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Teaching time telling and examining the relative effects of rate-building and rate-controlled practice on the retention and generalization of the time cues

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Abstract

The present study aimed at replicating some of the procedures used in the existing empirical research on teaching time telling in a population which has not previously been used, i.e., adults with mild intellectual disabilities. The first part aimed to train three adults with mild intellectual disability and with minimal skills to tell the time to the nearest 5 min interval. The target skill was trained in 12 phases and each phase consisted of acquisition training, discrimination training and review training. A multiple-probe design was used over phases. The results showed that the procedures used in the training were effective in establishing time telling with these intellectually disabled adults. The training had brought about 55 to 67 percent improvements in the time telling skills of all three participants and the target behaviour was acquired by all the participants in 48 to 65 days, with at least 30 min of training each day. The common discrimination errors encountered, the general effectiveness of the training program, the application and the social relevance of the trained skill are discussed. The second part of this study aimed at comparing the relative effects of “fast practice”, “slow practice” and “no practice” on the retention and generalization of the time telling skills, when amount of practice and reinforcement was controlled across conditions. An Alternating Treatments, repeated measure, within-subjects design was used. The results indicated that, while periods without practicing led to the deterioration in the accuracy of skill, retention or generalization of the skill was not enhanced by rate-building to a fluency performance standard over the same amount of rate-controlled practice. Limitations of the study to provide firm conclusions are discussed.

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Introduction

It is generally known that understanding time enables one to predict the future events and to judge the previous events and thereby gives one some control over present events. It is also known to aide our decision-making and problem-solving (Gibbon & Church, 1990; Hazeltine, Helmuth & Ivry, 1997). Society today demands high standards of time management from all people. The ability to follow a schedule or to meet specific deadlines is a normal and daily occurrence irrespective of whether a person is intellectually impaired or not. With the increased community participation by the intellectually disabled, skills such as the ability to tell the time and to regulate behaviour from time cues can be a crucial skill for successful functioning in one's day to day life (Sowers, Rush, Connis, & Cummings, 1980) and is also identified as a fundamental prevocational skill (Smeets, Lancioni, & Van Leishout, 1985).

Time telling in reference to intellectual disability/learning disorders.

It has been acknowledged that people with learning disabilities generally have difficulties in the understanding of time and other abstracts concepts (Sharpe, Murry, Mckenzie, Quigley & Patrick, 2001). Sharpe et al. (2001) studied the concept of understanding time with120 adults with learning disabilities through their case notes. They found a positive correlation between time telling ability and the individual's intellectual disability and also reported that the difficulty with understanding of the concept of time increased with the severity of the learning disability. They also reported that individuals who were able to give the correct answers to questions about seasons, months and date were more likely to comprehend the function of the clock and were able to tell the time. Although there is only very little research on the implications of the deficit in understanding

time, some studies suggest that the lack of this abilities could lead to increased feelings of powerlessness and anxiety for people with learning disabilities (Owen & Wilson, 2006).

According to Le Poidenin (2000) time perception is a complex cognitive process. Therefore any cognitive deficits, such as difficulty in acquiring numerical skills or in understanding the relational aspects of numbers or in the understanding of abstract concepts such as halves and quarters, are very likely to contribute significantly to deficits in the understanding of physical time (i.e., time that is measured by calendars and clocks) (Jeffers, 1979).

Literature on discrimination suggests that intellectually impaired students can have difficulty in responding to all the components of complex visual stimuli involved in time telling (Etzel & LeBlanc, 1979; Wilhelm & Lovaas, 1976). A time cue on an analogue clock consists of multiple visual components, which makes it difficult for the intellectually impaired students to discriminate between the various times cues and results in inadequate differential responding (Reisman, 1971). Reisman (1971) found that two of the common patterns of responding in intellectually disabled students were the tendency to interchange the minute hand for the hour hand(e.g., 6:00 instead of 12:30) and having trouble with telling the time in reference to the exact hour (2:20 instead of 1:20).

Empirical studies on teaching to tell the time to the disabled.

A number of strategies have been suggested and have been employed to help people with learning disabilities to understand and use the concept of time. Most studies have looked primarily at making the abstract concept of time more concrete, practical and meaningful for the individual by using visual daily timetables, daily diaries, pairing time with events and so on (Clements & Zarkowska, 2000; Moyer, 1983). While there are a number of books and curricula

for school that describe the various methods that can be used to teach time telling to normally developing children, there is only very little empirical research on the methodologies that could useful to help develop the concepts of time and on ways to teach the use of a clock for students with intellectual impairment. Most of the literature on teaching time telling, requires the pupils to have mastered certain numerical skills and other concepts related to time telling prior to starting to teach time telling, which intellectually disabled children often do not have (Partington, Sunderberg, Iwata & Mountjoy, 1979). One notable study in this field is by Bradley and Hundzaik (1965) who employed a teaching machine programme for teaching time telling to intellectually impaired subjects. Another is by Partington et al. (1979) who trained intellectually disabled and young normal children to tell the time on an analogue clock. Also, Smeets et al. (1985) trained intellectually disabled students to tell the time using an experimental device and Smeets (1986) taught students with intellectual disability to tell the time to the nearest 5-min interval using a multiple probe technique.

Bradley et al. (1965) investigated the usefulness of a time telling programme that was primarily written for normal children, to teach 15 intellectually disabled children to tell the time. The program consisted of clocks and numbered scales and required the participants to give some constructed responses and multiple choice answers. The selection criteria for the subjects in the study was the ability to count from 1 to 12, being able to count by fives to 55 and being able to read a list of 46 words that were printed on programs as instructions. Bradley et al. (1965) found that the subjects in the study responded well to the program and increased their accuracy scores. Though this program was reported by teachers to be satisfactory and useful within the classroom, it could be used with only those students who had the above mentioned pre-requisite skills.

Smeets et al. (1985) evaluated a programme which involved the use of an experimental clock-agenda combination (CAC) device, to teach three intellectually disabled children to tell the time to the nearest 5 minute interval and to make it for their scheduled appointments. A modified multiple-probe design was used to train the subjects to tell the time to the nearest 5 min and to use the CAC for making it to their appointments. Smeets et al. found that all the subjects learned to use the CAC device for time telling and to make scheduled appointments on time.

Smeets (1986), using a multiple-probe design, taught four intellectually disabled adolescents with minimal skills to tell the time to the nearest 5 min interval. The training was provided in 6 different phases and they found that all four participants acquired the target skill in 14.2 to 19.6 hours of individual training time. Smeets (1986) reported the various discrimination errors that frequently occurred during and post the training program.

While the above mentioned studies focus on the methodology for teaching time telling, some other studies have aimed at studying the instructional techniques that can be used to teach time telling. For example, Creekmore (1985) suggested the use of an applied digital method, wherein students are taught to pair the time cues to pictures of activities done in the classroom. Similarly, Krech (1998) included instructional techniques where the student is taught one clock hand at a time. Researchers have identified the need for individualised education program that would provide instruction related to all skills needed in time telling.

Precision Teaching

Since the 1960's educators and educational psychologists have recommended the application of behaviour analytic principles for the observation of human behaviour and to improve learning (Calkin, 2005). One widely used instructional

methods based on the behaviour analytic a principles is Precision Teaching. The beginning of Precision Teaching can be traced back to the work of Lindsey (1964), whereby he applied behaviour analytical principles and made use of count per minute measures in order to directly measure observable behaviour (Binder, 1990). The Precision Teaching method is based on a measurement framework and has been widely used for making educational decision for individual students (Binder, 1988). There are a number of articles that outline the various principles and practices of precision teaching (Johnson & Layng, 1992; Lindsley, 1990; Binder, 1996). Numerous successes with Precision Teaching have been reported for students of different capabilities and ages (Beck & Clement, 1991; Johnson & Layng, 1992; kubina & Morrison, 2000). White (1986) stated that Precision Teaching 'has been used successfully to teach the progress of learners ranging from the severely handicapped to university graduate students, from the very young to the very old' (p.530).

Some of the most successful applications and the greatest empirical evidence for Precision Teaching come from the impressive results of the precision teaching programme conducted at the Great Falls, Montana and the Morningside academy (Beck, & Clement, 1991; Johnson & Layng, 1992). According to Lindsey (1971), one of the most fundamental and guiding principle of precision teaching is the fact that the person, who is learning, knows the best. This suggests that, if the student progresses in learning the new behaviour or task, then the programme is working well for that student. However, if there is no progress then changes need to be made in the program to increase his/her performance. In Precision Teaching, the focus is on the directly observable behaviour that can be counted and recorded, so that the teacher has a clear and unambiguous picture of the learner's progress (White, 1986). For example, it would not be possible for the observer to count the

responses of a student who is counting numbers in his head. The student would have to count the numbers aloud so that the responses can be observed, counted and recorded. Combining all these principle and procedures, Precision Teaching has been used to demonstrate improved learning and performance across various student populations over the years (Binder & Watkins, 1990). However, it is important to bear in mind that Precision Teaching "is not a method of teaching, rather it is a general approach to determine whether or not an instructional method is achieving its aims" (Cheisa & Robertson, 2000). While the effectiveness of Precision Teaching is clear from its outcomes, there is a lack of scientific evidence to develop a clear understanding of why the method is effective and what aspects of precision teaching contributes to its effectiveness.

Response Rate as a Measure of Behaviour

An important aspect of precision teaching is the use of frequency or the rate of response, wherein precision teachers aim at building free-operant response rates to better performance and the use this response rate as a measure of behaviour. For example, precision teachers set up various response-rate aims for the skill being learnt and the learners are provided with 1-min timings to achieve those aims (Doughty, Chase & O'Shields, 2004). Lindsley, 1992 has defined response rate, or frequency, as the number of responses per unit time. While frequency is a widely used measure of behaviour in laboratory setting, behaviour analysts have chosen to use the term accuracy measure in educational settings. Accuracy training focuses on the accurate performance while neglecting the speed factor (Bucklin, Dickson, & Brethower, 2000). Thus, according to Binder (2003), with accuracy-only measures it is difficult to distinguish between an expert, and accurate but non-expert performance of a skill (Binder, 2003).

Fluency

One of the most important tenets of PT is fluency. Binder (1988) states that "the true definition of mastery is fluency, a combination of accuracy (quality) plus speed". According to Binder (1988) fluency means that a learner can easily perform tasks even in the midst of distraction and also the learner will retain and apply the newly learned skill to other real life situations. When teaching aims at fluency, mastery is said to be achieved when a student performs the behaviour quickly, accurately and effortlessly. According to Miller, Hall and Heward (1995), teachers have often tended to overlook the importance of rate measures and have relied on accuracy only data which makes it difficult to say if the student has mastered the skill. Miller et al (1995) also suggested that fluency of a skill is a functional construct and for any skill to be functional it has performed fluently. A number of researches, both scientific and informal have suggested that fluency directly contributes to three different types of learning outcome (Binder, 1996; Binder, 2003; Johnson & Layng, 1992; Kubina & Morrison, 2000):-

i) Retention - This refers to an individual's ability to produce high response rates after long periods of time (3 to 4 weeks) without practicing the target skill (Doughty et al., 2004).

ii) Endurance – This refers to an individual's ability to produce high response rates for longer durations without getting distracted (Binder, Haughton & Bateman, 2002)

iii) Application- This refers to the individual's ability to apply the skill that was learned to perform more complex skills or perform the same skill in novel situations ((Binder et al., 2002)

In addition to the outcomes of fluency (i.e. retention, endurance and application), fluent behaviours have more advantages for a number of reasons. According to Wolery, Bailey, and SugaiIn (1988), when fluency is achieved with a particular behaviour then it can compete more effectively with previously learned behaviours, which serve the same function and achieve the same reinforcers. For example, as a child grows older, walking becomes more fluent than crawling, while walking and crawling serves the same function of reaching once place to the other. Secondly, the opportunities for positive social reinforcement increase when behaviours are performed more fluently. For example, fluency in reading will enable a child to read stories to other students and the child is less likely to experience negative social consequences for not being able to read. Thirdly, some behaviour has to be performed both accurately and fluently for it to be useful. For example, one can remain afloat and move through the water only if he/she is performing the actions involved in swimming accurately and performing those actions with sufficient frequency.

Some researchers have proposed a two stage model of learning in precision teaching (i.e., acquisition stage and practice stage) (Binder, 2003; Miller & Heward, 1992). While the focus during the acquisition stage is on the quality of performance, in the practice stage the focus is on the quantitative aspects of performance. However, it is also suggested that while some learners can build fluency while acquiring the skills, others need to complete the accuracy training first (Johnson & Layng, 1994). At the same time, some research suggests that for skills like handwriting, it is beneficial to build rate first and improve accuracy later (Haughton, 1997).

