

**THE EFFECTS OF REGULAR PHYSICAL ACTIVITY ON THE COGNITIVE
PROCESSING OF ELDERLY ADULTS**

BY

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**A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of**

MASTERS OF ARTS

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of Manitoba in partial fulfillment of the requirements of the degree
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Abstract

This study investigated the effects of regular aerobic activity on the cognitive ability of elderly adults. A sample of 24 elderly adults involved in a regular exercise program for two years constituted the high active group. The control or low active group consisted of 19 elderly adults who are socially active. Participants from each group were assessed for fitness level, activity level as well as various cognitive tests. These tests included the fact and source memory recall test, Verbal Fluency, the Stroop Test, the Wisconsin Card Sorting Task, Trail Making, Mill Hill Vocabulary test, and a test of metamemory self-efficacy. Past research on the effects of aerobic fitness on cognitive functioning has been inconclusive, with contributing factors consisting of problems with sample size, cognitive tasks chosen, study designs, and equating groups on general activity and self-efficacy.

A series of multivariate analyses of covariance, with age as the covariate, determined that general memory functioning as indicated by fact recall and vocabulary scores, and metamemory measures of self efficacy were equal for both groups. Activity level, other than physical, and scores on interference-sensitive measures of frontal lobe functioning, with the possible exception of the Wisconsin Card Sorting Task, were also equivalent for both groups. The inconsistency of performance on these tasks leads to a possible dissociation of such frontal lobe measures which will be discussed in this paper. As well, possible neurological explanations are examined to account for such results.

From these results, it seems that the role of fitness on cognitive ability may

have been overemphasized in past research. Perhaps, general activity, including cognitive and social activity, is of greater important in maintaining cognitive functioning in healthy community dwelling elderly adults.

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**The Effects of Regular Physical Activity on Cognitive
Processing of Elderly Adults**

The effects of fitness on aging have become of increasing interest to researchers. Studies have examined the effects of fitness on various physiological measures of the elderly. More recently, however, the research focus has shifted to examine not only these physiological effects but also the cognitive benefits which can be acquired through regular aerobic exercise (Spirduso, 1994).

According to Piscopo (1985) and McPherson (1990), age related changes in the cardiovascular system include decreases in maximum heart rate and stroke volume. As well, maximum cardiac output shows declines of approximately 1% per year after maturity and diastolic and systolic blood pressure increases (deVries & Housh, 1994). DeVries and Housh cited evidence that total arterial cross section open to blood flow is 29% less in older (40 - 59) than in young (10 - 29) individuals. The combination of these changes contribute to the lowered efficiency of the cardiovascular system. DeVries and Housh also cited evidence for decreases in efficiency of the circulatory system which occurs with increased age.

Changes in the respiratory system include decreased elasticity of the lungs and a decrease in forced vital capacity, which is the amount of air which can be forcibly exhaled after full inspiration (McPherson, 1990). Also, there are decreases in diffusion and absorption capacities, maximum voluntary ventilation, and oxygen uptake (V_{O2} max) (McPherson).

DeVries and Housh (1994) explained that the physiological functions which

are dependent on two or more organ systems decline most with age. Therefore, with increased age, the combined cardio-pulmonary system undergoes numerous changes, which results in its decreased efficiency. McPherson (1990) discussed the effect of these systems on fitness level and concluded that "the coordination and efficiency of both the respiratory and cardiovascular systems are highly interrelated in determining the fitness capacity of a given individual" (p.164).

DeVries and Housh (1994) described research by Wessel and Van Huss (1969) who examined the effects of decreased physical activity with age. Wessel and Van Huss concluded that "losses in physiological variables important to human performance resulting from age were more highly related to the decreased habitual activity level than they were to age itself" (deVries & Housh, 1994, p.381).

Exercise and Physiological Functioning. As deVries and Housh (1994) and McPherson (1990) discussed, it is well documented that regular physical exercise has resulted in improvements in V_{O_2} max, diastolic and systolic blood pressure, heart rate, blood volume, cardiac output, and stroke volume in elderly adults. Shephard (1993) examined a number of positive physiological and anatomical changes in later years in life which accompany the implementation of fitness activity. Such changes range from respiratory muscle composition and function to improved alveolar ventilation and pulmonary diffusion. The improvements in physiological functioning of the cardio-pulmonary system results in greater efficiency of blood flow throughout the body. Therefore, cerebral blood flow would also show such improvements in efficiency. For these reasons, it has been postulated that such improvements in

physiological efficiency should result in increased performance in cognitive ability as well.

Studies conducted to determine the effects of exercise on cognition have examined a variety of abilities. Many have examined reaction time changes (Abourezk & Toole, 1995; Baylor & Spirduso, 1988; Blumenthal & Madden, 1988; Clarkson-Smith & Hartley, 1989; Clarkson-Smith & Hartley 1990; Dustman, Emmerson, & Shearer, 1994; Madden, Blumenthal, Allen, & Emery, 1989; Offenbach, Chodzko-Zajdo, & Ringel, 1990; Rikli & Busch, 1986; Rikli & Edwards, 1991; Spirduso, MacRae, MacRae, Prewitt, & Osborne, 1988), while others have examined the effects of exercise on more complex performance measures. These measures have included WAIS-R (Blumenthal, Emery, Madden, Schneibolk, Walsh-Riddle, George, McKee, Higginbotham, Cobb, & Coleman, 1991; Clarkson-Smith & Hartley, 1990; Shay & Roth, 1992; Stones & Kozma, 1989), fluid and crystallized intelligence (Christensen & MacKinnon, 1993; Elsayed, Ismail, & Young, 1980; Powell & Pohndorf, 1971), automatic and effortful processing (Chodzko-Zajko, Schuler, Solomon, Heini, & Ellis, 1992; Moul, Goldman, & Warren, 1995), working memory (Clarkson-Smith & Hartley, 1990), frontal lobe measures including Stroop and verbal fluency (Blumenthal et al., 1991; Shay & Roth, 1992), visuospatial functions (Shay & Roth, 1992), and the Ross Information Processing Assessment (RIPA) (Moul et al., 1995). Conflicting findings over this wide range of cognitive abilities has yielded inconclusive results as to the effects of exercise on cognition as a whole.

Study design can have an impact on research findings (Dustman et al., 1994). Those which have implemented an exercise program for 12-16 weeks, and then measured the effects, often find no differences in cognitive performance between the exercisers and the controls. Conversely, those studies which examined the long term effects of regular exercise on cognitive ability often reported differences between the groups (Dustman et al., 1994). These cross sectional designs allow for greater time for the effects of regular exercise to be examined. Similarly, as discussed by Bashore and Goddard (1993), the changes in $\dot{V}O_2$ max found in longitudinal designs may not be of great enough significance to create changes at the neurophysiological level. They concluded that the peripheral nervous system changes may need to reach a critical level before central nervous system changes become evident. Unfortunately however, the cross-sectional design results in less control over a number of confounding variables as well.

Exercise and Reaction Time. The studies which examined fitness effects on reaction time performance report conflicting findings. Baylor and Spirduso (1988) found faster reaction times for a group of aerobically trained female runners as compared to nonexercise controls. They concluded that the regular aerobic activity allowed for the central nervous system to respond effectively to incoming stimuli. Similarly, Rikli and Busch (1986) showed that older female golfers demonstrated improvements in choice reaction time as compared to an inactive group of their peers. These researchers supported past research which argued that lifelong physical activity has a positive impact on motor performance (Rikli & Busch, 1986).

In contrast, Blumenthal and Madden (1988) found no changes in reaction times after a 12-week jogging program and Madden et al. (1989) reported that 16 weeks of aerobic exercise training had no effect on reaction time for letter search or word comparison. Panton et al. (1990) found no differences in reaction times of elderly adults as a result of an exercise program of six months. As mentioned, study design differences may account for the conflicting results of these research studies. While Blumenthal and Madden and Madden et al. examined the short term effects of a fitness program on reaction time, Baylor and Spirduso (1988) and Rikli and Busch (1986) studied its long term effects. As suggested by Dustman et al. (1994) and Bashore and Goddard (1993), this greater duration may allow for the positive physiological effects of improved cerebral blood flow to translate into improved cognitive performance.

In a more recent study, however, Abourezk and Toole (1995) reported that simple reaction time (SRT) and complex choice reaction time (CCRT) show differences in active and inactive elderly women. While the active women performed faster on CCRT than their inactive peers, there were no differences found in SRT. In line with the suggestions by Chodzko-Zajko et al. (1992), these researchers concluded that fitness effects may be task dependent. As discussed later, these conclusions can be predicted based on the effects of fitness on neurological functioning, specifically that of the frontal lobes. It has been suggested that it is these structures which control ability to suppress interfering information.

Exercise and Complex Cognitive Processes. Evidence found in testing other

cognitive abilities of the elderly provides greater support for the positive effects of exercise on cognition. Cross sectional studies which have examined various cognitive abilities have shown that high-fit elderly possess greater ability in reasoning and working memory (Clarkson-Smith & Hartley, 1989), effortful tasks (Chodzko-Zajko et al., 1992), visuospatial processing tasks (Shay & Roth, 1992), and digit span tasks (Stones & Kozma, 1989). Using structural-equation modelling, Clarkson-Smith and Hartley (1990) concluded that there is a positive relationship between physical exercise and cognition in older adults. The study by Moul et al. (1995) of a longitudinal design reported not only an increase in V_{O_2} max after a 16 week training session, but also a 7.5% increase in scores on the Ross Information Processing Assessment (RIPA).

Shay and Roth (1992) used a cross-sectional design to examine the long term fitness effects on various cognitive measures. Based on a self-report measure, they compared active and inactive groups of elderly adults and tested their ability on various WAIS-R subtests, including digit span, visual reproduction, vocabulary, logical memory, and digit symbol as well as the Stroop test and verbal fluency. They determined that high fit elderly performed better on tests which required the reproduction of visual information. These included the WAIS-R visual reproduction and digit symbol tests and the trail detail placement test. From this, Shay and Roth concluded that regular aerobic activity preserves functioning of this type in elderly adults.

Moul et al. (1995) examined the effects of an exercise program on a variety of

cognitive tasks. Based on the Hasher and Zacks (1988) theory of changes with age, which distinguishes between automatic and effortful processing, Moul et al. wanted to determine the varying degrees of effortful cognitive ability in older adults. In order to do this they utilized the RIPA which is a clinical tool used to determine changes in an individual's ability to process information. Subjects were randomly assigned to a walking, weight training, or control group for a duration of 16 weeks and scores on various subtests of the RIPA were obtained before and after the program. The only results of significance were found for the walk group where an increase of 15.8% in VO_2 max and a 7.8% increase in scores on the RIPA were obtained. Moul et al. concluded that the more attentionally demanding a task, the greater its sensitivity to the effects of exercise. Generally, they concluded that aerobic training had a positive impact on cognitive performance

Chodzko-Zajko et al. (1992) examined frequency of occurrence and location as automatic tasks and free recall as an effortful task. Based on a fitness test, subjects were divided into high and low fit groups and then tested on these cognitive tasks. They found differences in performance in effortful tasks (free recall) but not differences in the automatic tasks (frequency of occurrence and location). Chodzko-Zajko et al. concluded that exercise has a positive effect on effortful tasks, where changes occur with age; however, exercise has no effect on automatic tasks, where changes with age are not expected.

The effects of exercise on fluid and crystallized intelligence scores have been investigated by researchers as well (Christensen & MacKinnon, 1993; Elsayed et al.,

1980; Powell & Pohndorf, 1971). While fluid intelligence has been found to be greater for high-fit than for low-fit elderly (Christensen & MacKinnon, 1993; Elsayed et al., 1980; Powell & Pohndorf, 1971), no differences have been reported for crystallized intelligence (Christensen & MacKinnon, 1993; Elsayed et al., 1980). Again, such findings mirror those typically found when comparing young and old adults (Kausler, 1991).

Studies conducted by Madden et al. (1989) and Blumenthal et al. (1991) found no increase in various cognitive measures as a function of physical exercise. Such measures included letter search and word comparison, as well as memory function, digit span (WAIS-R), perceptual motor function, verbal fluency and the Stroop colour test. However, Blumenthal et al. did report that verbal fluency measures were better for the elderly in the aerobic and yoga groups as compared to those in the waiting list group.

Theories of Cognitive Changes with Age. Much of the research summarized above on the positive effects of fitness has as its impetus research comparing the memory and cognitive performance of young and old adults. In broad summary, these studies have found differences in fluid intelligence, frontal lobe functioning, and episodic memory, but not in crystallized intelligence, semantic memory, automatic processes, or implicit memory. Therefore, research attempting to demonstrate the cognitive changes which accompany fitness programs have utilized those types of tasks where age differences have been shown. In areas where little change with age occurs, differences between high fit and low fit elderly are not expected.

