

## INTRODUCTION

Virtual Reality (VR) systems can affect the perception of the movements of users by providing visual feedbacks in an immersive environment. Altered visual feedback have a potential to work as intrinsic reinforcement factors to change individuals' decision-making process and behaviors, and further to counteract the learned non-use of the more impaired limb of stroke survivors.

The objective of this pilot study is to examine whether virtual amplification of hand movements in VR system can affect the limb selection patterns of healthy subjects in unsupported reaching tasks.

## METHODS

- Ten healthy subjects ( $21.8 \pm 1.4$  yrs), right-handed (Edinburgh Handedness Inventory score  $> 0.85$ ), participated in this study.
- Each subject completed 5 experimental blocks of 100 unsupported reaching trials in VR.
- x1.5 and x2 visual amplification in the 2nd and 4th blocks (counter balanced sequence order across subjects).

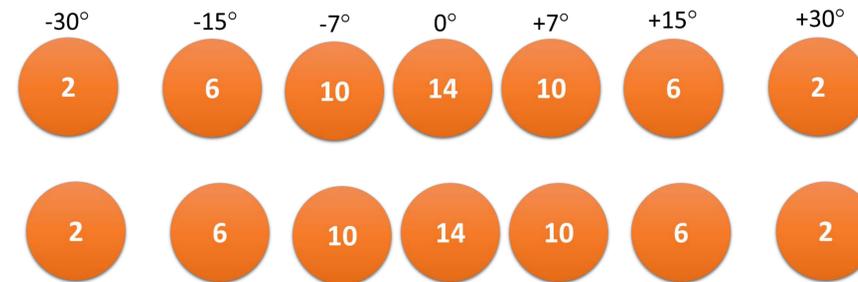


Figure 2 Targets Locations and Frequency for Each Block

## CONCLUSIONS

- The frequency of the right-hand usage was found to significantly increase under  $\times 1.5$  amplification ( $72.0\% \pm 6.0\%$ ) from baseline ( $61.6\% \pm 4.3\%$ ) ( $p = 0.028$ ), but not under  $\times 2$  amplification ( $65.9\% \pm 6.1\%$ ).
- Our findings support our hypothesis that visual amplification of the hand movements could affect the choice of the limb during functional activities.
- Our results also suggest that the level of amplification should be carefully selected, since the excessive degree of visual amplification of the movement may not be able to encourage the arm use, as observed in the  $\times 2$  amplification condition.
- Virtual reinforcement of the arm/hand movements in VR may have the potential to promote positive change in limb selection process for the stroke population.

## METHODS

### Visual amplification of hand movements

- Calculation for avatar's hand's position in VR ( $\times 1.5$  amplification level to the right hand)

$$X_v = (x_r - x_s) \times 1.5 ; y_v = (y_r - y_s) \times 1.5 ; z_v = (z_r - z_s) \times 1.5$$



Figure 1 Visual Amplification of Hand Movements in VR

- (A) Two avatar's hands reach for one target in VR
- (B) Hand positions in real world, without visual amplification
- (C) Hand positions in real world, with  $\times 1.5$  visual amplification to right hand

## METHODS & RESULTS

- The percent of right-hand use was used to characterize subjects' hand selections
- One-way within-subjects ANOVA and post hoc comparisons with Bonferroni correction were used to examine the difference of hand selection choices across conditions (SPSS version 25; IBM Corp.) with a significance level of  $p < 0.05$ .

Table 1 Right-Hand Use Percentage Results

Blocks	Percent of Right-Hand Use
Baseline	$61.6\% \pm 4.3\%$
Under $\times 1.5$ Amplification	$72.0\% \pm 6.0\%*$
Under $\times 2$ Amplification	$65.9\% \pm 6.1\%$

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