Role of practice

Practice in general has been known to improve performance of a skill and there is a large amount of literature suggesting the role and influence of practice in the acquisition and the retention of the skills (Doughty et al., 2004; Haughton, 1997; Johnson & Layng, 1996). While it is commonly agreed that practice is important, there is little agreement on the form and the duration of practice required (Miller & Heward, 1992). Individual differences have been found for the number of practice trails required to reach an accuracy of 100 percent (Haughton, 1997). Binder (1996, p. 179) has defined practice as 'the repetition of a given response class after it has been accurately established in a repertoire.' Binder et al. (1995) and Binder (1996) have also been suggested that practicing for long periods of time, especially when one's response rate is below fluency performance standards, can be associated with decreased performance and task avoidance behaviour. While some educationalists have asserted that rote learning cannot be instrumental in the acquisition of complex composite skills, fluency researchers have of the opinion that the skills practiced to fluency would rather enhance one's acquisition of complex composite skills. According to Binder (1996), the process of building any skill to fluency provides a large opportunity for practice and fluency is said to have achieved through repeated practice. To illustrate, in a typical school classroom 70 percent of the time is spend in establishing a skill and the remain 30 percent in testing and practice, whereas at the Morningside Academy 70 percent of the classroom time was spent in practice and the remain 30 percent was spent on charting, testing and establishing the skill (Johnson & Layng, 1994, p. 191).

Overlearning & Automaticity

Research has provided the evidence on the similarity of the goals in the teaching methods based on fluency, overlearning and automaticity (Bucklin et al.,

2000; Dougherty & Johnston, 1996; Ivarie, 1986). There is also some evidence that, though under different names, all these three fields aim to examine the same behavioural phenomenon (Dougherty & Johnston, 1996; Peladeau, Forget & Gagne, 2003).

Automaticity refers to the "expert, easeful and efficient" performance of a skill without any conscious thought or attention, where the behaviours are mostly performed quickly and almost automatically (Dougherty & Johnston, 1996). Though the teaching methods based on automaticity considers the time component, but does not necessarily require fast or fluent responses (Bucklin et al., 2000).

Overlearning involves teaching a student to a point beyond 100 percent accuracy and it only takes accuracy-only measures into account (Dougherty & Johnston, 1996).Some studies provide the evidence for improved performance , better retention and maintenance of skills with this kind of procedure (Driskell, Willis & Cooper, 1992). However, one of the limitations of this procedure is that overlearning makes it difficult to estimate the effectiveness or the impact the extra learning trials have bought about (Dougherty & Johnston, 1996).

According to Binder (2003), a combination of the rate measures and the accuracy measures would provide the teachers with more information about the behaviour in question. Knowledge about the rate and accuracy measures of behaviour would enable the teachers to understand the impact that each training session is having on the student.

Current research on rate building and retention

Today, rate building techniques are widely used in educational settings, occupational training and among populations of children, adults, those with developmental disorders, learning disability and so on (Doughty et al., 2004). A

number of studies have found fluency measures to have advantages over the accuracy-only measures (e.g., Pennypacker, 1982; Johnson & Layng, 1992; White, 1986; Bucklin et al., 2000). However, Doughty et al. (2004) in their reviewing rate building procedures, found only sparse empirical evidence for the fluency based teaching methods and little scientific data supporting the above mentioned outcomes of fluency.

Olander, Collins, McArthur, Watts and McDade (1986) found greater retention after a eight month period among a group of nursing students who were taught concepts of pathophysiology, using the traditional rate building measures as compared to the control group who were taught through lectures. However a number of methododological flaws in the study prevented any firm conclusions (Doughty et al., 2004). Other studies have shown better retention after a non-practice period, for skills that were trained to higher response rate and subjected to more practice (Ivarie, 1986; White, 1984, Bucklin et al. 2000). However, as the amount of practice was not controlled, it is difficult to ascertain if better retention was a result of the additional practice received in achieving the high response rates or if it was the result of achieving high response rates regardless of the practice required. To illustrate, for example, Bucklin et al. (2000) aimed at investigating the effects of training two component skills to fluency, on the performance and retention of a composite skill. They trained 29 graduate students on two component skills of a stimulus equivalence task. The students learnt associations between Hebrew symbols and nonsense syllables and between nonsense syllables and Arabic numerals. All the participants underwent training for both of the random associations and once they had reached 100 percent accuracy, half of the students ended practice and the other half of the students continued practicing until they met the fluency performance standard. Following

training, the participants were tested for application every 2 or 4 weeks (with random allocation for each person) for 16 weeks. The application test involved additional questions written in Hebrew Symbols and the subjects were required to write the answers in Arabic numerals. The researchers found that the students in the fluency group had higher response rates and better accuracy throughout the 16 weeks of follow-up tests as compared to the accuracy only group. Though the results of this study support the effects of fluency training, Bucklin and her colleagues acknowledged that, due to factors such as additional practice for the fluency group, it was not possible to isolate the aspect of the extra training that had led to the better performance.

On the other hand, there are some studies that have controlled the amount of practice for the two groups and have found no significant difference between paced and unpaced practice (Ormrod & Spivey 1990; Peladeau et al., 2003). For example, Ormrod and Spivey (1990) taught three groups of students to spell words. The first group was taught to spell words to accuracy only. The second group was taught to spell the words to accuracy and was given an additional of ten unpaced practice trials. The third group was taught to spell to accuracy and was given ten additional paced practice trails. The researchers found a significant difference in the means of the group that was trained to accuracy only, as compared to the other two groups that had received additional practice. However there were no differences in the means of the groups that had received unpaced practice and paced practice. These results suggest that, while extra practice beyond accuracy had enhanced retention, paced practice was no more effective than unpaced practice in enhancing retention. However, it has been pointed out that the failure to obtain significant differences between the unpaced practice

group and the paced practice group could be the result of the small sample size (Peladeau et al. 2003).

While both of the above mentioned studies controlled for practice without fluency performance standards, Shirley and Pennypacker (1994) checked for retention when practice was controlled with a fluency performance standard. They compared the retention of spelling words which were practiced beyond accuracy to a fluency performance standard, with the retention resulting from same amount of rate building practice but that had not met the fluency standards. They controlled for the amount of practice. Though the overall results of the study indicated that the words taught to fluency performance standard were retained better, this result was not clear and consistent across the various phases of the experiment and the participants.

The present study

One of the common beliefs among educators and people is that, adolescents and adults with intellectual disability are less likely to learn certain skills as compared to their younger counterparts, due to their prior learning histories being associated with failures. While there is a lot of literature and resources available today to teach people with learning disabilities to understand and use the concept of time, there is very little empirical research on the methodology for developing concepts of time and how to teach the use of a clock for students with intellectual impairment or people with minimal skills. Moreover most of the existing empirical research has been with either children or adolescents with disabilities.

There is little literature available to ascertain if adults with intellectual disability could be trained to tell the time and to function from those time cues. The first part of the present research aims to replicate some of the procedures used in the existing empirical research on teaching time telling with a population which

has not previously been used, i.e., adults with mild intellectual disabilities. The present study aimed to train four adults with intellectual disability and with minimal skills to tell the time to the nearest 5 min interval.

Though precision teaching has shown to be an effective way of instruction for children with intellectual disability (Kerr, Smyth, & McDowell, 2003), there is only a little evidence for its claims among older learners with intellectual disability. Doughty et al. (2004) in their review found that, of the existing empirical studies on the rate building procedures, only a few had controlled for the practice, or had balanced the reinforcement in different conditions. Though the literature claims that retention and generalisation are benefits resulting from rate-building procedures, there is only little data to support these claims.

In Part I of this study, since each class of time cues was considered as an independent task, it was regarded as appropriate for practice in Part II of the study. This study aimed at comparing the relative effects of “fast practice”, “slow practice” and “no practice” on the retention and generalization of the time cues. The present study aimed to balance the amount of practice and reinforcement across conditions to assess the retention and generalization of time telling skills under the above mentioned conditions.

Method

Participants and Entry requirements

The participants for the study were service users from IDEA Services (Intellectually disability Empowerment in Action). A formal agreement was obtained from IDEA services to conduct this research with their service users (See Appendix A for the letter sent to the organization). A brief notice that outlined the nature of the research and the researcher's contact details was put at the main office and the vocational day bases of IDEA services (the notice is included in the appendix B). Six service users expressed their interest to participate in the research. On receiving the expressions of interest, participants were given a description of the screening test that was involved and were informed that they may/not be recruitment into the program based on the assessment of their pre-requisite skills. The pre-requisites skills and the entry requirements for the study that were required are as follows:

(I) Adults diagnosed as having mild to moderate intellectual disabilities.

(II) The purpose of the screening test was to assess the current time telling skills of the participant. Participants needed to get a score of 25% or less on the screening test were recruited for the study. Time telling worksheets with analogue clocks were used for this purpose. The screening test had a total of 36 time cues, with equal representation from each class of time cues (the different classes of time cues are discussed in detail below). Only participants who have received a score of 9 or less out of the 36 time cues, were recruited for the study The recording sheet used for screening their existing time telling skills is included in the Appendix C.

(III) Proficiency with numbers from 1to 25, i.e., Ability to identify and rote recite numbers from 1 to 25. To test this proficiency, participants were shown numbers from 1 to 25 printed on cards in a random order and were asked to say the number. Only participants who had identified all 25 numbers correctly took part in the study.

(IV) Ability to discriminate between the short and the long hands on an analogue clock. To check this ability, the participants were shown an analogue clock and were asked to identify one of the hands on the clock. There were 4 trials in total. Only those participants who gave correct responses on all the 4 trials took part in the study.

(V) Ability to verbalize responses that has to be trained. In order to check this ability the participants were asked to repeat the responses after the experimenter. There are a total of 12 responses that had to be trained. Thus the participants were required to fluently verbalize all the 12 responses to take part in the study.

Of the six participants, only three participants had successfully met all the criteria and were recruited into the program. The ones that were not recruited had either did not have the pre-requisite skills or had better performance than were required. The three participants who were recruited for the program were then given a fuller description of the experiment and written consents were obtained from each participant (Participant information sheet and consent form included in the Appendix D & E respectively.)

Raymond was 33 years old male with a diagnosis of cerebral palsy and moderate intellectual disability. He had problems with mobility and always required a walker to move around, but this was not a factor in the present study. Though he could communicate effectively, he always spoke at a low tone and his

speech was stammered at times. He lived with his brother and attended a day program at one of the vocational day bases of IDEA services. On the screening test, Raymond could correctly identify 7 of the 36 time cues presented to him, and also met all the criteria for the other parts of the screening test.

Rebecca was 25 years old female with a diagnosis of Down syndrome and lived in residential care along with three other residents. Rebecca had good speech capabilities and was quite independent in her day to day functioning. She also went to the polytechnic school once a week to learn computer skills and attended a day program at a vocational day base on the rest of the days. On the screening test, Rebecca could correctly identify only 3 of the 36 time cues presented to her, while she managed to perform well on all the other tasks in the screening stage.

Karen was a 33 years old female with a diagnosis of mild intellectual disability and lived with her sister's family. Karen was capable of communicating and interacting well with others and was fairly independent, e.g. using public transport, cooking and so on. She also held a part-time job at a laundry and has been doing well at her job. She attended a day program until lunch time on weekdays and then went to her job. On the screening test, Karen could correctly identify only 9 of the 36 time cues presented to her and performed well on all the other tasks in the screening stage.

Setting

The teaching and testing were conducted at two of the vocational day bases of IDEA services. Since Raymond and Karen attend the same day program, both their training took place at the same day base. Since Rebecca used to attend a different day service program, training and testing for her was done at her day base. All training and experimental sessions occurred daily (Monday through

Friday) at the office of respective day base. Each session lasted for approximately 30 minutes for each participant.

Materials

I) Analogue clock made of cardboard. (A product from learning resources, Inc: production no: LER0573). It was a round yellow clock (12/cm radius) with red numbers (2/cm high). The minute hand was blue in color (5/cm) and the hour hand was red in color (7.5/cm). This clock was used to teach the subjects to tell the time (i.e., part 1 of the study).

II) Time telling Flash cards: (A product from Trend enterprise, Inc: Product no T-53108).

Each flash card measured 6/cm by 3.5/cm. Each flash card has a colorful analogue clock on the top of the card. The back of the card had the correct time corresponding to the top of the card. The class of time cues shown were as follows: time to "an hour", "half past the hour", "quarter past the hour", "5 past the hour", "10 past the hour", "20 past the hour", "25 past the hour", "25 to the hour", "20 to the hour", "quarter to the hour", "10 to the hour" and finally "5 to the hour". Each class of time cues had 12 cards each and thus there were a total of 144 cards. These cards were used in the second part of the study, wherein the participants engaged in "SLOW" and "FAST" practice of a specific class of time cues.