McIntyre and Craik (1987) demonstrated that young and old adults show marked differences in the ability to correctly identify the source of newly acquired information. Using facts about famous people these researchers found that young adults had higher performance in sourcing the information than the elderly adults in the study. The ability to recall the facts however, was equal for both groups. This type of finding has been further examined and results have been consistently the same (Schacter, Kasniak, Kihlstrom, & Valdiserri, 1991; Schacter, Osowiecki, Kasniak, Kihlstrom, & Valdiserri, 1994). Schacter et al. (1991) compared the source deficits exhibited by elderly adults under certain conditions to similar findings with amnesic patients (Schacter, Harbluk, & McLachlan, 1984). The argument is that older adults are disproportionately affected on tests of context or source memory in relation to fact memory. These differences in memory performance have been attributed to changes in frontal lobe functioning (Craik, Morris, Morris, & Loewen, 1990).

Many theories to account for the pattern of differences found between young and old age groups have been developed. One such theory introduced by Dempster (1992) hinges on the notion that elderly adults show difficulties in performing tasks which require the inhibition of irrelevant information. To explain this phenomenon, he outlined the ontogenetical and phylogenetical development of the frontal lobes of the brain. These structures are the most recently developed structure of the human brain and they are the last to develop in childhood. More importantly, the frontal lobes show the earliest and most extensive declines as one ages. Consequently, Dempster concluded that cognitive tasks which rely on these structures will show the

greatest decline with age. He stated that such recent phylogenetic and ontogenetic development of these structures make them particularly susceptible to changes as an individual ages.

Dempster (1992) cited tests which are interference sensitive, particularly the ability to ignore irrelevant information, which include the Stroop Colour Test, Wisconsin Card Sort, text processing, selective attention, and field dependence. The decreased performance on these tasks for elderly compared to young adults has been attributed to changes in the frontal lobes. Much research has been conducted to determine the role that the frontal lobes play in cognition. Studies with patients who have frontal lobe lesions support the claim that this area of the brain controls the inhibition of internal and external interference (Dempster, 1992). Perseveration and inflexibility of cognitive responses has been attributed to the frontal lobes; however, these responses are dependent on a variety of factors (Stuss & Benson, 1984). Stuss and Benson noted that patients with frontal lobe damage "are unable to change responses in accordance with varying environmental stimuli to overcome previously established response patterns" (p.18). This research has been extended to changes in cognitive performance of the elderly who show difficulties with tasks such as the Wisconsin Card Sorting Task. Perhaps increased age is accompanied by frontal lobe changes, similar to that of frontal lobe patients, and such changes contribute to the decline in performance on interference-sensitive tasks for elderly adults. From this reasoning, it would be expected that active elderly will perform better than their inactive peers on these types of tasks because these structures may be spared the

changes which normally occur with age.

Hasher and Zacks (1988) have also theorized that the changes in cognitive performance between young and elderly adults may be due to declines in frontal lobe functioning. Their analysis of text processing and memory for textual material with similar arguments to Dempster's (1992) theory and the inhibition of irrelevant information. Hasher and Zacks also distinguished between effortful and automatic tasks with age changes affecting the former and not the latter. As discussed by Moul et al. (1995), it has been suggested that declines normally found for effortful tasks are less for fit elderly adults as compared to their inactive counterparts. It has been suggested that exercise may preserve this area of functioning in elderly adults. Again, this conclusion is based on the assumption that physical activity should be accompanied by improved neurological functioning, specifically improved frontal lobe functioning, and consequently an increase in the ability to suppress irrelevant information.

Methodological and Procedural Questions. In reviewing past research in this area, several important findings emerge. First, there is a greater likelihood that cross-sectional designs will yield outcomes in line with predictions that suggest a positive benefit of exercise on cognitive performance. Studies which have examined the long term effects of aerobic exercise have often reported positive results. It is believed that these results reflect the true effects of the aerobic exercise on cognitive performance. In contrast, longitudinal designs, those which implement a relatively short duration exercise program, often report little change in performance. As discussed by Bashore

and Goddard (1993) and Dustman et al. (1994), the duration of the program may be too short to determine the true effects of the fitness program. Also, the increase in fitness level which has been attained in these designs may not be great enough to affect the processing of the central nervous system (Bashore & Goddard, 1993).

Ideally, the best possible design would be that of a long-term longitudinal type. This design would make comparisons of matched individuals at a certain age with one group commencing a fitness program and the other group not becoming aerobically active. A follow-up over time would yield the best results as to the true effects of the fitness program. However, this type of study design is difficult to undertake for a number of reasons. Since short-term longitudinal designs have not resulted in large effects, the cross-sectional design seems to be the most logical choice.

The use of cross-sectional designs, however, introduces additional problems. For example, much of the past research has not accounted for the social benefits of a fitness program. To make accurate conclusions, the improvements which are reported in the active groups must be attributable to the exercise, and thus changes in physiological functioning, rather than from the possible social benefits which may also accompany the program. To ensure that the differences in the groups are due to fitness alone, social variables need to be ruled out. Therefore, participants from each group should be equally involved in some type of social setting. In this way, the social interaction benefits become a variable common to all participants.

In examining cross-sectional studies on cognition and fitness, there is another psychological variable which needs attention. Based on social cognitive theory, the

self efficacy of an individual will greatly influence performance on a variety of tests (Bandura, 1986). This has been shown in cognitive performance (Hertzog, Dixon, & Hultsch, 1990) as well as in exercise adherence (Dzewaltowski, 1989; Garcia & King, 1991) and fitness progress (McAuley, 1991). More efficacious individuals have been reported to maintain a fitness program (Dzewaltowski; Garcia & King; McAuley & Jacobson, 1991) and cognitive performance is greater for those people with greater than lower self efficacy (Hertzog et al., 1990). Also, more efficacious individuals in exercise programs attributed their progress to personally controllable causes (McAuley, 1991), and also attained higher levels of exercise (McAuley & Jacobson, 1991). McAuley and Courneya (1992) found that higher self efficacy was related to lower perceptions of effort expenditure and a more positive affect during exercise. As well, individuals with high efficacy scores had higher exercise readiness and were more likely to follow through with an exercise program than those with low efficacy scores (Armstrong, Sallis, Hovell, & Hofstetter, 1993; Marcus & Owen, 1992). Therefore, the effects of self efficacy on both cognitive performance and exercise participation is of interest.

The criticisms and findings of past studies have lead to the purposes of the present study. First, the effects of a long term fitness program on the cognitive performance of elderly adults was of interest. Thus, a cross sectional design was implemented to compare physically active and inactive elderly adults on a variety of cognitive tasks. Second, the social variable, or amount of social activity of each participant, was incorporated into the study design to ensure that this was not a

confounding variable. Third, the effect of self efficacy on an individual's behaviour (the tendency to exercise) and performance (cognitive ability) was examined to determine the interacting nature of these variables. As mentioned, those individuals who are physically active have a greater tendency to follow through with an exercise program than their less active peers (Armstrong et al., 1993; Marcus & Owen, 1992). From a metamemory perspective, however, both groups tested were highly active: one physically and the other socially. Therefore, self-efficacy scores were expected to be equal for the two groups. This outcome would ensure that the cognitive performance differences were only due to the physical effects of exercise and not due to self-efficacy differences between the groups. It was hypothesized that elderly individuals who had been aerobically active for a minimum of 2 years would score higher than low active elderly on cognitive tests of working memory and frontal lobe functioning. Second, measures of self efficacy and scores on the Mill Hill Vocabulary test were expected to be the same for both groups.

Method

Participants

Forty three participants, 38 females and 5 males (age range 59-85; overall mean age = 73.4) were recruited on a voluntary basis from two populations. The low physically active group, 18 females and 1 male (n = 19; mean age = 75.7) were recruited from Creative Retirement Manitoba and a Senior's complex in Winnipeg. The high active group, 20 females and 4 males (n = 24; mean age = 71.5) were recruited from the Kinsmen's Predit Program. All participants completed the health

status questionnaire (See Appendix A) obtained from the Kinsmen Reffit Centre.

Table 1 outlines the demographic information as well as a health summary of the two groups. According to the Health Status Questionnaire, the high active group reported an average of 2.65 heart-related health problems per person, while the low active reported a mean of 1.67. The most frequent of these problems reported for both the high and low active groups were high cholesterol, heart rhythm disorder and high blood pressure. The range of problems reported per person for the high active was from 0 to 7 and for the low active group the range of problems was from 0 to 10. There was one smoker in the high active group, who was subsequently dropped from the fitness test for health reasons. There were no smokers in the low active group. There were 6 participants in the high active and 4 participants in the low active group who reported a health problem related to arthritis. Within the low active group, 1 participant reported degenerated cartilage of the hip and 1 participant in the high active group reported having asthma.

The activities reported by each participant in each group are summarized in Table 2. The number of participants within each group reported participation in each activity is shown. For both the high and low active groups, the aerobic activities, such as walking, aerobics and biking were reported at a minimum of 3 times per week for a minimum of a half hour duration. All other activities reported were at a minimum of once a week for various durations. The most frequent activities reported for the high active group were walking, strength and stretch class, and biking. For the low active group, walking, biking and bowling were the most frequent activities

Table 1. Demographic and Health-Related Information of the High and Low Active Groups.

Variable	High Active	Low Active
n	24	19
Mean Age (years)	71.5	75.7
Mean Education (years)	14.3	13.7
Males	4	1
Females	20	18
Mean Heart- Related Health Problems Reported	2.65	1.67
Range of Health Problems per person	0 - 7	0 - 10
Number of Smokers	1	0
Number Reporting Arthritis	6	4

Table 2. Regular Physical Activities of High and Low Active Groups. Number of People Participating in Each Activity within Each Group is Reported.

Activity	High Active (n=24)	Low Active (n=19)
Walking	22	9
Aerobics	5	3
Strength and Stretch Class	10	0
Weights	4	0
Tai Chi	1	1
Cross Country Skiing	1	1
Dancing	4	1
Cycling/Stationary Bike	6	5
Yoga	2	0
Rowing	6	0
Gardening	2	2
Golf	2	0
Roller Skating	1	0
Snowshoeing	0	1
Bowling	1	5
Badminton	0	1
Swimming	0	2
Horseback Riding	0	1
Hunting	0	1

reported.

The Reffit Centre's physician reviewed all health status questionnaires and determined those who were ineligible for fitness testing. The criteria included any previous heart or circulatory disease, or any other health problem which might put the participant at risk. While the groups did not differ in Education ($t(1, 36) = 0.61, p = 0.55$), they did differ in age ($t(1, 41) = -2.47, p = 0.018$). As a result, age was used as a covariate in the analyses which follow.

Materials

Cognitive Measures. Fact and source memory were tested using fake facts as in the in the McIntyre and Craik (1987) study. This consisted of reading to the participants a series of 'facts' about famous people. The source of the facts was blocked into groups of ten with the first ten facts read by a female, the second block of ten by a male source, the third block of ten by a female, and finally the last block of ten by a male source. These facts were of three types: 8 true facts (buffers) about someone well known ("Jerry Lewis hosts telethons for muscular dystrophy"), 16 fake facts about a well known personality (high knowledge: "Anne Murray's favourite colour is purple"), and 16 fake facts about someone who is less well known (low knowledge cent Van Gogh was afraid of spiders"). These facts were presented so that half of the high knowledge items were read by the male presenter and half by the female presenter. Similarly, half of the buffer items were presented by the female and half by the male source. These items were arranged to ensure that half of the high knowledge items and half of the low knowledge items were read in the first half of the

entire presentation and the other half of each were read in the second half. The 48-item test, presented one week later, consisted of 16 questions about true facts about famous people (i.e., 'Where was Pope John Paul II born?' Lure question). The other thirty-two items were based on the fake facts from the presentation; sixteen of the questions were of high knowledge items and the other sixteen questions were of the facts of low knowledge items. Participants were asked to give answers to both the fact and the source, guessing where necessary. For source memory the participant was asked to indicate "old" (a fact presented in the previous week) or "new" (a fact presented for the first time at testing. If old, the person also circled whether it was the male or female experimenter who had read the fact. For example, if the fake fact read in the presentation by the female presenter was 'Bill Cosby learned to play the piano in high school', the question would be, 'What did Bill Cosby learn to play in high school?'. The participant would have to answer 'piano' for fact and 'female' for source to score correctly on the two components. Scoring for the test consisted of the two components; total sources correct and total facts correct. The items and test questions for the fact/source memory test are included in Appendix B.

