	Errors-Latency		Errors-IQ		Latency-IQ	
	M	F		M	F	M	F	M	F
1	23	25	preschool	-.48*	-.11	-.30	-.60**	.10	.30
2	41	46	kindergarten	-.02	-.39**	-.09	-.33*	.23	.23
3	41	46	kindergarten	-.39*	-.26	-.27	-.22	.15	.39*
4	65	65	first	-.40**	-.56**	...	...	...	...
5	80	80	first	-.53**	-.59**	-.36**	-.33*	.20	.27*
6	50	50	third	-.69**	-.56**	-.47**	-.35*	.33*	.45**
7	30	28	third	-.66**	-.47*	-.53**	-.28	.36*	.22
8	60	60	third	-.57**	-.51**	-.47**	-.21	.05	.15
9	30	25	fourth	-.65**	-.60**	.10	-.40*	-.13	-.03

Note - Studies: 1, Lewis et al. (1968); 2 and 3, Ward (1968); 4, Kagan (1965); 5, Yando and Kagan (1968); 6, present study; 7, 8, 9, Kagan et al. (1964).

*p < .05. **p < .01.

Margolis, Brannigan and Ash (1980) attempted to further define the nature of the relationship between intelligence and tempo. The tests used were the MFFT and the WISC-R. It is important to note that the results indicated that reflective children scored significantly higher than did impulsive children on the attention-

concentration subtests and visual organization subtests. There were no significant differences on the verbal comprehension subtests. Mollick and Messer (1978) found that MFFT response times were unrelated to IQ whereas MFFT errors were moderately related. Walker (1985) found that reflectivity when coupled with higher SES was significantly and positively correlated with higher scores on four WISC-R subtests.

Fitzpatrick, Parr and Butler (1977) attempted to define common characteristics of the fast-accurate and slow-inaccurate tempo groups. They found that fast-accurate and reflective children tended to perform at a consistently higher level than did the impulsive and slow-inaccurate groups on intelligence and achievement test measures. Meichenbaum and Goodman (1969) found that reflective children scored significantly higher than did impulsive children on all subtests of the Primary Mental Abilities Test. In contrast, Lajoie and Shore (1987) reported no significant differences in mean IQ among the four tempo groups, when using a random sample from a normal population.

Academic Achievement

Many researchers have reported that conceptual tempo was significantly related to academic achievement. Greater reflectivity correlated significantly and positively with school achievement. Conceptual tempo also seemed to be a valid predictor of achievement in the areas of reading, mathematics and general academic achievement.

Barrett (1978); Becker (1976); Margolis, Brannigan, Molteni, Samuels, Heverley, Potter and Gould (1982); Messer (1970); and Weithorn and others (1984) attempted to link tempo with academic achievement. Their research showed that reflective children were significantly more successful in school than were their impulsive

counterparts. Cathcart and Liedtke (1969), and Engelhardt (1978) provided evidence indicating that reflective children performed better than their impulsive peers on mathematical tasks. Several researchers also related tempo to the acquisition of various reading skills. Brodzinsky, Fewer and Owens (1977); Margolis and Brannigan (1978); Kagan (1965a); Learner and Richman (1984); Rinehart (1988); Snyder and Butler (1985); Sousley and Gargiulo (1981); and Turner and Fletcher (1981) observed that reflective children were better readers than were their impulsive counterparts.

Some researchers did not find any support for the relationship between tempo and academic achievement. Denney (1974) was unable to link tempo with the acquisition of certain reading skills. Schmidt (1984) found that reflection-impulsivity was not related to achievement in aural skills.

In general, the research seemed to indicate that reflectivity was positively correlated with overall academic achievement as well as achievement in the areas of Mathematics and English.

Manipulation of Tempo

A very important body of research existed concerning modification of an individual's predisposition toward reflectivity and impulsivity. Unlike most other theoretical and abstract mental constructs, conceptual tempo seemed to be manipulable and modifiable. Certain training procedures and strategies have been found to be quite successful in reducing impulsivity. These findings may be extremely valuable for educators in the light of research that related reflection to increased school achievement and success.

Researchers obtained positive results in the manipulation of an individual's tempo performance, using a large number of widely varying techniques. Relaxation training was found by Bowman and Auerbach (1982); Porter and Omizo (1984); and

Rivera and Omizo (1980) to significantly increase reflectivity. Cognitive training and self-instruction was found by Bowman and Auerbach (1982); Campbell (1985); Cohen, Schlesser and Meyer (1981); Glenwick and Baracas (1979); Jacobs (1974); Kendell and Wilcox (1980); and Yang and Michael (1986) to be successful in significantly increasing reflectivity. Several types of modelling were also found to be effective in positively manipulating tempo, Callinan, Epstein and Silver (1977); Debus (1979); Denney (1972); Herman (1982); Yando and Kagan (1970). Several researchers also found that training in the areas of strategy, discrimination and attention, all significantly reduced impulsivity (Arnold and Forehand, 1978; Ayabe, 1969; Bender, 1980; Briggs, 1966; Brown, 1985; Cole and Hartley, 1978; Egeland, 1976; Kagan, Pearson and Welch, 1966; Learner and Richman, 1984; Matthews, 1973; Nelson, 1968; Toler and Toler, 1982; and Zelniker and Oppenheimer, 1973). External reinforcement also aided in reducing impulsivity. Briggs and Weinberg (1973); Cole and Hartley (1978); Loper, Hallahan and McKinney (1982); and Pitassi and Offenback (1978) reported success in increasing latency using various schedules of reinforcement. School and Cooper (1986) found that reflectivity could be increased by teaching skills in verbal rehearsal, visual imagery and verbal analogies. Televised feedback also significantly increased reflectivity (Campbell, 1985). Locler (1985) found that haptic training significantly increased reflectivity with learning-disabled children. Campbell et al. (1983); Gow, Ward and Balla (1986); and Yang and Michael (1986) reported increased reflectivity from verbal self-instructional training. Emihovict and Miller (1988) positively manipulated tempo using computer assisted instruction.

The results of these investigations of the modification of conceptual tempo supports the position that conceptual tempo differences reflect differences in

implicit information processing criteria which may be changed voluntarily and are not necessarily a simple reflection of automatic, dispositional, personality differences.

Visual Component of Tempo

Closely related to the hypotheses under investigation in this study was a class of variables that were related to the actual physical components of the eye's movement during the performance of visual tasks. Included in this group were studies relating to scanning strategies, vertical-horizontal eye movements, fixation patterns, and colour form sorting. The evidence from these studies indicated that there are real individual differences in the manner in which children approached and conducted tasks requiring visual discrimination.

Several researchers found that various aspects of the visual process were related to conceptual tempo. Weissbach (1978) found reflective children perform better than impulsive children on decoding tasks. Gaughan (1977) observed that impulsive subjects made between-stimuli eyeshifts more rapidly than did their reflective counterparts. Margolis (1976) found that reflective subjects performed significantly better than did impulsive subjects on a measure of auditory-visual integration. Weiner (1975) found that reflective children were significantly faster at processing visual material than were impulsive children. Massari (1975) found that reflective children performed better on a measure of field dependence than did impulsive children. Siegel, Babich and Kirasic (1974) found that reflective subjects demonstrated the greatest visual recognition memory when detailed feature analysis was necessary. Siegel, Kirasic and Kilburg (1973) found that reflective children performed significantly better than did impulsive children on a task measuring recognition memory. Reflective children were better at tasks requiring the most detailed feature analysis. Kilberg and Siegel (1973) also concluded that reflective

children were better at performing detailed visual feature analysis and that it was this tendency that was the most significant underlying cognitive component of the reflectivity-impulsivity dimension. Zelniker, Jeffrey, Ault and Parsons (1972) found that reflective subjects had a greater number of fixations while performing a visual task than did impulsive children. Neussle (1972) found that reflective children tended to be more proficient focusers than were impulsive children. Ault, Crawford and Jeffrey (1972) found that reflective children were more systematic with their visual scanning techniques than were impulsive children. Drake (1970) found that reflective children allocated larger portions of time looking at the standard stimuli in tasks requiring visual discrimination than did impulsive children. Siegelman (1969) also found evidence supporting Drake.

