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Preferred walking speed for assessment of mobility performance: sighted guide versus non-sighted guide techniques

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Background: If visually impaired people had their sight fully restored, it is assumed that they would walk at their optimal speeds. Previous mobility studies have used preferred walking speed (PWS) to measure walking efficiency of visually impaired adults. Therefore, the actual speeds that visually impaired people adopt on a route can be expressed as a percentage of their preferred walking speed (PPWS). There have been two approaches used in previous studies for determining preferred walking speed.

1. the sighted guide technique (SG), which requires a subject to walk with a sighted guide and regard the latter as a perfect mobility aid, with the subject setting the preferred (optimal) walking pace
2. the non-sighted guide technique (NonSG), which requires a subject to walk alone along an unobstructed straight path for a certain distance, adopting the preferred (optimal) walking speed.

There is some debate on which technique is the better. This study was conducted to determine if there is any difference between the two techniques for determining visually impaired subjects' preferred walking speeds.

Methods: Fourteen visually impaired adult subjects were recruited. PWS was determined by recording the time taken for a subject to walk an unobstructed, straight 20-metre corridor path using each technique.

Results: There was no significant difference in PWS using the sighted guide and non-guided techniques.

Conclusions: Either the SG or NonSG techniques can be used to determine PWS for a heterogeneous group of visually impaired subjects.

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Key words: non-sighted guide, percentage preferred walking speed, preferred walking speed, sighted-guide

Various measures have been adopted in an attempt to assess mobility performance of visually impaired adults. One measure of mobility performance is walking efficiency. Many studies have used a direct measure of walking speed,[1-3] while a number of other studies[4-6] have used percentage of preferred walking speed (PPWS) to assess walking efficiency of their subjects. If visually impaired people had their sight fully restored, it is assumed that they would walk at their optimal speeds,[4] which is referred to as the preferred walking speed (PWS).[4] The actual speeds that blind or visually impaired people adopt on a route can then be expressed as a percentage of their preferred walking speed (PPWS). PPWS is preferred to absolute walking speed as the measure of walking efficiency because it allows subjects to act as their own controls, normalising the data for differences in age, height and physical fitness.[4] It has been claimed that PPWS is able to distinguish behavioural differences between fully sighted and visually impaired travellers.[7] Moreover, it is known that time spent

walking is a reliable measure of mobility performance[8] and PPWS has a high correlation with the ratings of orientation and mobility performance by orientation and mobility instructors.[9]

Currently, there are two approaches to determining the preferred walking speed used in previous studies.

1. with sighted guide (SG)
2. without sighted guide (NonSG).

For the first method, a subject is required to walk with a sighted guide and regard the guide as a perfect mobility aid, with the subject setting the preferred walking pace.[4] The time is recorded for the subject to walk a certain distance with the sighted guide. This technique has been used by Beggs[7] and Haymes and colleagues.[10] For the NonSG technique, a subject is required to walk alone along an unobstructed straight path for a certain distance and the time to walk the distance is recorded. This technique was used by Black and colleagues.[6]

In the study by Haymes and colleagues,[5] the PPWS achieved by some subjects on their mobility course was greater than 100 per cent. This suggests that the subjects were not walking at their optimum speeds when their preferred walking speeds were determined with the sighted guide. Thus, the sighted-guide technique may underestimate the subjects' walking speeds. Black and colleagues[6] argued that for a simple unobstructed course, a sighted guide is not necessary as subjects are informed that there are no obstacles.

In view of this apparent discrepancy, this study was conducted to determine if there is any difference between the two techniques for determining visually impaired subjects' preferred walking speeds.

METHODS

Subjects

Fourteen visually impaired adult subjects who had various ocular diseases were recruited from the Queensland University of Technology Vision Rehabilitation Centre (QUT VRC). These subjects were patients attending the QUT VRC for low vision care and were available during the period of the study. The ages of the subjects ranged from 55 to 89 years; the mean age of the subjects was 79.1 years with a standard deviation of 10.1 years (Table 1). The visual acuities of the subjects ranged from 6/7.5 to 6/240. The experimental procedure for both techniques was explained, the subjects gave informed consent and they were allowed to discontinue the experiment if they wished to do so due to fatigue or for any other reason.

ID	Age	Ocular disease
X1	55	Albinism
X2	75	age-related macular degeneration
X3	81	glaucoma
X4	87	phthisis and age-related macular degeneration
X5	84	age-related macular degeneration
X6	81	age-related macular degeneration
X7	89	retinal haemorrhage and glaucoma
X8	74	age-related macular degeneration
X9	89	age-related macular degeneration
X10	89	(diagnosis not given)
X11	69	age-related macular degeneration
X12	66	retinal detachment
X13	83	albinism
X14	85	age-related macular degeneration

Table 1. Age and ocular disease of subjects for the assessment of PWS

Measurements of PWS

The subject's PWS was determined by measuring the time taken for the subject to walk an unobstructed, straight 20-metre corridor path. The average illuminance of the corridor was 290 lux.

