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Does Training in the Use of a Magnifier Improve Efficiency?

Norliza Mohamad Fadzil, Kerry Fitzmaurice, and Linda Malesic

***Abstract*—**Provision of optical devices without proper instruction and training may cause frustration resulting in rejection or incorrect use of the magnifiers. However training in the use of magnifiers increases the cost of providing these devices. This study compared the efficacy of providing instruction alone and instruction plus training in the use of magnifiers. 24 participants randomly assigned to two groups. 15 received instruction and training and 9 received instruction only. Repeated measures of print size and reading speed were performed at pre, post training and follow up. Print size decreased in both groups between pre and post training maintained at follow up. Reading speed increased in both groups over time with the training group demonstrating more rapid improvement. Whilst overall outcomes were similar, training decreased the time required to increase reading speed supporting the use of training for increased efficiency. A cost effective form of training is suggested.

***Keywords*—**Low vision, magnification, training, reading.

I. Introduction

THE impact of vision impairment on quality of life can be devastating when persons with vision impairment are unable to perform their daily living activities such as reading mail, reading price tags or travelling independently [1]. The impact may differ for children and adults with vision impairment. Children may experience developmental and educational delays, whereas adults may experience problems of job loss and difficulty finding employment due to the impairment. People may withdraw from social situations, experience frustration, uncertainty and loss of independence. However, people with vision impairment can improve their quality of life through vision rehabilitation services; teaching them how to use their remaining vision more effectively.

Vision rehabilitation encompasses a range of interventions that are aimed at improving visual abilities, visual functioning and coping with visual disabilities [2]. Vision rehabilitation training maximizes the use of remaining sight and provides patients with practical adaptations for activities of daily living. It has been reported that vision rehabilitation can improve the functioning and increase the independence of persons with vision impairment, reducing the impact of the impairment on their quality of life [3]-[4]. The rehabilitation provided may be as minimal as prescribing magnifiers and providing instructions in their use, to comprehensive training which consists of weeks or months of training sessions.

Magnifiers may be used to perform numerous daily tasks especially tasks that are related to reading; from spot reading (reading medicine labels, utility bills, menus) to fluent reading (reading newspapers, novels) [5]. It enables persons with low vision to read smaller print for a longer duration and at a faster rate [6]-[7]. Many individuals are able to use these devices with ease and comfort, acquiring visual information needed for efficient use of residual vision without training. However, previous studies have reported that providing training following the prescription of low vision devices is essential [8]-[11] and failure to do so may lead to frustration and lack of compliance in using the devices [12]-[14]. The benefit of training in the use of magnification is reflected not only in the improvement of perceived visual reading ability and quality of life but also in actual improvement in reading performance.

Previous studies have shown conflicting findings on reading performance when using magnifiers. Some research studies found that reading speed with magnifiers was not significantly reduced compared to that achieved using other forms of enlargement such as large print materials [15]-[17]. Whilst other studies reported significant reductions in reading speed when using magnifiers [5],[18]-[19]. These contradictory findings may have been due to the differences in the amounts of experience the participants have in reading with magnifiers and the characteristics of the participants. Those studies that showed no significant difference in reading speed with and without magnifiers had participants with vision impairment who were experienced in using magnifiers for reading [16]-[17]. They provided equivalent enlargement in print material to the effective enlargement achieved with magnification and reading speed for the two groups was not significantly different. Whereas, studies that demonstrated significant reductions in reading speed as a result of magnification use were performed on fully sighted participants [5], [18], [20]. These participants were inexperienced in reading with a restricted field of view and in manipulating the magnifiers. The fully sighted participants had a faster reading speed compared to a reader with low vision; reading speed is likely to reduce significantly when magnifiers were introduced since their habitual reading is interrupted [13]. The researchers further suggested that in

N. M. Fadzil is with the National University of Malaysia, Programme of Optometry & Vision Sciences, Faculty of Health Sciences, National University of Malaysia, Jalan Raja Muda Abd Aziz, 50300 Kuala Lumpur, Malaysia. (phone: +603-9289-7482; fax: +603-2691-0488; e-mail: norliza@medic.ukm.my).

K. Fitzmaurice is with the Department of Clinical Vision Sciences, Faculty of Health Sciences, La Trobe University, Melbourne, Victoria 3086, Australia (e-mail: k.fitzmaurice@latrobe.edu.au).

L. Malesic is with the Department of Clinical Vision Sciences, Faculty of Health Sciences, La Trobe University, Melbourne, Victoria 3086, Australia (e-mail: l.malesic@latrobe.edu.au).

persons with vision impairment whom were inexperienced in using magnifiers for reading, training would enable them to achieve better reading performance. This suggests that experience in the use of magnifiers for reading is important. Therefore, providing training in the use of magnifiers is likely to facilitate development of skill in magnifier use reducing the practice time required to achieve better reading performance.