Perhaps one of the most in-depth studies involving the visual aspects of conceptual tempo was undertaken by Vurpillot (1969). Investigating the relationship between the development of scanning strategies and their relationship to visual differentiation, Elaine Vurpillot (1969) provided strong evidence to support the existence of profound individual differences in the strategies employed to solve perceptual matching tasks. She attempted to determine the amount of information that was retained by children of varying ages, the type of strategy employed when making comparisons between stimuli; and the basis on which decisions were made. Nursery and elementary school-age children were divided into four groups. They were shown four pairs of identical and four pairs of non-identical picture stimuli. At the same time the subjects were performing the visual discrimination task of deciding whether pairs of pictures were identical or different, a camera recorded on film the displacement of the corneal reflection of the stimulus. The area of stimulus that was reflected on the centre of the pupil was the area upon which the subject was fixating at that moment. This enabled the researcher to make

paired comparisons of the eye movements relating successive eye fixations. Vurpillot obtained the following results: (1) The number of correct responses related directly to the age of the child and inversely to the number of differences between pictorial stimuli. (2) Up to age six, the number of differences between stimuli did not affect the number of fixations, i.e., young children viewed only six or seven of a possible twelve fixation points. However, after age six the number of fixations directly related to stimuli differences, suggesting that the amount of information collected varied according to task requirements. (3) Paired comparison data showed that from age 5 onward children made more paired comparisons on identical stimuli. However from age 7 onward, paired comparisons became directly related to the number of differences between stimuli.

Vurpillot interpreted these results as evidence for the postulation of an age-related succession of stages in performing visual-perceptual comparison tasks. In the first stage, pictures are scanned randomly and choices made independent of the visual information available. In stage two, scanning is limited only to part of the stimulus and no special frame of reference for all parts of the stimuli is considered. By stage 3, identifying is defined as an absence of differences which are relative only to homologous elements of the stimuli. During stage 4, a system of scanning emerges as well as a frame of reference that is temporarily sufficient to discriminate between stimuli that have already been scanned and those that have not.

Most closely related to this present study, was the work of Adejumo (1979); and Vega and Powell (1974). Adejumo (1979) examined the relationship between conceptual tempo and visual perceptual ability of 200 Nigerian male children aged 7 - 9 years. Subjects were classified into appropriate conceptual tempo groups using the MFFT. Performance on two validated visual perceptual tasks was also

measured; namely, the object comparison task; and the visual recognition task. It was found that performance on the MFFT correlated significantly with performance on the visual perceptual task ($r = .58$ for 7-year-olds, $r = .63$ for 9-year-olds). It was also found that 7-year-old subjects in the reflective and fast-accurate groups were superior in performance on the visual perceptual tasks, suggesting that conceptual tempo may also be a function of individual differences in visual perceptual abilities. Vega and Powell (1974) found that visual defects affected performance on some psychological tests. They hypothesized that children with defective vision would perform less ably than would children with normal vision on tasks requiring visual recognition and discrimination among specific stimuli. The Peabody Picture Vocabulary Test (PPVT), the Metropolitan Readiness Test (MRT) and the Goodenough-Harris Drawing Test (GHDT) were chosen because they required the child to do different tasks. Both the PPVT and the MRT require the subject to recognize and discriminate between line drawings of specific objects. However the GHDT simply required the child to draw human figures in the absence of specific stimuli. Specifically, the hypotheses were that the children with defective vision would perform less ably on the MRT and PPVT than would children with normal vision and that there would be no difference in their performance on the GHDT. Furthermore, it was expected that after correction of the visual defects, there would be no significant difference in performance between the two groups on either the MRT and the PPVT. Five hundred and twenty-five 'culturally disadvantaged' subjects attending a pre-school program were administered all three tests early in the school year. Optometrists administered vision tests and children with defective vision were referred for correctional treatment. This treatment was completed before the second administration of the three tests, which occurred toward the end of the school year. One hundred and ninety-seven students participated in

this second round of testing. For purposes of data analysis, all subjects who were diagnosed for corrective treatment by the optometrists were assigned to a Defective Vision group, while all other subjects assigned to a Normal Vision group. The visual problems identified by the optometrists included substandard visual acuity (20/40 or less), astigmatism, myopia, improper eye alignment, and various eye diseases.

The results showed that children in the Defective Vision group performed poorly on both the PPVT and the MRT. However, there were no significant differences between the two groups on the GHDT. It was surprising to find that the correction procedures effected on the Defective Vision group did not improve their performance, relative to the Normal Vision group on either the PPVT and the MRT. The authors speculated that the lack of improvement of the Defective group even after correctional procedures had been instituted were reflective of a reduced efficiency in learning to respond to visual stimuli. This led the authors to recommend that behavioral deficits caused by defective vision must be compensated for by more than a correction of the specific defect if these children are to achieve valid results on many psychometric measures.

Hypotheses

Based on the review of the tempo literature, the following hypotheses have been generated:

1. Near visual acuity is directly related to error rate on a test of conceptual tempo.
2. Near visual acuity is inversely related to response latency on a test of conceptual tempo.
3. Far visual acuity is not related to error rate or response latency on a test of conceptual tempo.

CHAPTER 3

PROCEDURE

Subjects

The total sample consisted of 164 children who were chosen randomly from recreational programs operating in the St. John's area. These programs were located in the following areas: (1) Cowan Heights, (2) St. John's Boys and Girls Club, (3) Virginia Park, (4) Wedgewood Park, (5) Bell Island, (6) Rotary Sunshine Camp, and (7) Mount Pearl. Table 1 provides a breakdown of the number of subjects tested at each site.

TABLE 3

Populations of Centres

Centre	Number of Subjects
Cowan Heights	14
St. John's Boys and Girls Club	58
Virginia Park	42
Wedgewood Park	18
Bell Island	8
Rotary Sunshine Camp	9
Mount Pearl	15

Procedure

Each subject was individually tested by the researcher, at the site of the child's recreation program. Each child was administered the MFFT, the Snellen Long Distance Test of Visual Acuity, and the Reduced Snellen test of short distance visual acuity. At each of the centers, an appropriate room was made available to the researcher. These rooms were adequately lit for the visual tasks

and were relatively quiet and free from distraction. The MFFT was administered in its outlined, standardized form. Each child was shown a picture and asked to choose from six similar alternatives, the picture that was exactly the same as the sample picture. Each child was timed to the nearest tenth of a second from the moment of presentation until the first response. This time was recorded as the response latency. The number of response errors per question, up to a maximum of five, was also recorded for each child.

Subjects were then tested for visual acuity. A Snellen chart was placed on a blank wall. The subject was seated on a chair twenty feet from the wall then asked to cover his right eye. He was then asked to begin reading the letters on the chart from the top downwards. The child was stopped at the end of the first line that included one or more errors. The visual acuity score for that eye was then recorded by reading from the chart the number of the last error-free line. The number of mistakes in the reading of the next line was also scored. This procedure was then repeated for the left eye.

Short-distance visual acuity was evaluated using a Reduced Snellen chart. The researcher held the chart 12-14 inches from the subject and asked him to cover his right eye. The subject then began to read down the chart until s/he completed a line where s/he had committed one or more errors. Scoring methods were exactly as they had been for the long-distance chart. This procedure was then repeated for the left eye.

The Snellen wall chart for measurement of long-distance visual acuity was a 12" x 20" poster containing nine lines each with varying numbers of individual alphabetical letters of differing sizes. The first line was labelled D. -200; the second line D. -120; the third line D. -80; the fourth line D. -60; the fifth line D. -40; the sixth line D. -30; the seventh line D. -20; the eighth line D. -15; the

ninth line D. -10. These numbers indicated the distance in feet that a person with normal vision could be from the chart and theoretically still be able to read that line. The size of the letters grew smaller as one proceeded from the top to the bottom of the chart. The number of letters in a line also changed as one proceeded from the top to the bottom. The number of letters in the lines were as follows: line 1 - 1; line 2 - 2; line 3 -3; line 4 - 4; line 5 - 5; line 6 - 6; line 7 - 8; line 8 - 10; and line 9 - 10.