The SG and NonSG techniques were administered alternately for each successive subject, with all trials of one technique being conducted before the second technique was used. The sighted guide for all subjects was a qualified orientation and mobility instructor (seconded from the Guide Dogs for the Blind Association of Queensland), who was very experienced with the technique. During the experiment, the sighted guide reminded each subject that walking pace was to be set by the subject (normal walking pace). When the NonSG technique was administered first, the sighted guide was not present during the trial. For the NonSG trials, each subject was instructed to walk at normal pace. The experimenter (the first author) walked behind each subject, recording the time taken for the 20 metres to be travelled.

Each subject wore habitual distance corrective glasses and habitual mobility devices were allowed during the experiment. One subject used a walking cane; another subject who normally used a walking cane did not bring it for the experiment. Four trials were performed for each technique.

Each subject's PWS was computed by

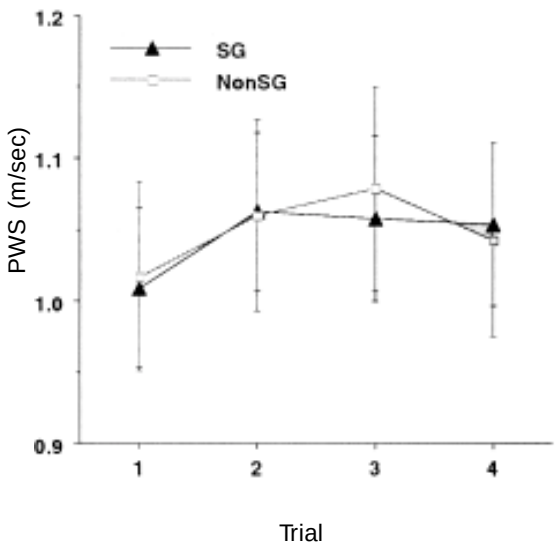

Figure 1. Walking speed of each trial using the SG and NonSG techniques for the determination of PWS (error bars show standard errors) (between techniques: $F_{1,11}$ = 0.047, p = 0.832; between trials for each technique: F = 0.195, df = 3, p = 0.899(SG) and F = 0.150, df = 3, p = 0.929 (NonSG)).

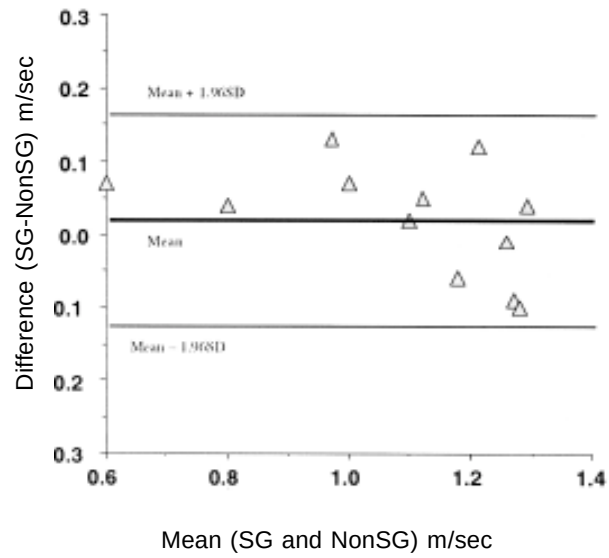

Figure 2. Relationship between mean difference (SG – NonSG) and mean of the SG and NonSG techniques (r = -0.489, p = 0.109)

dividing the distance walked by the time taken. Hence: Preferred walking speed (PWS) (m/s) = 20m/time taken (seconds)

Statistical analysis

The Kolmogorov-Smirnov test was used to ensure that measures were not significantly different from normal distributions so that parametric statistics could be used for analysis. The measures were not significantly different from a normal distribution ($p > 0.05$). Repeated measures two-way analysis of variance (ANOVA) was used to determine if there was a significant difference between the SG and NonSG techniques for determining the subjects' preferred walking speeds. One-way ANOVA was used to determine if there were statistically significant differences between trials for each technique. The level of agreement between the two techniques was examined using the analysis of Bland and Altman.[11]

RESULTS

There were no significant differences between PWS measured by the sighted guide and non-guided techniques for this group of subjects ($F_{1,11}$ = 0.047, p = 0.832) (Figure 1).

The scatterplot of the mean differences against the means of the two techniques demonstrated agreement between the techniques, with limits of agreement of about 0.15 m/sec (Figure 2). The mean of trials 2 and 3 was used for these calculations, as learning (trial 1) and fatigue (trial 4) appeared to reduce the walking speed (see below).