Design

A Multiple Probe design was used in the Part I of the study, i.e., to train the participants to tell the time on an analogue clock. An Alternating Treatments, repeated measure, within subjects design was used in the Part II of the study i.e.,

to compare the relative effects of practice on the retention and generalization of the skill.

Procedure

This study consisted of three parts with a number of phases in each part. Part I was designed to teach the subjects to tell the time on an analogue clock. In Part 2, participants engaged in slow practice for one class of time cues and fast practice for another class of time cues and no practice for the remaining classes of time cues. Part II aimed at assessing the retention and generalization of the trained skills.

Part 1: Learning to tell the time

This Part consisted of 12 phases. The Analogue clock made of cardboard was used in this part of the study. Each phase involved teaching the subject, a particular class of time telling responses in correspondence to the time cues. Phase 1 was directed towards enabling the participants to tell the time to "an hour". Phase 2 was directed towards enabling the participants to tell the time "half past the hour". Phase 3 was directed towards enabling the participants to tell the time "quarter past the hour". Phase 4 was directed towards enabling the participants to tell the time "5 past the hour". Phase 5 was directed towards enabling the participants to tell the time "10 past the hour". Phase 6 was directed towards enabling the participants to tell the time "20 past the hour". Phase 7 was directed towards enabling the participants to tell the time "25 past the hour". Phase 8 was directed towards training the participant to tell the time "25 to the hour". Phase 9 was directed towards enabling the participants to tell the time "20 to the hour". Phase 10 was directed towards enabling the participants to tell the time "quarter to the hour". Phase 11 was directed towards enabling the participants to tell the time

"10 to the hour". Phase 12 was directed towards enabling the participants to tell the time "5 to the hour".

Each phase encompassed a pre-training probe test, acquisition stage, discrimination stage, review stage (except step 1) and a post-training probe test. Pre-training probes and post training probe test details is discussed in the probes section.

Acquisition training

This stage began with demonstration trails, wherein the experimenter helped the participant to give the correct responses through verbal instruction, modelling and pointing. Once the participant was able to respond independently on two demonstration trials, he/she was then introduced to the set of training trials. Except for Phase 1, the acquisition stage in all other phases has two sub-stages. In the first sub-stage a white tape was stuck at the outer edge of the clock, right above the 5 minute interval that was to be trained. The tape had the first expression of the response that was to be trained written on it. For example, while training for phase 4 i.e., to tell the time "5 past the hour", the number 5 was written on the tape that was stuck right above the number (1) on the clock. The criterion to proceed to the next sub-stage was to respond independently and correctly to all the time cues on a set of trials. In the second sub-stage the white tape was removed and again the criterion to proceed to the next stage was to respond independently and correctly to all the time cues on 2 sets of trials.

Each set of training trails encompassed 12 individual trials (i.e. 12 different time cues from a particular class of time telling response e.g. 12 o' clock, 1o'clock, 2 o'clock…….). The 12 time cues were randomly presented in each set

of trial. On each trial, the experimenter would set a time on the clock and ask the subject "what time is it?"

After the participant has responded correctly and independently on two sets of trails in the second sub-stage, the participant then proceeds to the discrimination stage. Each correct response on a set of trials was followed by reinforcement (praise). Incorrect responses were followed the participant saying the correct responses after the experimenter. (An example of the response sheet used for acquisition training is presented in Appendix F)

Discrimination training

The purpose of this training was to ensure that there was discriminative control over the newly trained responses. In this step the participants were exposed to the previously trained, newly trained and some untrained items. The participants were exposed to 10 trials, of which 5 were newly trained and the remainders were a mix of previously trained and untrained items. The participants were instructed to respond with "I don't know" on all the untrained cues. If the participants failed to emit the correct response for the newly trained cues, then he/she had to go back to the acquisition stage of that phase again. On providing the correct response to all newly trained cues, and correctly discriminating the trained time cues from the untrained time cues, the participant proceeded to the next stage. (An example of the response sheet used for Discrimination training is presented in Appendix G)

Review training

The purpose of this training was to ensure that there was discriminative control over the previously trained and the newly trained responses. Three times cues from each class of time cues (previously and newly trained only) were presented

to the participant in each set of trials. The number of trails within each set of trials increased as the participants progressed from one phase to the next. The criterion for completing this stage was at least 95% or above correct in a set of trial. (An example of the response sheet used for Review training is presented in Appendix H)

Probes

For Part 1 of the study, pre-training and post-training probes were used to test the participant's time telling skills. Pre-training and post-training probes were conducted at the beginning and at the end of each phase respectively. The numbers of trials for the pre-training and post-training probes in each phase were 6 times the number of expressions to be taught in that phase. For example, Phase 1 aimed at teaching only one expression i.e., telling time to "an hour". Thus the number of trials in Phase 1(pre-training and post-training probes) was 6. On the other hand Phase 2 aimed at teaching three expressions i.e., "half past hour". Thus the numbers of trials in phase 2 (pre-training and post-training probes) was 18. Since all the Phases except Phase 1, aimed at teaching 3 expressions, all of them had 18 trials each in their pre and post-training probes sequences.

Once the participant had reached the criterion of 100% correct on the post training probe sequence of a particular phase then, before moving on the next phase, post-training probes were done again for all the learned phases and pre-training probes for unlearned phases. For example, if the participant got a 100% correct on post-training probe sequence of Phase 4, before moving to Phase 5, post-training probe sequence for Phases 1 to 4 and pre-training probe sequence for phases 5 to 12 were used. While doing the post-training probes for all the learned phases, the participant had to get at least 90% overall correct and at least 80%

correct on each set of probes. If the participant received less than 80% on the post-training probe sequence of a particular phase, then the participant was retrained on the acquisition and discrimination of that phase, until the participant got 80 % or above correct on the post-training probe sequence of that phase. The pre-training probes for all the unlearned phases were done to check if any generalizations had occurred while learning the previous phase. For each phase, similar items (time cues) were used for the pre-training and post-training probes.

Part 2: Practice, Retention and Generalization

In this part, time telling flash cards were used for practicing the time telling skills. This part of the experiment began with the testing phase, where the participants' accuracy for telling the time on the flash cards was recorded. Participants were shown 36 flash cards with equal representation from all the classes of time cues. After testing the participants for their accuracy on the flash cards they would move to the practice stage.

In this part of the experiment, only 6 classes of time cues were practiced. All the participants were asked to do fast practice (fluency condition) for a particular class of time cues and slow practice (accuracy condition) for another class of time cues. For example, the class of time cues trained in the Phase 10, 11 and 12 (i.e., telling the time to "quarter to an hour", "10 to the hour" and "5 to the hour") were practiced at a faster rate , whereas the class of time cues trained in Phase 3, 4 & 5 (i.e. to telling the time to "quarter past the hour", "five past the hour" and "ten past the hour") were practiced at a slower rate. The two sets of time cues mentioned above differed only in the rate at which they are practiced, while keeping the amount of practice equal for both sets of time cues. .

Three practice tests were held each day for each of the condition for 5 days. Flash cards were used in these practice tests. Each practice test consisted of 18 items, i.e., 6 time cues from a particular class of time cue to be practiced. For example, the fluency condition had 6 cards representing the time "quarter to an hour", another 6 stimuli representing the time "10 to an hour" and the last 6 representing the time "5 to an hour". Similarly the accuracy condition had 18 items, with 6 cards from each of the 3 time cues to be practiced. On each day, the order of the two conditions was randomized to prevent any order effects.

In the fluency condition, practice tests aimed at reaching the criterion of 18 correct responses in a minute, whereas in the accuracy condition the practice tests aimed at getting 100% accuracy in a particular set of trials. The practice tests for any condition were discontinued after 5 days of practice, irrespective of the participant reaching the above mentioned criterion or not.

Fluency condition

In this condition, the participant was instructed to tell the time appearing on the flash cards as quickly as possible. The total time taken to respond to the 18 cards was recorded for each of the practice test. The aim of this practice was to reach the criterion of 18 correct responses in a minute. If the participant did not know that time on the flash card, they were instructed to say pass instead of answering and were advised to move onto the next card. On making the correct response, the experimenter responded by saying "yes". In the case of incorrect responses, the experimenter would say "no" and add the card to the error pile. At the end of that practice test, the experimenter told the participant the right time on the cards in the error pile and asked the participant to repeat the correct response. The experimenter also used verbal instruction, modelling and pointing while going

through the cards in the error pile. The speed (time taken for each set of trial) and accuracy (number of correct responses) of was recorded on a standard recording sheet for each participant. (An example of the response sheet used for Fast practice is presented in Appendix I).

Accuracy condition

In this condition, the participant was instructed to tell the time slowly and as accurately as possible. In order to ensure slow practice, participants were asked to respond; only 10/ secs after the card had been exposed, i.e., the experimenter would prompt the participant to respond 10/secs after the card was exposed to them. If the participant did not know the time on the card, they were instructed to "pass" and were advised to move onto the next card. On making the correct response, the experimenter responded by saying "yes". In case of incorrect responses, the experimenter would say "no" and add the card to the error pile. At the end of that practice test, the experimenter said the correct time on the cards in the error pile and asked the participant to repeat the right response. The experimenter also used verbal instruction, modelling and pointing while going through the cards in the error pile. For each set of practice test in this condition, the number of correct and incorrect responses was recorded for each participant. (An example of the response sheet used for slow practice is presented in Appendix J.)

Reinforcement

The following procedure was used to ensure that reinforcement was equal in both conditions. Participants were reinforced on the following basis:

I) If they made an improvement over the previous day's performance, they were provided with positive feedback about their improvement.

II) If they did not make an improvement, they were only praised for their participation.

Retention and Generalization

Retention and generalization of the trained skill were assessed the day after the final day of practice tests and approximately two, four and eight weeks following the end of the practice sessions.

To test the retention of the time cues that were practiced at a faster rate, 18 flash cards representing those time cues were presented to the participant. Only the number of accurate responses was recorded and not the rate of responding. To test the retention of the time cues that were subjected to slow practice, 18 flash cards representing those time cues were presented to the participant and the number of accurate responses was recorded. To test the retention of the time cues that were not practiced, 18 flash cards representing those time cues were presented to the participant and the number of accurate responses was recorded.

To test the generalization of trained skill, a real analogue clock was used. 12 time cues representing each of the 12 class of time cues that were trained, was shown to the participant and the participant was asked to say the time. The experimenter manually adjusted the time on the clock for each trial. The total number accurate responses were recorded. An example of the response sheet used for the generalization test is presented in Appendix L.

Interobserver Agreement

Three students served as reliability observers and they had no special interests in the outcome of the study. All the three students were instructed on the training procedures used and also about the recording procedures. The experimenter and the observer recorded each response of the participant as correct or incorrect. For each participant, reliability checks were done for 10 days during the 1st part of the study (i.e. learning to tell the time). For the second part of the study (i.e. practicing 2 sets of time cues at different rates), reliability checks were carried out on days for each participant. At the end of each daily testing session, the percentage of agreement was calculated between the researcher and the observer's scores.

To test the fidelity of the training procedures used, reliability observers were asked to fill a checklist that checked for the procedures used by the experimenter. (A copy of the fidelity checklist can be seen in Appendix K)..

Results

The inter observer agreement per session varied from 95% to 100 %. Across the sessions the mean percentages for Raymond, Karen and Rebecca was 98.5, 99, and 98 percent respectively. Feedback on the fidelity checklist revealed that all the reliability observers agreed that the experimenter had followed all the procedures outlined in the checklist.

Part 1

All the three participants completed the training program successfully. Figure 1 shows the performance of the participants on the time telling screening test and the post-training test. The screening test and the post-training test were exactly identical to each other. On the screening test Karen, Raymond and Rebecca had scores of 25%, 19% and 8%respectively. It can be seen from the post-training data all the participants made a substantial improvement in their performance on time telling test. The percentage of improvement across the three participants varied from 55 to 67 percent. On the post-training test Karen got a score of 80%, Raymond got a score of 83% and Rebecca got a score of 75%.

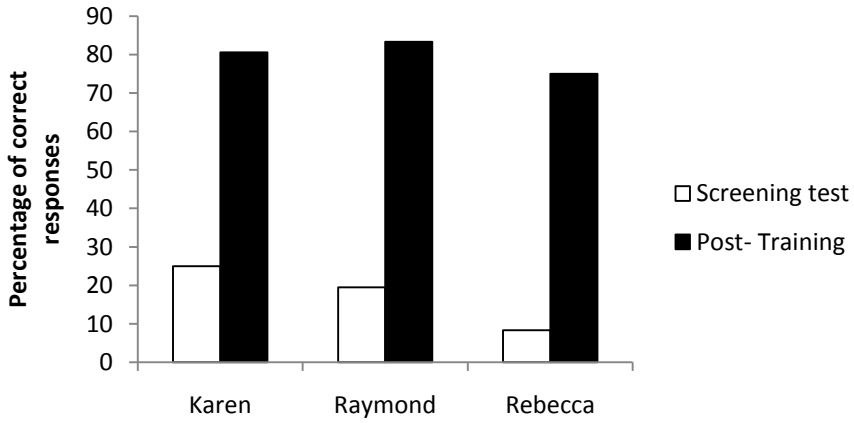

Figure 1. Karen's, Raymond's and Rebecca's performances on the time telling screening test and the post-training test.