The Reduced Snellen Test for measurement of short-distance visual acuity, was an 8" x 11" hand-held chart. There were seven lines, each containing three letters. The size of the letters in the lines became smaller as one proceeded from the top to the bottom. The lines were labelled 200, 120, 80, 60, 40, 30 & 20 from the top to the bottom respectively.

CHAPTER 4

RESULTS

Initially, 164 subjects participated in the study of the relationship between visual acuity and conceptual tempo. They ranged in age from 7-11 years and spanned school grades 1-7. As the analyses progressed, nine subjects deemed significantly far enough from the norm as to contaminate results were eliminated from the sample. These included: one grade I subject, three grade II subjects, two grade VII subjects and three seven-year-old subjects.

The data for several variables were collected and analyzed. Descriptive statistics were computed for the classificatory independent variables: sex, glasses, centre, age and grade, as well as for the principal independent variable, vision, and its several components. In addition, descriptive statistics were also computed for the dependent variable, conceptual tempo, which, for purposes of clarity, was further broken down into two categories: response latency and response error. Next, each of these variables was subjected to an inferential analysis, starting with the classificatory variables. Last, inferential analyses between the principal independent variable of vision and the dependent variables of response latency and response error were computed.

From the revised sample of 155 subjects, it was found that males and females were equally represented. Fifty-one percent or 79 of the subjects were female and forty-nine percent or 76 of the subjects were male. One-way analyses of variance of the two conceptual tempo variables, response latency and error showed no significant differences between males and females ($F(1,153) = .0082$, $p = .9278$; $F(1,153) = .1408$, $p = .7080$, respectively). Sex was also not significant for the

near or the far vision variable ($F(1,153) = .8221$, $p = .3660$; $F(1,153) = 1.1573$, $p = .2837$, respectively).

The subjects in this study were also placed in one of two categories concerning the wearing of glasses. Eighty-seven percent or 135 of the subjects had never been prescribed glasses. Thirteen percent or 20 of the subjects had been prescribed and were wearing glasses at the time of testing. One-way analysis of variance of the glasses and tempo variables showed no significant differences between subjects based on the wearing of glasses for either the latency ($F(1,153) = 2.7547$, $p = .0991$) or error ($F(1,153) = 1.0154$, $p = .3152$) variables.

Subjects in the study were chosen randomly from one of seven recreation centres in and around the city of St. John's, Newfoundland, Canada. The numbers of subjects at each centre varied (see Table 4).

TABLE 4

Subject Selection, Location and Frequencies for the Total Sample

Centre	Frequency	Per Cent
Cowan Heights	14	9.0
St. John's Boys and Girls Club	53	34.2
Virginia Park	40	25.8
Wedgewood Park	18	11.6
Bell Island	8	5.2
Rotary Sunshine Camp	7	4.5
Mount Pearl	15	9.7
	155	100%

One-way analyses of variance were computed for the centre variable using the near and far vision variables and also the response latency and response error

variables. No significant effects were noted for centre on the response latency variable ($F(1,153) = .6721$, $p = .4136$) or the response error variable ($F(1,153) = 2.3239$, $p = .1295$). As well, centre was not significantly related to the near vision variable ($F(6,148) = .8229$, $p = .5538$) however, significant differences were found for the far vision variable (see Table 5). A Newman Keuls multiple range test revealed that the Boys Club differed significantly from the other centres ($p < .05$).

Farbinocular means for each centre are presented in Table 6.

TABLE 5

One-Way Analysis of Variance Results of Far Distance Vision by Test Centre

Source	D.F.	Sum of Squares	Mean Square	F-Ratio	F-Probability
Between Groups	6	3909.4348	651.5725	3.4968	.0029
Within Groups	148	27577.4176	186.3339		
Total	154	31486.8524			

TABLE 6

Far Binocular Mean by Test Centre

Cowan Heights	82.0000
St. John's Boys and Girls Club	84.4717
Virginia Park	73.3813
Wedgewood Park	81.0278
Bell Island	83.0938
Rotary Sunshine Camp	87.5000
Mount Pearl	77.3833

Although the chronological age variable was incidental to this study, it was anticipated that it would significantly influence the conceptual tempo measures in the directions noted in the literature; that is, response latency would significantly increase and errors significantly decrease with age. The mean age was 9.36 and the standard deviation was .993. Table 7 shows the breakdown for the number of subjects at each age level.

TABLE 7

Frequency and Percentage of Total Population Broken Down by Age

Age	Frequency	Per Cent
8	35	22.6
9	52	33.5
10	45	29.0
11	23	14.8

The subjects were distributed unevenly among four grades. These numbers are presented in Table 8.

TABLE 8

Distribution of Subjects by Grade

Grade	Frequency	Per Cent
3	22	14.2
4	53	34.2
5	52	33.5
6	28	18.1

The principal independent variable, vision, was a complicated variable comprised of four separate measurements. The right and left eye were measured separately on both far and near distance viewing. Table 9 shows the efficiency coefficient frequency distributions for each measure.

Using Staetler's (1982) formula, the two vision variables used in the final analyses, Near-binocular Efficiency (Nearbi) and Far-binocular Efficiency (Farbi), were created by combining three-quarters of the efficiency of the best eye with one-quarter of the efficiency of the worst eye. Visual efficiency frequencies for the Farbi and Nearbi variables are presented in Table 10.

Means and standard deviations for the near right and left eye, the far right and left eye and the near binocular as well as far binocular efficiencies were also calculated (see Table 11).

Using Kagan's dual-median-split procedure, subjects were categorized into four individual tempo groups, fast-inaccurate, slow-inaccurate, fast-accurate, and slow-accurate (see Table 12).

One-way analyses of variance were computed for near and far visual efficiency for the four tempo groups. No significant differences were revealed for tempo with either near vision, ($\underline{F}(3,151) = 1.4071$, $\underline{p} = .2430$) or far vision, ($\underline{F}(3,151) = 1.0667$, $\underline{p} = .3651$).

TABLE 9

Frequencies of Efficiency Coefficients for Near Right Eye, Near Left Eye, Far Right Eye, Far Left Eye

	Efficiency Coefficient	Frequency	Per Cent
Near Right Eye	20	1	.6
	59	1	.6
	70	3	1.4
	84	5	3.2
	91	47	30.3
	100	98	63.2
Near Left Eye	37	1	.6
	59	3	1.9
	70	1	.6
	84	7	4.5
	91	40	28.5
	100	103	66.5
Far Right Eye	15	1	.6
	20	4	2.6
	37	6	3.9
	59	10	6.5
	70	22	14.2
	84	82	52.9
	91	26	16.8
	100	4	2.6
Far Left Eye	20	6	3.9
	37	4	2.6
	59	5	3.2
	70	19	12.3
	84	76	49.0
	91	39	25.2
	100	6	3.9

TABLE 10

Frequencies of Efficiency Coefficients for Farbi and Nearbi

FARBI			NEARBI		
Efficiency Coefficient	Frequencies	Per Cent	Efficiency Coefficient	Frequencies	Per Cent
20.00	3	1.9	53.50	1	.6
32.75	2	1.3	77.75	1	.6
37.00	2	1.3	80.00	1	.6
53.50	3	1.9	83.00	2	1.3
57.50	1	.6	84.00	3	1.9
59.00	3	1.9	85.75	3	1.9
61.75	1	.6	89.25	5	3.2
67.25	2	1.3	91.00	33	21.3
70.00	8	5.2	92.50	1	.6
73.25	1	.6	97.75	11	7.1
77.75	3	1.9	100.00	94	60.6
78.75	1	.6			
80.50	17	11.0			
83.00	1	.6			
84.00	57	36.8			
85.75	14	2.6			
89.25	22	14.2			
91.00	18	11.6			
96.00	2	1.3			
97.75	1	.6			
100.00	3	1.9			

TABLE 11

Snellen Chart Means and Standard Deviations for Right, Left and Binocular Vision for Near and Far Distances

	Mean	Standard Deviation
Near Right Eye	95.394	9.038
Near Left Eye	95.561	8.787
Near Binocular	96.182	6.283
Far Right Eye	78.071	16.477
Far Left Eye	80.168	1.317
Far Binocular	80.708	14.299

TABLE 12

The Number of Subjects in Each of the Four Tempo Groups

		Response Latency	
		Fast	**Slow**
Response Error	**Accurate**	n = 33 (26.5%)	n = 46 (29.7%)
	Inaccurate	n = 41 (26.5%)	n = 35 (22.6%)

Both Near and Far measures were taken for vision as both types are needed in performing various school tasks. The correlation between the two measures was significant, but low ($F(1,154) = .30$, $p < .0001$), indicating that nearbi and farbi are similar but not identical measures of vision. Nearbi was assessed to be the variable most closely related to the MFFT tasks and thus to the hypotheses under investigation in this study. For that reason, the Farbi variable was not included in further analyses.