Frontal Lobe Functioning Measures. To assess frontal lobe functioning the computerized version of the Wisconsin Card Sort Test (WCST) was administered. This task is one of cognitive functioning particular to the frontal lobes and the ability to suppress inhibiting information (Dempster, 1992; Heaton, 1993). This is a nonverbal task in which subjects were required to match a deck of 128 cards on the basis of number (one, two, three, or four), shape (crosses, circles, stars, or triangles),

or colour (blue, yellow, red, or green). The matching criterion was based on one of these three possibilities. When 10 successive responses were achieved on one sort criterion the criterion for a match changed. The test continued until the participant was exposed to all 128 cards or achieved the sorting criterion for 6 categories. As indicated by Hau (1994) there are a number of dependent measures which could be used with this task; however, the best dependent measure to assess frontal lobe functioning is the number of perseverative errors. A perseverative error is defined as "one which would have been correct on the immediately preceding stage of the test, or, in the first stage, as a continued response in terms of the [participant's] initial preference" (Milner, 1963, p.91). This type of error is indicative of the individual's inability to suppress inhibiting information. This response has been attributed to changes which occur in the frontal lobes of the brain and has been well documented in research with patients with frontal lobe lesions (Stuss & Benson, 1984). Reliability of the manual version of this test is high with intrascorer and interscorer agreement correlated at .93 and .96, respectively (Heaton, Chelune, Talley, Day, & Curtiss, cited in Hau, 1994). The construct and content validity of this test has been demonstrated as well (Puente, 1985).

The Verbal Fluency task is a test to measure the ability to generate words rapidly. Subjects were given five letters (e.g., B,N,R,A,P) and asked to generate as many English words as possible within a one minute period (Corsini, 1983). Hau and McIntyre reported test-retest reliabilities of .76 to .81 for the Verbal Fluency test under these conditions (Personal Communication, December 20, 1995). The

dependent measure was the total number of words produced across the five letters.

The inhibiting component of this task is that subjects will experience retrieval blocks as they attempt to recall more items from the letter.

The third task to assess frontal lobe functioning was the Stroop Colour Test. This is a test of a person's ability to inhibit interfering information. Subjects had to distinguish between colors and words and respond to each separately. There were three pages presented to subjects. The first page had color words printed in black ink (word page) and the task was to read the words aloud as fast as possible. The second page had an "X" printed in different colors (color page) and participants were asked to read the color. The last page had the color words printed with different colored ink. The ink color and word did not match one another (word-color page). Subjects were required to say the color of the ink. The task for page three was to separate the color from the written word, naming only the colour. It was this component which makes the Stroop Colour Test an inhibiting task. The subject was required to ignore the written word (greater inclination to read the word) and instead say the color of ink it was printed in (less inclination). The time to read each page was measured and the dependent variable was the difference in reading time between page 3 and page 2 ($T_3 - T_2$) divided by the reading time of page 2 (T_2), yielding a measure of proportional increase in reading speed on the task.

The Trail Making test (See Appendix C) required the participant to join a series of numbered or lettered circles in numerical or alphabetical order. The first part of the test was to join a series of numbers in increasing order. The second, critical

task was to use both number and letter sequences, alternating from number to letter. The inhibiting component in this task is to ignore the tendency of connecting the circles only numerically (i.e., 1 to 2 to 3, etc.); instead the number-letter-number-letter sequence was required (ie., 1-A-2-B etc.). The dependent variable was the time difference to complete the task under number conditions versus that to complete the letter and number condition divided by the number only condition $((T2-T1)/T1)$. This dependent variable also represents a proportional increase in time required under interference conditions.

Self Efficacy Measures. The Metamemory in Adulthood Questionnaire (MIA) (See Appendix D) was used to assess self efficacy of the elderly adults. According to Hertzog et al. (1990), the Capacity Scale of the MIA is a highly reliable and valid measure of memory self efficacy. The Capacity Scale involves Likert scale ratings (1 = agree strongly to 5 = disagree strongly) of various memory components and scenarios, such as "I am good at remembering names". The MIA was administered in its entirety, and included the following scales; Strategy, Task, Achievement, Anxiety, Change, and Locus (Hertzog et al., 1990).

Physical Fitness Measures. The fitness measure used was the 6-minute walking test (See Appendix E). The materials for this test included a blood pressure cuff, stethoscope, stopwatch, measuring stick and the Borg's perceived exertion chart (See Appendix F). Aerobic activity has been emphasized in past research as this has been shown to improve the efficiency of blood flow to the various parts of the body. The distance which an individual can walk in six minutes is a reflection of their

cardiovascular endurance. It assumed that those individuals walking a greater distance would have a higher VO_2 Max as they would have a greater level of cardiovascular endurance than those walking a lesser distance. According to Guidelines for Exercise Testing and Prescription (4th ed.) (1994), the six minute walking test is a sub-maximum test and is both a valid and reliable measure of an individual's level of fitness.

Demographic and Vocabulary Tests. At the beginning of the study the health status questionnaire used by the Kinsmen Rehfitt Centre was administered. This questionnaire consisted of general demographic questions (gender, age, etc.), as well as information on health status, and personal and family medical history (See Appendix A). The Mill Hill Vocabulary Test is a 21-item 6-alternative synonyms test of English words (Mill Hill Vocabulary Test; 1965) (See Appendix G) used frequently in studies of adult age differences in cognition (e.g, McIntyre & Craik, 1987).

Activity Scale. To assess general level of activity, the scale used by Hultsch, Hammer, and Small (1993) was employed (See Appendix H). This is a 9-point (0 = never to 8 = daily) Likert Scale of various activities which are divided into six categories. These activity categories included (1) physical activities, such as jogging, (2) social activities, such as dinner parties, (3) self maintenance activities, such as housework, (4) passive activities, such as watching television, (5) integrative information processing, such as doing household repairs and (6) novel information processing, such as doing crossword puzzles. Each participant was given a score for

each of these categories based on their responses to the various questions.

Procedure

Cognitive tests. The participants who were members of the Kinsmen Reffit Centre constituted the high active group while all other recruits made up the low active group. Cognitive tests were held at an Age and Opportunity Centre and the Senior's Complex for the inactive group, and at the Kinsmen Reffit Centre for the active group. In the first session the fake facts were presented to the participants and the verbal fluency and vocabulary tests were administered. The participants were given the Metamemory, Activity, and Health Status Questionnaires, which they were asked to complete at home and return at the next session. One week later, in the second session, the questionnaires were returned and the recall test for the facts and source was given. In a third session, the WCST - computerized, the Stroop and the Trail Making test were administered. For the WCST, participants were given instructions as to how to proceed with the test, including which computer keys were used to sort the various cards. The third session took approximately one hour.

After the third session the fitness tests were scheduled for those participants who met the requirements as determined by the physician at the Kinsmen Reffit Centre.

Fitness tests. A six minute walking test was administered on the track at the Kinsmen Reffit Centre to both the high and low active groups. These tests were conducted by a physiotherapist and physiotherapy students who had been trained in performing such tests. Participants' resting heart rate and blood pressure were taken

before administration of this test. They were then asked to walk at their own pace for 6 minutes and informed that they could stop for rest periods at any point during the test. The participants were instructed that the distance walked in 6 minutes was the measurement being used. This would ensure that they attempted to walk the greatest distance possible. The walking test was conducted twice to allow for a learning effect. Once heart rate and blood pressure had returned to resting levels, the second test was conducted. The instructions were the same as for the first test. Once completed, the distance walked, their perceived exertion (0-20), according to the Borg scale (see Appendix F), exercise heart rate and blood pressure, and time to return to resting heart rate and blood pressure (recovery rate) were recorded. The dependent measures used in this study were those taken on the second occasion. The walking test was conducted twice to account for learning effects. The measurements for the walking test were recorded after the second walk only. Measurements were not recorded after the first walk and therefore, the reliability from walk 1 to walk 2 are not available. However, for most participants, we were able to approximate the distance walked on the second walk based on the first one.

The number of participants who were ineligible to perform the walking test for health reasons were 3 from the high active and 4 from the low active group. As a result of scheduling difficulties, 3 participants from each of the high and low active groups were unable to perform the walking test. In total, there were 30 participants who completed the walking test.

After this session, participants were given verbal feedback and informed that

written feedback would be forwarded them at the completion of the study.

Results

As a result of missing data, for health and scheduling reasons, and due to a relatively small sample size, no overall multivariate analysis of the entire set of data was undertaken. Instead, the data were divided into five broad categories and multivariate analyses of covariance (MANCOVA) were conducted on tests in these areas. These categories were fitness measures, activity scale scores, metamemory scores, cognitive/frontal lobe measures, and memory measures as represented in Tables 3-7. Within each multivariate analysis of covariance, group was the independent variable, age served as the covariate, and the various other measures were entered as dependent variables. Univariate analyses of covariance (ANCOVA) on the individual dependent variables within each multivariate set are also reported.

Fitness measures. Table 3 provides a summary of the adjusted and observed means on each fitness variable for the two groups as well as univariate covariance F values. The multivariate analysis of covariance on the fitness measures included the following variables; distance walked in six minutes, resting heart rate, exercise heart rate, and perceived exertion. There was a significant overall difference between the high and low active groups (multivariate $F(4, 24) = 3.91, p = 0.014$). In examining the univariate analyses of covariance, significant results were obtained on the following: distance walked in 6 minutes ($F(1, 27) = 7.82, p = 0.009$) and perceived exertion ($F(1, 27) = 5.01, p = 0.034$). The Prefit group walked further ($M = 616.3$ vs. $M = 498.2$ metres), had a higher reported perceived exertion ($M = 12.7$ vs. $M = 11.4$)

Table 3. Physical Fitness Measures of the Six Minute Walking Test for the High and Low Active Groups

Variables	High Active	Low Active	
	M	M	E
Overall Multivariate Analysis of Covariance			3.91*
Univariate Analyses of Covariance:			
Resting HR (beats/min.)	73.11 ^a 72.33 ^b	78.22 ^a 78.22 ^b	2.09
Exercise HR (beats/min.)	100.47 ^a 99.33 ^b	104.86 ^a 106.00 ^b	0.69
Distance in 6 mins. (Metres)	601.74 ^a 616.28 ^b	512.70 ^a 498.27 ^b	7.82**
Perceived exertion (Borg's Scale)	12.84 ^a 12.72 ^b	11.30 ^a 11.42 ^b	5.01*

^a indicates adjusted means

^b indicates observed means

* p<.05

** p<.01

*** p<.001

N = 30

and a lower resting heart rate ($M = 72.3$ vs. $M = 79.0$) than the Creative Retirement group. Although resting heart rate was greater for the low than high active group ($M = 72.3$ vs. $M = 79.0$), this result did not reach significance ($F(1,27) = 2.09, p = 0.16$). Also, the exercise heart rate difference between the groups did not reach significance ($F(1, 27) = 0.69, p = 0.41$). Blood pressure and recovery rate measures were not used as dependent variables for fitness as they were solely used for monitoring purposes to ensure that participants' measures had returned to resting levels.

Activity Scores. Table 4 outlines the adjusted and observed mean scores of the two groups on the various components of the activity scale. The activity scale multivariate analysis of covariance results show an overall difference in scores between the groups (multivariate $F(6, 35) = 3.21, p = 0.013$). The univariate analyses of covariance indicate no difference between the two groups on the following: integrative processing ($F(1, 40) = 1.15, p = 0.29$), novel processing ($F(1, 40) = 0.31, p = 0.58$), passive activity ($F(1, 40) = 1.39, p = 0.25$), self maintenance ($F(1, 40) = 0.06, p = 0.94$), and social activity ($F(1, 40) = 0.02, p = 0.88$). The overall multivariate F appears to be due principally to a significant difference between the two groups on the physical activity component of the scale ($F(1, 40) = 17.53, p = 0.00$), with the Prefit group having higher physical activity scores ($M = 16.9$) than the Creative Retirement group ($M = 9.2$). These physical scores represent the composite score of 4 questions. Each question has a maximum value of 8 (participate in the activity daily). The average for the high active group on the 4 questions was 16.9 or an average score per question of 4.23.

Table 4. Activity Scale Scores for the High and Low Active Groups.

