AN INDIRECT MEASURE (TIME ESTIMATION) AS A PREDICTOR OF TYPING SKILL

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Irene Johnson
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ABSTRACT

This study investigates the possibility of predicting performance on a complex skill (typing), with an indirect test (time estimation on a card-sorting task). It was hypothesised that typing skill could be predicted from the time subjects estimated they took to perform the card sorting task; independently of the actual time they took to do the task or their achievement motivation.

The various methods of personnel selection are reviewed, as well as the factors influencing time perception.

Sixty adolescents and forty-two adults in beginners' typing classes were administered the time estimation task and an achievement motivation questionnaire. Their typing performance was tested after eight months.

The results did not confirm the hypothesis. No significant relationship was found between time estimation and subsequent typing performance; while achievement motivation was significantly correlated with typing performance.

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CHAPTER 1. INTRODUCTION

Personnel Selection

Personnel selection is an increasingly researched and debated subject area. Psychological literature abounds in opinion and data as to the most efficient, fair and economic means of choosing between people for jobs. The views range from the advocates of random selection such as Fine (1975), through a majority who suggest a varying mixture of psychological testing, interviewing and other procedures; to those who see testing, in itself, as the most objective means available to select personnel (e.g. Ghiselli, 1966).

Arguing rather forcefully against the use of standardised paper and pencil tests, Fine (1975, p.57) states that "effective selection requires the assessment of the whole person in relation to the total job...to overemphasise one category such as mental ability at the expense of another, such as adaptability", is to invite future problems. He argues that selection procedures are frequently used to provide a cover for discrimination so that the organisation may hire the type of worker they want in terms of sex or race and, in this way, it is unlikely that they are hiring the best workers.

Richardson and Spears (1972), together with many other researchers, support this view. They see the "psychometric approach" as discriminating against minority groups in that it fails "to take account of cognitive style, of the social context of testing, of the diversity of human abilities...of the differences of score distributions and trait distributions" (Ash and Kroeker, 1975, p.486).

Fine (1975) in his advocacy of random selection believes in the greater use of differential placement rather than selection. He sees the usual selection strategy of application forms, tests and interviews as screens that penalise people "for being what they are." Differential placement is advocated because it employs people on the basis of their "existing capabilities and potential." (Fine, 1975, p.56). Thus an employer, instead of selecting (by testing or otherwise) one person for

each pre-determined vacancy, would randomly select an appropriate number of people and attempt to match the various tasks required to be done to the abilities which these people possess.

Another criticism advanced against the use of paper and pencil standardised tests is related to their reading difficulty level. Ash and Kroeker (1975) see this as a neglected dimension of test construction. They cite a study by Campbell (1960) demonstrating that reducing the reading level difficulty of tests can increase test-performance criterion correlations in many cases. And, "if the test requires a level of reading comprehension substantially higher than the job qualification calls for, the possibility of unfair discrimination exists" (Ash and Kroeker, 1975, p.493). Ash (1973), using the S.M.O.G. index of readability (McLaughlin, 1969) found that 36 of 76 tests for positions with specified minimum educational requirements had reading level grades significantly higher than the educational requirements, and that of 58 tests for positions with no minimum educational requirement, 25 required a comprehension level beyond high school graduation. But Schoenfeldt, Schoenfeldt, Acker and Perlson (1976) argue that applicants should be screened with respect to reading ability and that the latter, in itself, is an important selection device. They maintain that "the identification of reading as a critical skill was the result of extended discussions with management and operating personnel as well as more formal job analyses." (Schoenfeldt et al., 1976, p.581). They argue that many accidents occur as a result of failure to read and understand job-related instructions and procedures.

Ash and Kroeker (1975, p.482) come to the conclusion, in their review of the literature on testing as used in personnel selection, that the majority of studies demonstrate that tests "do not predict job performance for <u>any</u> group", and they cite Boehm (1972); Lent, Aurbach and Levin (1971); and Smith, Nieedzwiedz, Davis and Kniesner (1973) to support this conclusion.

Criticism is also levelled at the use of self-report measures, such as the 16 PF (Catell, Eber and Tatsuoka, 1970), in personnel selection, in that they are often easily faked. Meredith (1968) clearly

established the effect of negative and positive social desirability on the 16 PF. So, in order to detect faking and to apply correction, a motivational distortion scale was built into Forms C and D. But studies by Braun and La Faro (1968) and Jeske and Whitten (1975) found that this scale had limited usefulness in discriminating between control and faked protocols. As Jeske and Whitten (1975, p.379) point out, the job applicant may not be "as much concerned with presenting a favourable picture of his total personality as with demonstrating that he possesses the personality characteristics required for the particular job." A study by Bull (1974) also considers the 16 PF unsuitable for selection decisions because of problems of factorial validity and item-factor relationships.

Arguing for the use of standardised testing in personnel selection, Ghiselli (1966, p.4) maintains that although tests should often be used in conjunction with other devices "...as compared with those other devices, such as the employment interview, the application blank, references from previous employers...tests in general are more objective, they give more reliable quantitative assessments, and more is known about them." But Ghiselli (1966, p.127) also cautions that tests cannot be claimed to predict occupational success "with what might be termed a high degree of accuracy. Nevertheless in most situations tests can have a sufficiently high degree of predictive power to be of considerable practical value in the selection of personnel." Lawshe and Balma (1966, p.16) share this opinion. They state: "The adequacy of a test or testing program is evaluated not in terms of perfection but of average success."

Schneider's (1976, p.141) conclusion is that "it is an uncontrovertible fact, that we can...predict behaviour based on the assessment of an individual's traits [by tests] at the time of hire." But he cites no data to support this statement.

Brenner (1968) points out that one factor frequently considered important is "attitude to work". This factor is not commonly used because of the difficulty in measuring it. Brenner's study compared teachers' ratings of individuals' work habits and co-operation behaviour, at high

school, with later job performances as evaluated by work supervisors. He found that "the degree of relationship...is greater than that normally obtained with aptitude tests" (Brenner, 1968, p.30). This supports an argument put forward by Seashore (1939) that favourable work methods may account for a greater proportion of individual differences than any combination of basic motor abilities.

Cohen (1973) advocates using training time as a selection criterion. Each trainee would proceed at his own pace in the training programme and the fastest learners would be selected. This appears to have several disadvantages in that it is wasteful of time and resources for both the individual and the organisation and it assumes that the fastest learners will continue to be the most productive. In fact, these people may become bored quickly and contribute to a high turnover rate.

Analysis of personal history items - found on standard application forms - is advocated by some researchers. (England, 1971; Fleishman and Berniger, 1960; Owens and Henry, 1966). They argue that the "accuracy of biographical data as a predictor of future work behaviour is superior to any known alternatives" (Cascio, 1976, p.576). The legality and fairness of using biographical data has frequently been questioned and legislation in the United States specifies that personal history items must be job related and not unfairly discriminatory against either minority or non-minority sub-groups. Cascio (1976, p.579) found that even after satisfying legal requirements for using biographical data, "turnover [his criterion of success] can still be predicted with an appreciable degree of accuracy."

The selection interview has been the target of a large amount of research. According to Schneider (1976, p.194) the pre-employment interview is an "unreliable, time-consuming, expensive and inefficient means of collecting information, and decisions based on the collected information are generally unreliable (across judges) and thus non-valid." Schneider (1976) cites several sources of support for this statement (e.g. Carlson, Thayer, Mayfield and Peterson, 1971; Downs, 1968; Ulrich and Trumbo, 1965; and Wright, 1969). Studies by Leonard (1974), and

Weiner and Schneiderman (1974) show that the reliability of the interview can be increased by providing interviewers with a set of objective job requirements. This serves to limit the amount of irrelevant discussion, focuses attention on job-relevant questions and reduces reliance on personal theories and stereotypes. A study by Langdale and Weitz (1973) also supports this finding.

Schneider (1976) suggests retaining the interview as a communication process rather than as a process leading to a decision and Ulrich and Trumbo (1965) suggest limiting interviews to the assessment of such applicant characteristics as motivation to work and ability to adjust socially on the job. No data appears to be available to demonstrate whether this latter assessment will have any more inter-interviewer reliability than assessments of any other abilities.

Ash and Kroeker (1975, p.500) conclude that "as the standards for the use of more elaborate psychometric devices are raised by government regulation it is likely that the role of the interview will increase even more." But they stress that increasing interviewer effectiveness requires both training and the imposition of structure through the use of guides and rating scales.

CHAPTER 2. SELECTION FOR MANUAL SKILL PERFORMANCE

Selection of personnel for manual skills would appear to be of a more straightforward nature than selection for more abstract occupations. But there is no agreement in the literature on the efficacy of any single type of testing or selection procedure. An additional complication is that the number of simple repetitive tasks that can be quickly and inexpensively taught are being reduced by mechanisation and automation. As Taylor and Nevis (1961, p.389) point out: "The more demanding jobs of the automated factory, although fewer in number, necessarily require more careful and accurate selection. Not only has it become more costly to train the replacement for an unsuccessful operator, but the increased complexity of his task has made the cost of errors he might make much, much greater than those of his preautomation counterparts."

Another factor to be taken into account is that the capacity to learn, and improve in performance, is more relevant in the current industrial situation than the capacity to perform. Frequent technological changes require personnel who can quickly adapt to, and learn, new jobs.

Ghiselli (1966), in his comprehensive work on the validity of occupational aptitude tests, finds, in general, that tests of motor abilities are not useful either in the prediction of capacity to learn the job or in the prediction of proficiency of workers once trained.