The results of the pre-training and post-training probes for Karen, Raymond and Rebecca are shown in Figures 2, 3, and 4 respectively. These figures indicate that with some exception, Raymond's, Karen's & Rebecca's initial performances on the pre-training probes for the all phases were very low (at or near zero level). Only Raymond had a score of 100 percent on the pre-training probes of Phase 1, indicating that he had no difficulty in telling the correct time for the hour cues. However, it can be seen that, as the training days progressed, all participants' scores on pre-training probes of some phases had a remarkable increase. For example, Raymond's score on the pre-training probes for Phase 4 increased from 0% to 100%. For him, some increase in the scores pre-training probes was also seen on Phases 3, 5, 6, 10 and 11. He had an increase of 35% on Phase 3, 28% in Phase 5, 16% in Phase 6, 55% on Phase 10 and 33 % on Phase 11. Similarly Karen's score on the pre-training probes for Phases 4, 5 and 6 increased from 0% to 100% after the learning for Phase 3 had occurred. Though Rebecca did not have a 100% increase in the pre-training probes of any phases, some increase in the scores pre-training probes was seen for Phases 10 and 11. She had a 38% increase on Phase 10 and an 11% increase on Phase 11. Figures 2, 3 and 4 also show that for some of the phases, criterion performance was not always achieved and all the three participants needed some remedial training in some of the trained phases. For Raymond, remedial training was required in Phases 2, 4, 5, 7, 8 and 9. Karen required remedial training on Phases 2, 7, 8 and 9 and Rebecca was given remedial training on Phases 2, 3, 6, 7, 8 and 9. Thus it can be seen that while Raymond and Rebecca required the remedial training on more phases as compared to Karen, all three of them had difficult on Phases 2, 7, 8 and 9 (i.e. to tell the time to half hour, 25 past the hour, 25 to the hour, and 20 to the hour).