A two-way analysis of variance was computed using response error as the dependent variable with age and grade as the independent variables. The results are presented in Table 13.

TABLE 13

Two-Way Analysis of Variance for the Dependent Variable, Response Error by Age and Grade

Source of Variation	Sum of Squares	D.F.	Mean Square	F	Signif. of F
Main Effects	5.924	6	0.987	4.649	0.000
Grade	2.395	3	0.798	3.760	0.012
Age	0.257	3	0.086	0.404	0.750
2-Way Interactions	1.780	4	0.445	2.095	0.084
Grade Age	1.780	4	0.445	2.095	0.084
Explained	7.704	10	0.770	3.628	0.000
Residual	30.580	144	0.212		
Total	38.284	154	0.249		

A two-way analysis of variance was also computed using response latency as the dependent variable with age and grade as the independent variables. Neither the main effects nor the interactions were significant. The results are presented in Table 14.

In order to summarize more fully the relationship between the dependent variables, response error and response latency and the independent variables, nearbi, grade and age, multiple regression procedures were used. Significance was not attained for any of the variables in the latency equation with grade (see Table 15).

In contrast, significant results were obtained for the error variable with the same independent variables, nearbi and grade. These results are presented in Table 16.

TABLE 14

Two-Way Analysis of Variance for the Dependent Variable, Response Latency with Age and Grade

Source of Variation	Sum of Squares	D.F.	Mean Square	F	Signif. of F
Main Effects	1.426	6	0.238	0.967	0.450
Grade	1.360	3	0.453	1.845	0.142
Age	0.779	3	0.260	1.056	0.320
2-Way Interaction	1.853	4	0.463	1.885	0.116
Grade Age	1.853	4	0.463	1.885	0.116
Explained	3.278	10	0.328	1.334	0.218
Residual	35.393	144	0.246		
Total	38.671	154	0.251		

TABLE 15

Step-wise Regression Analysis for the Dependent Variable, Response Latency and the Independent Variables, Nearbi and Grade

			Analysis of Variance		
Multiple R	.04215				
R Square	.00178		D.F.	Sum of Squares	Mean Square
Adjusted R Square	.01136	Regression	2	.06871	.03436
Standard Error	.50395	Residual	152	.60225	.25396

F = .13528 Signif. F = .8736

Variables in the Equation

Variable	B	Se B	Beta	T	Sig. T
Nearbi	4.24178	.006485	-.005319	.065	.9479
Grade	.021884	.042999	-.041384	.509	.6115
(Constant)	1.617885	.639388		2.530	.0124

TABLE 16

Step-wise Regression Analysis for the Dependent Variable, Response Error with Grade and Nearbi

			Analysis of Variance		
Multiple R	.34012				
R Square	.11568		D.F.	Sum of Squares	Mean Square
Adjusted R Square	.10405	Regression	2	24.42878	2.22439
Standard Error	.47194	Residual	152	33.85509	.22273

F = 9.94201 Signif. F = .0001

Variables in the Equation

Variable	B	Se B	Beta	T	Sig. T
Nearbi	.011779	.006073	.148432	1.929	.0543
Grade	.154761	.040268	.294130	3.843	.0002
(Constant)	3.282604	.598784		5.482	.0000

While grade had a significant effect on response error ($p < .0001$), nearbi only approached significance ($p = .0543$). Given these results, it was decided to compute another regression analysis substituting age for grade. Even though conceptual tempo is a developmental concept and it was expected that age was a significant factor and also that age and grade would be quite highly correlated, the extremely strong effect of grade made it difficult to clearly determine the effect of vision. The puzzling strong effect of grade may have been caused by a distortion in the sample; e.g., a large number of subjects who had failed a grade. In order to get a closer look at the nearbi variable, the regression analysis was computed using the independent variables age, and nearbi, with the dependent variables response error and response latency. The latency equation did not attain significance (see Table 17).

TABLE 17

Step-wise Regression Analysis for the Dependent Variable, Response Latency with Nearbi and Age

				Analysis of Variance	
Multiple R	.03145				
R Square	.00099		D.F.	Sum of Squares	Mean Square
Adjusted R Square	.01216	Regression	2	.03826	.01913
Standard Error	.50415	Residual	152	38.63271	.25416

F = .07526 Signif. F = .9275

Variables in the Equation

Variable	B	Se B	Beta	T	Sig. T
Nearbi	8.59426	.006481	.010776	.133	.8947
Grade	.015293	.041019	.030297	.373	.7098
(Constant)	1.416889	.710381		1.995	.0479

In contrast, significance was attained in the response error equation (see Table 18).

TABLE 18

Step-wise Regression Analysis for the Independent Variable, Response Error with Nearbi and Age

				Analysis of Variance	
Multiple R	.29318				
R Square	.08596		D.F.	Sum of Squares	Mean Square
Adjusted R Square	.07393	Regression	2	3.29070	1.64535
Standard Error	.47981	Residual	152	34.99317	.23022

F = 7.14692 Signif. F = .0011

Variables in the Equation

Variable	B	Se B	Beta	T	Sig. T
Nearbi	.012396	.006168	.156210	2.010	.0462
Age	.119353	.039039	.237637	3.057	.0026
(Constant)	3.754334	.676092		5.553	.0000

These results indicate that response latency is not significantly related to any of the independent variables under investigation in this study. Response error, however, was found to be significantly related to age (($\underline{p}$ = .0026), and near binocular vision ($\underline{p}$ = .0462).

CHAPTER 5

DISCUSSION

This chapter provides a summary of the major findings of this study and a discussion of the significance of those results in relation to the proposed hypotheses. Conclusions are drawn and the implications for educators are noted. Finally, recommendations for further study in this area are also presented.

Summary

The purpose of this study was to examine the relationship between visual acuity and conceptual tempo. These research questions were posed. Does visual acuity significantly affect error rate as measured by the MFFT? Does visual acuity significantly affect response latency as measured by the MFFT? To investigate these questions, 164 subjects, all members of various recreation programs in the city of St. John's, were administered the MFFT and two tests of visual acuity, near and far. The data were collected and analyzed. The results of these analyses are discussed below.

Discussion of Results

The incidental independent variables of sex, glasses and centre were examined in this study and none were found to be significantly related to either the principal independent variable, vision, or the dependent variables response error and response latency. Sex, and the wearing of glasses was not significantly related to either the vision or the tempo variables. Centre was significantly related to only far binocular vision. The Boys Club subjects, the largest number of subjects in the sample (n = 53), had significantly poorer far binocular vision than did the subjects

from the other centres. As the sample was chosen at random, and there is no obvious reason for the poorer vision, at this centre, it was concluded that this result was likely a Type 1 error. The analyses indicated that the dependent variable, latency was not significantly related to any of the other variables in the study. However, the dependent variable, error, was significantly related to age, grade and near binocular vision.

Far binocular vision was measured simply because it is the vision screening method used in a lot of schools. The researcher was interested to see if there was any basis for using a test for far visual acuity, to determine the ability of a child to perform school tasks which require near visual acuity. The low correlation found for far and near visual acuity ($r = .336$, $p = .001$) indicated that while the relationship between these two variables was positive and significant, it was not sufficient to justify the use of far vision tests in the place of near vision tests. Since near binocular and far binocular vision are only marginally correlated, and students in schools engage in tasks requiring both near binocular and far binocular vision, it is reasonable to conclude that both near and far measures of vision are necessary to assess thoroughly visual handicaps that may impede a student's academic progress. Of prime interest in this study however was the near vision variable, because it is clearly related to the tasks on the MFFT.