In using motor aptitude tests to select personnel, one makes the assumption that there are "certain basic co-ordinations, measurable in a short period of time, which determine the degree of skill likely to be attained through longer training in more complex performances." (Walker and Adams, 1934, p.173). But several researchers - originally Muscio (1922) and Seashore (1930), and later Fleishman (1956) - provide evidence that there is no such thing as "general physical proficiency or general psychomotor skill or general manual dexterity. Rather, each of these areas breaks up into a limited number of unitary abilities." (Fleishman, 1956, p.461). The measure of a person's performance on one test, such as a fine manipulation task, is quite independent of his ability on another

test, involving, for example, a more gross physical ability. In a study by Hempel and Fleishman (1955) no factors were found that overlapped the areas of gross physical and fine manipulative skills.

Walker and Adams (1934) cite studies that refute another hypothesis, that individual differences in motor performance are determined by simple variables such as reaction time. These studies showed that speed in "simple reaction" was not related to such tasks as speed of tapping, even when the same hand and the same apparatus were used in both tests.

A third hypothesis suggests that individuals are endowed with certain "basic motor capacities" such as serial discrimination, eye-hand co-ordination and postural stability. Combinations of these are presumed to determine the ability to perform certain complex tasks. These "capacities" were believed to be innate and therefore subject to little improvement with practice. But as Walker and Adams (1934) point out, serial discrimination, for example, can be greatly changed with practice. Fleishman (1962) cites studies indicating that the particular combinations of abilities contributing to performance on various laboratory criterion tasks will change as practice continues and proficiency increases. "These changes are progressive and systematic through the practice period until a point later in practice where they become stabilised. In other words, the combination of abilities contributing to individual differences later in training may be quite different from those contributing early in training." (Fleishman, 1962, p.147). And a related finding by Fleishman (1956) was that even after extensive training, personnel differ considerably in the skill they achieve in complex tasks. And prolonged practice may actually increase differences among people in proficiency. As early as 1913, Hollingsworth (p.414) commented, "...preliminary trials do not necessarily represent the final capacities of the individuals. They... reveal only momentary ability, not ultimate capacity...the only real correlation for attenuation is by continuing the test until the individual has reached the limit of practice in the test."

Fleishman (1956) argues however, that it is possible to devise tests that tap the same skill areas as the job demands. And his research

with pilots shows that certain kinds of psychomotor tests have considerable validity for predicting subsequent performance. He found that the addition of psychomotor tests to paper and pencil tests raised the multiple correlation of the battery from 0,50 to 0,70. But these tests have many disadvantages. The equipment is costly to build and maintain; only a small number of personnel can be tested at one time; uniformity is difficult to ensure (rigorous calibration of equipment is necessary). And the effects of practice are difficult to monitor.

Work Sample Tests

Work sample tests for the selection of personnel are becoming increasingly advocated in the literature. The assumption with this form of testing is that the more nearly the test resembles the job, or some phase of the job, the more accurately test performance will predict job performance.

Several studies support the use of work sample tests. Campion (1972) demonstrated that work sample performance was significantly related to foremen's evaluations of job success, whereas traditional paper and pencil tests were not related. This finding followed arguments put forward by Wernimont and Campbell (1968). These researchers suggested that it would be more fruitful "to focus on meaningful samples of behaviour, rather than signs of dispositions, as predictors of later performance." (Wernimont and Campbell, 1968, p.372). Thus, rather than using tests as signs, or indicators, of predispositions to behave in certain ways, they should be used as "samples of the characteristic behaviour of individuals."

Muchinsky (1975) found work sample tests to be an effective selection device for equipment mechanics. And research by Mount, Muchinsky and Hanser (1977) found both the predictive and concurrent validity coefficients of the work sample to be comparable to those coefficients obtained from paper and pencil tests. These researchers suggest that because of the greater relevance of the test, more interest and motivation will be engendered.

A study by Asher and Sciarrino (1974) found the motor type work sample second only to the biographical item in predicting job proficiency. Their findings suggested that the motor type work sample tended to be a somewhat better predictor of job proficiency than of success in training. Three different hypotheses that may explain the success of work samples in prediction are cited. "One explanation...is a point-to-point theory which states that the more points in common between the predictor and criterion space, the higher the validity coefficient. Of all the predictors, the realistic motor work samples had the most visible point-to-point connection with job proficiency criteria....If a point-to-point theory has merit, then complex work sample tests that are miniature replicas of on-the-job behaviour should have more predictive power than simple motor skills tests." (Asher and Sciarrino, 1974, pp.524-5). Evidence from Fleishman (1956) [cited p.6] supports this expectation.

Another hypothesis which may explain the predictive power of complex work sample tests is Seashore's (1939) concept of "work methods". The work sample task may elicit work methods or habits which individuals use to solve specific problems. And the third explanation is experience. The miniature work sample may be sorting applicants into a continuum of individuals with progressively more criterion-related experience; or experience which has transfer to the criterion task.

Work sample tests have several advantages. They provide relevance to both the employer and employee and dispense with theorising about what particular abilities the job may involve. The results cannot be faked as they can be in self-report selection procedures; invasion of privacy is not a problem; and the fairness of test content reduces the chance of discrimination on the grounds of sex or race.

But job sample tests are relevant only for simple selection into a specific task and would be difficult to apply to multiple selection or classification. And a further disadvantage of this form of testing is that it allows no assessment of an individual's ability to learn from instruction. For skilled tasks which cannot be done without training, work sample tests are only relevant to select trained people; not to select people for training.

A method of selection for manual skills which is basically an extension of job-sample tests is that described by Downs (1968) - trainability testing. A sample of work is chosen and the applicant is instructed in that particular task. The applicant then performs that task unaided and is evaluated on his performance, using a standardised check list. The objective of trainability testing "is to assess whether the applicant has the potential to reach a satisfactory standard of performance after training." (Downs, 1968, p.2). Downs found this type of selection particularly suitable for older people and for immigrants, especially those wanting to learn an entirely different skill from those they had previously used. These people are often uncomfortable with written tests and intelligence and aptitude tests may seem "irrelevant or even incomprehensible". And trainability testing allows the applicant to assess the type of work involved and make a judgement about his own interest in, and competence for, the job.

A further advantage of trainability testing is that the training staff themselves are involved in the process of selection, giving them more confidence in the people selected, and in some cases, allowing for differential placement.

Disadvantages of this form of selection are several. It is time-consuming as it needs to be carried out individually or with, at the most, two or three individuals. It is costly in terms of development, materials and time. Its success is directly dependent on the skill of the instructors. And, because of its job-specific nature, a new test must be designed for each skill (Smith and Downs, 1975).

Downs (1972, 1973) and Smith (1972) cite the positive use of trainability tests for such varied skills as manual sorters in a Postal School, carpentry and welding, machinists, electronic assemblers and dentists. From the results of their research with apprentice ship-builders, Smith and Downs (1975) postulated that trainability testing will be of most use in predicting performance in semi-skilled work which requires a short training period.

Careful job analysis is the essential aspect of work sample selection

procedures and the important aspects of each job must be identified. But as Rouleau and Krain (1975) point out, many job-related applicant characteristics, such as personality factors, cannot be measured in this way. And Thomas (1971) warns that while work sample tests may have higher construct validity than paper and pencil tests for manually-oriented occupations, they have less validity for those occupations requiring abstract reasoning.

Indirect Testing

Indirect testing involves the performance of a task which seems completely irrelevant to the skill being predicted except for the predictive correlation. Indirect methods of testing for ability in manual skills are a fairly recent and largely unused innovation. They have many advantages over other forms of testing. They are able to be administratively brief and require a minimum of equipment. Both of these factors contribute towards reduced expense. Faking is not possible; and the tests are able to be simple enough to reduce the likelihood of confounding variables, such as anxiety, affecting the results. Allowing for the possibility of making the tests very simple also contributes to a reduction in discrimination on the grounds of reading level, cultural familiarity and intelligence. As compared with other forms of testing, indirect testing can be made almost totally objective, increasing reliability and reducing the importance of the personnel involved in the selection procedures. Indirect testing also allows for the possibility of designing a test which is as valid for a whole group of manual skills as for the one being tested.

The major disadvantage of indirect tests is their lack of face validity. This may render the task so irrelevant to the testee that there may be complete lack of motivation to perform. But a study by Delprato (1975) would suggest otherwise. He found that acceptance of the results of four personality tests, varying in face validity from high to non-existent, was high for all tests and was independent of the type of test from which the results were derived.

Disadvantages of indirect methods of testing, held in common with

most other personnel selection tests, include the fact that they are measuring only a limited area - personality and 'attitude to work' are ignored. And, as with all tests except those in the work sample class, no idea is conveyed to the participant of the eventual nature of the work situation.

Using an indirect method for predicting the performance of apprentice gas fitters, Wilson, Tunstall and Eysenck (1972) demonstrated that involuntary rest pauses in a tapping task, and the number of taps, was effective in predicting performance. They found that the test maintained its validity and reliability when administered under high drive conditions such as motivation. These researchers also confirmed the finding of Eysenck (1964) that these measures correlate with measures of motivation. Eysenck (1964) tested the hypothesis that involuntary rest pauses occurring during massed practice on a tapping task would be more numerous for extroverted subjects and his results confirmed this. He also predicted that involuntary rests would be less numerous under conditions of high drive than under conditions of low drive. There was only limited support for this prediction.