Variables	High Active	Low Active	F
	M	M	
Overall Multivariate Analysis Covariance			3.21*
Univariate Analyses of Covariance:			
Physical Activity	16.87 ^a 16.88 ^b	9.17 ^a 9.16 ^b	17.52***
Social Activity	23.79 ^a 23.88 ^b	24.11 ^a 24.19 ^b	0.02
Integrative Processing	29.67 ^a 30.79 ^b	25.86 ^a 24.74 ^b	1.15
Passive Activity	34.96 ^a 35.33 ^b	37.64 ^a 37.26 ^b	1.38
Novel Processing	63.90 ^a 65.50 ^b	61. 60.00 ^b	0.31
Self Maintenance	30.00 ^a 30.46 ^b	29.88 ^a 29.42 ^b	0.01

^a indicates adjusted means

^b indicates observed means

*p<.05

**p<.01

***p<.001

N = 42

Overall, these participants were involved in some form of physical activity between once a month and 2-3 times a month. The low active group possible 32 or an average of 2.3 out of 8 per question. This translates into between once a year and 2-3 times a year these individuals were involved in some type of physical activity. More specifically, in examining the question on aerobic activity, the high active group had a mean score of 6.74 out of 8 or approximately 2-3 times a week these individuals were involved in aerobic activity. The low active group had a mean score of 3.05 out of 8 on this question, or 2-3 times per year these individuals engaged in some form of aerobic activity. Therefore, the PreFit group had higher physical activity scores, both overall and on the aerobic activity question, than the Creative Retirement group. 3 times a week these individuals were involved in aerobic activity. The low active group had a mean score of 3.05 out of 8 on this question, or 2-3 times per year these individuals engaged in some form of aerobic activity. Therefore, the PreFit group had higher physical activity scores, both overall and on the aerobic activity question, than the Creative Retirement group.

Metamemory Scores. Table 5 summarizes the adjusted and observed mean scores obtained for each group on the various sections of the Metamemory in Adulthood Scale (MIA). The multivariate analysis of covariance for the MIA indicated no difference in scores between the high and low active groups (multivariate $F(7, 33) = 0.55, p = 0.79$). Nor were any of the univariate F tests significant, including the Capacity Scale ($F(1, 39) = 1.89, p = 0.18$) which was the measure of self efficacy.

Table 5. Metamemory in Adulthood Scale Mean Scores for the High and Low Active Groups.

Variables	High Active	Low Active	F
	M	M	
Overall Multivariate Analysis of Covariance			0.55
Univariate Analyses of Covariance:			
Achievement	60.14 ^a 59.78 ^b	57.54 ^a 57.90 ^b	1.38
Anxiety	42.89 ^a 42.44 ^b	45.33 ^a 45.79 ^b	0.58
Capacity	54.26 ^a 55.04 ^b	50.05 ^a 49.26 ^b	1.89
Change	50.58 ^a 51.09 ^b	50.03 ^a 49.53 ^b	0.03
Locus	30.17 ^a 30.57 ^b	30.77 ^a 30.37 ^b	0.25
Strategy	65.11 ^a 65.44 ^b	66.22 ^a 65.90 ^b	0.20
Task	62.21 ^a 62.44 ^b	62.38 ^a 62.16 ^b	0.01

^a indicates adjusted means

^b indicates observed means

*p<.05

**p<.01

***p<.001

N=41

Cognitive Measures. The adjusted and observed mean group scores of the various cognitive tests are summarized in Table 6. A multivariate analysis of covariance was conducted on the cognitive measures which assess frontal lobe functioning. Overall, this analysis shows no difference between groups (multivariate $F(5, 31) = 1.56, p = 0.20$). The univariate analyses of covariance on these five variables (frontal lobe functioning) indicate no difference on these variables which are the following: Stroop test ($F(1, 35) = 0.007, p = 0.93$), trail making test ($F(1, 35) = 1.69, p = 0.20$), verbal fluency ($F(1, 35) = 0.49, p = 0.49$), source memory items correct ($F(1, 35) = 0.90, p = 0.35$). The Wisconsin Card Sorting Test - Computerized, specifically the number of perseverative errors shows no significant difference between the groups using the univariate analysis of covariance ($F(1, 35) = 2.58, p = 0.06$) however, it is worthwhile noting that the univariate analysis of variance for this dependent measure is significant ($F(1, 36) = 4.51, p = 0.02$).

The final two variables, Mill Hill Vocabulary test and fact memory items correct are summarized in Table 7. This multivariate analysis of covariance did not reach significance ($F(2, 35) = 0.39, p = 0.68$). The univariate results show no difference between the groups for vocabulary ($F(1, 35) = 0.23, p = 0.66$) or fact memory ($F(1, 35) = 0.79, p = 0.38$).

Discussion

The purpose of this study was to compare the cognitive performance of a group of high physically active elderly adults to that of a group of less physically active

Table 6. Frontal Lobe Functioning Tasks - Mean Scores for High and Low Active Groups

Variables	High Active	Low Active	F
	M	M	
Overall Multivariate Analysis of Covariance			1.56
Univariate Analyses of Covariance:			
WCST Perseverative Errors	12.74 ^a 12.24 ^b	17.45 ^a 17.94 ^b	2.58
Stroop Colour Test	0.88 ^a 0.84 ^b	0.89 ^a 0.93 ^b	0.07
Verbal Fluency	55.74 ^a 59.24 ^b	60.44 ^a 56.94 ^b	0.49
Trail Making Test	2.29 ^a 2.35 ^b	1.57 ^a 1.51 ^b	1.69
Source Memory Correct	17.70 ^a 19.05 ^b	19.81 ^a 18.47 ^b	0.90

^a indicates adjusted means

^b indicates observed means

* p < .05

** p < .01

*** p < .001

N = 37

Table 7. Mean Scores for High and Low Active Groups on Memory and Vocabulary Measures (Not Assessing Frontal Lobe Functioning).

Variables	High Active	Low Active	F
	M	M	
Univariate Analyses of Covariance:			
Mill Hill Vocabulary Test	15.72 ^a	15.30 ^a	0.65
	15.91 ^b	15.11 ^b	
Fact Memory Correct	20.89 ^a	19.11 ^a	0.38
	21.71 ^b	18.78 ^b	

^a indicates adjusted means

^b indicates observed means

*p<.05

**p<.01

***p<.001

N = 38

counterparts. Because of the method of recruiting participants, it was hoped that they differed only on physical activity and not on general activity level or self efficacy. We were successful in equating our two groups on the activity and self efficacy measures as determined by the activity and MIA questionnaires. The high and low active groups attained equal scores on the Capacity Scale of the MIA and on levels of activity other than the physical component. In defining these two groups differing only on level of physical activity, we found only limited support for the hypothesis that aerobic activity enhances memory or frontal lobe functioning in highly active elderly adults. The groups were determined on the basis of membership of the Kinsmen Prefit Program. This differentiation was supported based on the following: fitness measures, physical activity, and specifically, the aerobic component of physical activity. The Prefit group showed enhanced performance on measures of fitness, including distance walked in 6 minutes, perceived exertion and a marginal difference on resting heart rate. Exercise heart rate, however, showed no difference between the groups. As discussed in the Results section, the physical activity component of the activity scale showed that the members of the Prefit program reported a higher frequency of physical activity. Also, based on question 22 of the activity scale ("Within the last two years, I engaged in exercise activities such as jogging swimming, bicycling, tennis, fast-walking, cross-country skiing, basketball, fencing, squash, racquet ball, hockey, judo, snow shoeing"), the Prefit group reported a greater frequency of participation in these aerobic activities than those individuals recruited from Creative Retirement. On this question, Prefit participants reported

aerobic activity of approximately 2-3 times per week whereas the low active group reported only an activity level of approximately 2-3 times a year. A separate set of statistical tests were conducted grouping participants as high and low active based on the above question - those scoring 7 or 8 became high active and those scoring 6 or less constituted the low active. This differentiation resulted in movement of 7 out of the 43 participants with 3 Prefit members becoming low active and 4 Creative Retirement participants moving into the high active category. Univariate Analyses of Variance on this new set of data yielded substantially similar results to that of the initial groupings. Changes to the results included no difference between the groups for perceived exertion and resting heart rate. The Wisconsin Card Sorting Task became only marginally significant under these conditions. The initial differentiation of groups by Prefit membership appears to be justified based on the above.

The results support the hypothesis that the groups would not show differences on measures of vocabulary, as the high and low active groups performed equally on the Mill Hill Vocabulary test. This supports past research which has found that vocabulary scores are unrelated to the fitness or activity level of elderly adults (Shay & Roth, 1992). However, researchers expecting no difference between high and low fit elderly have reported a difference in vocabulary between exercisers and controls (Clarkson-Smith & Hartley, 1989). They used age, education and self-rated health as covariates and vocabulary scores were found to be significantly different between the two groups on the combined covariates. Clarkson-Smith and Hartley do not provide a basis for this conflicting result. Differences would not be expected on the basis that

age-related differences between young and older adults are not generally found in this area of cognitive functioning. The present study supports the notion that fitness effects should not enhance vocabulary in elderly adults. In fact, McIntyre and Craik (1987) and others have reported results favouring older subjects on this type of test. These results are congruent with past research involving general tests of semantic memory and crystallized intelligence, again where no adult age differences between young and old adults are found (Kausler, 1991).

This study failed to find a significant difference as a function of activity on measures of episodic memory. Both fact and source recall were the same for high and low active elderly in the present study. Past research examining the effects of activity or fitness on episodic memory of elderly adults is minimal. Further research in this area should be pursued since we know there is significant decline in episodic memory performance with age (Craik, 1994). In examining frontal lobe functioning, normal aging and episodic memory, Craik et al. (1990) established correlations between source amnesia, which is the inability to correctly source information, the WCST and Verbal Fluency scores. They found that source amnesic responses correlated significantly with the WCST ($r = .53$) and Verbal Fluency ($r = -.38$). These researchers concluded that normal aging is accompanied by declines in frontal lobe functioning, which results in deficits in the ability to source information and in performance on the WCST. In this study the correlations between source memory (total sources correct) and WCST and Verbal Fluency were $r = .20$, and $r = .44$, respectively. These relationships between measures of frontal lobe functioning and

age warrant further study.

Fact recall, a second component of episodic memory, was also equal for the high and low active groups, a finding similar to past research (Chodzko-Zajko et al., 1992; Moul et al., 1995). As determined by Moul et al. (1995) in the Ross Information Processing Assessment (RIPA), scores on the memory subtests of the RIPA were equal for the walking, weight training, and control groups. Chodzko-Zajko et al. found that high and low fit elderly performed equally well on a measure of free recall. This area of functioning, as with vocabulary, appears to be unaffected by the effects of physical activity.

Clarkson-Smith and Hartley (1989) found fitness effects for measures of working memory which is thought to involve extensive frontal lobe functioning. In particular, tasks measuring reasoning ability showed the greatest fitness effects for participants. Similarly, Shay and Roth (1992) examined a number of frontal lobe functioning measures to determine whether fitness level influenced the ability to perform such tasks. The frontal lobe measures which they examined were the Stroop colour test, Verbal Fluency, and the Trail Making Test. They also tested a variety of visuospatial tasks including Wechsler Memory Scale Visual Reproduction test, and the Rey-Osterrieth Complex Figure Reproduction Test, both of which involve the reproduction of a visual stimulus. In contrast to Clarkson-Smith and Hartley, Shay and Roth found no fitness effects for the frontal lobe measures. However, both visuospatial tasks showed interactive age and fitness effects. In a similar way, the present study examined the activity level of elderly adults related to performance on

such interference sensitive tasks thought to tap frontal lobe functioning. According to the results, the MANCOVA indicates that there are no differences between the two groups on all measures of frontal lobe functioning with p set at the .05 level. As noted earlier, however, the Wisconsin Card Sorting Task reached significance when analysed using a multivariate analyses of variance (MANOVA), without using age as a covariate. This finding is of interest for it may indicate a difference which exists as a result of activity level. While the interpretation needs to be made with great caution, I have speculated on the possibility that fitness is related to frontal lobe functioning in older adults. The high and low active groups exhibited equal performance on all measures of frontal lobe functioning, with the possible exception of the WCST. This outcome is similar to that of Shay and Roth (1992).

The marginally significant difference in performance between the two groups on the WCST and no other frontal lobe measure suggests a possible functional dissociation between these frontal lobe tasks, a finding which corroborates Hau (1994) and Chow (1996) working with young adults. Hau (1994) examined the intercorrelations between various measures which have been used to assess functioning of the frontal lobes. He found that the WCST and Verbal Fluency were not significantly correlated with each other in his study with young adults. To explain this, Hau argued that there may be a neurological distinction between production of a response (Verbal Fluency) and the inhibition of one (WCST). Similarly, Chow (1996), as a follow-up to Hau (1994) attempted to correlate interference-sensitive tasks. This research failed to show significant correlations

between WCST and Verbal Fluency, a field dependence task (Rod and Frame Test) and Stroop Colour Test and between the Trail Making Test and WCST. As expected, a significant negative correlation was found between the Trail Making Test and Verbal Fluency and a significant positive correlation was found between WCST and the Stroop Colour test. The lack of consistent significant correlations among these tasks leads to the notion that perhaps these tasks are tapping into separate components of neurological functioning. Neurological findings of Stuss and Benson (1984) indicated that the size of a patient's frontal lobe lesion seems to be more important than its location when examining responses of perseveration and inflexibility. As well, even though perseveration, which is "defined as an abnormal repetition of a specific behavior" (p.13) is common to patients with frontal lobe damage, it is found in patients without such damage and not found in all patients who have damage to the frontal lobes. This can lead one to conclude that the frontal lobes are more complex than simply the control site where the inhibition of irrelevant information occurs. Further research in the area of neuropsychology is needed to determine the specific functioning of each part of this "massive cerebral area" (Stuss & Benson, 1984, p. 3). The tests which have been used to determine the functioning of the frontal lobes may be assessing separate areas of these structures. Another possibility is that measures of frontal lobe functioning are useful in assessing gross damage such as that occurring in Alzheimer's or Korsakoff's syndromes, but not in evaluating differences in normal functioning adults. In the present study, it is of interest that performance was equal for high and low active groups on Trail Making, Stroop Colour Test, and Verbal

Fluency and performance was higher for high active on the WCST.