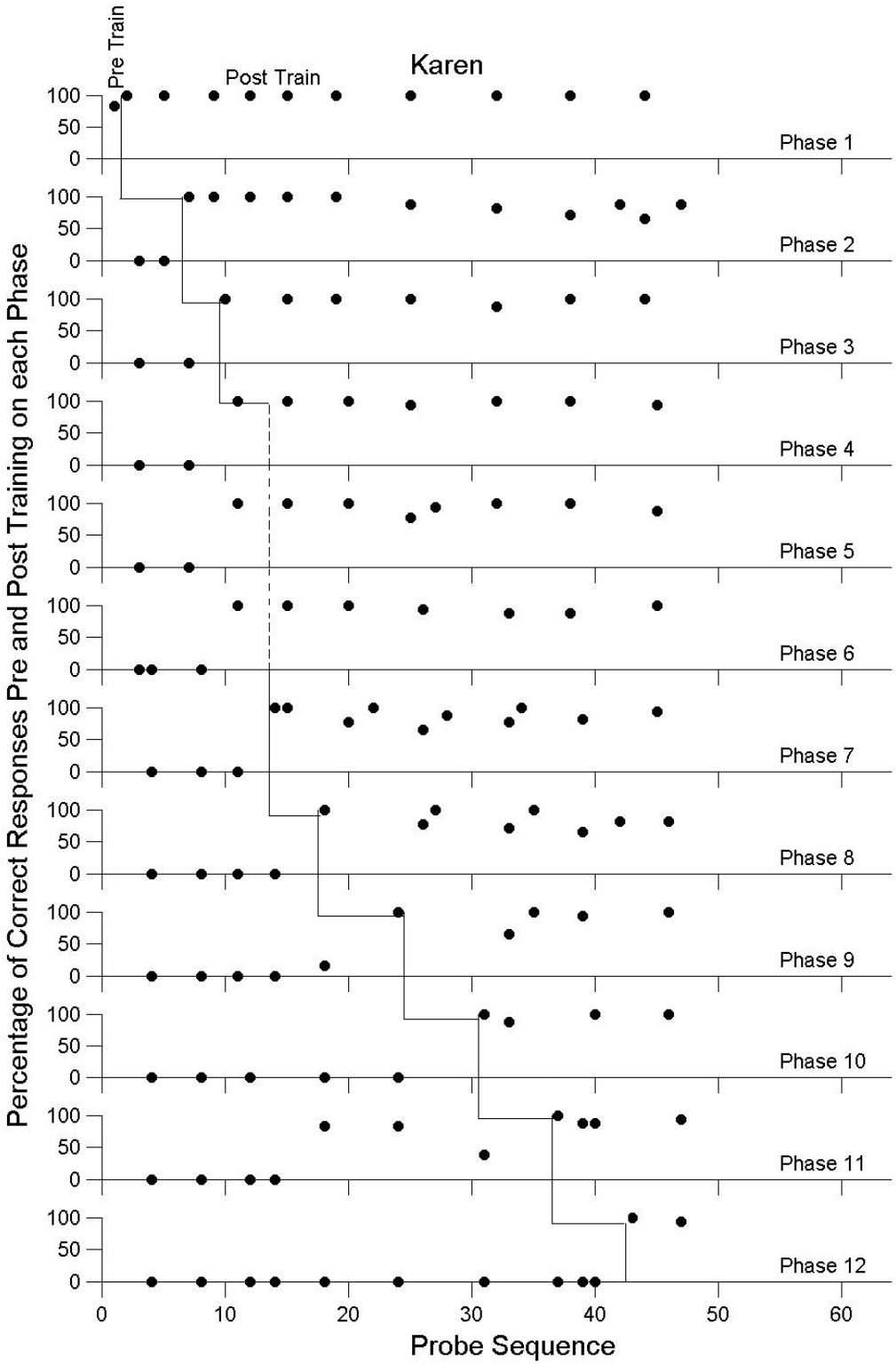

Figure 2: Karen's performance on the pre-training and the post-training probes

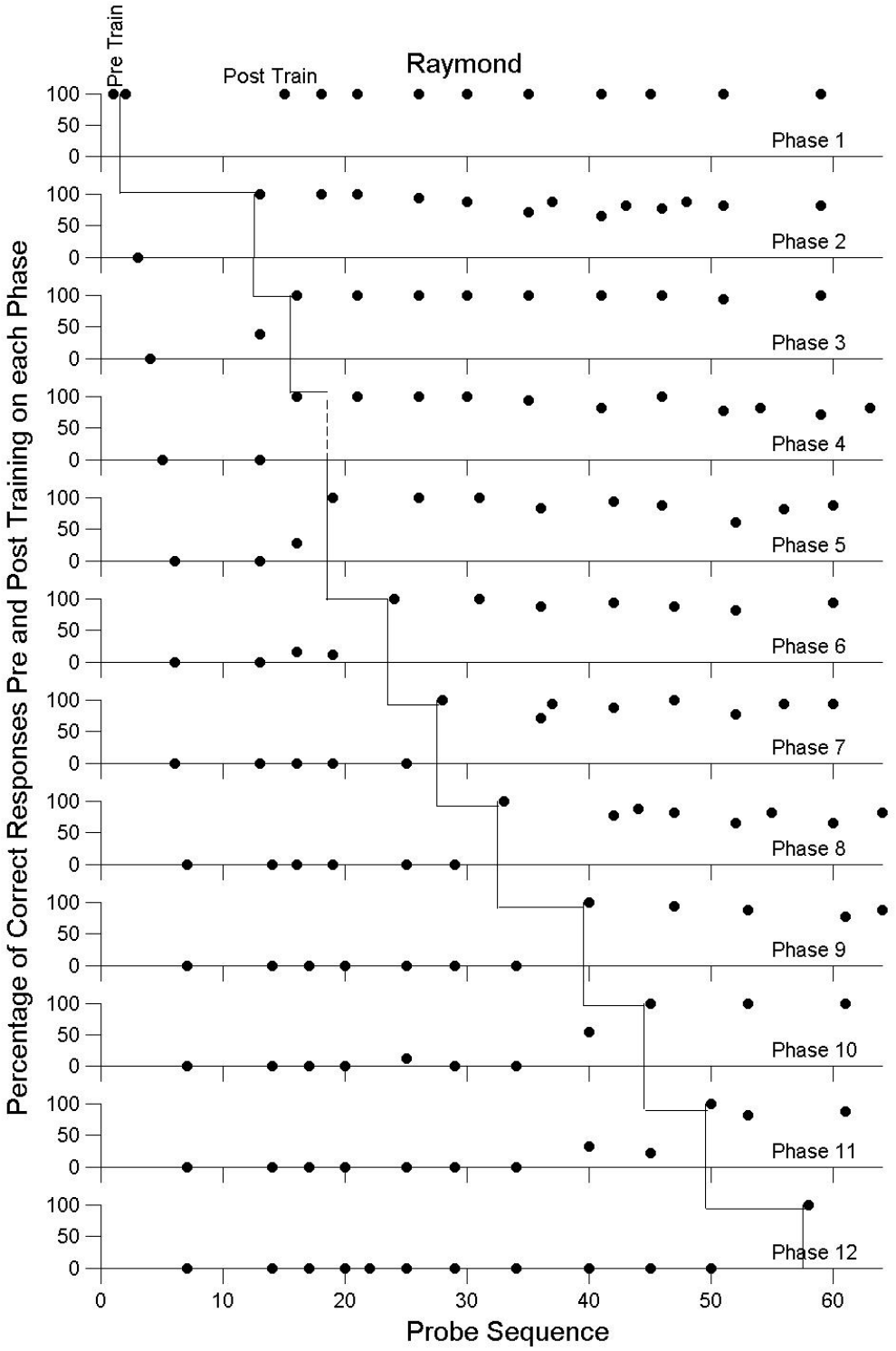

Figure 3: Raymond's performance on the pre-training and the post-training probes

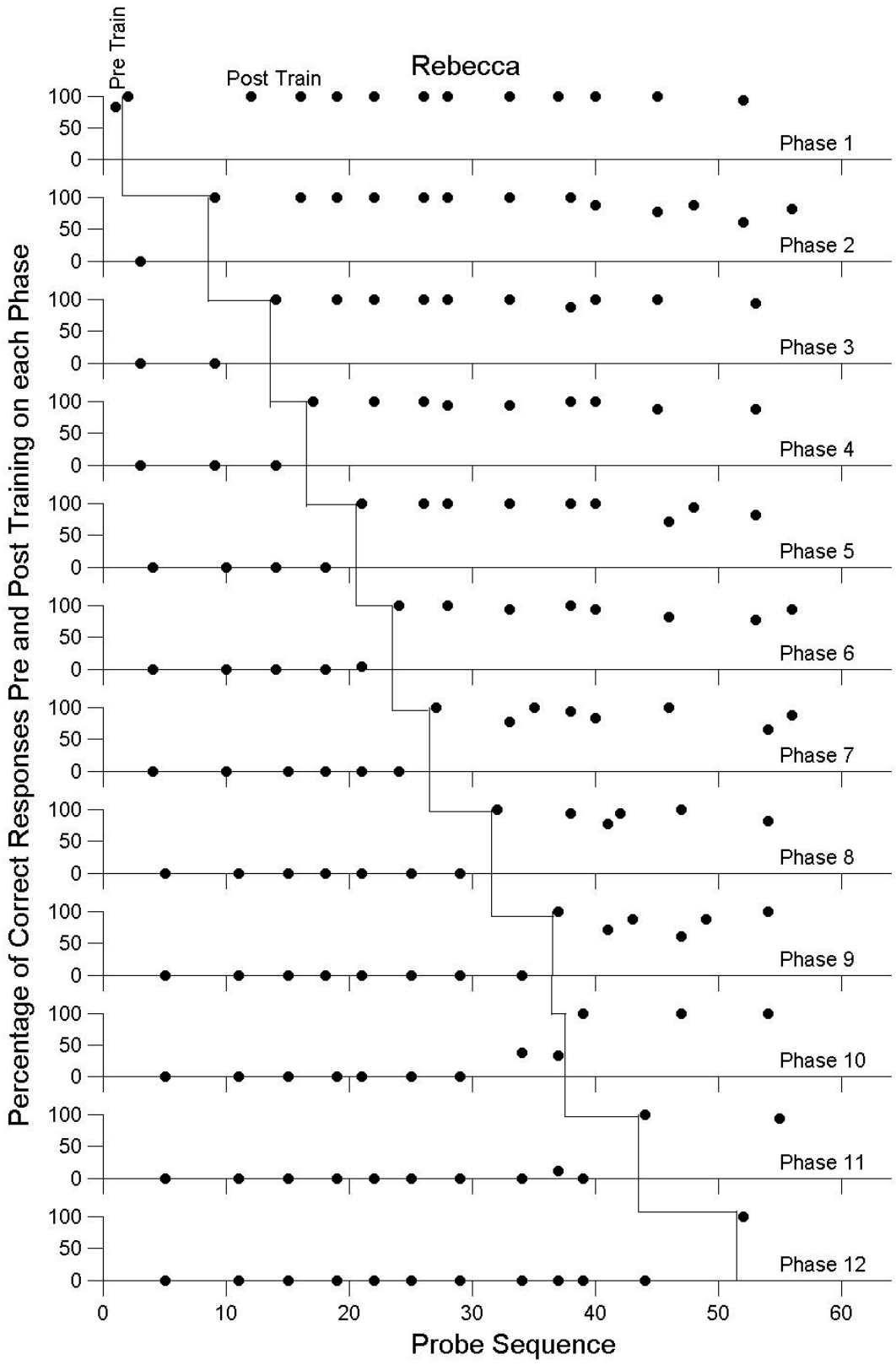

Figure 4: Rebecca's performance on the pre-training and the post-training probes

Table 1 presents the results for each phase of the program, for each of the participants. The table reports the number of trials taken by each participant to complete a particular phase and it also reports the percentage of accurate responses on each phase, for each participant. While Table 1 indicates that Karen, Raymond and Rebecca took a total of 1928, 2264 and 2629 trails respectively, there were not many variations in the percentage of accurate responses for all three of them. Though the percentage of accurate responses varied only from 86 to 88 percent, considerable differences between the individual phases can be observed within and across subjects.

Table 2 presents an analysis of the errors made during the acquisition, discrimination and review training. The errors were classified into 6 different categories i) Incorrect hour references, e.g., “25 past 1” to 2:25 cue. ii) Incorrect "past"-"to" references, e.g., “5 past 12” to 11:55 cue. iii) Incorrect minute references – e.g. “25 past 4” to 4:20 cue. iv) Minute hour hand discrimination, e.g., 9’o clock to 11:45 cue. v) Don’t know to trained cues VI) others, e.g., “10 past 4” to 3:30 cue. While individual differences in the distribution of errors are evident from the data, the data shows that all the three participants had difficulty in responding accurately to the time cues where the hour hand was positioned between the two numbers. While for Karen and Rebecca most of the errors were accounted by incorrect hour references, Raymond had most of errors due to incorrect "past"-"to" references.

Table 1. Training results for each phase for each participant.

	Karen		Raymond		Rebecca	
Phases	Trials	%correct	Trials	%correct	Trials	%correct
1	48	87.5			48	91.66
2	224	83.4	336	80.65	326	85.88
3	76	88.15	86	94.18	104	86.53
4	32	90.62	176	87.5	128	89.06
5	132	87.12	191	88.48	249	85.14
6	46	93.47	116	87.93	218	89.9
7	292	86.3	303	84.48	369	87.8
8	358	89.1	320	84.37	278	84.89
9	190	91.05	219	87.67	338	89.05
10	168	89.28	108	82.4	160	91.25
11	156	87.82	189	85.18	192	89.58
12	206	86.89	220	87.27	210	90.95
Mean/Total	1928	88.39	2264	86.37364	2620	88.47

Table 2. Number and percentage of errors on the learning trials for each participant

	Karen		Raymond		Rebecca	
Type of Errors	Trials	%Errors	Trials	%Errors	Trials	%Errors
1.Incorrect hour references	69	30.8	53	18.53	160	52.98
2. Incorrect "past"-"to" references.	51	22.76	132	46.15	33	10.92
3. Incorrect minute references.	34	15.17	22	7.69	29	9.6
4. Minute hour hand discrimination.	22	9.82	28	9.79	40	13.24
5. Don’t know to trained cues.	30	13.39	21	7.34	18	5.96
6. Others.	18	8.03	30	10.48	22	7.28

Part II

All the three participants were exposed to the slow practice condition and the fast practice condition for 5 sessions. Each session for each condition had 3 sets of trials and 18 time cues in each set of trials. For fast practice the performance standard was set to be 18 correct responses in a minute, whereas slow practice aimed at getting correct responses on all the 18 trials of a set. All the participants had reached the performance standards for both the conditions during the practice sessions. Figures 5.1, 5.2 and 5.3 show Karen's performance on the slow practice and fast practice across the three trials on the 5 practice sessions. The data indicates that Karen had reached the performance standard for both the conditions on the 2nd practice session Figures 5.1 and 5.2 indicate that, as the fast practice sessions progressed, Karen's performance got faster and more accurate. Except for the first fast practice session, performance standards were reached on all the remaining fast practice sessions. Figure 5.3 indicates that Karen's performance on the slow practice session got better on the last four sessions. It can also be seen that, while she reached the performance standard for slow practice on the last four sessions, she had 100% correct responses on all the three trials of sessions 3 and 5.

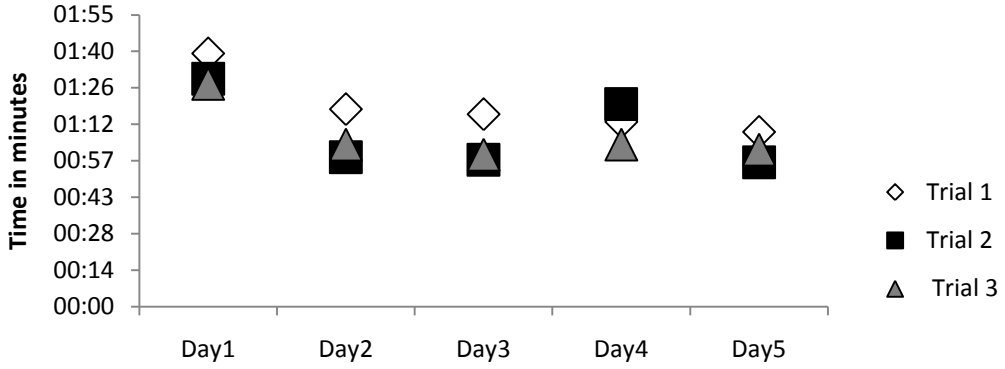

Figure 5.1 . Time taken on each fast practice trail on the 5 days of practice

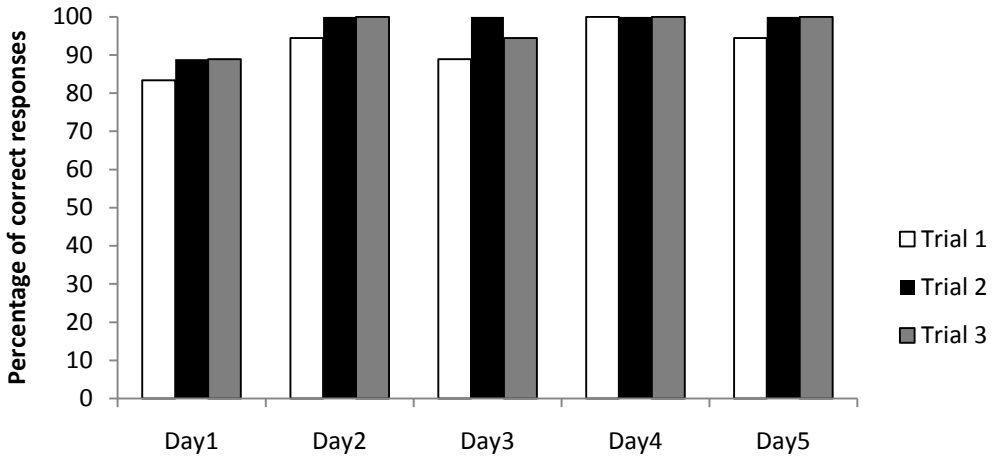

Figure5.2 . Percentage of correct responses on each fast practice trail on the 5 days of practice

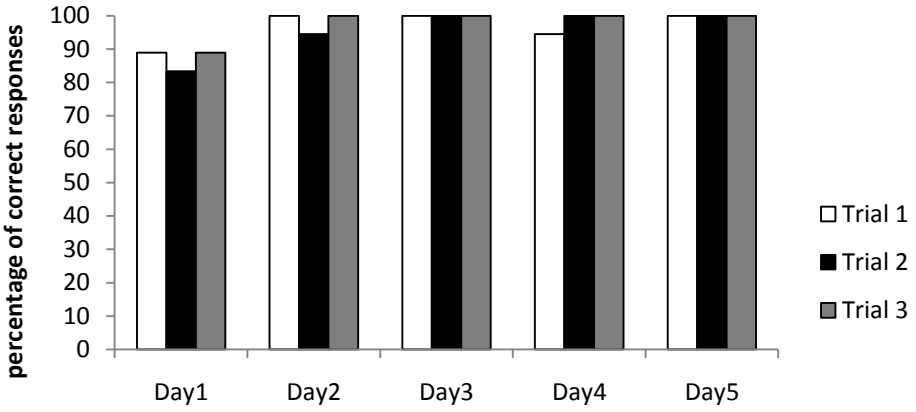

Figure 5.3 .Percentage of correct responses on each slow practice trail on the 5 days of practice

Figures 6.1, 6.2 and 6.3 show Raymond's performance on the slow practice and fast practice across the 5 days of practice. Considering Raymond's stammering problem the performance standard set for him was to give 18 correct responses in 75 sec. It can be seen that while he reached the performance standard for the slow practice condition on the 2nd day of practice, performance standard for fats practice condition was met on the 3rd day of practice. Figures 6.1 and 6.2 indicate that, he got faster as the sessions progressed and the percentage of correct responses also increased. Figure 6.3 indicates that after the three trails on first session, his percentage of correct responses got better and he reached the performance standard for slow practice condition in all the last four sessions.

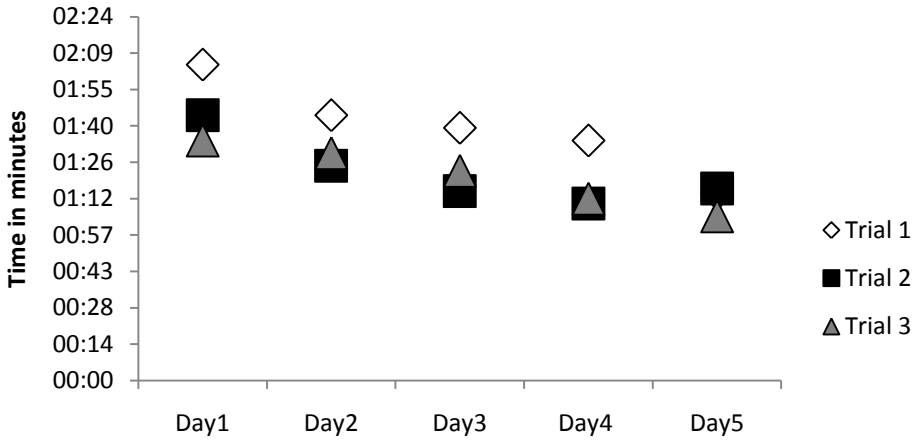

Figure 6.1 .Time taken on each fast practice trail on the 5 days of practice

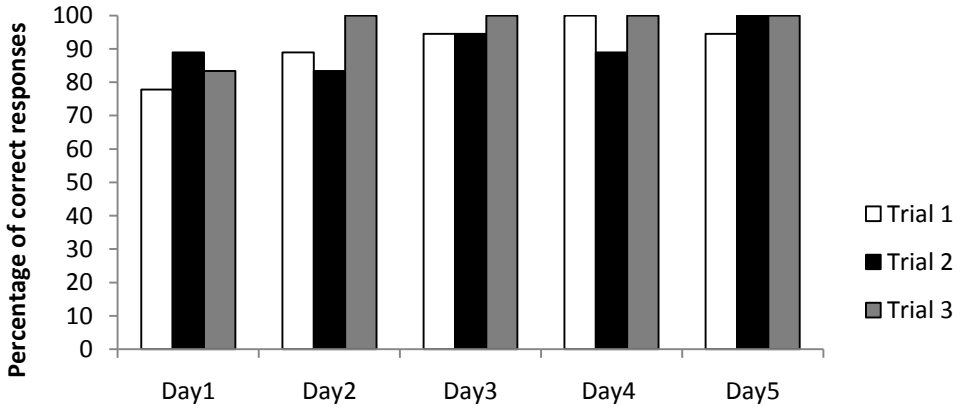

Figure6.2 . Percentage of correct responses on each fast practice trail on the 5 days of practice