Smith (1976), seeing in tapping performance an administratively short way of predicting ability in motor skills, found mean inter-tap intervals and number of taps to be significantly related to practical dental performance.

Two earlier researchers, Robinson (1926) and Ohmann (1926) used tapping tasks in an attempt to predict success in typewriting. These tests were found to be of little value in estimating future typing proficiency.

Using another indirect method of assessment - time estimation - Smith (1974) demonstrated a significant relationship between the self-estimated time that it took to do a simple task and the subsequent speed performance on an unrelated manual skill. Two related experiments were carried out. The first experiment involved first-day electronic assemblers, with the criterion being speed of working, as rated by supervisors on a 1 to 10 scale. And the second involved office workers, with the criterion

being handwriting speed. Subjects were given a simple unrelated manual task to perform - in the first case, marble sorting and in the second, card sorting. All subjects were asked to estimate how long they thought the task would take them and, when completed, how long they thought they had taken. The task was timed by the experimenter.

In the first experiment the correlation between self-estimated time and supervisors' measure of working speed was 0.9138 ($p < 0.0001$). In the second experiment the correlation between self-estimated time and handwriting speed was 0.5432 ($p < 0.01$).

In both experiments there was no significant correlation between task performance and the actual time taken.

The strong relationship between these self-estimated times and the subsequent speed performance on an unrelated manual skill served as the basis for the present study.

Because time estimation was the principal focus of this study, all available research in the area of time estimation was reviewed. This literature indicates some of the complex factors that operate on the individuals' experience of the duration of time.

CHAPTER 3. FACTORS INFLUENCING PERCEPTION OF TIME

Many factors have been found to effect the psychologically experienced duration of time. The first major influence is the content of the time interval itself; i) its complexity, that is, the number and variety of stimuli occurring within that interval, and, related to this, ii) whether the interval is filled with stimuli or activity or is comparatively lacking in these - such as occurs in sensory deprivation.

Also, iii) the unity of the interval, that is, the degree to which the stimuli are organised into a coherent whole; and iv) the passivity or activity that is required of the individual during the interval to deal with these stimuli.

The second principal influence on the apparent length of time is the personality factors of the individual experiencing this time. These include stable factors such as level of i) achievement motivation and ii) anxiety (trait-anxiety) plus factors that are temporary to the situation, such as i) motivation to finish a task or reach a goal and ii) state-anxiety, that is, a transitory state of anxiety fluctuating within situations.

There are two levels of theorising with regard to the explanation of the mechanism underlying the perception of time. The first postulates the existence of an internal clock, a "biological chronometer producing a periodicity directly related to the passage of real or clock time." (Schiffman and Bobko, 1974, p.156). The source of this internal clock has been variously proposed as: chemical changes within the brain, general metabolic processes such as heart rate and body temperature, and the alpha rhythm (Hoagland, 1933; Holubar, 1969; and Pfaff, 1968). This first theory has produced inconclusive evidence and, according to Ornstein (1969) and Schiffman and Bobko (1974), has not met wide acceptance.

The second level of theorising with regard to the perception of time, proposes that the character of the stimulus events occurring and

perceived within a given passage of time is the major determinant of its experienced duration. Ornstein (1969) proposed a conceptual framework for time estimation studies with his 'storage-size' hypothesis. His studies showed that; a) an increase in the number of stimuli filling a given interval lengthened the experience of duration of that interval, and b) as the complexity of the stimuli increased, up to a point, the duration of experience lengthened, but with further increases of complexity above that point no increase in the experience of duration was found. In explanation of these findings Ornstein states that an increase in the number of events in an interval will increase storage size because it takes more space to store new events. This will lengthen the experience of duration of that interval. Also, because it takes more space to store increasingly complex events, the experience of duration will lengthen with the complexity of the stimuli. Ornstein points out, though, that it is only the registered information in a stimulus array which will affect duration experience.

Fraisse (1963) explains this same phenomenon, the lengthening experience of duration with an increase in complexity or changes in a period of time, by stating that the awareness of duration arises from the consciousness of the changes which took place in it. He claims that individuals are not aware of duration when they give their whole attention to the situation present at that time. According to Fraisse (p.202), "we only find length in time when we find it too long." Thus his argument is that time is "fundamentally nothing but the conscious interval between a need and its fulfillment". (Fraisse, 1963, p.202). An activity which is exactly adequate to the present motivation will provide satisfaction and thus unconsciousness of duration. Inversely, frustration will bring dissatisfaction and a feeling of duration. Fraisse denies that one can experience time where there is no dissatisfaction with the present. When motivation to do the task is slight, our attention will turn to various steps of the task and will be easily distracted by outside incidents or chance thoughts. When motivation is strong, the task itself will absorb us. A study by Jahoda (1941), with factory girls, demonstrates this. This motivation, Fraisse maintains, leads to an increase in the organisation of the task, greater unity, and thus a decrease in perceived duration. This also confirms Ornstein's (1969) view that greater unity will reduce the

number of changes in an interval and in this way will reduce perceived duration.

Harton (1939a) studied the influence of different degrees of unity of organisation in the activities of individuals on their perceived duration of time. He concluded that "there is very good evidence that the greater degree of organisation, the smaller the estimates of time, unless other factors are operative which become more dominant during a given period of time than the degree of unity in the organisation of the subject's activity." (Harton, 1939a, p.47). The "other factors" refer to anxiety and fear of failure.

A further study by the same researcher (Harton, 1942) confirmed the above finding. These results showed that periods of time spent at a task involving one goal, that is, highly unified tasks, are estimated less, with statistical reliability, than equal periods of time spent at tasks involving several goals.

Harton (1939b) also found that 'successful' experiences were estimated as shorter than 'failure' ones. He cited this as support for his contention that organised tasks have a shorter apparent duration. As Fraisse (1963, p.232) concludes: "Everything which tends to organise the different elements of an activity into one unit of purpose - structure, significance, motivation - has the effect of reducing the apparent duration."

Roelofs and Zeaman (1951) report evidence for Ornstein's proposal that an increase in the number of stimuli lengthens experienced duration and a study by Fraisse (1961) repeated and confirmed this finding. In further confirmation of this proposal Ornstein cites studies of sensory deprivation where duration experience is shortened. A study by Banks and Cappon (1962) found that a 90 minute interval of reduced sensory input produces a significant underestimation of time. And Vernon and McGill (1963), confining subjects for periods ranging from 8 to 96 hours under sensory deprivation conditions found a strong tendency for subjects to underestimate the time they had spent in this state.

A study by Schiffman and Bobko (1974) confirmed the Ornstein hypothesis that stimulus complexity has direct and positive effects on time perception. Using brief intervals, 3 to 23 seconds, and patterns of

lights of three different levels of complexity, Schiffman and Bobko found that the greater the degree of complexity of the stimuli within an interval of time, the longer that interval would be perceived. McNanamy (1966), also using three levels of stimulus complexity, found that time reproduction of 30 seconds increased as a function of the complexity factor.

The length of the time interval to be estimated also has some effect on its apparent duration. Hawkins and Meyer (1965) found significant differences between three time intervals - 50 seconds to 150 seconds - in the estimation of occupied and unoccupied time. And Fraisse (1963) found, in a series of studies, that if one subject has to evaluate different durations, he will overestimate the short ones and underestimate the long ones. Ornstein (1969) also offers support for this finding but comes to the same conclusion as Woodrow (1951, p.1226) that there is no interval which can be said in the case of all subjects exactly to separate shorter uniformly overestimated from longer uniformly underestimated times.

A study by Loehlin (1959) set out to determine what different kinds of influence the contents of time intervals have on the apparent duration of the intervals. This investigator reported that the major variables influencing duration were a) the interest versus the boredom of the task. Persons who found the tasks in general to be less interesting tended also to perceive them as longer. And, related to this, b) repetition of an activity. Repetitive tasks were rated as relatively shorter by less able subjects and longer by more able subjects. c) Filled versus unfilled tasks. Intervals lacking in variety of content were overestimated. Loehlin sees this as being due to greater attention being given to the passage of time during such periods. And d) activity versus passivity during intervals to be estimated resulted in the overestimation of passive time.

Loehlin's findings confirmed those of Gulliksen (1927) where subjects estimated the length of 8 periods of 8 different activities, each of approximately 3 minutes duration. From longest to shortest in estimated time were: rest (empty and passive), holding arm extended (empty and passive)

listening to slow metronome (passive and uninteresting) and listening to rapid metronome, palm on thumb tack (suggested as active and challenging as the pain was deliberately inflicted by the subject), reading directions in a mirror (active and filled), dictation, and long division (active, filled and interesting). An explanation of these findings in the terms of Fraisse and Ornstein, already cited, would be that such factors as interest and activity lead to an increase in the unity of the interval, in the participant's experience, and thus would lead to a decrease in the experience of duration.

Supporting the findings on passive situations, Fraisse (1963) found that spectators of a film overestimated its length to almost double the true duration. A study by Meade (1968) on passive and active ways of spending time also confirms the findings of Loehlin that passive intervals are judged as significantly longer than those involving active response. Meade explains this in terms of experienced progress. Activities such as doing arithmetic and taking dictation involve skill on the part of the subject and also yield information to the subject concerning how much he has accomplished at any given moment. Thus these conditions allow the subject to experience progress. According to experimental results obtained by Meade (1959, 1963, 1966a), experience of progress results in shorter psychological time than does lack of progress. Meade (1968) found that these results; of differently experienced time during a) activities involving skilled work that results in observed output and b) passive engagement in activities, were evident only in American students and in certain Indian subcultures where higher achievement motivation is found, but not in those subcultures which are lower in achievement motivation.