As well, this difference in performance on the WCST indicates that the high active group, making fewer perseverative errors, had less difficulty inhibiting irrelevant information than their inactive peers. This leads to questions as to possible selective neurological changes which may occur in elderly adults who engage in regular physical activity. As discussed by Shay and Roth (1992), the age-related perceptual decline resulting from neurological changes may be spared through regular physical activity. Specifically, active elderly may undergo right lateralized preservation, consequently protecting the brain from the normal declines associated with the aging process (Shay & Roth). However, as these researchers indicated, anatomical and neurophysiological evidence would need to emerge to make such conclusive statements. Taking this a step further, perhaps the frontal lobe tasks which they used, the Stroop Colour Test, Verbal Fluency, and Trail Making, rely on the functioning of the left hemisphere of the frontal cortex while those tasks involving visuospatial performance place demands on the right hemisphere. It may be possible that the high fit elderly undergo improvements in functioning of the right hemisphere of these structures with performance associated with the left hemisphere remaining unchanged. Until future research in this area is complete, such possible explanations remain uncertain.

The relatively small sample size of the present study, coupled with missing data for some variables, made more powerful statistical tests impossible. For example, a regression analysis might provide a better means to determine the relative

importance of physical activity on these numerous variables. Another possibility would be a discriminant analysis which could further examine variable combinations which may best differentiate high and low fit groups. There was also the risk of a self-selection bias within the study. The high active were younger and had more male participants than the low active group. On average, this group also reported a greater number of health problems than the low active group. If these health problems affected their cognitive performance in any way, this may have masked any effects of the physical activity. Although all participants were community dwelling individuals, some of the low active elderly were residents of a Senior's Complex which may have affected their level of activity. Arthritis was reported in both groups, 6 participants of the high active and 4 participants of the low active group, which may have affected these individuals' activity level.

The mean age of the groups is also of interest when discussing the results of the present study. The overall mean age of this sample is 73.43 years, whereas the studies conducted previously report mean ages ranging from 53.4 to 66.98. As discussed by Moul et al. (1995), this variation in mean ages between the various studies may account for discrepant results. As discussed by Craik and Simon (1980), information processing begins to decline in the mid-fifties and becomes quite noticeable by the age of sixty-five. With the mean age 8.43 years above sixty-five, changes may be more evident in subjects in the present study. However, the high and low active group mean ages were relatively equal, differing by only 4.21 years. The multivariate analysis of covariance corrected the groups on the basis of age, which

ensured that the groups were the same on this variable. Therefore, within this particular study, subject comparisons are possible. However, drawing accurate conclusions in comparing to past studies, where mean ages are markedly different, becomes problematic. As well, subjects of the Moul et al. (1995) study were inactive (i.e., reporting not more than one moderate to vigorous aerobic or resistance training session of more than 20 min/week). These researchers wanted to ensure that the implementation of the walking program would result in fitness benefits. They used the Ross Information Processing Assessment (RIPA) to determine participants' ability to process information. They were able to examine the relationship between the fitness performance and cognitive functioning as indicated by the RIPA. In examining the RIPA, this relationship may be a result of the inactivity of these participants. Furthermore, an analysis of the RIPA suggests that it would be useful only in picking up gross changes in general cognitive functioning. It is believed that all participants in the present study would exhibit very high performance or ceiling effects on this type of test. This makes a cross-study comparison of elderly's cognitive performance as it relates to physical fitness a difficult one. The participants of the Moul et al. study would be considered markedly different than those of the present comparison.

The conclusion drawn is that under the conditions of the present study (two groups of community dwelling, healthy elderly, active in a variety of ways and equal on self efficacy), that a duration of physical activity of at least two years may not prove to be of great cognitive benefit to elderly who are active cognitively as well.

The benefits of a fitness program may only become evident for individuals who are not actively involved at the start of the program. Appropriate controls were not included in this study but should be present in future work on this topic. However, these results indicate that the role of fitness alone on cognitive ability may not be as important as indicated in past research. The role of general activity, in particular cognitive and social activity, may be of greater importance to cognitive functioning of elderly adults.

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Appendix A

Health Status Questionnaire

MANITOBA CARDIAC INSTITUTE (REH-FIT) INC.**Health Status Questionnaire**

NAME: _____

DATE OF BIRTH: _____ WEIGHT: _____ HEIGHT: _____

The following questions are designed to obtain a general description of your health status. Complete confidentiality is assured.

Please complete the following:

- | 1. Have you ever been told that you have any of the following? | Yes | No |
|---|-----|-----|
| (a) Heart problems as a child (rheumatic fever, congenital defects) | () | () |
| (b) Angina | () | () |
| (c) Hardening of the arteries | () | () |
| (d) Coronary artery disease | () | () |
| (e) Heart valve disorder | () | () |
| (f) Heart rhythm disorder, such as skipped beats or palpitations | () | () |
| (g) Heart murmurs | () | () |
| (h) "A heart condition" | () | () |
| (i) Claudication | () | () |
| (j) Blockage of any artery | () | () |
| (k) An enlarged heart | () | () |
| (l) Stroke or "near" stroke (T.I.A.) | () | () |
| (m) High blood pressure (> 145/90) | () | () |
| (n) A high level of cholesterol and/or triglycerides | () | () |
| (o) Diabetes | () | () |

Health Status Questionnaire

Page 2

- | | Yes | No |
|--|-----|-----|
| 2. Have you ever been admitted to hospital for any condition or problem related to your heart or blood vessels?
<i>If Yes, indicate why, when and where you hospitalized.</i> | () | () |
| _____ | | |
| _____ | | |
| 3. Are you a smoker now? | () | () |
| <i>If the answer to question 3 is no, have you smoked in the past 12 months?</i> | () | () |
| 4. Have you ever experienced any of the following symptoms? | | |
| (a) Pain/discomfort or tightness in the chest, neck, jaw, arms | | |
| (i) when you exert yourself - e.g. running for the bus | () | () |
| (ii) after eating | () | () |
| (iii) when walking in the cold or against the wind | () | () |
| (iv) with emotional stress | () | () |
| (v) at rest | () | () |
| (b) Fainting spells or lightheadedness | () | () |
| (c) Palpitations, irregular heart beat | () | () |
| (d) Cramping pain in your calves with exercise | () | () |
| 5. Please list any current medication(s) and dosage. | | |
| _____ | | |
| _____ | | |
| 6. Do you have any medical problems not mentioned above? <i>If so, please list.</i> | | |
| _____ | | |
| _____ | | |
| _____ | | |

Health Status Questionnaire
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7. Please list any allergies to medications.

Yes No

8. Have any family members ever had a heart attack, stroke, diabetes or high blood pressure?

() ()

Please list family member(s) and approximate age affected.

9. Please list your current regular physical activities:

	Activity	Approximately Times/Week	Length/Workout on Average
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____

I have answered all questions truthfully and to the best of my knowledge. I have not knowingly withheld any information regarding my health.

Signature: _____

Date: _____

Appendix B

List Items

Fact and Source Memory Test

Appendix B
List Items

Experimenter 1

1. Fidel Castro usually wears a military uniform. (T)
2. Pierre Cardin plays poker every Wednesday. (F)
3. George Bush owns a Cadillac. (H)
4. Benjamin Spock wrote poetry for relaxation. (L)
5. Mary Tyler Moore is married to a younger man. (T)
6. Tony Randall is a gourmet cook. (L)
7. Wayne Gretzky's favorite composer is Mozart. (H)
8. Bing Crosby spoke Spanish fluently. (H)
9. Frank Sinatra does not drink beer. (H)
10. John Lennon had difficulty spelling. (L)

21. Gordon Sinclair often wore a kilt. (T)
22. Jack Nicholson always wears black suspenders. (H)
23. Charles Manson's grandmother was an expert in archery. (L)
24. Sean Connery wants to travel when he retires. (H)
25. Liberace always had a candelabra on top of his piano. (T)
26. Arnold Schwarzenager excelled in math while in high school. (L)
27. Bette Davis was superstitious about the number 3. (H)
28. Princes Diana is allergic to cats. (H)

29. Tom Cruise is a Catholic. (L)
30. Don Johnson's favorite food is avocados. (L)

Experimenter 2

11. Winston Churchill had a pet rabbit as a child. (H)
12. Vincent Van Gogh was afraid of spiders. (L)
13. Pierre Trudeau's father was an alcoholic. (H)
14. Ronald Reagan's favorite candies are jelly beans. (T)
15. Anne Murray's favorite colour is purple. (H)
16. Don Cherry's favorite food is Italian. (H)
17. Bob Dylan always eats oatmeal for breakfast. (L)
18. Catherine Deneuve advertises Chanel perfume. (T)
19. Mick Jagger enjoys watching game shows on T.V. (L)
20. Marshall McLuhan broke an arm at the age of 7. (L)

31. Michael Jackson is an avid sportsfan. (L)
32. Jerry Lewis hosts telethons for muscular dystrophy. (T)
33. Brian Mulroney is a self-taught carpenter. (H)
34. Humphrey Bogart loved to travel by train. (L)
35. Joan Collins' sister wrote a book about Hollywood. (T)
36. Francois Mitterand hated horseback riding as a child. (L)
37. Burt Reynolds enjoys reading novels in his spare time. (L)

38. George Burns is an expert in Shakespeare's writing. (H)

39. Susan Thompson's favorite season is autumn. (H)

40. Bill Cosby began to play the piano in high school. (H)

Trivia Test 1996

Name: _____

Date: _____

1. What theory of physics is Albert Einstein best known for?

Answer _____

Source _____

2. How did Humphrey Bogart love to travel?

Answer _____

Source _____

3. What beverage does Frank Sinatra not drink?

Answer _____

Source _____

4. What is Don Cherry's favorite kind of food?

Answer _____

Source _____

5. What is Tony Randall, other than an actor?

Answer _____

Source _____

6. What is Michael Jackson an avid fan of?

Answer _____

Source _____

7. What country did Anwar Sadat initiate peace talks with?

Answer _____

Source _____

8. What does Sean Connery want to do when he retires?

Answer _____

Source _____

9. What part of the U.S. did Tennessee Williams write about?

Answer _____

Source _____

10. What did Bill Cosby learn to play in high school?

Answer _____

Source _____

11. What does Mick Jagger enjoy watching on TV?

Answer _____

Source _____

12. What body part did Marshall McLuhan break at the age of 7?

Answer _____

Source _____

13. What sport is Jimmy Connors famous for?

Answer _____

Source _____

14. What did John Lennon have difficulty in?

Answer _____

Source _____

15. What was Bette Davis superstitious of?

Answer _____

Source _____

16. Who was Jacqueline Onassis' first husband?

Answer _____

Source _____

17. What country is Pablo Picasso a native of?

Answer _____

Source _____

18. What was Charles Manson's grandmother an expert in?

Answer _____

Source _____

19. What color suspenders does Jack Nicholson always wear?

Answer _____

Source _____

20. Where was Pope John Paul II born?

Answer _____

Source _____

21. What was Vincent van Gogh afraid of?

Answer _____

Source _____

22. What did Napoleon Bonaparte always have inside his jacket?

Answer _____

Source _____

23. What kind of pet did Winston Churchill have as a child?

Answer _____

Source _____

24. Who is Wayne Gretzky's favorite composer?

Answer _____

Source _____

25. What country was Adolf Hitler born in?

Answer _____

Source _____

26. What is George Burns an expert in?

Answer _____

Source _____

27. What is Don Johnson's favorite food?

Answer _____

Source _____

28. When does Pierre Cardin play poker?

Answer _____

Source _____

29. What sport is Mario Lemieux known for?

Answer _____

Source _____

30. What did Francois Mitterand hate as a child?

Answer _____

Source _____

31. What is Susan Thompson's favorite season?

Answer _____

Source _____

32. What color wig does Dolly Parton always wear?
Answer _____ Source _____
33. What language did Bing Crosby speak fluently?
Answer _____ Source _____
34. What war was Abraham Lincoln president during?
Answer _____ Source _____
35. What is Princess Diana allergic to?
Answer _____ Source _____
36. What does Burt Reynolds enjoy doing in his spare time?
Answer _____ Source _____
37. What is Anne Murray's favorite color?
Answer _____ Source _____
38. What did Benjamin Spock do for relaxation?
Answer _____ Source _____
39. What skill did Brian Mulroney teach himself?
Answer _____ Source _____
40. What famous chapel did Michelangelo paint?
Answer _____ Source _____
41. What does Bob Dylan always eat for breakfast?
Answer _____ Source _____
42. What was Thomas Edison's famous invention?
Answer _____ Source _____