The significant results reported for the error variable were expected. As indicated in the literature review, error more often than latency was the unstable variable or the variable most often affected by training procedures and modifications. The tests for visual acuity required the individual to be able to distinguish minute differences in the visual details of certain letters. The MFFT test required the individual to do the same thing using pictures.

The significant relationship between error rate and age was compatible with that noted in other studies in this area, Brown and Quay (1981), Cairns (1978), and Katz (1971). The subjects in this study were similar to those of other studies in that older subjects made significantly fewer errors on the MFFT than did younger subjects. This developmental trend was also expected to exist to some degree for the grade variable. As grade level increased, children were not only getting chronologically older, but also getting increased educational opportunities which would improve their performance on the MFFT. However, for this study, the effects of grade were extremely strong, overpowering both the age and nearbi variables. It was concluded that the sample may have contained an unusually large number of subjects who had failed one or more grades. Unfortunately, it was not possible to obtain the data necessary to test this assumption.

Because there appeared to be evidence of a main effect for all three variables age, grade and nearbi on the error variable, two separate regression analyses were computed. One regression analysis examined the relationship between near binocular vision and grade level, while the other examined the relationship between near binocular vision and age. Significance was found for near binocular vision and error rate in the equation that contained the age variable. In other words, subjects with better near binocular vision made significantly fewer errors. This result was expected given that the nearbi vision test most closely resembled the MFFT which required near binocular visual discrimination.

Conclusions

1. Near binocular vision and far binocular vision measure two different aspects of the same sense and may not be used interchangeably. Neither may one be used as a satisfactory predictor for another.

2. Error rate is significantly affected by changes in age and grade. As age and grade increase, error rate decreases.

3. Error rate is significantly related to differences in near visual acuity. Subjects with good visual acuity make significantly fewer errors than do those with poor visual acuity.

Recommendations

On the basis of this study, the following recommendations are made for further research.

1. A similar study should be conducted, whereby greater controls are placed on the independent variables of age, grade and centre. Using subjects of the same age, the same grade and from the same centre would greatly aid in determining relationships between visual acuity, latency and error.

2. A more sophisticated test of visual acuity should be used in order to achieve the best possible measure of visual acuity. For example, a Titmus Eye Projector controls for differences in lighting and seating arrangements. It is also a newer and technically superior device to the Snellen Chart used in this investigation.

3. Further research should be conducted on the relationship between near visual acuity and other psychometric tests that require near binocular vision.

4. The measurement of near and far visual acuity for all students in primary and secondary schools should be mandatory.

5. The assessment of visual acuity should be a primary step in the overall assessment of children. Tests of near vision should precede the administration of other psychometric instruments.

REFERENCES

Achenbach, T.M. and Weisz, J.R. Impulsivity-Reflectivity and Cognitive Development in Preschoolers: A Longitudinal Analysis of Developmental and Trait Variance. Developmental Psychology, 1975, 11, 413-414.

Adams, W.V. Strategy Differences Between Reflective and Impulsive Children. Child Development, 1973, 43, 1076-1080.

Adejamo, Dayo. Conceptual Tempo and Visual Perceptual Ability of Some Nigerian Children. Psychological Reports, 1979, 45, 911-916.

Arnold, S.C. and Forehand, R. A Comparison of Cognitive Training and Response Cost Procedures in Modifying Cognitive Styles of Impulsive Children. Cognitive Therapy and Research, 1978, 2, (2), 183-188.

Ault, R.L. Problem-Solving Strategies of Reflective, Impulsive, Fast-Accurate and Slow-Inaccurate Children. Child Development, 1973, 44, 259-266.

Ault, R.L., Crawford, D.E. and Jeffrey, W.E. Visual Scanning Strategies of Reflective, Impulsive, Fast-Inaccurate, and Slow-Inaccurate Children on the Matching Familiar Figures Test. Child Development, 1972, 43, 1412-1417.

Ayabe, Harold I. The Effect of Reflective-Impulsive Training on Conceptual Tempo. Unpublished Doctoral Dissertation, Indiana University, 1969.

Ayabe, Harold I. and Santo, Susan. Conceptual Tempo and the Oriental American. The Journal of Psychology, 1972, 81, 121-123.

Barrett, David E. Reflection-Impulsivity as a Predictor of Children's Academic Achievement. Child Development, 1978, 48 (4), 1443-1448.

Becker, L.D. Conceptual Tempo and the Early Detection of Learning Problems. Journal of Learning Disabilities, 1976, 9 (7), 38-47.

Becker, L.D., Bender, N.N. and Morrison, G. Measuring Reflectivity-Impulsivity: A Critical Review. Journal of Learning Disabilities, 1978, 11 (10), 626-632.

Bender, Nila N. Self Instruction and Impulsivity Control by Deaf Children. Paper presented at Annual Meeting of the American Educational Research Association, Boston, 1980.

Berzonsky, M.D. Reflectivity, Internality and Animistic Thinking. Child Development, 1974, 45, 785-789.

Bjorkland, David E. and Butler, Elliot J. Can Cognitive Impulsivity Be Predicted from Classroom Behaviour? The Journal of Genetic Psychology, 1973, 123, 185-194.

Block, Jack. Misgivings about the Matching Familiar Figures Test: Premature or Overdue. Developmental Psychology, 1987, 23 (5), 740-741.

Block, J., Block, J.H. and Harrington, D.M. Some Misgivings about the Matching Familiar Figures Test as a Measure of Reflection-Impulsivity. Developmental Psychology, 1974, 10 (5), 611-632.

Block, Jack and others. More Misgivings About the Matching Familiar Figures Test as a Measure of Reflection-Impulsivity: Absence of Construct Validity in Preadolescence. Developmental Psychology, 1986, 22 (6), 820-831.

Blumenthall, James A., McKee, Daphne C., Williams, Redford B. and Haney, Thomas. Assessment of Conceptual Tempo in the Type A (Coronary Prone) Behaviour Pattern. Journal of Personality Assessment, 1981, 45 (1), 44-51.

Bombe, Anne K. and others. Personality Correlates of Conceptual Tempo. Paper presented at the Annual Meeting of the Oklahoma Home Economics Association, Chickasha, 1987.

Borys, Suzanne V. and Spitz, Herman H. Reflection-Impulsivity in Retarded Adolescents and Nonretarded Children of Equal MA, American Journal of Mental Deficiency, 1978, 82 (16), 601-604.

Bowman, Phillip and Auerbach, Stephen M. Impulsive Youthful Offenders: A Multimodel Cognitive Behavioral Treatment Program. Criminal Justice and Behavior, 1982, 9 (4), 432-454.

Briggs, C.H. An Experimental Study of Reflection-Impulsivity in Children. Unpublished Doctoral Dissertation, University of Minnesota, 1966.

Briggs, Chari H. and Weinberg, Richard A. Effects of Reinforcement in Training Children's Conceptual Tempos. Journal of Educational Psychology, 1973, 65 (3), 383-394.

Broberg, Gayle Christensen and Moran, James D. III. Creative Potential and Conceptual Tempo in Preschool Children. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Baltimore, 1987.

Brodzinsky, D.M. Children's Comprehension and Appreciation of Verbal Jokes in Relation to Conceptual Tempos. Child Development, 1977, 48, 960-967.

Brodzinsky, David M. The Role of Conceptual Tempo and Stimulus Characteristics in Children's Humor Development. Developmental Psychology, 1975, 2 (6), 843-850.

Brodzinsky, David, M., Fewer, Vick and Owens, Justine. Detection of Linguistic Ambiguity by Reflective, Impulsive, Fast/Accurate and Slow/Inaccurate Children. Journal of Educational Psychology, 1977, 69 (3), 237-243.

Brodzinsky, David M., Tew, John D. and Palkovitz, Robin. Control of Humorous Affect in Relation to Children's Conceptual Tempo. Developmental Psychology, 1979, 15 (3), 275-279.