In work by Von Sturmer, Wong and Coltheart (1968) on filled versus unfilled intervals these researchers argued that events which occur during an interval of time may be classified in terms of their effects on the alertness of the subject, and in terms of the degree to which they distract him from the task of detecting and processing time-relevant cues. A distracting task, defined by the number of arithmetical operations a subject was required to perform, was presented while reproductions of an interval were being made. The data supported Von Sturmer et al's prediction

that the higher the level of distraction, the less time a subject will judge to have elapsed during an objective period. This confirms Fraisse's (1963) point that the more 'attention' is paid to the task of judging the duration of an interval, the more time will be judged to have elapsed. And a paper by Von Sturmer (1966) also supports the view that the more alert the subject is in his task of judging durations, the more time he will judge to have elapsed during a given interval. Von Sturmer et al's (1968) view of the filled versus unfilled time problem is that the judgement of lapsed time involves two factors - alertness and response competition. These variables were studied by directing one group that the arithmetic task was most important and the other group that the time estimation task was most important. As predicted, the distracting effect was greatest, and hence less time was judged to have elapsed, in the group which was told that the arithmetical task was the most important.

Other data on filled versus unfilled time agree with the views put forward by Von Sturmer et al. For example, in a study by Kleiser (1953) subjects first worked on some task for a fixed (standard) interval, then rested (comparison interval) until they judged as much time had elapsed as had elapsed during the standard interval. Kleiser found that the greater the "assumed cognitive demand" of the task used during the standard interval, the shorter subjects estimate, that is, the shorter the comparison interval. And Dewolfe and Duncan (1959) confirmed these findings.

But other studies (Triplett, 1931; Clausen, 1950) have shown no reliable difference in the apparent length of psychological time when it was experienced during an empty or filled interval. In these studies the filled intervals consisted of sensory stimulation to which subjects attended, and an absence of such stimulation constituted the empty intervals.

In summarising some of the findings in this area Wallace and Rabin (1960, p.221) conclude: "The issue of filled versus unfilled time still remains unsettled....Perhaps the lack of significant results is due to the fact that the distinction between filled versus unfilled time is in the mind of the experimenter rather than the experience of the subject." As Gilliland, Hofeld and Eckstrand (1946, p.166) suggest; "the interval may be filled with a large amount of visual, auditory, or other type of

external exchange. However, these may have little or no attention value for the subject who is estimating the time. On the other hand, the time interval may be relatively quiet so far as external stimuli are concerned and still be richly filled with mental content for the subject." Gilliland and Humphreys (1943) suggest a further reason for conflicting findings in this area of filled versus unfilled time. A subject who knows that time is underestimated during activity and over-estimated in boredom may correct, or over-correct, for these influences when estimating the time that has passed.

The inter-relationship between achievement motivation and time estimation appears to be a complex one. Several investigators have explored this area with varying and sometimes contradictory conclusions. Knapp (1959, 1960), in a series of experiments, demonstrated that subjects with high need for achievement, as demonstrated by the procedure of McClelland, Atkinson, Clark and Lowell (1953), i.e. analysing Thematic Apperception Test pictures for achievement imagery, appear to be more aware of the passage of time, and thus see time as passing more rapidly. Green and Knapp (1959) asked subjects to indicate when certain events of recent history, such as the outbreak of the Korean War, had occurred. They found that those subjects who displayed qualities of high need for achievement tended to recall the past events as nearer the present. The subjects also were asked to estimate how long a moving point would take to reach a certain target after it was hidden from their view. Again, the individuals with higher need for achievement tended to estimate the conclusion of this act sooner than low need achievers.

A related effect was found by Knapp and Green (1961). Subjects were asked to estimate the time that had passed after listening to intervals filled with music. Subjects with high need for achievement were found to keep better track of the time, whereas those of low achievement need underestimated the time that had passed - they were, presumably, more absorbed in the music. The investigators' explanation of this finding is that individuals with high need for achievement try to maintain their "executive efficiency" with respect to their environment and resist environmental stimuli which interfere with this. Thus they will not "surrender readily to affectively laden experiences involving the primary

processes." (Knapp and Green, 1961, p.264). They offer the alternative explanation that subjects low in need for achievement may be inherently more distractable.

A further study by Knapp (1960) also emphasised the time consciousness of individuals with high needs for achievement. In factor analysing a questionnaire consisting of twenty-three time attitudes and practices, Knapp discovered that high need for achievement individuals tended to be annoyed to find their watch had stopped; guilty if they slept late; anxious if they were not certain of the time; etc. Negatively loaded on the factor were statements dealing with having lots of leisure time or being frequently early for an appointment. The correlation of agreement with items in this factor and with the estimation of need for achievement was significant.

McClelland (1961) also cites studies by Knapp and Garbutt (1958) and Ricks and Epley (1960) concerning time imagery. His conclusion is that: "So far as individuals in the United States are concerned, the evidence from a variety of sources strongly supports the hypothesis that individuals with high need for achievement are acutely aware of time passing rapidly." (McClelland, 1961, p.327). Shannon (1976) compared time perception in Native Americans, Mexican Americans and Anglo-Americans. Low and high need for achievement subjects estimated lengths of time spent in idleness as compared with time spent in some type of achievement. High achievement subjects perceived time spent in meaningful tasks passing rapidly and seeming short. This finding was only evident with Native Americans.

Measuring need for achievement, also using the techniques of McClelland et al (1953), Meade (1970) found that individuals who are high in achievement motivation experienced time as shorter when they were making progress toward a goal and longer when no progress was being made. Whereas subjects with low achievement motivation were not affected and their time estimations did not vary significantly.

A laboratory study conducted by Burnam, Pennebaker and Glass (1975) investigated some of the behavioural consequences of a coronary-prone behaviour pattern, Type A, which is characterised by excessive achievement

striving and a sense of time urgency. The impatient tendencies of these subjects led them to judge the completion of a time interval sooner than non-coronary-prone Type B subjects when the subjects were required to read an article out loud with instructions to stop after one minute. Both Frankenhaueser (1959) and Fraisse (1963) have suggested that impatience leads to increased attentiveness to stimulus changes. Therefore these individuals experience events or stimuli occurring more slowly and therefore time passing more quickly than it actually is. Thus, Burnam et al (1975) conclude that the impatience of Type A high achievement striving subjects leads them to report the completion of the time interval sooner than Type B low achievement strivers.

Another phenomenon described in the literature is the increasing underestimation of time as a goal is approached. Hindle (1951) found that as a subject proceeds through a task, he perceives his rate of progress to be increasing and, thus, time estimates do not increase as rapidly near the goal as they do far from it. A series of studies by Meade (1959, 1960b, 1963) shows that rate of progress affects time estimates of subjects in which motivation has been produced experimentally, and has little effect on those who are not motivated. Meade (1966a) then studied those whose need for achievement is a permanent dimension of their personality - as measured by the techniques of McClelland et al (1953) - and found, as he predicted, that high need achievers experienced time as shorter under conditions of fast progress and longer under conditions of slow progress. Similar results were found by Meade and Singh (1967) in India. Time estimations for six minute periods were inversely related to motivation. The study by Meade (1968) already cited, [see p.18] demonstrating that those individuals with high achievement motivation perceive passive time as being longer than active time is explained by the assumption that because those subcultures with high achievement motivation value time to a greater extent, they will regard passive time as unproductive and wasted and it will thus appear longer. Conversely, those with lower motivation who do not value time so greatly will be relatively unaffected by whether time spent is productive or passive. A further investigation by Meade and Singh (1970) was undertaken to determine to what extent experimentally induced motivation and rate of progress affect the perception of time. Time estimations were inversely related to progress under conditions of high motivation but

unaffected by progress in the low motivation conditions.

As early as 1890, William James suggested that motivation to have time pass influences the speed of apparent time passage. Filer and Meals (1949) offer support for this contention. Using the motivation of 'end of class' and the awarding of prizes, these investigators found that subjects who are motivated to have time pass will estimate a given period of time to be of longer duration than will subjects who are not so motivated. Meade (1959) extended this investigation. He found that a) for subjects not motivated to reach the end of the task, perceived duration is unrelated either to rate of progress or to distance from the end of the task, and b) for subjects motivated to reach the end of the task, perceived duration is inversely related to rate of progress and distance from the goal.

Various, more permanent, personality variables have been looked at in relation to the judging of apparent duration of time. According to Eysenck (1959) extroverts underestimate the length of time intervals. But in a study by Bell and Watts (1966) into the relationship between personality factors and time estimation, no significant findings were made.

Large numbers of studies have been done which attempt to relate time estimation to the presence or absence of anxiety. Most of these studies concentrate on state-anxiety, that is, anxiety that is defined by Auerbach (1974, p.187) as a"transitory emotional state which fluctuates as a function of situational stress." This is to be distinguished from trait-anxiety which is a more permanent personality disposition.

Rosenzweig and Koht (1933) found a general tendency for subjects to estimate that less time had elapsed under a condition of high "need-tension" - in this case the task was designated an intelligence test. Working on the assumption of Rosenzweig and Koht (1933) that the desire for time to be long will lead to the experiencing of time as short, Greenberg and Kurz (1968) expected a shorter estimation of time in their 'failure' condition as compared to their 'no-stress' condition. This was found to be so. But Meade (1960a, b), replicating Rosenzweig and Koht's general procedures, found no significant difference between high and low

need tension groups. Another study, Cohen and Mezey (1961) used stage fright as an anxiety producing stimulus and found no differences in time estimation between high and low stress groups.