43. What is Tom Cruise's religion?

Answer _____

Source _____

44. What product is Orville Reddenbacher known for?

Answer _____

Source _____

45. Why was Ben Johnson disqualified from the 1988 Olympics?

Answer _____

Source _____

46. What kind of car does George Bush own?

Answer _____

Source _____

47. What addiction did Pierre Trudeau's father suffer from?

Answer _____

Source _____

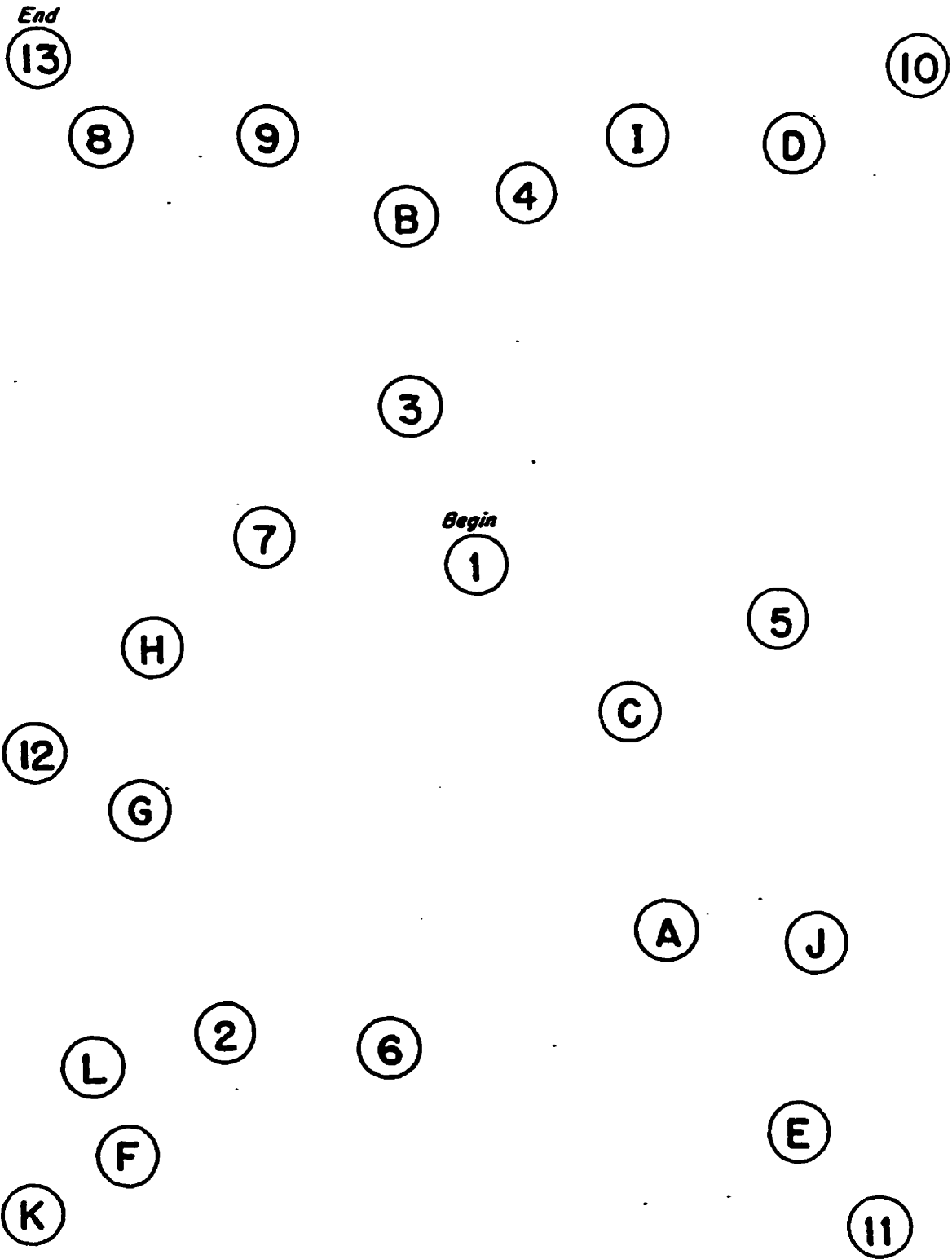
48. What subject did Arnold Schwarzenager excel at in high school?

Answer _____

Source _____

Appendix C

Trail Making Test



Appendix D

Metamemory in Adulthood Questionnaire

(MIA)

Code No. _____

MEMORY QUESTIONNAIRE**Directions**

Different people use their memory in different ways in their everyday lives. For example, some people make shopping lists, whereas others do not. Some people are good at remembering names, whereas others are not.

In this questionnaire, we would like you to tell us how you use your memory and how you feel about it. There are no right or wrong answers to these questions because people are different. Please take your time and answer each of these questions to the best of your ability.

Each question is followed by five choices. Draw a circle around the letter corresponding to your choice. Mark only one letter for each statement.

Some of the questions ask your opinion about memory-related statements; for example:

My memory will get worse as I get older. b.

- a. agree strongly
 agree
 c. undecided
 d. disagree
 e. disagree strongly

In this example you could, of course, choose any one of the answers. If you agree strongly with the statement you would circle a. If you disagree strongly you would circle letter e. The b and d answers indicate less strong agreement or disagreement. The letter c answer gives you a middle choice, but don't use the c unless you really can't decide on any of the other responses.

Some of the questions ask how often you do certain things that may be related to your memory. For example:

Do you make a list of things to be accomplished during the day?

- a. never
 b. rarely
 c. sometimes
 d. often
 e. always

Again, you could choose any one of the answers. Choose the one that comes closest to what you usually do. Don't worry if the time estimate is not exact, or if there are some exceptions.

Keep these points in mind:

- (a) Answer every question, even if it doesn't seem to apply to you very well.
 (b) Answer as honestly as you can what is true for you. Please do not mark something because it seems like the "right thing to say."

-
1. For most people, facts that are interesting are easier to remember than facts that are not.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
2. I am good at remembering names.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
3. Do you keep a list or otherwise note important dates, such as birthdays and anniversaries?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
4. It is important to me to have a good memory
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
5. I get upset when I cannot remember something.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
6. When you are looking for something you have recently misplaced, do you try to retrace your steps in order to locate it?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
7. I think a good memory is something of which to be proud.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

-
8. I find it harder to remember things when I am upset.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
9. I am good at remembering birthdates.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
10. I can remember things as well as always.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
11. When you have not finished reading a book or magazine, do you somehow note the place where you have stopped?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
12. I get anxious when I am asked to remember something.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
13. It bothers me when others notice my memory failures.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
14. I'm less efficient at remembering things now than I used to be.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

15. I have difficulty remembering things when I am anxious.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
16. The older I get the harder it is to remember clearly.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
17. Do you think about the day's activities at the beginning of the day so you can remember what you are supposed to do?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
18. I am just as good at remembering as I ever was.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
19. I have no trouble keeping track of my appointments.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
20. For most people, it is easier to remember information they need to use immediately than information they will not use for a long time.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

21. Most people find it easier to remember directions to places they want or need to go than to places they know they will never be going.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
22. I am usually uneasy when I attempt a problem that requires me to use my memory.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
23. I feel jittery if I have to introduce someone I just met.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
24. Having a better memory would be nice but it is not very important.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
25. Do you post reminders of things you need to do in a prominent place, such as bulletin boards or note boards?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
26. It doesn't bother me when my memory fails.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
27. I am poor at remembering trivia.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

28. I am much worse now at remembering the content of news articles and broadcasts than I was 10 years ago.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
29. Do you routinely keep things in a familiar spot so you won't forget them when you need to locate them?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
30. Compared to 10 years ago, I am much worse at remembering titles of books, films, or plays.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
31. For most people it is easier to remember words they want to use than words they know they will never use.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
32. I remember my dreams much less now than 10 years ago.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
33. I can't expect to be good at remembering postal codes at my age.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
34. Most people find it easier to remember the names of people they especially dislike than people they hardly notice.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

35. I have little control over my memory ability.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
36. When you want to take something with you, do you leave it in an obvious, prominent place, such as putting your suitcase in front of the door?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
37. I think it is important to work at sustaining my memory abilities.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
38. I misplace things more frequently now than when I was younger.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
39. As people get older they tend to forget where they put things more frequently.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
40. I work hard at trying to improve my memory.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

-
41. Compared to 10 years ago, I now forget many more appointments.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
42. If I am put on the spot to remember names, I know I will have difficulty doing it.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
43. For most people, it is easier to remember the names of people they especially like than people that don't make much of an impression on them.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
44. Most people find it easier to remember words they understand than words that don't mean very much to them.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
45. My memory for important events has improved over the last 10 years.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
46. I admire people who have good memories.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
47. My friends often notice my memory ability.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

48. When you try to remember people you have met, do you associate names and faces?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
49. I am good at remembering the order that events occurred.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
50. For most people, words they have seen or heard before are easier to remember than words that are totally new to them.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
51. Familiar things are easier to remember than unfamiliar things.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
52. I am good at remembering conversations I have had.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
53. I would feel on edge right now if I had to take a memory test or something similar.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
54. My memory for phone numbers will decline as I get older.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

55. I often notice my friends' memory ability.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
56. My memory for dates has declined greatly in the last 10 years.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
57. When you have trouble remembering something, do you try to remember something similar in order to help you remember?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
58. My memory for names has declined greatly in the last 10 years.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
59. I often forget who was with me at events I have attended.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
60. Do you consciously attempt to reconstruct the day's events in order to remember something?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
61. As long as I exercise my memory it will not decline.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

62. I am good at remembering the places I have been.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
63. I know if I keep using my memory I will never lose it.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
64. Do you try to relate something you want to remember to something else hoping that this will increase the likelihood of your remembering later?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
65. It's important that I am very accurate when remembering names of people.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
66. When I am tense and uneasy at a social gathering I cannot remember names very well.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
67. Do you try to concentrate hard on something you want to remember?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
68. It's important that I am very accurate when remembering significant dates.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

69. It's up to me to keep my remembering abilities from deteriorating.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
70. When someone I don't know very well asks me to remember something I get nervous.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
71. I have no trouble remembering where I have put things.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
72. It is easier for most people to remember things that are unrelated to each other than things that are related.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
73. Even if I work on it, my memory ability will go downhill.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
74. Most people find it easier to remember concrete things than abstract things.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
75. Do you make mental images or pictures to help you remember?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-

-
76. I know of someone in my family whose memory improved significantly in old age.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
77. I am good at remembering things like recipes.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
78. I get anxious when I have to do something I haven't done for a long time.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
79. It bothers me when I forget an appointment.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
80. Most people find it easier to remember things that happen to them than things that happen to others.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
81. Do you mentally repeat something you are trying to remember?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
82. My memory has improved greatly in the last 10 years.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

83. I like to remember things on my own, without relying on other people to remind me.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
84. I get tense and anxious when I feel my memory is not as good as other peoples'.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
85. Do you ask other people to remind you of something?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
86. I'm highly motivated to remember new things I learn.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
87. I do not get flustered when I am put on the spot to remember new things.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
88. I am good at remembering titles of books, films, or plays.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
89. My memory has declined greatly in the last 10 years.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

90. For most people it is easier to remember things in which they are most interested than things in which they are less interested.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
91. I have no trouble remembering lyrics of songs.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
92. My memory will get better as I get older.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
93. It is easier for most people to remember bizarre things than usual things.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
94. Do you write yourself reminder notes?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
95. I am good at remembering names of musical selections.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
96. Most people find it easier to remember visual things than verbal things.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

97. After I have read a book I have no difficulty remembering factual information from it.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
98. Do you write appointments on a calendar to help you remember them?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-
99. I would feel very anxious if I visited a new place and had to remember how to find my way back.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
100. I am good at remembering the content of news articles and broadcasts.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
101. No matter how hard a person works on his memory, it cannot be improved very much.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
102. If I were to work on my memory I could improve it.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
103. It gives me great satisfaction to remember things I thought had forgotten.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-

104. Remembering the plots of stories and novels is easy for me.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
105. I am usually able to remember exactly where I read or heard a specific thing.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
106. I think a good memory comes mostly from working at it.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
107. Most people find it easier to remember unorganized things than organized things.
- a. agree strongly
 - b. agree
 - c. undecided
 - d. disagree
 - e. disagree strongly
-
108. Do you write shopping lists?
- a. never
 - b. rarely
 - c. sometimes
 - d. often
 - e. always
-

Appendix E

Six Minute Walking Test Data Sheet

EXERCISE LAB DATA COLLECTION SHEETS
SIX MINUTE WALK

SUBJECT: _____						Date: _____
	H.R.	DISTANCE	# OF STOPS	B.P.		R.P.E.
REST						
EXERCISE:	_____					
⊙ 2 minutes						
⊙ 6 minutes						
Recovery 1 min.						
3 min.						
5 min.						