Brown, Heather J. and Others. Cognitive Style and Learner Strategy Interaction in the Performance of Primary and Related Maze Tasks. Research Quarterly for Exercise and Sport, 1985, 56 (1), 10-14.

Brown, R.T. and Quay, L.C. Reflection-Impulsivity in Normal and Behaviour Disordered Children. Journal of Abnormal Child Psychology, 1981, 5 (4), 457-462.

Cairns, E. Age and Conceptual Tempo. The Journal of Genetic Psychology, 1978, 133 (1), 13-18.

Cairns, E. The Reliability of the Matching Familiar Figures Test. The British Journal of Educational Psychology, 1977, 47 (2), 197-198.

Cairns, Ed and Cammock, Tommy. Development of a More Reliable Version of the Matching Familiar Figures Test. Developmental Psychology, 1978, 14 (5), 555-560.

Callinan, D., Epstein, M.H. and Silver, L. Modification of Impulsive Tempo in Learning Disabled Pupils. Journal of Abnormal Child Psychology, 1977, 5 (4), 437-444.

Cameron, Roy. Problem-Solving Inefficiency and Conceptual Tempo: A Task Analysis of Underlying Factors. Child Development, 1984, 55 (6), 2031-2041.

Campbell, Donald S. Television Feedback in Self-Instruction Training for the Impulsive Student. B.C. Journal of Special Education, 1985, 9 (2), 163-168.

Campbell, Donald S. and Others. Adolescent Impulsivity and Self-Instruction Training: A Pilot Study. Review and Evaluation Bulletin, 1983, 4 (6), 21-35.

Campbell, S.B. and Douglas, V.I. Cognitive Styles and Responses to the Threat of Frustration. Canadian Journal of Behavioural Science, 1972, 4, 30-42.

Cathcart, W.G. and Liedtke, W. Reflectiveness and Mathematics Achievement. The Arithmetic Teacher, 1969, 16, 563-567.

Cathcart, W. George and Liedthe, Werner W. Role of Conceptual Tempo in Concept Formation. The Alberta Journal of Educational Research, 1973, 19 (3), 216-223.

Cohen, Robert, Schlesser, Robert and Myer, Andres. Self-Instruction: Effects of Cognitive Level and Active Rehearsal. Journal of Experimental Child Psychology, 1981, 32, 65-76.

Cole, P.M. and Hartley, D.G. The Effects of Reinforcement and Strategy Training and Impulsive Responding. Child Development, 1978, 49 (2), 381-384.

Debus, R.L. Effects of Brief Observation of Model Behaviour on Conceptual Tempo of Impulsive Children. Developmental Psychology, 1979, 2 (1), 22-32.

Denney, D.R. Modeling Effects Upon Conceptual Style and Cognitive Tempo. Child Development, 1972, 43, 105-119.

Denney, D.R. Relationship of Three Cognitive Style Dimensions to Elementary Reading Abilities. Journal of Educational Psychology, 1974, 66 (5), 702-709.

Draguns, J.G. and Multari, G. Recognition of Perceptually Ambiguous Stimuli in Grade School Children. Child Development, 1961, 32, 541-550.

Drake, Diana M. Perceptual Correlates of Impulsive and Reflective Behaviour. Developmental Psychology, 1970, 2 (2), 202-216.

Egeland, Byron and Others. Achievement and Adjustment Correlates of the Matching Familiar Figures Test. Journal of School Psychology, 1980, 18 (4), 361-372.

Emihovich, Catherine and Miller, Gloria. Effects of LOGO and CAI on Black First Grades Achievement, Reflectivity, and Self-Esteem. Elementary School Journal, 1988, 88 (5), 473-487.

Engelhardt, Jon M. Cognitive Style and Children's Computational Errors. Perceptual and Motor Skills, 1978, 46, 323-330.

Epstein, Michael H., Cullinan, Douglas and Lloyd, John. Reliability of the Matching Familiar Figures Test Scores of Learning Disabled Children. Perceptual and Motor Skills, 1977, 45, 56-58.

Epstein, Michael H., Cullinan, Douglas and Sternberg, Les. Impulsive Cognitive Tempo in Severe and Mild Learning Disabled Children. Psychology in the Schools, 1977, 14 (3), 290-294.

Eska, B. and Black, K.N. Conceptual Tempo in Young Grade School Children. Child Development, 1971, 42, 505-516.

Finch, A.J. Jr., Crandell, C. and Deardoff, P.A. Reflection-Impulsivity and Need for Achievement in Emotionally Disturbed Children. Journal of Genetic Psychology, 1976, 129, 329-331.

Finch, A.J. Jr., Nelson, W.M. III, Montgomery, L.E. and Stein, A.B. Reflection-Impulsivity and Locus of Control in Emotionally Disturbed Children. Journal of Genetic Psychology, 1974, 125, 273-275.

Finch, A.J. Jr., Pezzuti, K.A., Montgomery, L.E. and Kemp, S.R. Reflection-Impulsivity and Academic Attainment in Emotionally Disturbed Children. Journal of Abnormal Child Psychology, 1974, 2 (1), 71-74.

Finch, A.J. Jr., Spirito, Anthony and Brophy, Christopher J. Reflection-Impulsivity and WISC-R Performance in Behaviour-Problem Children. Journal of Psychology, 1982, 111, 217-221.

Fitzpatrick, Jody L., Parr, Gerald, D. and Butler, L.G. Fast-Accurate and Slow Inaccurate Conceptual Tempos: Are They Distinct Groups? Perceptual and Motor Skills, 1977, 45, 643-647.

Fuhrman, Michael J. and Kendell, Phillip C. Cognitive Tempo and Behavioral Adjustment in Children. Cognitive Therapy and Research, 1986, 10 (1), 45-50.

Fuqua, R.W., Bartsch, T.W. and Phye, G.D. An Investigation of the Relationship Between Cognitive Tempo and Creativity in Preschool Age Children. Child Development, 1975, 46 (3), 779-782.

Gaughan, Daniel James III. Convergent Measures of Conceptual Tempo and Their Respective Generality to Performance on a Visual Scanning Task. Unpublished doctoral dissertation, University of Kansas, Kansas, 1977.

Glenwick, David S. and Baracas, Ralph. Training Impulsive Children in Verbal Self-Control By Use of Natural Change Agents. Journal of Special Education, 1979, 13 (4), 387-398.

Goldman, Amy P. and Everett Frances. Delay of Gratification and Time Concept in Reflective and Impulsive Children. Child Study Journal, 1985, 15 (3), 167-179.

Gow, Lyn and Ward, James. Effects of Modification of Conceptual Tempo on Acquisition of Work Skills. Perceptual and Motor Skills, 1980, 50, 107-116.

Gow, Lyn and Ward, James. Extension of the Use of Measures of Cognitive Style of Moderately-Severely Retarded Trainees in a Field Setting. Perceptual and Motor Skills, 1982, 55, 191-194.

Gow, Lyn, Ward, James and Balla, John R. The Use of Verbal Self Instructional Training to Promote Indirect Generalization. Australia and New Zealand Journal of Developmental Disabilities, 1986, 12 (2), 123-132.

Grush, Joseph E. and Others. A New Self-Report Measure of Impulsivity. Unpublished report for Research/Technical (143), 1983.

Hall, Vernon C. and Russell, William J.C. Multitrait-Multimethod Analysis of Conceptual Tempo. Journal of Educational Psychology, 1974, 66 (6), 932-939.

Heman, Barbara and Others. Treating Cognitively Impulsive Children Using Academic Materials and Peer Models. Unpublished Doctoral Dissertation, Indiana University, 1982.

Jackson, Merrill S. and Haines, Allan T. Reflection-Impulsivity in Retarded Adolescents and Non-retarded Children. The Exceptual Child, 1983, 30 (3), 230-232.

Juliano, D.B. A Developmental Study of Conceptual Tempo, Concept Learning, and Abstraction. The Journal of Psychology, 1977, 96, 243-249.

Kagan, J. Developmental Studies in Reflection Analysis. Perceptual and Conceptual Development in the Child, 1964.