Several studies (Falk and Bindra, 1954; Hare, 1963; and Langer, Werner and Wapner, 1961) show that subjects under high stress conditions reported higher time estimations than those under low stress conditions. In all of these studies the level of state-anxiety was defined on a priori grounds in terms of conditions designed to be stressful. In two investigations, (Hendrickson, 1948; Whyman and Moos, 1967) in which independent self-report measures of state-anxiety intensity were employed, highly anxious subjects gave lower time estimations than low state-anxiety subjects.

Felix (1965) attempted to relate time estimates to an inferred continuum of state-anxiety arousal. This investigation used variations in instructions and feedback conditions to induce differential levels of anxiety in subjects which Felix ordered on a continuum of increasing arousal. As for the previously cited studies, the arousal continuum was arranged on a priori grounds with no independent measure of arousal.

Thus, studies attempting to relate time estimation to state-anxiety show no consistent trend. Auerbach (1974) explains this inconsistency as being due in part to a failure by most researchers to measure anxiety in the situation in which the time estimation was obtained. He aimed to replicate the study by Felix (1965) with the addition of an independent measure of the degree to which state-anxiety was actually aroused in each subject by the conditions to which he was assigned. The results did not replicate those of Felix. Subjects did not differ significantly on time estimation as a function of experimental conditions. But Auerbach did find that time estimation, in terms of over-estimation or under-estimation of the standard, tended to remain stable within subjects across time intervals. This suggests that trait-anxiety, rather than state-anxiety may be the more important variable for future research.

A study by Aitken and Gedye (1968) on aircraft pilots, used two levels of arousal to determine their effect on the apparent duration of a

ten minute interval. One period involved a tracking task and the other, passivity. On one occasion for each task condition they were exposed to distracting stimulation. It was found that both distraction and task performance increased arousal, but arousal changes could not account for more than an insignificant proportion of the observed alteration in apparent duration.

Curton and Lordahl (1974), reviewing the contradictory findings in the area of time estimation as it is affected by state-anxiety, suggested that two sets of variables are being confused here - those of arousal and those of attentional focus. These investigators suggest that stimuli increasing the level of subjects' arousal could also be diverting attention away from the interval to be judged. In studies that have used physiological measures of arousal (Cahoon, 1969; Hawkes, Joy and Evans, 1962), it has been found that heart rates tend to be positively correlated with time estimates, at least within subjects and over a moderate range of changes in heart rates. On the other hand, there are indications that diverting subjects' attentional focus from the interval to be estimated causes estimates to decrease (Smith, 1969). The lack of control for one, or both, of these variables might have contributed to the inconsistent findings in this area. The results of Curton and Lordahl's research, with these variables controlled, was that the attentiveness of subjects had a large effect on their ability to estimate the length of an interval. With other variables held constant, subjects whose attention was focused on the interval to be estimated gave higher estimations than subjects whose attention was focused away from the interval. No conclusive evidence was found for time estimation and arousal.

It seems then, that the apparent duration of time appears to be shortened by a) increasing the unity and organisation of the interval measured. Success, interest and activity increase motivation and thus have this effect.

b) decreasing the number and complexity of the stimuli occurring during a time interval,

and c) distracting tasks and greater cognitive demand turning attention from the passage of time.

The evidence is inconclusive for anxiety states. The fluctuation here appears to be within individuals rather than across individuals.

Achievement motivation affects the estimation of time in varying ways depending on the rate of progress experienced and impatience to complete the task.

The influence of attitudinal and motivational factors appears to be so strong and difficult to control that it may obscure or distort non-emotional experimental variables.

CHAPTER 4. ACHIEVEMENT MOTIVATION

The research involving the relationship between achievement motivation and time estimation suggests the possibility of 'need for achievement' being an intervening variable in the correlation between time estimation and speed in a manual skill found by Smith (1976).

The concept of need for achievement (n Ach) has been defined by Murray (1938, p.64) as "the desire or tendency to do things as rapidly and/or as well as possible....To excel one's self. To rival and surpass others. To increase self-regard by the successful exercise of talent." And McClelland et al (1953) used Thematic Apperception Test (T.A.T.) cards (Morgan and Murray, 1935) to measure this notion. Vast amounts of research have since been done on the need for achievement and Heckhausen (1967) provides a compact summary of this research.

In a major work on the subject (Atkinson and Raynor, 1975), one of the conclusions reached by Atkinson was that measured differences in intelligence, aptitudes and abilities can be influenced by need for achievement. To test for the possibility that achievement motivation may account for any apparent correlation between time estimation and typing skill all subjects in the present study were tested for 'need for achievement' at about the same time that they did the time estimation work.

Many measures of n Ach have been developed since that of McClelland et al (1953). These include: Costello's Achievement Motivation Scale (Costello, 1967); Lynn's Achievement Motivation Questionnaire (Lynn, 1969) and Hermans' Achievement Motive Questionnaire (Hermans, 1970). These measures were mostly normed on student populations, but others, such as Fineman's (1975) Work Preference Questionnaire were developed for, and normed on, well defined groups of individuals such as managerial populations.

The questionnaire developed by Mehrabian and Bank (1978) was chosen for the present study because of its easily understood language, its simplicity of administration, its quick scoring and its psychometric adequacy (Fineman, 1975).

Mehrabian (1968, 1969), constructed his questionnaire measures of Individual Differences in Achieving Tendency using Atkinson's (1964) model of achievement motivation. This model described high achievers as individuals with a stronger motivation to achieve success (Ms) relative to their motivation to avoid failure (Maf); and low achievers were conceived of as having a stronger motive to avoid failure relative to their motive to achieve success. Achieving tendency in the Atkinson (1964) model consisted of the difference between the McClelland et al (1953) T.A.T. n-achievement score and the Mandler and Sarason (1952) Test Anxiety questionnaire (T.A.Q.) score.

The measure of need for achievement based on the T.A.T. has been the most commonly employed test of achievement but it does not have satisfactory test-retest reliability (Krumboltz and Farquhar, 1957; Haber and Alpert, 1958; or Birney, 1959). Also, the administration and scoring of the T.A.T. measure of need-achievement require considerable training, and the scoring is time-consuming.

Mehrabian (1968) developed his questionnaire measure of achieving tendency in order to obtain greater reliabilities and to simplify data collection and scoring. These 1968 scales were revised in 1969 and further improved and expanded in 1978. The latter scale was used in this research. According to Mehrabian and Bank (1978, p.475) this "38-item questionnaire is based on a general and large pool of items tapping most aspects of achieving tendency identified in the literature and in other measures of achievement....The goal was to obtain a simple and broad-based measure that would be equally applicable to both sexes and would be more reliable than the earlier versions." A description of this process is detailed in Mehrabian and Bank (1978).

High achievers are characterised, in the scales, as having a realistic aspiration level, preferring intermediate risk situations, being better able to delay gratification, and as striving to achieve closure in the tasks they undertake. In contrast, low achievers have relatively low or high aspiration levels, prefer extreme risk situations, i.e. very easy or very difficult tasks; tend to prefer gratifying activities which do not necessarily lead to any future goals or rewards, and are not as concerned with closure in the tasks they undertake.

The scale is balanced for response bias such that 19 items are positively worded and 19 are negatively worded. Subjects respond to each item by using a 9-point scale which ranges from +4 (strong agreement) to -4 (strong disagreement). Across-sex norms give a mean of 51 and a S.D. of 35.

The scale has high internal consistency as evidenced by a coefficient of 0.91 obtained from use of the Kuder-Richardson (1937) formula. The measure is also independent of social desirability as it correlated 0.02 with the Crowne and Marlowe (1960) social desirability scale.

Numerous studies have employed the Mehrabian measures, and several studies have found that the measures correlate positively and significantly with other measures of achievement motivation (e.g. Murray and Mednick, 1975; Schultz and Pomerantz, 1974; and Weiner and Kukla, 1970). And a series of validation studies were carried out by Cohen, Reid and Boothroyd (1973) in connection with the 1968 and 1969 scales. These were found to differentiate between students in terms of their self-images, their intellectual achievement responsibility, and their occupational aspirations.

CHAPTER 5. THE PRESENT STUDY

An essential component of the present study was a pool of subjects who were involved in acquiring a manual skill. No industries were available which taught an easily measured skill to a large number of individuals at any one time. Secondary-school typing classes were chosen for this study because they fulfilled the necessary requirements. There was a large number of novices at the skill; all were being taught by the same method, by the same teacher, at the same time; and typing is a skill which can be measured for speed and accuracy easily and reliably.

A card-sorting task was chosen for time-estimation purposes. This was a simple, non-threatening task which required very little explanation. It was easy to standardise and took only a short time; thus making it suitable for a large number of subjects.

Achievement motivation was examined as outlined in Chapter 4.

Intelligence is an obvious influence on many forms of achievement so it was desirable to examine its influence on the relationship between time estimation and typing skills. Intelligence quotient scores which were already available for most of the subjects were included in the analysis.

Hypotheses

The present study was designed to examine the following four hypotheses:

1. That a time estimation test - that is, subjects estimating the time they have taken to do a short task - can be used as a predictor of speed and accuracy of typing. It is predicted that the time estimation score will be negatively correlated with speed and accuracy.