Appendix F

Borg's Perceived Exertion Chart

Borg's Perceived Exertion Chart

6	
7	very, very light
8	
9	very light
10	
11	fairly light
12	
13	somewhat hard
14	
15	hard
16	
17	very hard
18	
19	very, very hard
20	

Appendix G

Mill Hill Vocabulary Test

VOCABULARY TEST

NAME (PLEASE PRINT) _____ DATE _____

IN EACH GROUP OF SIX WORDS BELOW, UNDERLINE THE WORD WHICH MEANS THE SAME AS THE WORD ABOVE THE GROUP, AS HAS BEEN DONE IN THE FIRST EXAMPLE.

- | | | | | | |
|---|----------------------------------|--|---------------------------------|---|---|
| 1. <u>CONNECT</u>
ACCIDENT
LACE
FLIRT | JOIN
BEAN
FIELD | 8. <u>THRIVE</u>
FLOURISH
THRASH
THINK | CRY
LEAP
BLAME | 15. <u>PERPETRATE</u>
APPROPRIATE
PROPTIATE
CONTROL | COMMIT
DEFACE
PIERCE |
| 2. <u>PROVIDE</u>
HARMONIZE
HURT
ANNOY | COMMIT
SUPPLY
DIVIDE | 9. <u>PRECISE</u>
NATURAL
FAULTY
SMALL | STUPID
GRAND
EXACT | 16. <u>LIBERTINE</u>
MISSIONARY
PROFLIGATE
REGICIDE | RESCUER
CANARD
FARRAGO |
| 3. <u>STUBBORN</u>
OBSTINATE
HOPEFUL
ORDERLY | STEADY
HOLLOW
SLACK | 10. <u>ELEVATE</u>
REVOLVE
RAISE
WAVER | MOVE
WORK
DISPERSE | 17. <u>QUERULOUS</u>
ASTRINGENT
PETULANT
INQUIRING | FEARFUL
CURIOUS
SPURIOUS |
| 4. <u>SCHOONER</u>
BUILDING
SHIP
PLANT | MAN
SINGER
SCHOLAR | 11. <u>LAVISH</u>
UNACCOUNTABLE
ROMANTIC
EXTRAVAGANT | SELFISH
LAWFUL
PRAISE | 18. <u>FECUND</u>
ESCULENT
PROFOUND
SUBLIME | OPTATIVE
PROLIFIC
SALIC |
| 5. <u>LIBERTY</u>
WORRY
RICH
FOREST | FREEDOM
SERVIETTE
CHEERFUL | 12. <u>SURMOUNT</u>
MOUNTAIN
OVERCOME
APPEASE | DESCEND
CONCEDE
SNUB | 19. <u>ABNEGATE</u>
CONTRADICT
RENOUNCE
BELIE | DECRY
EXECUTE
ASSEMBLE |
| 6. <u>COURTEOUS</u>
DREADFUL
TRUTHFUL
CURTSEY | PROUD
SHORT
POLITE | 13. <u>BOMBASTIC</u>
DEMOCRATIC
BICKERING
DESTRUCTIVE | POMPOUS
CAUTIOUS
ANXIOUS | 20. <u>TRADUCE</u>
CHALLENGE
SUSPEND
MISREPRESENT | ATTENUATE
ESTABLISH
CONCLUDE |
| 7. <u>RESEMBLANCE</u>
ATTENDANCE
ASSEMBLE
LIKENESS | FONDNESS
REPOSE
MEMORY | 14. <u>ENVISAGE</u>
CONTEMPLATE
SURROUND
ENFEEBLE | ACTIVATE
ESTRANGE
REGRESS | 21. <u>TEMERITY</u>
IMPERMANENCE
NERVOUSNESS
PUNCTUALITY | RASHNESS
STABILITY
SUBMISSIVENESS |

Appendix H

Activity Scale

Code No: _____

ACTIVITIES QUESTIONNAIRE

Our lives are organized to a great extent by the types of activities we participate in. In this questionnaire, you will find a list of activities that different people do in their everyday lives.

You may never have participated in some of these activities. Others you may have participated in several years ago. In this questionnaire, we would like you to tell us how many of these activities you have participated in within the last two years.

You will be asked to indicate about how often you engage in each activity. Do not worry if you cannot give an exact figure. Circle the letter that **MOST NEARLY** describes the frequency with which you have done the activity during the past two years. Here is an example:

I go shopping at a mall or downtown:

- | | |
|--------------------------|-------------------------|
| a. Never | e. About once a month |
| b. Less than once a year | f. 2 or 3 times a month |
| c. About once a year | g. About once a week |
| d. 2 or 3 times a year | h. 2 or 3 times a week |
| | i. Daily |

Let's assume that you go to a mall or downtown once or twice a month most of the time. There may have been a month when you did not go at all, or there may have been a month when you went more often. But once or twice a month most nearly describes what you usually have done over the last two years. Thus alternative f is circled.

In addition to estimating how often you do them, there are two other things we would like you to tell us about the activities you have participated in over the last two years.

First we would like you to tell us whether you participated in an activity for the very first time within the last two years. Here is an example:

I travel in a foreign country:

- | | | |
|--------------------------|-------------------------|--|
| a. Never | e. About once a month | I did this for
the "very
first time"
within the
last two years |
| b. Less than once a year | f. 2 or 3 times a month | |
| year | g. About once a week | |
| c. About once a year | h. 2 or 3 times a week | |
| d. 2 or 3 times a year | i. Daily | |

Let's assume that you traveled to a foreign country once within the last two years. Thus, alternative c is circled. But let's assume this was the very first time you had taken such a trip. Thus an X is placed in the front of the "very first time" statement.

Second, we would like you to tell us whether you did something new or different related to an activity during the last two years. Here is an example:

- | | | |
|--------------------------|-------------------------|--|
| a. Never | e. About once a month | <input type="checkbox"/> I did this for |
| b. Less than once a year | f. 2 or 3 times a month | the "very |
| c. About once a year | g. About once a week | first time" |
| d. 2 or 3 times a year | h. 2 or 3 times a week | within the |
| | i. Daily | last two years |
| | | <input type="checkbox"/> I did something |
| | | "new and |
| | | different" |
| | | related to |
| | | this activity |
| | | within the |
| | | last 2 years |

Let's assume you play cards about once a week. Thus, alternative g is circled. Let's also assume that you have been playing cards for a number of years. Thus, the "very first time" statement is NOT checked. But, finally, let's assume that in addition to playing the game you usually play, you were introduced to a new card game within the last two years. This represents a departure from the routine of your participation in card playing. It would be something new and different related to an activity you have been doing within the past two years. Thus, an X is placed in front of the "new and different" statement.

For each of the activities below, please circle the number that most nearly describes the frequency with which you have participated in them during the last two years. Also, for those activities you have participated in place an X beside the "very first time" or "new and different" statements if these describe your experience with the activity within the last two years.

1. I prepare a meal:
- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | ___ "new and different" |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |
2. I do housework (dishes, laundry, vacuuming, etc.):
- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | ___ "new and different" |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |
3. I go food shopping:
- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | ___ "new and different" |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |
4. I go shopping at a mall or downtown:
- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | ___ "new and different" |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |
5. I drive a car:
- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | ___ "new and different" |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |

6. I take a bus:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | ___ "new and different" |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |

7. I take care of someone in my family (invalid or disabled):

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

8. I take care of one or more pets:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

9. I do household repairs (painting, leaky faucets, etc):

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

10. I repair a car, lawn mower, or other mechanical device:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

11. I purchase a new item requiring some set-up or assembly:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

12. I do woodworking, carpentry, or furniture refinishing:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

13. I play a musical instrument:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

14. I engage in creative writing, writing poems, writing newspaper articles, etc.

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

15. I engage in photography:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

16. I collect stamps, coins, dolls, or other memorabilia:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

17. I engage in sewing, knitting, or needlework:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

18. I engage in painting, sculpting, ceramics, drawing, etc.:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

19. I participate in a theatrical activity:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

20. I sing in a choir

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

21. I garden indoors or outdoors:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. about once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

22. I engage in exercise activities such as jogging, swimming, bicycling, tennis, fast-walking, cross-country skiing, basket-ball, fencing, squash, racquet ball, hockey, judo, snow shoeing:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

23. I engage in outdoor activities such as sailing, fishing, backpacking, ice-skating, horseback riding, canoeing, hunting:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

24. I engage in recreational sports such as bowling, golf, badminton, curling, darts, billiards, tai chi, lawn bowling, dancing:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

25. I work crossword puzzles, acrostics, or anagrams:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

NOTE! For questions 22, 23, and 24 above please circle the activities in which you have participated during the last two years.

26. I play card games such as Pinochle or Bridge:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | ___ "new and different" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |

27. I do jigsaw puzzles:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | ___ "new and different" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |

28. I play board games such as chess and checkers:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | ___ "new and different" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |

29. I play knowledge games such as Trivial Pursuit:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | ___ "new and different" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |

30. I play word games such as Scrabble:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | ___ "very first time" |
| b. Less than once a year | f. 2 or 3 times a month | ___ "new and different" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | |

31. I read newspapers:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

32. I read books or magazines for leisure:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

33. I read books or magazines as part of my job, career, or formal education:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

34. I go to the library:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

35. I watch news programs on television:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

36. I watch documentary or educational programs on television:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

37. I watch game shows such as Tic Tac Dough or Wheel of Fortune on television:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

38. I watch comedy, or adventure programs on television:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

39. I watch continuing dramas on television:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

40. I listen to radio programs:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

41. I write a letter (to a friend, relative, business, etc.):
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |
42. I program software for a personal computer:
- | | | |
|--------------------------|-------------------------|------------------------|
| 1. Never | 5. About once a month | |
| 2. Less than once a year | 6. 2 or 3 times a month | __ "very first time" |
| 3. About once a year | 7. About once a week | |
| 4. 2 or 3 times a year | 8. 2 or 3 times a week | __ "new and different" |
| | 9. Daily | |
43. I use pre-programmed software on a personal computer:
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |
44. I use an electronic calculator:
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |
45. I balance a checkbook:
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

46. I prepare my own income taxes:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

47. I prepare someone else's income taxes:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

48. I do arithmetic or mathematical calculations:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

49. I attend films (travel films, commercial movies, etc.):

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

50. I attend a concert or a play:

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | ___ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | ___ "new and different" |
| | i. Daily | |

51. I attend a public lecture or talk:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

52. I attend sports events such as hockey, soccer, football, baseball, lawn bowling, or cricket:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

53. I eat out at a restaurant:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

54. I visit a physician, dentist, or other professional:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

55. I visit relatives, friends, or neighbours:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

56. I give a dinner or a party for friends:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | __ "new and different" |

57. I attend church services or synagogue:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | __ "new and different" |

58. I engage in prayer, meditation, or philosophical contemplation:

- | | | |
|--------------------------|-------------------------|------------------------|
| 1. Never | 5. About once a month | |
| 2. Less than once a year | 6. 2 or 3 times a month | __ "very first time" |
| 3. About once a year | 7. About once a week | |
| 4. 2 or 3 times a year | 8. 2 or 3 times a week | |
| | 9. Daily | __ "new and different" |

59. I attend meetings of service organizations such as Lions, Rotary, or Seniors Serving Seniors:

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | __ "new and different" |

60. I attend meetings of clubs (hobby club, book club, discussion club, etc.)

- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | |
| | i. Daily | __ "new and different" |