Pearson correlation showed no significant relationship between mean difference (SG-NonSG) and the mean for the two techniques (r = -0.489, p = 0.109). There was no bias to one technique or the other, although the subjects who completed the course faster tended to walk faster using the NonSG technique (Figure 2). However, there was a significant interaction effect between technique and trial ($F_{3,9}$ = 4.084, p = 0.044); that is, the subjects' performance was dependent on the order in which the techniques were administered.

There were significant differences between trials for the SG and NonSG techniques ($F_{3,9}$ = 8.340, p = 0.006). However, there were no significant differences between trials for each technique (SG: F = 0.195, df = 3, p = 0.899; NonSG: F = 0.150, df = 3, p = 0.929) (Figure 1). Although there were no significant differences between trials, it was noted that for both techniques, the subjects tended to walk slower in 'trial 1' than in the other three trials.

DISCUSSION

As there was no significant difference between the SG and NonSG techniques, preferred walking speed can be measured using either technique to assess walking

efficiency of a heterogeneous group of visually impaired adults. However, it is more practical and convenient to use the NonSG technique, as it does not require an extra experimenter, who is an experienced sighted guide.

For both techniques, the subjects started off with slightly slower walking speeds (trial 1); walking speeds were then faster and similar in trials 2 and 3. While our finding was not statistically significant, it does agree with that of Clark-Carter.[12] Their subjects became adapted to walking on the experimental route due to their prior experience in the first trial and this enabled them to maintain the speed at which they preferred to walk in subsequent trials. Therefore, walking speed on subsequent trials (trial 2 or 3 or the average of both trials) should be taken to determine visually impaired adults' preferred walking speed. The mean of trials 2 and 3 has been used as the basis for Figure 2.

For the SG technique, the subjects appeared to maintain similar walking speeds in the last three trials, after having become adapted to walking with the sighted guide on the straight path in the first trial. In contrast, for the NonSG technique, the subjects appeared to be slightly slower to complete their travel on the fourth trial compared with the third. It is possible that this was due to fatigue. This was perhaps due to poor physical fitness as the subjects who participated in the experiment were all aged 65 years and over, except for one subject who was aged 55 years. The subjects may have used the sighted guide as a 'support' during the SG experiment and hence, were able to walk more consistently in the last three trials. Because of the preponderance of older subjects in this experimental group, these findings need to be confirmed with a larger number of subjects, including those in the 60 to 70 year age group. This is necessary before the hypothesised 'fatigue effect' for the NonSG technique can be supported.

CONCLUSIONS

The sight guided or non-sight guided techniques can be used to determine preferred walking speed for the assessment of walking efficiency in visually impaired adults.

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REFERENCES

1. Geruschat DR, Turano KA, Stahl JW. Traditional measures of mobility performance and retinitis pigmentosa. *Optom Vis Sci* 1998; 75: 525-537.
2. Kuyk T, Elliott JL, Fuhr PSW. Visual correlates of mobility in real world settings in older adults with low vision. *Optom Vis Sci* 1998; 75: 538-547.
3. Turano KA, Rubin GS, Quigley HA. Mobility performance in glaucoma. *Invest Ophthalmol Vis Sci* 1999; 40: 2803-2809.
4. Clark-Carter D, Heyes A, Howarth C. The efficiency and walking speed of visually impaired people. *Ergonomics* 1986; 29: 779-789.
5. Haymes S, Guest D, Heyes A, Johnston A. Mobility of people with retinitis pigmentosa as a function of vision and psychological variables. *Optom Vis Sci* 1996; 73: 621-637.
6. Black A, Lovie-Kitchin J, Woods R, Arnold N, Byrnes J, Murrish J. Mobility performance with retinitis pigmentosa. *Clin Exp Optom* 1997; 80: 1-12.
7. Beggs WDA. Psychological correlates of walking speed in the visually impaired. *Ergonomics* 1991; 34: 91-102.
8. Dodds A, Carter D, Howarth C. Improving objective measures of mobility. *J Vis Impair Blind* 1983; 77: 438-442.
9. Dodds A, Davis D. Assessment and training of low vision clients for mobility. *J Vis Impair Blind* 1989; 83: 439-446.
10. Haymes S, Guest D, Heyes A, Johnston A. The relationship of vision and psychological variables to the orientation and mobility of visually impaired persons. *J Vis Impair Blind* 1996; 90: 314-324.
11. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *The Lancet* 1986; 1: 307-310.
12. Clark-Carter DD. Factors affecting blind mobility. Unpublished PhD thesis. Nottingham: University of Nottingham, 1985.

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