2. That this relationship, if it exists, is independent of achievement motivation.

3. That this relationship, if present, is also independent of intelligence.

4. That there is no difference between adolescents and adults in the results derived from testing hypotheses 1 and 2.

Subjects

One hundred and two subjects were used in the initial testing. Sixty of these were adolescents, aged 12-14 years of age, in two first-year secondary school typing classes. The other forty-two subjects were adults, 20 years of age and over, taking evening classes in beginning typing.

Both groups of subjects were predominantly female - there were two male adolescents and six male adults.

There was some loss of adult subjects in the period of time between initial and final testing. Fourteen adults took the final test. Only two adolescent subjects were lost in this time.

Procedure

All subjects were initially asked, in their class groups, to assist with a piece of research. It was explained that all that was required of them was a short card-sorting task, done individually. No mention was made of time-estimation or of the aim of the experiment. It was made clear that class members were under no obligation to participate; but all were willing.

Each subject left the class in turn and was given a pack of lexicon cards and asked to make eight specified 3-4 letter words which were printed clearly on a piece of card (see Appendix I). The order of letters in the pack of cards was standardised (see Appendix I).

The instruction given to each subject was to make these words, in any order, as quickly as possible.

The subject was timed, with a stop-watch, from the end of the instruction to the completion of the eight words. On completion, the subject was asked to estimate, as accurately as possible, how long they

thought the task had taken them.

After all subjects had completed this procedure, achievement motivation was measured using the Mehrabian and Bank questionnaire - see Appendix II. This was administered to each class as a group. These measures were all completed in the first term of the school year.

During the third term of the school year, all subjects were given an identical typing test, carried out in their class groups. This involved a timed period of ten minutes in which subjects were required to type a standard set of sentences (see Appendix III). Typing speed was calculated by the formula:

$$S = \frac{N + 1 - 10E}{2} \quad \text{(truncated)}$$

where N is the number of words typed (1 word = 5 taps) and E is the number of errors made.

The accuracy score was given by:

$$A = \begin{cases} 10 - E & \text{if} \quad E < 10 \\ 0 & \text{if} \quad E \geq 10 \end{cases}$$

A composite score was also obtained by taking the average of the speed and accuracy scores.

Intelligence quotient scores were obtained from school records. All third form pupils were tested with the Raven's Standard Matrices (1958) at the beginning of the school year.

CHAPTER 6. RESULTS

The major hypothesis presented in this study was that a time estimation test could be used as a predictor of ability at the manual skill of typing. The results of this study do not confirm this hypothesis. No correlation of any significance was found between estimated time and either the speed or the accuracy of typing.

The second hypothesis put forward for investigation was that this relationship between time estimation of a task and ability to type, if it existed, would be independent of achievement motivation. The present results show no relationship between estimated time and typing skill, but do show a significant relationship between typing skill and achievement motivation ($p = .021$, Tables 1 and 2, pp.34, 35). For the adolescents separately, the correlation is even higher ($p = .011$, Tables 1 and 3, pp.34, 36). This result indicates strongly that even in the event of any relationship between estimated time and the skill of typing, the relationship would not be independent of achievement motivation.

Hypothesis number three stated that the relationship between time estimation of a task and typing skill, if it existed, would be independent of intelligence. However, the results show that intelligence is significantly related to both the actual time of the task ($p = .045$, Table 3, p. 36); the estimated time of the task ($p = .026$, Table 3); as well as to speed of typing ($p = .036$, Table 3). This is evidence that any relationship between estimated time and typing skill would not be independent of the influence of intelligence.

The fourth hypothesis stated that there is no difference between adolescents and adults in the results derived from hypotheses 1 and 2. This is true for hypothesis 1, in that no significant relationship was found between time estimation and typing ability for either the adults or the adolescents. But for hypothesis 2 there is a distinct difference. For the adults there is a very low positive correlation between achievement motivation and typing skill (Tables 1 and 4, pp. 34, 37). But for the adolescents the correlation is significant at the .01 level (Table 3).

TABLE 1: Description of Variables Used in Tables 2, 3 and 4

Actual time:	the time taken for subjects to carry out the card-sorting task.
Estimated time:	the time subjects estimated that they had taken to do the card-sorting task.
Achievement Motivation:	the subjects' scores on Mehrabian and Bank's 'Individual differences in Achieving Tendency' questionnaire (Chapter 4, p.28).
Speed:	typing speed as described in Chapter 5 (p.32).
Accuracy:	typing accuracy as described in Chapter 5 (p.32).
IQ:	the subjects' scores on the Raven's Standard Matrices (1958).
Accuracy of estimation:	the absolute difference between actual time and estimated time.
Typing Skill:	the average of the speed and accuracy scores.

Raw scores are listed in Appendix IV

TABLE 2: Pearson Correlation Coefficients for Measured Variables on all Subjects

	Actual Time	Estimated Time	Achievement Motivation	Speed	Accuracy	IQ	Accuracy of Estimation	Typing Skill
Actual Time	1.0000 n = 102 (S = 0.001)	0.3250 n = 102 (S = 0.001)	-0.3519 n = 102 (S = 0.001)	-0.0975 n = 72 (S = 0.208)	0.0144 n = 72 (S = 0.452)	-0.2525 n = 46 (S = 0.045)	0.3093 n = 102 (S = 0.001)	-0.0543 n = 72 (S = 0.325)
Estimated Time	0.3250 n = 102 (S = 0.001)	1.0000 n = 102 (S = 0.001)	-0.0597 n = 102 (S = 0.276)	-0.0098 n = 72 (S =0.467)	0.1400 n = 72 (S = 0.120)	-0.2881 n = 46 (S = 0.026)	0.3521 n = 102 (S = 0.001)	0.0706 n = 72 (S = 0.278)
Achievement Motivation	-0.3519 n = 102 (S = 0.001)	-0.0597 n = 102 (S = 0.276)	1.0000 n = 102 (S = 0.001)	0.2658 n = 72 (S = 0.012)	0.1298 n = 72 (S = 0.138)	0.0381 n = 46 (S = 0.401)	-0.1894 n = 102 (S = 0.028)	0.2410 n = 72 (S = 0.021)
Speed	-0.0975 n = 72 (S = 0.208)	-0.0098 n = 72 (S = 0.467)	0.2658 n = 72 (S = 0.012)	1.0000 n = 72 (S = 0.001)	0.4149 n = 72 (S = 0.001)	0.2702 n = 45 (S = 0.036)	0.0859 n = 72 (S = 0.236)	0.8662 n = 72 (S = 0.001)
Accuracy	0.0144 n = 72 (S = 0.452)	0.1400 n = 72 (S = 0.120)	0.1298 n = 72 (S = 0.138)	0.4149 n = 72 (S = 0.001)	1.0000 n = 72 (S = 0.001)	0.0057 n = 45 (S = 0.485)	0.0842 n = 72 (S = 0.241)	0.8140 n = 72 (S = 0.001)
IQ	-0.2525 n = 46 (S = 0.045)	-0.2881 n = 46 (S = 0.026)	0.0381 n = 46 (S = 0.401)	0.2702 n = 45 (S = 0.036)	0.0057 n = 45 (S = 0.485)	1.0000 n = 46 (S = 0.001)	0.0924 n = 46 (S = 0.271)	0.1719 n = 45 (S = 0.129)
Accuracy of Estimation	0.3093 n = 102 (S = 0.001)	0.3521 n = 102 (S = 0.001)	-0.1894 n = 102 (S = 0.028)	0.0859 n = 72 (S = 0.236)	0.0842 n = 72 (S = 0.241)	0.0924 n = 46 (S = 0.271)	1.0000 n = 102 (S = 0.001)	0.1011 n = 72 (S = 0.199)
Typing Skill	-0.0543 n = 72 (S = 0.325)	0.0706 n = 72 (S = 0.278)	0.2410 n = 72 (S = 0.021)	0.8662 n = 72 (S = 0.001)	0.8140 n = 72 (S = 0.001)	0.1719 n = 45 (S = 0.129)	0.1011 n = 72 (S = 0.199)	1.0000 n = 72 (S = 0.001)

TABLE 3: Pearson Correlation Coefficients for Measured Variables on Adolescent Subjects