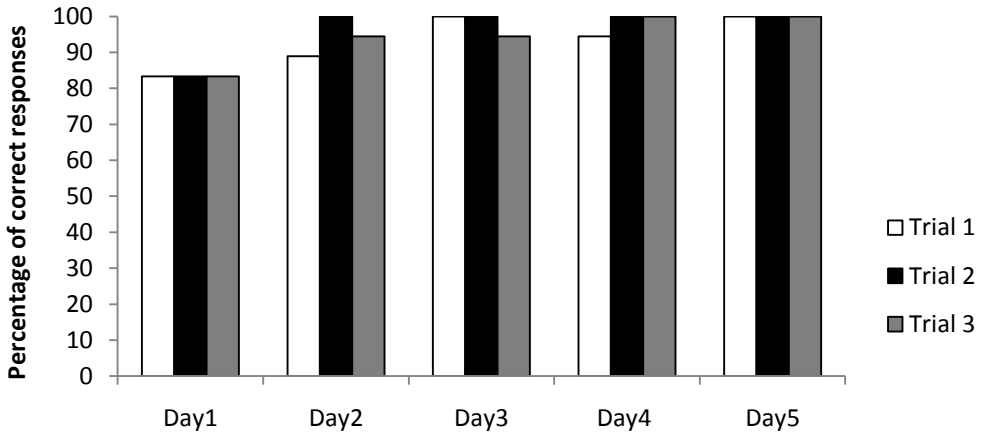

Figure6.3 .Percentage of correct responses on each slow practice trail on the 5 days of practice

Figures 7.1, 7.2 and 7.3 show Rebecca's performance on the slow practice and fast practice across the 5 days of practice. It can be seen that just like Karen; Rebecca also reached the performance standard for both the conditions on the 2nd day of the practice. Figures 7.1 and 7.2 indicate that, as the fast practice sessions progressed, Karen's performance got faster and more accurate. It can also be seen that, on the last two sessions of fast practice, she had reached the performance standards on all the three trails. Figure 7.3 indicates that her percentage of correct responses generally got better as the slow practice sessions progressed.

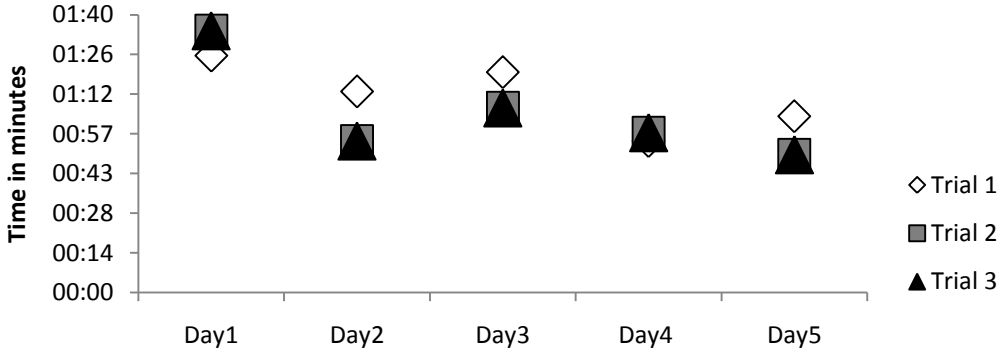

Figure 7.1 . Time taken on each fast practice trail on the 5 days of practice

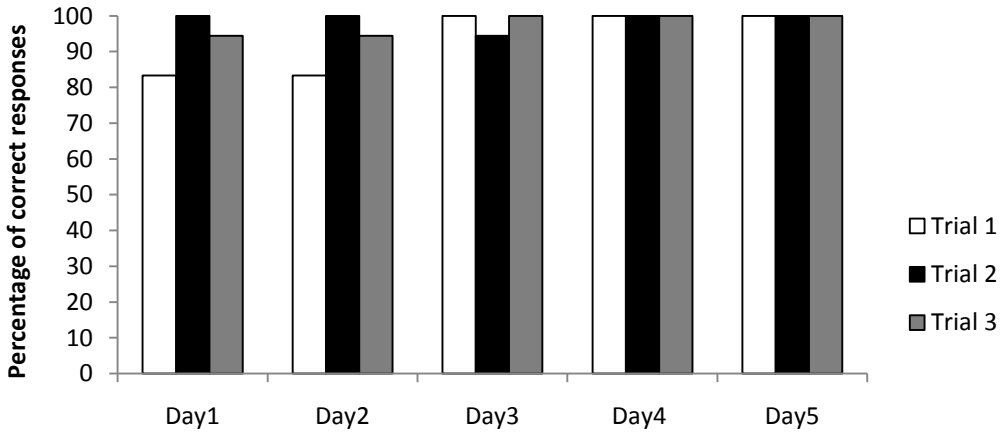

Figure7.2 . Percentage of correct responses on each fast practice trail on the 5 days of practice

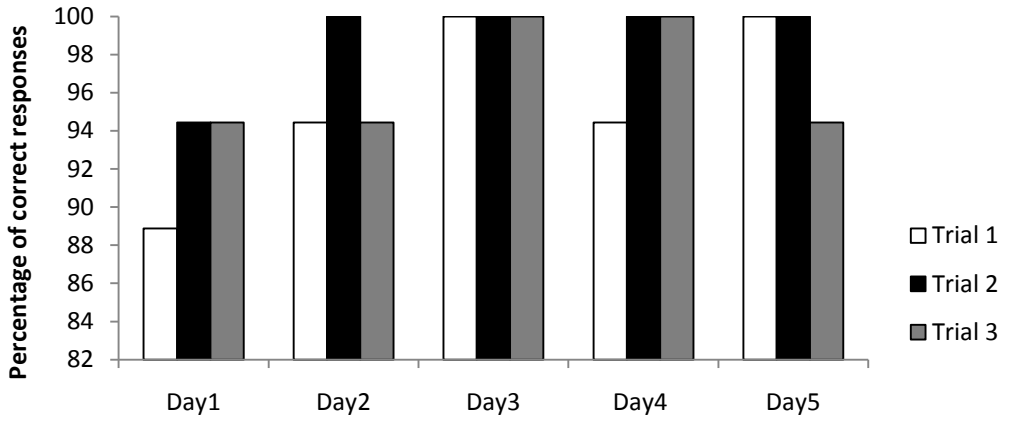

Figure7.3 .Percentage of correct responses on each slow practice trail on the 5 days of practice

All the three participants were given retention and application tests on the following day after practice and then 2 weeks, 4 weeks and 8 weeks after practice. All the 4 retention and application tests had the same items and the same test was given to all the three participants. The retention tests in this study only aimed at measuring the accuracy of the responses and not the rate of responding. The results of the study indicated that there were no significant differences in the accuracy measures for the "fast" & "slow" practice items for all the three participants. However, differences were found in the accuracy measures for the "practiced" and the "unpracticed" time cues for Karen and Rebecca.

Figure 8 shows the percentage of correct responses for Karen on the 4 retention tests across the three conditions, i.e., fast practice, slow practice and unpracticed time cues. The figure indicates that Karen had a good retention for the class of time cues that were either subjected to fast or slow practice. It can also be seen that while there were little or no difference in the retention of the time cues that were practiced at a fast or slow rate, her retention for the class of unpracticed time cues were much below than those practiced. Her average percentage of correct

response on all the 4 retention tests for fast practice was 97.22 and for slow practice was 100 percent. In comparison to these scores, her average percentage of correct response for the unpracticed time cues was only 69 percent. An analysis of the errors made for the unpracticed time cues, revealed that she had difficulty in telling the time to the exact hour (when the hand was positioned between the 2 numbers on the clock) and was making incorrect "past"- "to" references for the time cues "20 min past" and "25 min past".

Figure 9 shows the percentage of correct responses for Raymond on the 4 retention tests across the three conditions, i.e., fast practice, slow practice and unpracticed time cues. It can be seen that Raymond had an overall good retention of all the time cues. It can be seen that there was only a little or no difference in the retention of the time cues practiced at a fast or slow rate. His average percentage of correct response on all the 4 retention tests for fast practice was 100 percent and for slow practice was 98.61 percent. Though his average percentage of correct response for the unpracticed time cues were not as high as for those practiced, he had managed to get 90 percent of them correct. Most of the errors committed by him during the retention of the unpracticed time cues were due to the difficulty in telling the time to the exact hour.

Figure 10 shows the percentage of correct responses for Raymond on the 4 retention tests across the three conditions i.e., fast practice, slow practice and unpracticed time cues. While no differences can be seen in the retention of the time cues practiced at faster and slower rates, it can be seen that her retention of the unpracticed time cues gradually decreased with the passage of time. Her average percentage of correct response on all the 4 retention tests for fast practice was 98.61 and for slow practice was 97.22 percent. Though her average scores for

the unpracticed time cues were not as low Karen's, she had an average score of only 80 percent.

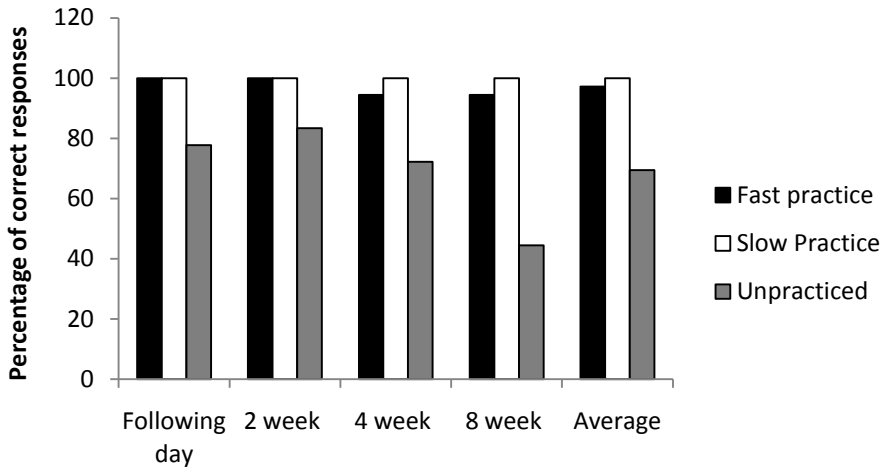

Figure 8. Karen's performance on the 4 retention tests across the three conditions.

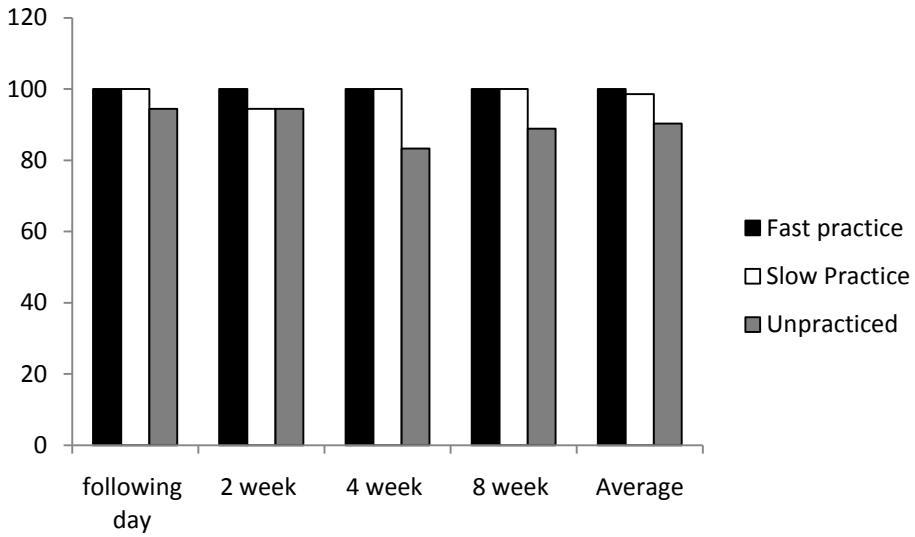

Figure 9. Raymond's performance on the 4 retention tests across the three conditions.