Kagan, J. Body Build and Conceptual Impulsivity in Children. Journal of Personality, 1966, 34, 118-128. (a)

Kagan, J. Individual Differences in the Resolution of Response Uncertainty. Journal of Personality and Social Psychology, 1965, 2 (2), 154-160. (b)

Kagan, J. Impulsive and Reflective Children: Significance of Conceptual Tempo. Learning and the Educational Process, 1965, 133-161. (a)

Kagan, J. Misgivings about the Matching Familiar Figures Test: A Brief Reply to Block, Gjerde and Block. Developmental Psychology, 1987, 23 (5), 738-739.

Kagan, J., Pearson, L. and Welch, L. Conceptual Impulsivity and Inductive Reasoning. Child Development, 1966, 37, 583-594. (a)

Katz, J.M. Reflection-Impulsivity and Color-Form Sorting. Child Development, 1971, 42, 745-754.

Kendell, Phillip C. and Wilcox, Lance E. Cognitive-Behavioral Treatment for Impulsivity: Concrete Versus Conceptual Training in Non Self-Controlled Problem Children. Journal of Consulting and Clinical Psychology, 1980, 48 (1), 80-91.

Kilburg, R.R. and Siegel, A.W. Differential Feature Analysis in the Recognition Memory of Reflective and Impulsive Children. Memory and Cognition, 1973, 1 (4), 413-419.

Klein, G., Blockovich, R.N., Buchalter, P.S. and Huggle, L. Relationship Between Reflection-Impulsivity and Problem-Solving. Perceptual and Motor Skills, 1976, 42 (1), 67-73.

Kotze, J.M.A. Deficits in Problem Solving of Learning Disabled Children: A Cognitive Learning Style Approach. Paper presented at the Annual Conference of the Association for Children and Adults with Learning Disabilities, New York, 1986.

Lajoie, Susanne P. and Shore, Bruce M. Impulsivity, Reflectivity, and High IQ. Gifted Education International, 1987, 4 (3), 139-141.

Lawry, Janice A. and Others. Cognitive Tempo and Complex Problem Solving. Child Development, 1983, 54 (4), 912-920.

Learner, Kathy M. and Richman, Charles L. The Effect of Modifying the Cognitive Tempo of Reading Disabled Children on Reading Comprehension. Contemporary Educational Psychology, 1984, 9 (2), 122-134.

Lee, Dong Yul and Cottreau, Ruby. Training in Conceptual Tempo: Its Effects on Mentally Retarded Children's Responding Style to Questionnaire Items. Psychological Reports, 1979, 44, 198.

Lewis, M., Rausch, M., Goldberg, S., and Dodd, C. Error, Response Time and I.Q.: Sex Differences in Cognitive Style of Preschool Children. Perceptual and Motor Skills, 1968, 26, 563-568.

Locler, Paul J. Use of Haptic Training to Modify Impulse and Attention Control Deficits of Learning Disabled Children. Journal of Learning Disabilities, 1985, 18 (2), 89-93.

Loper, Ann B. and Hallahan, Daniel P. A Comparison of the Reliability and Validity of the Standard MFFT and MFFT 20 with Learning Disabled Children. Journal of Abnormal Child Psychology, 8 (3), 1980, 377-384.

Loper, Ann B., Hallahan, Daniel P. and McKinney, James D. The Effect of Reinforcement for Global or Analytic Strategies on the Performance of Reflective and Impulsive Children. Journal of Experimental Child Psychology, 1982, 33, 55-62.

Lorr, Maurice and Wunderlich, Richard A. A Measure of Impulsiveness and Its Relation to Extraversion. Educational and Psychological Measurement, 1985, 45 (2), 251-257.

Lowry, P.W. and Ross, L.E. Severely Retarded Children as Impulsive Responders: Improved Performance with Response Delay. American Journal of Mental Deficiency, 1975, 80 (2), 133-138.

Margolis, Howard. Relationship Between Auditory-Visual Integration, Reading Readiness, and Conceptual Tempo. The Journal of Psychology, 1976, 93, 181-189.

Margolis, H. and Brannigan, G.G. Conceptual Tempo as a Parameter for Predicting Reading Achieve Journal of Educational Research, 1978, 71 (6), 342-344.

Margolis, Howard, Brannigan, G. and Ash, C. Journal of Reading Behavior, 1980 (Win.) 10 (4), 359-362.

Margolis, Howard, Brannigan, Gary G., Molteni, Andrew, Heverley, Mary Ann, Potter, John, Gould, Jonathon, Samuels, Douglas D. Conceptual Tempo as a Moderator Variable in Predicting First Grade Achievement Test Scores. Journal of School Psychology, 1982, 20 (4), 313-322.

Margolis, Howard, Leonard, H. Skipton, Brannigan, Gary G. and Heverley, Mary Ann. The Validity of Form F of the Matching Familiar Figures Test with Kindergarten Children. Journal of Experimental Child Psychology, 1980, 29, 12-22.

Massari, D.J. The relation of Reflection-Impulsivity to Field Dependence-Independence and Internal-External Control in Children. The Journal of Genetic Psychology, 1975, 126, 61-68.

Massari, D.J. and Massari, J.A. Sex Differences in the Relation of Cognitive Style and Intellectual Functioning in Disadvantaged Preschool Children. Journal of Genetic Psychology, 1973, 122, 175-181.

McKinney, J.D. Teacher Perception of Classroom Behaviour of Reflective and Impulsive Children. Psychology in the Schools, 1975, 12 (3), 348-352.

McKinney, J.D. Problem-Solving Strategies in Impulsive and Reflective Second Graders. Developmental Psychology, 1973, 8 (1), 145.

Messer, Stanley. The Effect of Anxiety over Intellectual Performance on Reflection-Impulsivity in Children. Child Development, 1970, 41, 723-734. (a)

Messer, Stanley. Reflection-Impulsivity: Stability and School Failure. Journal of Educational Psychology, 1970, 61 (6), 487-490.

Messer, S. and Kagan, J. Changes in Reflection-Impulsivity Following Situationally Induced Anxiety. Proceedings at the 77th Annual Convention of the American Psychological Association, 1969, 4 (1), 331-332.

Messer, Stanley B. and Brodzinsky, David M. The Relation of Conceptual Tempo to Aggression and Its Control. Child Development, 1979, 50, 758-766.

Miechenbaum, D.H. and Goodman, J. Training Impulsive Children to Talk to Themselves: A Means of Developing Self-Control. Journal of Abnormal Psychology, 1969, 40, 785-797.

Mollick, L.R. and Messer, S.B. The Relation of Reflection-Impulsivity to Intelligence Tests. Personal Communication, March 9, 1978.

Nagle, R.J. and Thwaite B.C. Are Learning Disabled Children More Impulsive? A Comparison of Learning Disabled and Normal Achieving Children on Kagan's Matching Familiar Figure Test. Psychology in the Schools, 1979, 16 (3), 351-355.

Nelson, T.F. The Effects of Training in Attention Development on Observing Behaviour in Reflective and Impulsive Children. Unpublished Doctoral Dissertation, University of Minnesota, 1968.

Nelson, W.M. III, Finch, A.J. Jr. and Hooke, J.F. Effects of Reinforcement and Response-Cost on Cognitive Style in Emotionally Disturbed Boys. Journal of Abnormal Psychology, 1975, 84 (4), 426-428.

Neussle, W. Reflectivity as an Influence on Focusing Behaviour of Children. Journal of Experimental Child Psychology, 1972, 14, 265-276.

Oas, Peter. Impulsivity and Delinquent Behavior Among Incarcerated Adolescents. Journal of Clinical Psychology, 1985, 41, (3), 422-424.

Oas, Peter. Validity of the Draw-a-Person and Bender Gestalt Tests as Measures of Impulsivity with Adolescents. Journal of Consulting and Clinical Psychology, 1984, 52 (6), 1011-1019.

O'Brien, Deborah Harris. Reflection-Impulsivity in Total Communication and Oral Deaf and Hearing Children: A Developmental Study. American Annals of the Deaf, 1987, 132 (3), 213-217.

Peters, R. Dev. and Bernfeld, Gary A. Reflection-Impulsivity and Social Reasoning. Unpublished paper presented at Child Development Conference, Waterloo, 1980.