	Actual Time	Estimated Time	Achievement Motivation	Speed	Accuracy	IQ	Accuracy of Estimation	Typing Skill
Actual Time	1.0000 n = 60 (S = 0.001)	0.2928 n = 60 (S = 0.012)	-0.3077 n = 60 (S = 0.008)	-0.1515 n = 58 (S = 0.128)	0.0799 n = 58 (S = 0.276)	-0.2525 n = 46 (S = 0.045)	0.2516 n = 60 (S = 0.026)	-0.0566 n = 58 (S = 0.337)
Estimated Time	0.2928 n = 60 (S = 0.012)	1.0000 n = 60 (S = 0.001)	0.0267 n = 60 (S = 0.420)	-0.0664 n = 58 (S = 0.310)	0.0899 n = 58 (S = 0.251)	-0.2881 n = 46 (S = 0.026)	0.2213 n = 60 (S = 0.045)	0.0046 n = 58 (S = 0.486)
Achievement Motivation	-0.3077 n = 60 (S = 0.008)	0.0267 n = 60 (S = 0.420)	1.0000 n = 60 (S = 0.001)	0.3069 n = 58 (S = 0.010)	0.1885 n = 58 (S = 0.078)	0.0381 n = 46 (S = 0.401)	0.0407 n = 60 (S = 0.379)	0.3021 n = 58 (S = 0.011)
Speed	-0.1515 n = 58 (S = 0.128)	-0.0664 n = 58 (S = 0.310)	0.3069 n = 58 (S = 0.010)	1.0000 n = 58 (S = 0.001)	0.4048 n = 58 (S = 0.001)	0.2702 n = 45 (S = 0.036)	0.0431 n = 58 (S = 0.374)	0.8721 n = 58 (S = 0.001)
Accuracy	0.0799 n = 58 (S = 0.276)	0.0899 n = 58 (S = 0.251)	0.1885 n = 58 (S = 0.078)	0.4048 n = 58 (S = 0.001)	1.0000 n = 58 (S = 0.001)	0.0057 n = 45 (S = 0.485)	0.0390 n = 58 (S = 0.386)	0.8004 n = 58 (S = 0.001)
IQ	-0.2525 n = 46 (S = 0.045)	-0.2881 n = 46 (S = 0.026)	0.0381 n = 46 (S = 0.401)	0.2702 n = 45 (S = 0.036)	0.0057 n = 45 (S = 0.485)	1.0000 n = 46 (S = 0.001)	0.0924 n = 46 (S = 0.271)	0.1719 n = 45 (S = 0.129)
Accuracy of Estimation	0.2516 n = 60 (S = 0.026)	0.2213 n = 60 (S = 0.045)	0.0407 n = 60 (S = 0.379)	0.0431 n = 58 (S = 0.374)	0.0390 n = 58 (S = 0.386)	0.0924 n = 46 (S = 0.271)	1.0000 n = 60 (S = 0.001)	0.0491 n = 58 (S = 0.357)
Typing Skill	-0.0566 n = 58 (S = 0.337)	0.0046 n = 58 (S = 0.486)	0.3021 n = 58 (S = 0.011)	0.8721 n = 58 (S = 0.001)	0.8004 n = 58 (S = 0.001)	0.1719 n = 45 (S = 0.129)	0.0491 n = 58 (S = 0.357)	1.0000 n = 58 (S = 0.001)

TABLE 4: Pearson Correlation Coefficients for Measured Variables on Adult Subjects

	Actual Time	Estimated Time	Achievement Motivation	Speed	Accuracy	Accuracy of Estimation	Typing Skill
Actual Time	1.0000 n = 42 (S = 0.001)	0.4776 n = 42 (S = 0.001)	-0.2997 n = 42 (S = 0.027)	-0.0024 n = 14 (S = 0.497)	-0.2523 n = 14 (S = 0.192)	0.3625 n = 42 (S = 0.009)	-0.1525 n = 14 (S = 0.301)
Estimated Time	0.4776 n = 42 (S = 0.001)	1.0000 n = 42 (S = 0.001)	-0.1772 n = 42 (S = 0.131)	0.3019 n = 14 (S = 0.147)	0.2973 n = 14 (S = 0.151)	0.6942 n = 42 (S = 0.001)	0.3448 n = 14 (S = 0.114)
Achievement Motivation	-0.2997 n = 42 (S = 0.027)	-0.1772 n = 42 (S = 0.131)	1.0000 n = 42 (S = 0.001)	0.3197 n = 14 (S = 0.133)	0.0238 n = 14 (S = 0.468)	-0.3540 n = 42 (S = 0.011)	0.1908 n = 14 (S = 0.257)
Speed	-0.0024 n = 14 (S = 0.497)	0.3019 n = 14 (S = 0.147)	0.3197 n = 14 (S = 0.133)	1.0000 n = 14 (S = 0.001)	0.5082 n = 14 (S = 0.032)	0.2410 n = 14 (S = 0.203)	0.8566 n = 14 (S = 0.001)
Accuracy	-0.2523 n = 14 (S = 0.192)	0.2973 n = 14 (S = 0.151)	0.0238 n = 14 (S = 0.468)	0.5082 n = 14 (S = 0.032)	1.0000 n = 14 (S = 0.001)	0.2343 n = 14 (S = 0.210)	0.8797 n = 14 (S = 0.001)
Accuracy of Estimation	0.3625 n = 42 (S = 0.009)	0.6942 n = 42 (S = 0.001)	-0.3540 n = 42 (S = 0.011)	0.2410 n = 14 (S = 0.203)	0.2343 n = 14 (S = 0.210)	1.0000 n = 42 (S = 0.001)	0.2734 n = 14 (S = 0.172)
Typing Skill	-0.1525 n = 14 (S = 0.301)	0.3448 n = 14 (S = 0.114)	0.1908 n = 14 (S = 0.257)	0.8566 n = 14 (S = 0.001)	0.8797 n = 14 (S = 0.001)	0.2734 n = 14 (S = 0.172)	1.0000 n = 14 (S = 0.001)

CHAPTER 7. DISCUSSION

The results of the present study do not corroborate those of Smith (1974) who found a strong relationship between the self-estimated time on a task and an unrelated manual skill - both in an industrial setting and in the laboratory.

Various reasons may be postulated for the differing results between the two studies. The first, and most obvious, is that different manual skills are involved. In the laboratory setting used by Smith, the criterion was speed of performance on a well mastered and practised skill - handwriting. The present study used novice typing pupils, all of whom were tested before they were even very familiar with keyboard layout. Typewriting may be a skill too complex to measure by indirect methods. Apart from its manual component of finger dexterity, it involves verbal factors such as comprehension, and abilities in spelling and punctuation.

The actual task involved in the indirect testing could also have had some influence on the results. In Smith's study, the industrial operators carried out a test task that bore some resemblance to the actual job skills of electronic assembly. The present study used a test task that had no obvious similarity to the skill of typing.

The methodology involved could possibly have accounted for some of the variance in the results. Smith used an average of estimated times over five trials. The present study used only one trial, and subjects were unaware during the task that they were going to be asked to estimate the time they took. Whereas, after the first trial in Smith's study subjects would be aware that time estimation was relevant. This awareness could well influence their perception of the apparent duration of time and it could also influence the relationship between their perception of time and their innate ability to perform the manual skills under consideration.

It is possible that performance in typewriting may be related more to the amount of practice carried out than to either motivation or any innate

psychomotor ability. Therefore, even if indirect testing was an adequate measure of this innate ability, this fact could be masked in the present experiment because of the lack of consideration of the time spent in practice.

The results show a significant relationship between achievement motivation and typing performance. But this result was not true for the adult sample.

One explanation might be that for adolescents of high achievement motivation a great deal of effort might be put into their typing, as this skill represents a significant factor in their lives. For the adults, however, the typing would, on the whole, be a hobby and their high need for achievement would, perhaps, be directed into other aspects of their lives. Adult high achievers in this night-class setting may not find enough challenge in this particular skill to persevere. This suggestion seems to be confirmed by the fact that the mean achievement motivation score of those adults who remained to the end of the course, and took the typing test (14 of the 42 subjects), was 24. The mean achievement motivation score for the 28 other adult subjects was 52.7.

($t = 4.8$, $p < .001$)

It is difficult, in the present study, to ascertain how many of the factors influencing the apparent duration of time are applicable. Because only one task - card-sorting - was used, no comparative conclusions can be reached as to whether this task was perceived as being interesting or boring; meaningful or pointless; or anxiety-producing or non-stressful. The task was simple enough, and the situation comfortable enough, to appear non-stressful. But individual responses to the situation could differ markedly and this was not measured.

The correlation between intelligence and estimated time ($p = .02$); and intelligence and actual time ($p = .04$); are both negative. This indicates that those who were more intelligent sorted the cards more quickly and also estimated the time taken as less. Subjects used many strategies for the card-sorting task. These included the more efficient one of making all the words at once, requiring only one screening of the pack of cards; and the least efficient one of making each word separately, requiring eight siftings through the pack. It is a reasonable assumption

that the more intelligent subjects used more efficient means of sorting and thus completed the task in a shorter time.

The high drop-out rate for adults - 28 of 42 subjects - in the third term of the year was disappointing but not altogether unexpected. Adults who voluntarily attend evening classes have often learnt all they want to know about a subject by that time of the year or find pressures of personal commitments increasing. Typing classes are not unique in this respect. All evening classes appear to have a similar drop-off in attendance.

But in the context of this research the results are probably not representative of the group as a whole. Although test and no-test (for typing) groups had very similar mean scores for actual and estimated times, their scores on a test of typing skill might be very different.

Different results from those of the present study could possibly be anticipated if experienced typists were used as subjects rather than the novice typists of this study. Suggested research would include testing experienced typists - with established and stable typing speeds - on a time estimation task, to ascertain if a more significant correlation could be found between the time estimated and typing skill. Although this relationship - between estimated time and typing skill - would be of no predictive value in experienced typists, it seems a reasonable assumption that their performance in estimating the time of an unrelated task would not be different from their performance on such a task before they had acquired their typing skill. This assumption could only be tested by a longitudinal study over several years.

APPENDIX I

a) Words presented to subjects for time-estimation task:

cut

safe

hot

pie

bill

run

way

kid

b) Order of cards in the pack presented to subjects:

F S R T D I O N R A E K J W A S P F D I U E

Z L M C B U H O N A C G K H E X I T U O W A

G M V B Q E L D P H Y R T S

APPENDIX II

Mehrabian and Bank (1978) Test for Individual Differences in Achieving Tendency

Please use the following scale to indicate the degree of your agreement or disagreement with each of the statements on the following pages. Record your answers in the spaces provided below.