Most of the studies on the impact of use of magnifiers on reading performance have used adult participants with vision impairment or fully sighted adults. Studies on the impact of magnifiers on reading performance in children with vision impairment are limited. As reading is an important aspect of education all means of reducing the impact of vision impairment on reading should be explored. Children with low vision are at risk of academic difficulties if their reading speeds are not competitive with those of their sighted classmates. They need to be able to read text of a particular size fluently for long periods of time. As a child progresses through school, the print size of reading material gets smaller, whilst reading level and reading speed are expected to be higher [21]. Slow reading speeds can therefore have a great impact on their ability to achieve good academic grades and also limits employment choices for jobs that require literacy skills [22]. Assisting children to use magnification for reading efficiently in the shortest possible time will be of benefit for the child and their education.

II. Method

Participants in this study were children in Special Education Schools for the Blind (primary and secondary) in Kuala Lumpur and patients attending the Low Vision Clinic in the Department of Optometry, Universiti Kebangsaan Malaysia, Kuala Lumpur. Permission to conduct the research in the two special education schools was sought and granted from the Ministry of Education Malaysia. An invitation to participate informing parents about the project and a consent form were given to the parents of all children with low vision. Once informed consent was obtained the children's vision was assessed in the Optometry Clinic, Universiti Kebangsaan Malaysia. This study was granted ethics approval from the Human Research Ethics Committee, La Trobe University (Application No. 08-006) and also from the Ethics Committee, Universiti Kebangsaan Malaysia (FF-013-2008).

Twenty four participants were randomly assigned to two groups. 15 participants (mean age 15.8 SD 2.11 years) were provided with magnifiers, instruction in the use and extended training in the application of the magnifiers; 9 participants (mean age 15.7 SD 1.78 years) were provided with instruction only in the appropriate use of magnifiers. Following instruction in the use of magnifiers all participants were given a period of two weeks to adapt to the magnifiers. Reading performance measures taken after this two week period were regarded as the pre training measurement. Participants in the training group received training in the use of the magnifier after this adaptation period. Participants in the non training group were given instructions in the use of the magnifier and no further training. No reading material for practice at home was given. Dependant variables indicating reading performance were print size and reading speed. Dependant variables were measured at three points: pre training/baseline (time 1) after the two week adaptation time, post training (time 2) five weeks after baseline and at six months follow up after training was complete (time 3).

III. Results

TABLE I
Mean And Median Print Size in both Training and Non Training Groups in Log Units

Time		Training Group (n=15)	Non Training Group (n=9)
Time 1	Mean	1.15 SD 0.16 (N40)	1.11 SD 0.15 (N40)
	Median	1.10	1.10
Time 2	Mean	0.45 SD 0.08 (N8)	0.48 SD 0.07 (N10)
	Median	0.40	0.50
Time 3	Mean	0.45 SD 0.08 (N8)	0.49 SD 0.06 (N10)
	Median	0.40	0.50

The mean print sizes decreased post introduction of magnification in both groups and this was statistically significant (Friedman χ^2 (df=2, n=15)=27.55; $p<0.001$ training group and Friedman χ^2 (df=2, n=9)=17.43; $p<0.05$ non training group). Print size was compared between the training and non training group at time 1, time 2 and time 3 (Table I). The statistical analysis indicated the difference between groups was not significant; Mann-Whitney U test: time 1 (U=56.50, p=0.52, r=0.14), time 2 (U=55.00, p=0.48, r=0.09) and time 3 (U=49.00, p=0.29, r=0.05). These results indicate that the introduction of magnification is sufficient to decrease print size.

Reading speed increased for both groups from pre training to follow up. However the rate of change appeared to vary between the training and non training groups, this difference was investigated further.

An independent t-test at time 1 indicated that the groups were homogenous for reading speed at baseline (related words t = - 0.44; p = 0.66; unrelated words t = -1.29; p = 0.21). However at time 2 the training group demonstrated a higher mean reading speed and the difference between groups was statistically significant (related words t = -2.09; p = 0.04; unrelated words t = 2.38; p= 0.02) (Table III).

TABLE II
MEAN READING SPEED OF RELATED AND UNRELATED WORDS

Time	Reading Speed Related Words (words/min)	Reading Speed Unrelated Words (words/min)
Training Group (n=15)		
Time 1	44.12 SD 14.75	22.77 SD 8.94
Time 2	54.33 SD 15.99	27.54 SD 10.61
Time 3	57.32 SD 17.15	29.62 SD 11.27
Non Training Group (n=9)		
Time 1	41.62 SD 10.07	18.56 SD 4.67
Time 2	43.16 SD 10.07	20.09 SD 4.49
Time 3	43.07 SD 10.89	19.77 SD 4.73

TABLE III
INDEPENDENT T-TEST BETWEEN TRAINING AND NON TRAINING GROUP AT POST TRAINING (TIME 2)