Peters, R. Dev. and Davies, K. Effects of Self-Instructional Training on Cognitive Impulsivity of Mentally Retarded Adolescents. American Journal of Mental Deficiency, 1981, 85 (4), 377-382.

Pitassi, Tullio David and Offenbach, Stuart I. Delay of Reinforcement Effects with Reflective and Impulsive Children. The Journal of Genetic Psychology, 1978, 133, 3-8.

Porter, Sally S. and Omizo, Michael, M. The Effects of Group Relaxation Training, Large Muscle Exercise and Parental Involvement in Attention to Task, Impulsivity and Locus of Control Among Hyperactive Boys. Exceptional Children, 1984, 31 (1), 54-64.

Pratt, Michael W. and Wickens, Garth. Checking It Out: Cognitive Style, Context and Problem Type in Children's Monitoring of Text Comprehension, Journal of Educational Psychology, 1983, 75 (5), 716-726.

Reali, N. and Hall, V. Effect of Success and Failure on the Reflective and Impulsive Child. Developmental Psychology, 1970, 3 (3), 392-402.

Rinehart, Steven D. Conceptual Tempo, Studying and Reading. Journal of Educational Research, 1988, 81 (3), 138-142.

Rivera, Edelwina and Omizo, Michael, M. The Effects of Relaxation and Biofeedback on Attention to Task and Impulsivity Among Male Hyperactive Children. The Exceptional Child, 1980, 27 (1), 41-51.

Rohrbeck, Cynthia A. and Twentyman, Craig, T. Multimodal Assessment of Impulsiveness in Abusing, Neglecting, and Nonmaltreating Mothers and Their Preschool Children. Journal of Consulting and Clinical Psychology, 1986, 54 (2), 231-236.

Rosenfield, Sylvia, Houtz, John C. and Steffero, Francis, A. Relationship of Children's Conceptual Tempo to Problem-Solving and Creativity. Psychology in the Schools, 1977, 14 (3), 364-371.

Salkind, N.J., Kojima, H. and Zelniker, T. Cognitive Tempo in American, Japanese and Israeli Children. Child Development, 1978, 49 (4), 1024-1027.

Schliefer, M. and Douglas, V.I. Moral Judgments, Behaviour and Cognitive Style in Young Children. Canadian Journal of Behavioural Science, 1973, 5 (2), 133-144.

Schmidt, Charles P. The Relationship Among Aspects of Cognitive Style and Language-Bound/Language-Optional Perception to Musicians Performance in Aural Discrimination Tasks. Journal of Research in Music Education, 1984, 32 (3), 159-168.

School, Beverley and Cooper, Arlene. Reflective Thinking. Academic Therapy, 1986, 21 (4), 441-446.

Siegel, Alexander W., Babich, Joanne M. and Kirasic, Kathleen C. Visual Recognition Memory in Reflective and Impulsive Children. Memory and Cognition, 1974, 2 (2), 379-384.

Siegel, A.W., Kirasic, K.C. and Kilburg, R.R. Recognition Memory in Impulsive and Reflective Preschool Children. Child Development, 1973, 44, 651-656.

Siegleman, E. Reflective and Impulsive Observing Behaviour. Child Development, 1969, 40, 1213-1222.

Smith, J. Nelson, David and Kemler, Deborah G. Is the More Impulsive Child a More Holistic Processor? A Reconsideration. Child Development, 1988, 59 (3), 719-727.

Snyder, Frederick R. and Butler, Eliot J. Performance of Good and Bad Readers at Two Grade Levels on an Auditory Cognitive Style Task. Contemporary Educational Psychology, 1985, 10 (1), 1-13.

Souch, S. A Cross-Sectional Study of Reflection-Impulsivity. Unpublished Doctoral Dissertation, University of Alberta, 1970.

Sousley, Sharon A. and Gargiulo, Richard M. Effects of Conceptual Tempo on Kindergarten Reading Readiness. Perceptual and Motor Skills, 1981, 53, 127-134.

Staetler, James W. Binocular Vision Anomolies. London: Butterworth and Co. Publishers Ltd., 1982.

Stein, N. and Prindaville, P. Discrimination Learning and Stimulus Generalization by Impulsive and Reflective Children. Journal of Experimental Child Psychology, 1976, 21 (1), 25-39.

Susman, Elizabeth, J., Huston-Stein, Aletha and Friedrich-Coler, Lynette. Relation of Conceptual Tempo to Social Behaviours of Head Start Children. The Journal of Genetic Psychology, 1980, 137, 17-20.

Tolor, Belle and Tolor, Alexander. An Attempted Modification of Impulsivity and Self-Esteem in Kindergartners. Psychology in the Schools, 1982, 19 (4), 526-531.

Turner, William, E. and Fletcher, Claire, M. The Relationship Between Conceptual Tempo, Phonological Awareness, and Word Recognition in Beginning Readers. Journal of Reading Behavior, 1981, Volume XIII, No. 2.

Vega, Manual and Powell, Arnold. Visual Defects and Performance on Psychological Tests. Journal of Negro Education, 1974, 45, 127-130.

Vurpillot, E. The Development of Scanning Strategies and their Relation to Visual Differentiation. Journal of Experimental Child Psychology, 1969, 6, 632, 650.

Walker, William N. Companion of Cognitive Tempo and Time Estimation by Young Boys. Perceptual and Motor SKills, 1982, 54, 715-722.

Walker, William N. Impulsivity in Learning Disabled Children: Past Research Findings and Methodological Inconsistencies. Learning and Disability Quarterly, 1985, 8 (21), 85-94.

Walker, William N. Interactional Effects of Socioeconomic Status and Cognitive Tempo on WISC-R Performance. Measurement and Evaluation in Counseling and Development, 1985, 18 (2), 58-63.

Walker, William N. Impulsivity in Learning Disabled Children: Past Research and Methodological Inconsistencies. Learning Disability Quarterly, 1985, 8 (2), 85-94.

Weiner, A.S. Visual Information-Processing Speed in Reflective and Impulsive Children. Child Development, 1975, 46 (4), 998-1000.

Weiner, A.S. and Adams, W.V. The Effect of Failure and Frustration on Reflective and Impulsive Children. Journal of Experimental Child Psychology, 1974, 17, 353-359.

Weissbach, Marilyn. The Effect of a Reflective or Impulsive Conceptual Tempo upon the Decoding Ability of Emotionally-Disturbed Boys. Unpublished doctoral dissertation, Hofstra University, 1978.

Weithorn, Corrinre J. and Others. The Relationship of Activity Level Ratings and Cognitive Impulsivity to Task Performance and Academic Achievement. Journal of Child Psychology and Psychiatry and Allied Disciplines, 1984, 25 (4), 587-606.

Wolfe, Raymond, Egelston, Richard and Powers, John. Conceptual Structure and Conceptual Tempo. Perceptual and Motor-Skills, 1972, 35, 331-337.

Yando, R. and Kagan, J. The Effect of Teacher Tempo on the Child. Child Development, 1968, 39, 867-874.

Yando, R.M. and Kagan, J. The Effect of Task Complexity on Reflection-Impulsivity. Cognitive Psychology, 1970, 1, 192-220.

Yang, Ok Seung and Michael, William B. The Effect of Verbal Plan and Review Training on Preschoolers. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, 1986.

Zelniker, Tamar, Jeffrey, W.E., Ault, Ruth and Parsons, Jacquelynne. Analysis and Modification of Search Strategies of Impulsive and Reflective Children on the Matching Familiar Figures Test. Child Development, 1972, 43, 321-335.

Zelniker, Tamar and Oppenheimer, Louis. Modification of Information Processing of Impulsive Children. Child Development, 1973, 44, 445-450.

Zern, D.S., Kenney, H.J. and Kvaraceus, W.C. The Cognitive Style Dimension of Reflectivity-Impulsivity in Normal and Emotionally Disturbed Adolescents. The Journal of Genetic Psychology, 1977, 131, 107-113.

Zucker, J.S. and Stricker, G. Impulsivity-Reflectivity in Preschool, Headstart and Middleclass Children. Journal of Learning Disabilities, 1968, 1, 578-583.