+4 = very strong agreement
+3 = strong agreement
+2 = moderate agreement
+1 = slight agreement
0 = neither agreement nor disagreement
-1 = slight disagreement
-2 = moderate disagreement
-3 = strong disagreement
-4 = very strong disagreement

1. _____	9. _____	17. _____	25. _____	33. _____
2. _____	10. _____	18. _____	26. _____	34. _____
3. _____	11. _____	19. _____	27. _____	35. _____
4. _____	12. _____	20. _____	28. _____	36. _____
5. _____	13. _____	21. _____	29. _____	37. _____
6. _____	14. _____	22. _____	30. _____	38. _____
7. _____	15. _____	23. _____	31. _____	
8. _____	16. _____	24. _____	32. _____	

1. I usually end up carrying out the things I plan at work.
2. I have difficulty working in a new and unfamiliar situation.
3. I am very optimistic about my work career.
4. I don't usually tackle problems that others have found to be difficult.
5. I am hesitant about making important decisions at work.
6. The idea of struggling my way to the top does not appeal to me.
7. I would prefer a job which is important, difficult, and involves a 50% chance of failure to a job which is somewhat important but not difficult.
8. I am usually tempted to take on more responsibilities than a job originally entails.
9. The thought of having to take on a new job would bother me.
10. I find it especially satisfying to complete an important job that required a lot of effort.
11. I don't work well under pressure.
12. I believe that if I try hard enough, I will be able to reach my goals in life.
13. I take pride in my work.
14. Learning new skills doesn't excite me very much.
15. I only work as hard as I have to.
16. I tend to set very difficult goals for myself.
17. I like tasks that require little effort once I've learned them.
18. I am ambitious.
19. I prefer small daily projects to long-term ones.
20. I really enjoy a job that involves overcoming obstacles.
21. I appreciate opportunities to discover my own strengths and weaknesses.
22. I find little satisfaction in working hard.
23. These days, I see little chance for promotion on the job unless a person gets a break.

24. Solving a simple problem is not as satisfying to me as trying a difficult one.

25. I prefer a job which requires original thinking.

26. I like a job which doesn't require my making risky decisions.

27. I only work because I have to.

28. I often succeed in reaching important goals I've set for myself.

29. I feel relief rather than satisfaction when I have finally completed a difficult task.

30. I perform best in competitive situations.

31. Constant work toward goals is not my idea of a rewarding life.

32. I more often attempt difficult tasks that I am not sure I can do than easier tasks I believe I can do.

33. I am not satisfied unless I excel in my work.

34. I don't like to have the responsibility of handling a difficult situation.

35. I prefer my work to be filled with challenging tasks.

36. When I do a job, I set high standards for myself regardless of what others do.

37. I try to anticipate and avoid situations where there is a moderate chance of failure.

38. I would rather do something at which I feel confident and relaxed than something which is challenging and difficult.

APPENDIX III

Typing Test administered to all subjects

We had now come in full view of the old family mansion, 55
partly thrown in deep shadow, and partly lit up by the cold 115
moonshine. It was an irregular building, of some magnitude, 176
and seemed to be of the architecture of different periods. 235
One wing was evidently very ancient, with heavy stone-shafted 297
bow windows jutting out and overrun with ivy, from among the 358
foliage of which the small diamond-shaped panes of glass 415
glittered with the moonbeams. The rest of the house was in 475
the French taste of Charles the Second's time, having been 534
repaired and altered, as my friend told me, by one of his 592
ancestors, who returned with that monarch at the Restoration. 654

The grounds about the house were laid out in the old 708
formal manner of artificial flower-beds, clipped shrubberies, 770
raised terraces, and heavy stone balustrades, ornamented with 832
urns, a leaden statue or two, and a jet of water. The old 891
gentleman, I was told, was extremely careful to preserve this 953
obsolete finery in all its original state. He admired this 1013
fashion in gardening; it had an air of magnificence, was 1070
courtly and noble, and befitting good old family style. The 1131
boasted imitation of nature in modern gardening had sprung 1190
up with modern republican notions, but did not suit a monarch- 1253
ical Government; it smacked of the levelling system. I could 1315
not help smiling at this introduction of politics into garden- 1378
ing, though I expressed some apprehension that I should find 1439
the old gentleman rather intolerant in his creed. Frank 1496
assured me, however, that it was almost the only instance in 1557
which he had ever heard his father meddle with politics; and 1618
he believed that he had got this notion from a member of 1675
Parliament who once passed a few weeks with him. The squire 1736
was glad of any argument to defend his clipped yew trees and 1797
formal terraces, which had been occasionally attacked by 1854
modern landscape-gardeners. 1892

(378 words)
37 w.p.m.

APPENDIX IV

Subjects' Raw Scores (see Table 1, p.34 for definition of variables)

a) Adolescent Subjects (n = 60)

Actual Time	Estimated Time	Achiev. Motiv.	Speed	Accuracy	IQ
305	180	+ 17	3	1	95
120	180	- 1	6	6	96
110	150	+ 13	6	1	
190	120	+ 20	8	4	114
220	60	+ 56	5	5	104
205	120	+ 33	9	8	116
220	90	- 21	7	0	112
185	180	+ 43	10	1	112
191	120	+ 38	6	1	114
225	600	+ 45	5	6	112
197	120	+ 21	2	2	101
150	120	- 9	5	0	100
132	150	+ 52	6	0	89
135	120	+ 10	10	2	118
145	270	+ 1	1	0	94
200	300	+ 3	9	0	115
257	60	- 6	5	0	118
261	120	- 12	0	0	93
205	240	+ 31	5	1	119
256	120	- 2	9	8	113
175	105	+ 36	7	7	120
236	300	- 24	0	0	99
194	120	+ 49	2	0	107
253	300	- 13	8	2	99
330	360	+ 11	7	1	96
185	360	+ 43	9	5	117
158	75	+ 38	7	0	120
248	60	- 29	8	0	116
195	450	+ 16	8	2	
152	120	+ 19	2	1	
180	240	- 15	3	1	
257	30	+ 4	7	3	114
187	180	+ 17	0	0	
165	180	+ 40			109
140	120	+ 7	7	6	
330	390	+ 5	2	5	
232	90	- 6	0	0	
111	120	+ 8	9	5	
160	120	+ 2	8	5	121
111	90	+ 34	10	3	132
135	240	+ 57	5	0	106
227	210	- 15	1	1	121
233	210	- 34	0	0	115
150	90	+ 39	5	2	104
150	90	+ 38	7	3	107
199	140	+ 20	7	7	111
247	240	+ 18	4	0	115
195	39	+ 21	10	5	119

.../contd.

Actual Time	Estimated Time	Achiev. Motiv.	Speed	Accuracy	IQ
210	150	+ 9	2	3	117
156	180	+ 31	9	3	
243	180	+ 24	10	6	
196	90	+ 9	2	0	124
90	180	+ 34			
150	120	- 13	0	4	
225	240	+ 10	7	4	103
120	180	+ 5	1	0	119
280	300	+ 13	5	10	89
225	180	+ 4	3	5	111
187	120	+ 7	10	3	
150	25	+ 19	3	1	121
b) Adult Subjects					
153	90	+ 77	8	2	
211	300	+ 44	6	9	
141	120	+ 32			
162	120	+ 43	0	0	
182	150	+ 52			
163	120	+ 28			
174	120	- 19	4	3	
185	240	+ 95			
190	270	+ 23			
169	180	- 10	1	0	
182	180	+109			
152	180	+ 35			
190	300	+ 70			
190	90	+ 43			
142	180	- 4	6	7	
123	90	+ 49			
192	210	+ 22	2	1	
160	120	+ 90			
129	180	+ 83			
166	120	+ 61			
235	120	- 58	0	0	
161	85	+ 72			
120	120	+ 80	8	5	
144	120	+ 18			
146	180	+ 59			
245	480	+ 2	8	0	
135	75	+ 10			
151	90	+ 40			
145	120	+ 5			
157	120	+ 35	3	0	
195	150	+ 58	7	3	
227	180	+ 58			
130	180	+ 75	0	0	
110	120	+126			
229	330	+ 45			
168	180	+ 44			
130	240	+ 68			
135	375	- 9	5	9	
217	180	+ 60			
214	300	- 12			
150	120	+ 65			
176	120	+ 47			

APPENDIX V

a) Means and Standard Deviations of Variables for all Subjects

Variable	Cases	Mean	Standard Deviation
Actual Time	102	183.8431	48.1318
Estimated Time	102	174.3039	98.9110
Achievement Motivation	102	26.2843	32.1852
Speed	72	5.1389	3.2210
Accuracy	72	2.6111	2.7709
IQ	46	110.1522	10.0575
Accuracy of Estimation	102	71.1078	63.1740
Typing Skill	72	7.7500	5.0456

b) Means and Standard Deviations of Variables for Adolescent Subjects

Variable	Cases	Mean	Standard Deviation
Actual Time	60	194.6000	53.8265
Estimated Time	60	173.9000	106.9313
Achievement Motivation	60	14.5000	21.7813
Speed	58	5.3793	3.2218
Accuracy	58	2.5690	2.6299
IQ	46	110.1522	10.0575
Accuracy of Estimation	60	80.1000	69.7970
Typing Skill	58	7.9483	4.9148

c) Means and Standard Deviations of Variables for Adult Subjects

Variable	Cases	Mean	Standard Deviation
Actual Time	42	168.4762	33.5619
Estimated Time	42	174.8810	87.4398
Achievement Motivation	42	43.1190	37.0887
Speed	14	4.1429	3.1344
Accuracy	14	2.7857	3.4009
Accuracy of Estimation	42	58.2619	50.3350
Typing Skill	14	6.9286	5.6767

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