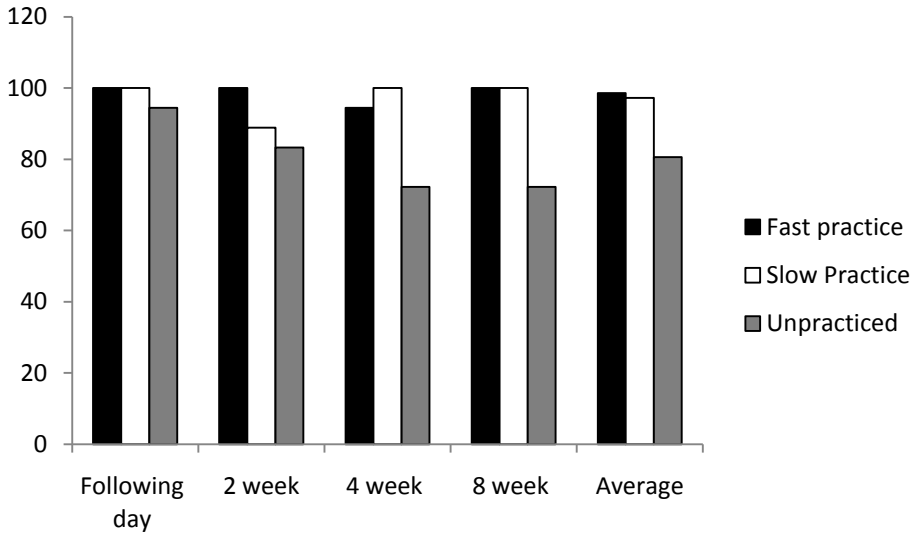

Figure 10. Rebecca's performance on the 4 retention tests across the three conditions.

To test the generalization of trained skill participants were required to tell the time appearing on a real analogue clock. Figure 11 shows the performance of all the three participants on the generalization test. A total of 12 time cues representing each of the 12 class of time cues that were trained were presented to the participant on each of the generalization test. It can be seen from the figure that both Karen and Rebecca had a score of 80 percent and above in all the four generalization test. The figure indicates that Raymond had the most difficulty in the generalization tests and his performance decreased with the passage of time. An analysis of the errors also revealed that Karen and Rebecca were almost always correct in responding to the time cues that were practiced and had made most of the errors with time cues that were not practiced. However, this was not the case with Raymond and he was found to have difficulty in giving the correct responses to practiced as well as unpractised time cues.

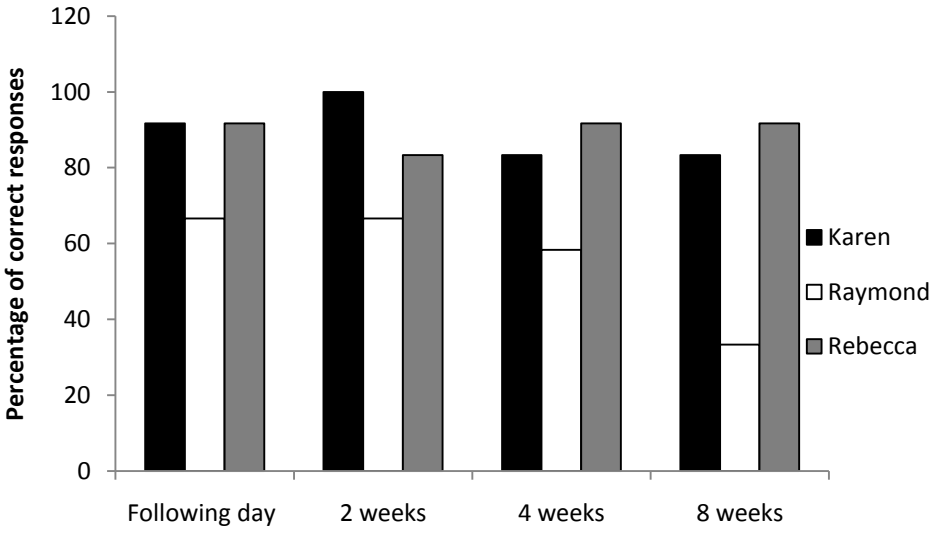

Figure 11. Shows performance of Karen, Raymond and Rebecca on the 4 generalization tests.

Discussion

PART I

The first part of the study aimed at training three adults with intellectual disability and but with minimal time telling skills to tell the time to the nearest 5 minute interval. The results of the study revealed that the procedures used in the training were effective in establishing time telling with these intellectually disabled adults. The training had brought about 55 to 67 percent improvements in the time telling skills of all three participants. The target behaviour was acquired by all the participants in 48 to 65 days, with at least 30 min of training each day. While the results of the training program are encouraging, it is important to address certain aspects such as the common discrimination errors committed, general effectiveness of the training program and the application of the trained skill.

Firstly, the data (Table 2) indicate that all the three participants had considerable difficulties in telling the time to the exact hour (e.g. “25 past 1” to 2:25 cue). The difficulty in telling the time in reference to the exact hour occurred almost exclusively when the hour hand was positioned between the two numbers on the clock face. Stein, Silbert, and Carnine (1997) have pointed out that one of prerequisite skills for telling the time to the exact hour is the knowledge of the direction in which the hands of the clock move, i.e., clockwise or anticlockwise. The participants in this study were not checked for this pre-requisite before they were recruited for the study. Moreover, during the training session it was found that all the three participants were almost and always unsure as to the direction in which the hands of the clock moved. Stein et al. (1997) have suggested that a convenient way to teach students about the direction in which the clock moves is

by having them to write the missing numerals on clocks containing boxes instead of numbers. However, there are no empirical studies to back up their suggestions. Research also indicates individuals with intellectual disability are known to have problems with verbal responses that lack point to point correspondence with the stimuli (Braam & Poling, 1983). At this point, it is difficult to say if the errors made here were caused due to the lack of the pre-requisite skill of being able to tell the direction the hands on a clock move, or if it was the physical dimension of the time cues, or if it was related to the instructional procedures.

Another frequent error indicated by the data (Table 2) was the incorrect "past"-"to" references to the time cues. While Raymond had the most difficulty in using "past" and "to", Karen and Rebecca also seemed to have some considerable difficulty in this area. In the present study the participants were first trained to tell the time "past" the hour (Phases 2 to 7) and were then trained to tell the time "to" the hour (Phases 8 to 12). Most of the incorrect "past"-"to" errors occurred during the discrimination phases and review training of Phases 8 to 12. The data (Figures, 2, 3 & 4) also indicates that during the training of phases 8 to 12, the performance of all the three participants on the post training probes for some previously trained phases had dropped and so they required retraining. For Raymond and Karen retraining of the previously trained phases were most for incorrect "past"-"to" references. The data thus suggests that the participants started getting confused when the training for telling the time "to the hour" began. However it could also be argued that, the time cues indicating 5 to and 5 past, 10 to and 10 past, 20 to and 20 past, 25 to and 25 past, have much in common and are reversed stimuli that are difficult to discriminate (Touchette, 1969). At this point it is not clear if this confusion was caused because of sequence in which the phases were introduced. It would be interesting to see if the extent of incorrect "past"-"to"

references would have been any different, had the participants been trained simultaneously for two classes of time cues that had much in common and required to be discriminated by "past" and "to" references. For example, simultaneously training to tell the time "5 past the hour" and "5 to the hour".

In comparison to the above mentioned errors, all the three participants had relatively fewer errors for incorrect minute references, minute hour hand discrimination, don't know to trained cues and other errors. It is important to note that all the three participants in this study had learning histories associated with time telling skills but were not able to use the skill. Some of the above mentioned errors could be thus related to their prior learning history. Some other common factors that could to have led to these errors could be fatigue and failing to pay attention to the time cues. For example, for most of the minute-hour hand discrimination errors, all the participants were able to give the correct response most of the times when they were prompted to look carefully.

The retention test conducted in the second part of the study reveal some facts about the efficacy of the training program. The data (Figures 8, 9 and 10) indicates that for the time cues that were subjected to additional practice for 5 days, the average percentage of retention across 8 week period was 98 percent and above for all the three participants. However, it is interesting to find that the average percentage of retention across the 8 week period, for the time cues that were not subjected to practice was 80% and above for Raymond and Rebecca and 69 % for Karen.. Thus looking at the overall retention scores for all the participants, it is indicated that the training was effective in establishing time telling skills to a good extent.

Considering the lack of recent empirical research that provides information on the method that can be used to teach time telling to intellectually disabled adults

and with only a few proposed programs mentioning their success rates, it is difficult to compare the efficacy of the training program used in this study. In the study done by Partington et al. (1979), all the four participants had completed the program successfully and the average percentage of correct responses for his participants ranged from 93 to 96 percent. Similarly in the study done by Smeets (1986), all the four adolescents with intellectual disability were reported to have completed the program and the average percentage of correct responses for his participants raged from 87 to 90 percent. In comparisons to the two of the above mentioned studies, all the three participants in the present study also successfully completed the program and the average percentage of correct responses for the participants in this study raged from 86 to 88 %.

While this training program was instrumental in establishing the time telling skills among intellectually disabled adults, it is important to evaluate the results in terms of their social relevance. There have been a number of arguments as to whether being able to tell the time necessarily implies that one has understood the concept of time or could manage time. The present study only trained and tested the participants' ability to tell the time appearing on an analogue clock. The present study did not test if the participants could function from those time cues or if they had understood the concept of time e.g., how many minutes make an hour or ability to independently reach for appointments on time. According to Moyer (1983), one's ability to tell the time does not necessarily means that he/she can understand the concept of time or the passage of time. Manganello (1994) has asserted that for teaching the concept of time the instruction should go beyond learning to tell the time. However, Smeets et al (1985) have asserted that the ability to tell the time is a prerequisite for learning to function from the time cues. To date there are no empirical programmes available to teach individuals to tell

time appearing on the analogue clock and then teach them to manage their time based on the time cues appearing on the analogue clock. While there is considerable amount of research on teaching time management to intellectually disabled individuals using experimental devices (Smeets et al., 1985; DiPipi-Hoy, Jitendra, & Kern, 2009), none of the research has looked at teaching those individuals to manage time based on the time cues appearing on an analogue or digital clock. Future research should be directed towards, developing programs for teaching intellectual impaired individuals to function from the time cues appearing on a digital or analogue clock.

Part II

The second part of the study aimed at examining one of the key aspects of precision teaching i.e., fluency, in particular of the relative effects of rate building practice, rate controlled practice and no practice on the retention and generalization of the time telling skill over a 2, 4, and 8 week period. In this part of the study, 6 classes of time cues that were learned in the Part I of the study were subjected to either fast or slow practice. During the Part I of this study, the training for one class of time cues had not resulted in much generalization for the other classes of time cues for all the participants. Therefore in the second part of this study, each class of time cues were considered to be an independent task and appropriate for practice. The present study aimed at measuring only the accuracy of responses and not the rate of responding during the retention tests. The study extended previous research by controlling for amount of practice and the reinforcement across the two practiced conditions.

During the practice phase, all the three participants were subjected to fast practice (rate building) for 3 classes of time cues and slow practice (rate

controlled) for the another 3 classes of time cues and no practice for the remaining classes of time cues. In order to ensure that there was a difference in the time taken between fast and slow practice, the presentation rate of the stimuli in the slow practice condition was controlled by asking the participants respond only 10/s after the card was exposed. The experimenter prompted the participant to give their response after 10/s. In order to balance the reinforcement the participants received in each of the practice condition, reinforcement (praise) was provided only if they made an improvement over the previous day's performance. If they did not make an improvement, they were only praised for their participation.

A number of researchers have suggested that rate building methods lead to faster rates of responding or better accuracy as compared to accuracy only measures (Berquam, 1981; Binder 1996; Johnson and Layng 1996; & Olander et al. 1986). However these studies did not control the amount for practice. The present study controlled for the amount of practice in the two conditions and found that rate-building to a fluency performance standard did not lead to any differences in the percentage of accurate responses between the two conditions. All the participants in this study took more or less the same number of trails to reach their set performance standards for the both fast and slow practice. In the fast practice condition, as the practice days progressed, the percentage of accurate responses on each trail increased and the amount of time take also gradually decreased for all the three participants. In the slow practice condition, all the three participants reached the performance standard on the second day of practice and practice but practice was continued until the 5^{th} day to equalize the amount of practice for the two conditions. One of the possibilities for no differences being observed in the number of trails taken while learning to fluency or accuracy could

be due to the extensive training the subjects underwent during the acquisition of those time cues.

On the retention tests across the following day of practice to 8 weeks, all the participants had a score of 98 percent and above for both fast and slow practice. Though these results supports the proposed outcomes of rate-building procedures leading to good retention (Lindsley, 1996; Merbitz, Vieitez, Hansen-Merbitz, & Binder, 2004), it fails to indicate that rate-building procedures had lead to better retention than any other practice methods. There was no clear bias in the retention of the time cues that were practiced at faster rates. The results of this study are consistent with some of the other within-subject studies that checked for the differences in the accuracy levels for the two methods of practice (Wheetley, 2005; McGregor, 2006; Clark, 2007). However, it can be seen that the percentage of accurate responses for the unpractised time cues were considerable less for all the three participants. The lower scores on the unpractised time cues provides further evidence for no generalization to have taken place between the various classes of time cues and each class of time cues was an independent task for these participants. Thus it can be seen that, while these results provide evidence to the popular expression that 'practice makes perfect'; they fail to show that varying kinds of practice made any difference in achieving mastery over the learned task.