TIME 2 (Post Training)	Reading Speed Related Words (words/min)	Reading Speed Unrelated Words (words/min)
Training Group (n=15)	Mean 54.33 SD 15.99	Mean 27.54 SD 10.61
Non Training Group (n=9)	Mean 43.16 SD 10.07	Mean 20.09 SD 4.49
Independent t-test between two groups	t=-2.09; df=22; p=0.04	t=-2.38; df=22; p=0.02

The result of mixed between-within ANOVA indicated that reading speed for related words changed over time and this change was significant: [$F(2, 44)=140.03$, $p<0.001$, partial $\eta^2=0.86$ (effect size=0.92)]. The interaction between groups and time, for related words was also significant [$F(2, 44)=86.36$, $p<0.001$, partial $\eta^2=0.79$ (effect size=0.88)]. The change in reading speed of unrelated words over time was significant: [$F(1.24, 27.23)=61.55$, $p<0.001$, partial $\eta^2=0.73$, (effect size, $\eta^2_L)=0.61$] and interaction between groups and time for unrelated words was also significant [$F(1.24, 27.23)=27.47$, $p<0.001$, partial $\eta^2=0.55$, (effect size, $\eta^2_L)=0.41$]. Both groups demonstrated increases in reading speed for both related and unrelated words from the time 1 to time 3 and this was statistically significant. The difference between groups in increased reading speed from time 1 to time 3 (training and non training group) for both related words [$F(1, 22)=2.43$, $p=0.13$, partial $\eta^2=0.10$] and unrelated words [$F(1, 22)=3.87$, $p=0.06$, partial $\eta^2=0.15$] was not significant, suggesting the effect of the two strategies at the end of the study were similar. Whilst both groups reached the same level of improvement at the end of the study, the improvement was demonstrated to be more rapid in the training group than non training group (time 2: related words: mean difference=11.17, t=-2.09; df=22; p = 0.04; unrelated words: mean difference=7.45, t=-2.38; df=22; p = 0.02) (Table III); indicating that training may have provided greater efficiency in improving reading speed.

IV. DISCUSSION

The pattern of improvement for reading performance between participants in the training and non training group was different. Both the training and non training groups demonstrated an increase in reading speed from baseline to follow up for related and unrelated words which was significant. However participants in the training group demonstrated rapid improvement whilst participants in the non training group demonstrated gradual improvement. The quantum of improvement in reading performance of participants in the training group was larger compared to those of participants in the non training group at time 2 (post training). At time 3, the improvement was maintained in participants in the training group whilst participants in the non training group had continued to improve. At time 3 both training and non training groups demonstrated a similar quantum of improvement. The outcome of this study supports additional training in the use of a magnifier to improve reading performance more quickly. However, with time and continuous independent practice with the magnifier, the same outcome can be achieved.

The result of this study demonstrated that participants in the training group demonstrated faster reading speeds and a greater difference between time 1 (pre training) and time 2 (post training) reading speed assessments. The instruction received by both groups was similar. Participants in the training group received basic instruction in the use of the magnifier at the time of prescription plus training in the use of the magnifier. Participants in the non training group received only basic instruction in the use of magnifier at the time of prescription with no further training. The difference in outcome in terms of reading speed between the two groups may be due to the training assisting in the acquisition of good magnifier navigation skills in a shorter time than participants in the non training group. This outcome also supports other studies that suggested training in the use of magnifiers will lead to better reading performance [9], [13], [14], [23].

Although the mean reading speed of participants in the training group was higher compared to those in the non training group post training (time 2), the overall increase in reading speed (time 1 – time 3) between the two groups for the duration of the study was not statistically significant.. This study supports the use of magnification to improve reading efficiency as measured by reading speed but also indicates that training may add efficiency to the acquisition of skill in the use of the magnifier. Whilst both groups demonstrated similar results at the follow up test time, the value of training appears to be in facilitating a more rapid progression to this end point. If children learn to use their magnifiers quickly and efficiently, the possibility of rejecting the magnifiers can be reduced [24].

In summary, training in the use of a magnifier assists efficient handling of the magnifier, facilitating better reading performance over a shorter period of time. However, the same outcome can be achieved over a longer period of time if the child practices using the magnifier independently. This finding supports previous studies that found navigation skills and magnifier handling strategy develop with time after a magnifier is prescribed [25]-[27]. The advantage of providing training in the use of magnifiers is that it facilitates efficiency more quickly reducing the possibility of magnifier rejection. However, the disadvantage is that training time increases the clinic cost i.e. increasing consultation hours. Perhaps a solution to balancing clinic costs against the advantages of learning to use the magnifier quickly and efficiently might be to include clear instructions in the use of the magnifier with structured training exercises that can be undertaken under the supervision of an appropriate person such as parents or teachers.

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