61. I give a public talk or lecture (to a club, service organization, etc.):
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |
62. I do volunteer work for an organization such as a hospital, church, school, or political party:
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |
63. I engage in business activities such as investments or real estate transactions not related to my job or career:
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |
64. I engage in an on-the-job training program:
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |
65. I enroll in a course at a college or university:
- | | | |
|--------------------------|-------------------------|------------------------|
| a. Never | e. About once a month | |
| b. Less than once a year | f. 2 or 3 times a month | __ "very first time" |
| c. About once a year | g. About once a week | |
| d. 2 or 3 times a year | h. 2 or 3 times a week | __ "new and different" |
| | i. Daily | |

66. I enroll in a correspondence course:

- a. Never
- b. Less than once a year
- c. About once a year
- d. 2 or 3 times a year
- e. About once a month
- f. 2 or 3 times a month
- g. About once a week
- h. 2 or 3 times a week
- i. Daily

___ "very first time"

___ "new and different"

67. I study or practice a language other than my native tongue:

- a. Never
- b. Less than once a year
- c. About once a year
- d. 2 or 3 times a year
- e. About once month
- f. 2 or 3 times a month
- g. About once a week
- h. 2 or 3 times a week
- i. Daily

___ "very first time"

___ "new and different"

68. I travel away from my home in Manitoba:

- a. Never
- b. Less than once a year
- c. About once a year
- d. 2 or 3 times a year
- e. About once a month
- f. 2 or 3 times a month
- g. About once a week
- h. 2 or 3 times a week
- i. Daily

___ "very first time"

___ "new and different"

69. I travel outside Manitoba:

- a. Never
- b. Less than once a year
- c. About once a year
- d. 2 or 3 times a year
- e. About once a month
- f. 2 or 3 times a month
- g. About once a week
- h. 2 or 3 times a week
- i. Daily

___ "very first time"

___ "new and different"

70. I travel in a foreign country:

- a. Never
- b. Less than once a year
- c. About once a year
- d. 2 or 3 times a year
- e. About once a month
- f. 2 or 3 times a month
- g. About once a week
- h. 2 or 3 times a week
- i. Daily

___ "very first time"

___ "new and different"

Appendix I

Raw Data Scores

subject	group	physact	smact	passact	socact	iniproc	noviproc	mlaestrat	mlatask	mlacap
1	1.00	16.00	23.00	32.00	26.00	32.00	71.00	58.00	63.00	47.00
2	2.00	8.00	26.00	47.00	22.00	28.00	57.00	58.00	55.00	74.00
3	3.00	7.00	30.00	41.00	16.00	14.00	56.00	64.00	62.00	44.00
4	4.00	20.00	36.00	38.00	16.00	31.00	68.00	72.00	69.00	44.00
5	5.00	21.00	35.00	28.00	13.00	27.00	47.00	62.00	64.00	62.00
6	6.00	22.00	33.00	37.00	34.00	48.00	71.00	72.00	63.00	54.00
7	7.00	20.00	30.00	43.00	24.00	36.00	62.00	67.00	71.00	56.00
8	8.00	22.00	44.00	37.00	21.00	30.00	75.00	71.00	61.00	70.00
9	9.00	15.00	41.00	30.00	33.00	30.00	63.00	66.00	55.00	59.00
10	10.00	11.00	34.00	38.00	24.00	26.00	57.00	74.00	62.00	48.00
11	11.00	17.00	26.00	34.00	35.00	39.00	64.00	63.00	65.00	66.00
12	12.00	18.00	33.00	38.00	25.00	39.00	66.00	60.00	62.00	67.00
13	13.00	21.00	27.00	35.00	20.00	37.00	69.00	59.00	63.00	51.00
14	14.00	21.00	35.00	38.00	26.00	23.00	51.00	72.00	60.00	49.00
15	15.00	7.00	35.00	35.00	17.00	14.00	62.00			
16	16.00	16.00	27.00	28.00	22.00	19.00	48.00	65.00	65.00	49.00
17	17.00	19.00	20.00	31.00	21.00	33.00	67.00	62.00	66.00	66.00
18	18.00	9.00	29.00	45.00	33.00	26.00	56.00	57.00	75.00	54.00
19	20.00	14.00	30.00	52.00	34.00	14.00	76.00	66.00	49.00	57.00
20	21.00	3.00	26.00	40.00	29.00	13.00	58.00	63.00	71.00	51.00
21	22.00	12.00	29.00	40.00	26.00	53.00	63.00	70.00	65.00	50.00
22	23.00	13.00	41.00	30.00	31.00	16.00	48.00	55.00	53.00	43.00
23	24.00	6.00	30.00	40.00	19.00	13.00	44.00	63.00	66.00	65.00

	mlahe	mlasch	mlaenx	mloloc	vl	stropo	lraill	wcast	vos	lollacor	tsoure
1	56.00	65.00	40.00	35.00						29	34
2	56.00	72.00	28.00	25.00	54.00	.68	2.30	20.00	15.00	23	20
3	40.00	46.00	40.00	25.00	70.00	.78	3.10	9.00	15.00	18	13
4	35.00	67.00	64.00	34.00	50.00	.74	5.60	19.00	14.00	22	24
5	46.00	54.00	43.00	34.00	52.00	.78	4.36	6.00	15.00	22	24
6	46.00	63.00	40.00	27.00	64.00	1.21	5.60	19.00	19.00	21	9
7	66.00	66.00	61.00	32.00	51.00	.88	2.11	6.00	16.00	17	13
8	63.00	57.00	34.00	35.00	107.00	1.07	1.67	4.00	17.00	32	26
9	64.00	55.00	32.00	31.00	62.00	.29	.70	11.00	20.00	31	26
10	66.00	64.00	36.00	28.00	34.00	1.00	2.00	5.00	15.00	20	16
11	56.00	53.00	34.00	36.00	57.00	.41	.66	7.00	18.00	21	19
12	57.00	68.00	51.00	39.00	53.00	.66	5.50	17.00	14.00	23	24
13	49.00	52.00	42.00	30.00	49.00	1.04	4.16	12.00	19.00	21	16
14	36.00	69.00	59.00	30.00	66.00	.72	.16	13.00	16.00	12	21
15					36.00	1.14	3.45	29.00	11.00	14	17
16	35.00	65.00	62.00	26.00	29.00	.80	.61	12.00	13.00	14	7
17	55.00	69.00	29.00	33.00	36.00	1.35	1.52	10.00	15.00	23	14
18	58.00	61.00	34.00	31.00	68.00	.69	2.05	23.00	18.00	14	26
19	71.00	47.00	39.00	35.00	42.00	1.29	.76	6.00	19.00	15	20
20	30.00	71.00	59.00	34.00	52.00	.69	.65	40.00	17.00	19	16
21	53.00	52.00	42.00	30.00	65.00	.85	1.58	20.00	18.00	26	27
22	51.00	50.00	32.00	25.00	37.00	.29	1.08	7.00	16.00	16	23
23	43.00	66.00	55.00	33.00	57.00	.43	3.31	7.00	16.00	23	24

	totalc	nr	ehr	dist	perax	age	educ
1	199	64	125	568	12	72	.
2	188	68	112	678	15	75	11
3	184	72	106	599	11	72	12
4	210	62	86	702	13	69	15
5	171	68	96	614	15	67	15
6	243	60	96	678	8	66	12
7	215	60	88	686	9	67	12
8	229	76	96	624	12	69	17
9	232	92	120	666	13	66	15
10	180	76	112	669	13	75	15
11	235	72	88	660	13	61	16
12	239	.	.	.	.	70	12
13	209	.	.	.	.	61	9
14	194	64	80	670	12	75	12
15	170	.	.	.	.	64	12
16	188	76	104	311	16	60	11
17	191	.	.	.	.	74	21
18	198	80	112	493	12	83	13
19	220	68	116	467	12	72	14
20	166	.	.	.	.	77	.
21	243	72	96	486	13	64	14
22	179	.	.	.	.	82	.
23	152	.	.	.	.	73	15

subject	group	physact	smact	psact	socact	lnproc	novproc	mlastrat	mlastak	mlscap
24	25.00	2.00	10.00	28.00	15.00	27.00	60.00	65.00	60.00	44.00
25	26.00	2.00	7.00	49.00	17.00	15.00	47.00	68.00	63.00	43.00
26	27.00	2.00	6.00	43.00	13.00	7.00	62.00	68.00	69.00	37.00
27	28.00	2.00	21.00	48.00	34.00	41.00	77.00	80.00	69.00	32.00
28	29.00	2.00	20.00	36.00	29.00	31.00	67.00	68.00	59.00	46.00
29	30.00	2.00	2.00	19.00	20.00	18.00	59.00	72.00	61.00	57.00
30	31.00	2.00	3.00	34.00	13.00	57.00	63.00	62.00	63.00	58.00
31	32.00	1.00	23.00	38.00	16.00	33.00	68.00	64.00	61.00	60.00
32	33.00	1.00	19.00	29.00	34.00	45.00	87.00	51.00	59.00	54.00
33	34.00	1.00	21.00	33.00	38.00	41.00	78.00	67.00	67.00	61.00
34	35.00	1.00	9.00	27.00	26.00	35.00	48.00	64.00	61.00	61.00
35	36.00	1.00	21.00	30.00	10.00	24.00	47.00	54.00	65.00	41.00
36	37.00	1.00	13.00	41.00	37.00	22.00	71.00	73.00	62.00	49.00
37	38.00	1.00	19.00	40.00	19.00	35.00	60.00	67.00	66.00	37.00
38	39.00	2.00	6.00	33.00	19.00	15.00	33.00	74.00	60.00	56.00
39	40.00	2.00	7.00	42.00	35.00	26.00	46.00	72.00	59.00	43.00
40	41.00	2.00	6.00	30.00	17.00	20.00	60.00	76.00	69.00	47.00
41	42.00	2.00	.00	38.00	17.00	26.00	62.00	69.00	61.00	62.00
42	43.00	2.00	18.00	35.00	22.00	19.00	52.00	59.00	57.00	42.00
43	44.00	2.00	11.00	27.00	35.00	33.00	78.00	45.00	63.00	49.00

	miacha	miasch	miasnx	mialoc	vi	stroop	trail	wcst	voc	lollacor	tsourc
24	37.00	64.00	50.00	27.00	33.00	.51	1.31	10.00	13.00	17	18
25	37.00	65.00	55.00	34.00	34.00	2.37	5.00	35.00	12.00	19	16
26	44.00	56.00	44.00	31.00	56.00	1.35	1.63	8.00	21.00	20	32
27	51.00	60.00	36.00	31.00	71.00	.60	1.94	24.00	11.00	24	18
28	42.00	53.00	52.00	31.00		3.21	3.43	17.00	16.00	13	0
29	64.00	64.00	50.00	36.00	49.00	.43	1.46	25.00	15.00	23	15
30	64.00	50.00	40.00	33.00	90.00	.42	.79	16.00	19.00	27	25
31	57.00	57.00	36.00	25.00	64.00	1.18	.60	7.00	18.00	27	16
32	57.00	59.00	40.00	31.00	69.00	1.20	2.13	12.00			
33	55.00	55.00	39.00	30.00	101.00	.56	1.33	6.00	15.00	28	34
34	62.00	62.00	34.00	30.00	99.00	.72	1.70	6.00	16.00	16	17
35	49.00	57.00	39.00	25.00		1.05	1.00	6.00			
36	45.00	55.00	44.00	30.00	56.00	.66	.91	16.00	15.00	26	15
37	41.00	53.00	53.00	32.00	51.00	.66	1.26	17.00	16.00	23	27
38	61.00	62.00	53.00	31.00	34.00	2.68	1.57	16.00	10.00	12	1
39	44.00	57.00	42.00	23.00	61.00	.76	.59	17.00	12.00	13	16
40	40.00	62.00	50.00	26.00	73.00	.78	.87	19.00	14.00	14	8
41	47.00	59.00	38.00	31.00	50.00	1.00	.71	12.00			
42	40.00	56.00	56.00	26.00	31.00	1.10	1.00	24.00	11.00	2	16
43	64.00	54.00	43.00	29.00	65.00	.37	.06	6.00	16.00	23	13

	totact	rhr	ehv	dlat	perex	age	eduo
24	174	84	108	634	11	73	13
25	169	.	.	.	.	74	10
26	167	88	132	572	11	73	17
27	248	84	104	488	11	78	.
28	214	84	104	487	11	78	16
29	146	.	.	.	.	82	10
30	203	72	84	584	9	69	18
31	188	78	84	620	13	80	17
32	244	.	.	.	.	81	20
33	241	64	100	683	13	64	18
34	169	64	78	622	13	69	16
35	187	84	100	783	15	70	13
36	214	84	112	880	13	78	11
37	201	.	.	.	.	74	14
38	128	88	108	402	11	88	10
39	166	.	.	.	.	71	13
40	163	72	104	475	11	82	12
41	171	80	100	517	13	73	13
42	174	.	.	.	.	77	.
43	218	78	104	448	12	74	17