To test the generalization of trained skill, the time cues were shown to the participants on a real analogue clock. The results of the present study indicate Karen and Rebecca had a good generalization across the 8 week period for both the fast and slow practice conditions. However, their generalization for the unpractised time cues were much below the practiced time cues. The results also indicate that Raymond had comparatively poor generalization scores for both the

fast and slow practice conditions. The number of errors made by Raymond for the fast practiced time cues and the slow practiced time cues were more or less the same. Also, Raymond's generalizations of the unpractised time cues were not as good as the practiced time cues. Thus while fast and slow practice led to better generalization for Karen and Rebecca, the same was not the case for Raymond. Thus the results of this study do not indicate that fluency-based instruction results in superior generalisation than accuracy-based instruction, as proposed by precision teaching and fluency-based literature.

It is important to note that, though the present study controlled for the response rates of the time cues that were learnt to accuracy, it failed to check for any difference in the final response rate for the time cues learnt to fluency and the time cues learnt to accuracy. Hence, it cannot be ascertained that the rate-controlled practice had not reached the fluency performance standard. This is one of the major limitations of this study and thereby prevents it from making any firm conclusions. The only conclusions that can be drawn from this part of the study are regarding the role of practice in skill retention. Firstly when retention is assessed by accuracy, either as an absolute rate or as relative loss, retention does not seem to be enhanced by rate-building to a fluency performance standard over the same amount of rate-controlled practice. Secondly, it can be concluded that for any skill that is learned, periods without practicing that skills leads to the deterioration in the accuracy of that skill.

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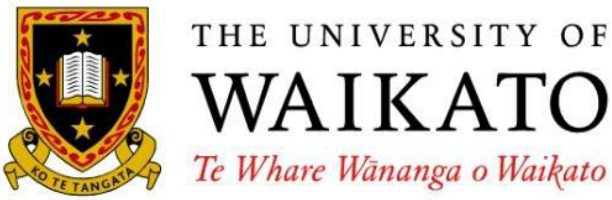
Appendix A



To

The Area Manager,

IDEA Services

Hamilton.

Dear Vonny,

I'm currently pursuing my Masters degree in Applied Psychology from the University of Waikato. As a part of the Masters program, I'm working on a research project. The aim of my research is to teach adults with intellectual disabilities to tell the time appearing on an analogue clock, to the nearest 5 minute interval. The study will also aim at comparing the relative effects of "fast practice" and "slow practice" on the retention and generalization of the trained skill. My supervisor for this project is Dr. Mary Foster. This study has ethical approval from the department of psychology, Human participants' ethics committee.

I would like to conduct this study on the service users of IDEA services and thereby require you support and approval for the same. Only those individuals, who are interested in learning time telling, will be recruited for the research, provided they meet the pre-requisites for the study. A formal consent will be taken from all the participants before they begin the program. By being a research participant, the service users will spend about 30 minutes, five days a week for 5 to 6 weeks, wherein they will be individually taught to tell the time. Also, the

program will be conducted at the service users' residential units or the vocational day base, whichever is convenient to them.

I shall be highly obliged if you could grant me the permission to conduct this study on the service users of IDEA services. Please find enclosed a copy of the consent form and the participant information sheet which would be given to the participant before they enter the program.

Kind Regards,

Subin Mathews

For ethical concerns about this research, contact:

Dr. Robert Isler (Convenor of research and ethics committee)

Human Participants Ethics Committee

Phone: 078384466 ext 8410

The University of Waikato

Appendix B

Do you know what time is it?

Would you like to learn to tell the time?

Participants wanted for a research on teaching time telling skills to adults with special needs.

My name is Subin Mathews, and I am a student at the University of Waikato. I am working on a research project. The supervisor for my project is Dr. Mary foster.

The aim of my research is to teach time telling skills to adults, who have difficulty in telling the time and to examine if practicing this skill would improve their performance. We have designed some material that will help you learn to tell the time to the nearest 5 minute interval. In order to take part in the study, you will have to firstly take part in a time telling screening test. You would be recruited for the study based on your performance on the screening test. On being successfully recruited for the study, you will need to spend about 30 minutes, five days a week for 5 to 6 weeks with me and I will teach you to tell the time.

A little time each day can improve learning!

Interested???

Please contact me for more information.

Subin Mathews

0211395200

Subin.mathews@gmail.com

Appendix C

Card	Time	Response
1	3:00	
2	2:20	
3	2:25	
4	3:35	
5	3:40	
6	1:05	
7	12:55	
8	12:50	
9	1:45	
10	1:10	
11	4:30	
12	6:15	
13	5:45	
14	1:00	
15	8:50	
16	5:05	
17	8:55	
18	6:25	
19	6:30	
20	7:35	
21	5:10	
22	7:40	
23	6:20	
24	8:15	
25	4:55	
26	10:25	
27	8:00	
28	10:15	
29	11:35	
30	11:45	
31	11:40	
32	4:50	
33	9:10	
34	8:30	
35	9:05	
36	10:20	

Appendix D

Title of thesis: Teaching time telling and examining the relative effects of rate-building and rate-controlled practice on the retention and generalization of the time cues.

Researcher: Subin Tom Mathews (subin.mathews1982@gmail.com)

Supervisor: Dr. Mary Foster (m.foster@waikato.ac.nz)

To (participant's name)

My name is Subin Mathews, and I'm a student at the University of Waikato. I am studying to complete my masters in psychology. This information sheet is to let you know about the research that I am conducting and to invite you to participate in this research. I have spoken to management at IDEA services and have the support of the organization to conduct this research.

If you have difficulty in telling the time, I would like to teach you to do this by using a round clock. I would also like to see if practicing this skill, helps you maintain it. In order to take part in the study, you will have to first take a time telling screening test. You will be recruited for the study based on the performance on the screening test. On being successfully recruited for the study, you will need to spend about 30 minutes, five days a week for 5 to 6 learning to tell the time.

Your identity as the participant of this study will not be disclosed, even if the results are published or reported. You can choose whether or not, you want to take part in this study. You do not have to give a reason if you choose not to take part. If you change your mind later and decide to pull out of the study, you can withdraw yourself anytime. All the information collected during the study will be

kept in a locked cabinet in the psychology department at the University. Only myself and my supervisor will be able to access this information.

If you have any questions, please feel free to ask them.

Thank you

Subin Mathews.

For ethical concerns about this research, contact:

Dr. Robert Isler (Convenor of research and ethics committee)

Human Participants Ethics Committee

Phone: 078384466 ext 8410

The University of Waikato

Appendix E

University of Waikato

School of Psychology

PARTICIPANT'S COPY

Research Project: Teaching time telling and examining the relative effects of rate-building and rate-controlled practice on the retention and generalization of the time cues.

Name of Researcher: Subin Tom Mathews

Name of Supervisor (if applicable): Dr. Mary Foster

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee (Dr Robert Isler, phone: 838 4466 ext. 8401, e-mail r.isler@waikato.ac.nz)

Participant's

Name:_____Signature:_____Date:_____

Appendix F

ACQUISITION PHASE 3

PARTICIPANTS NAME:

TRIAL

TIME	2:15	1:15	5:15	4:15	7:15	9:15	11:15	10:15	12:15	8:15	6:15	3:15	TOTAL
RESPONSE													

TRIAL

TIME	7:15	9:15	11:15	10:15	12:15	8:15	6:15	3:15	2:15	1:15	5:15	4:15	TOTAL
RESPONSE													

TRIAL

TIME	8:15	6:15	3:15	2:15	1:15	5:15	4:15	7:15	9:15	11:15	10:15	12:15	TOTAL
RESPONSE													

TRIAL

TIME	7:15	9:15	11:15	10:15	12:15	8:15	6:15	3:15	2:15	1:15	5:15	4:15	TOTAL
RESPONSE													

TRIAL

TIME	8:15	6:15	3:15	2:15	1:15	5:15	4:15	7:15	9:15	11:15	10:15	12:15	TOTAL
RESPONSE													

TRIAL

TIME	8:15	6:15	3:15	2:15	1:15	5:15	4:15	7:15	9:15	11:15	10:15	12:15	TOTAL
RESPONSE													

TRIAL

TIME	8:15	6:15	3:15	2:15	1:15	5:15	4:15	7:15	9:15	11:15	10:15	12:15	TOTAL
RESPONSE													

Appendix G

DISCRIMINATION PHASE 2

PARTICIPANTS NAME**:**

TRIAL

TIME	2:30	1:30	5:30	4:30	7:30	9:30	11:30	10:30	12:30	8:30	TOTAL
RESPONSE											

TRIAL

TIME	7:30	9:30	11:30	10:30	12:30	8:30	6:30	3:30	2:30	1:30	TOTAL
RESPONSE											

TRIAL

TIME	12:30	8:30	6:30	3:30	2:30	1:30	5:30	4:30	7:30	9:30	TOTAL
RESPONSE											

TRIAL

TIME	7:30	9:30	11:30	10:30	12:30	8:30	6:30	3:30	2:30	1:30	TOTAL
RESPONSE											

TRIAL

TIME	12:30	8:30	6:30	3:30	2:30	1:30	5:30	4:30	7:30	9:30	TOTAL
RESPONSE											

TRIAL

TIME	2:30	1:30	5:30	4:30	7:30	9:30	11:30	10:30	12:30	8:30	TOTAL
RESPONSE											

TRIAL

TIME	2:30	1:30	5:30	4:30	7:30	9:30	11:30	10:30	12:30	8:30	TOTAL
RESPONSE											

TRIAL

TIME	2:30	1:30	5:30	4:30	7:30	9:30	11:30	10:30	12:30	8:30	TOTAL
RESPONSE											

Appendix H

Review Training Phase 2

Participants Name:

TRIAL

TIME	2:00	1:30	5:30	4:00	7:00	9:30	TOTAL
RESPONSE							

TRIAL

TIME	3:00	1:30	8:00	1:00	7:30	9:30	TOTAL
RESPONSE							

TRIAL

TIME	11:30	1:00	5:00	6:30	7:30	12:00	TOTAL
RESPONSE							

TRIAL

TIME	9:30	3:30	6:00	4:30	1:00	10:00	TOTAL
RESPONSE							

TRIAL

TIME	2:00	1:30	5:00	4:30	7:30	9:00	TOTAL
RESPONSE							

TRIAL

TIME	7:00	4:30	12:30	9:00	7:30	5:30	TOTAL
RESPONSE							

TRIAL

TIME	3:00	6:00	7:30	2:30	7:00	5:30	TOTAL
RESPONSE							

Appendix I

Name:

Day:

	Trial 1		Trial 2		Trial 3	
Sr. no	Time	Response	Time	Response	Time	Response
1	5:45		12:50		4:50	
2	11:50		5:55		8:55	
3	4:55		3:45		1:45	
4	3:45		6:50		7:50	
5	9:50		7:55		2:45	
6	8:45		4:50		10:50	
7	6:45		8:45		5:50	
8	1:50		1:55		11:55	
9	7:55		7:50		12:45	
10	2:55		2:45		5:55	
11	10:55		10:55		3:50	
12	12:45		5:50		6:45	
13	5:50		11:55		7:55	
14	3:55		4:45		4:55	
15	6:45		3:55		3:45	
16	7:55		9:50		9:50	
17	4:50		8:45		8:45	
18	8:50		6:45		6:55	
Total						

Appendix J

Name:

Day:

Trial 1			Trial 2		Trial 3	
Sr. no	Time	Response	Time	Response	Time	Response
1	5:05		12:15		4:05	
2	11:15		5:05		8:15	
3	4:10		3:10		1:10	
4	3:05		6:15		7:15	
5	9:15		7:05		2:05	
6	8:05		4:10		10:05	
7	6:10		8:10		5:10	
8	1:15		1:05		11:10	
9	7:05		7:10		12:15	
10	2:10		2:15		5:10	
11	10:10		10:05		3:05:15	
12	12:15		5:10		6:10	
13	5:05		11:10		7:10	
14	3:15		4:05		4:05	
15	6:10		3:15		3:15	
16	7:15		9:15		9:05	
17	4:05		8:05		8:15	
18	8:10		6:15		6:05	
Total						

Appendix K

1. Before the start of any session, does the researcher make sure that the participant is willing to do the training on that day, and also make sure that the participant is comfortable?	Yes/No Yes/No
2. Does the researcher make sure that the participant is given adequate intervals between 2 sets of trials?	Yes/No
3. Does the researcher make sure that the subject is given a feedback after any trial? Correct responses should be followed by reinforcement (praise). Incorrect responses are followed by no reinforcement and subject is asked to repeat the correct response after the experimenter. (Only for Acquisition, discrimination, review training & post- training phases).	Yes/No
4. Does the researcher make sure that no reinforcement is given during the pre-training probes session?	YES/No