Predicting the behavior of each individual: kinematic parameters during sensorimotor adaptation determine the magnitude of interlimb transfer and after-effects in right- and left-handers

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Introduction

Humans can adapt their reaching behavior to various perturbations such as prismatic deviations, visuomotor rotations or novel limb dynamics. Recent research has studied the transfer of short-term adaptation between the arms (Kitazawa et al. 1997; Criscimagna-Hemminger et al. 2003; Malfait & Ostry 2004; Seidler 2010) and revealed the existence of an effector-specific motor representation and, in smaller proportions, of a more general, effector-independent representation (Wang & Sainburg 2003; Vangheluwe et al. 2006; Joiner et al. 2013; Lei & Wang 2014).

Despite these recent advances, one question remains: can we predict how each individual adaptation will generalize?

Here, we investigated whether inter-individual differences may determine the heterogeneity of findings on transfer of learning. Based on previous work (e.g., Lefumat et al. 2015), we hypothesized that kinematic parameters such as movement speed and variability could determine the interlimb transfer of prism adaptation.

Methods

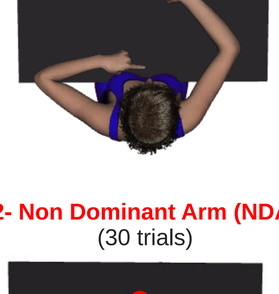
Young adults had to reach 'as fast and as accurately as possible' toward flashed visual red targets, with the dominant and the non-dominant arm, before, while and after they wore prisms.

Prisms deviated the visual field by 17.1 deg. rightward.

Experimental Conditions

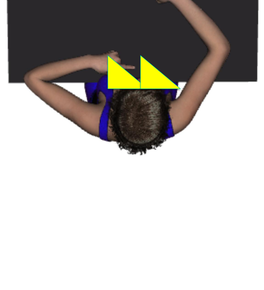
Pre-adaptation

1- Dominant arm (DA)
(30 trials)



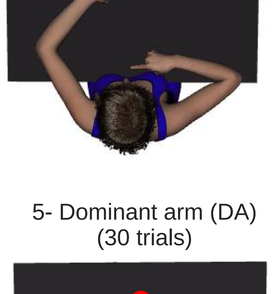
Prism adaptation

3 - Dominant arm (DA)
(100 trials)

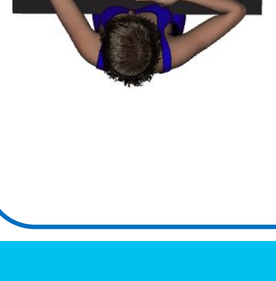


Post-adaptation

4- Non Dominant arm (NDA)
(30 trials)



2- Non Dominant Arm (NDA)
(30 trials)

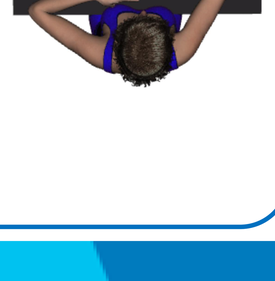


N=20, mean age: 24 years

13 males and 7 females

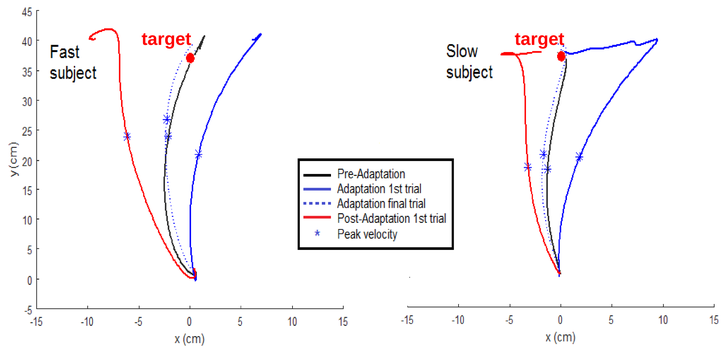
12 right-handers
and 8 left-handers
according to Oldfield (1971)

5- Dominant arm (DA)
(30 trials)



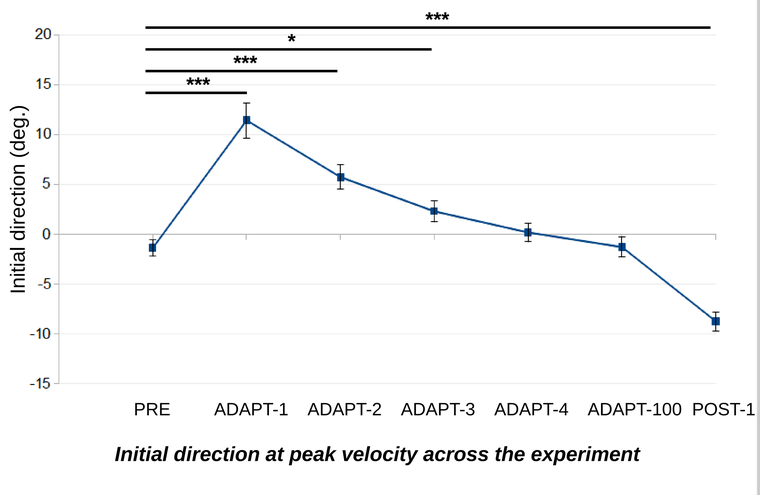
Results

1- Adaptation (Dominant Arm)



Top views of hand paths for 2 representative subjects

Mean movement time = 435 ± 103 ms ; Mean peak velocity = 3.1 ± 0.8 m/s

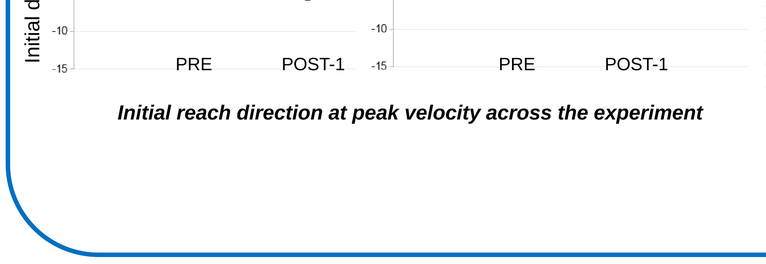


Initial direction at peak velocity across the experiment

2- Generalization across movement direction (Dominant Arm)

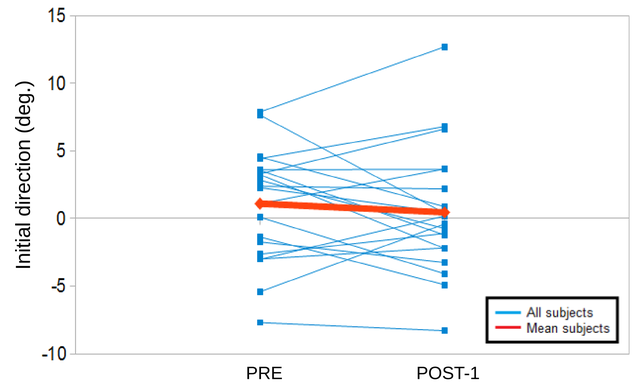
Adaptation of reaching toward the central target influenced reaching toward lateral targets.

Left target (-20 deg.) ***Right target (20 deg.)***



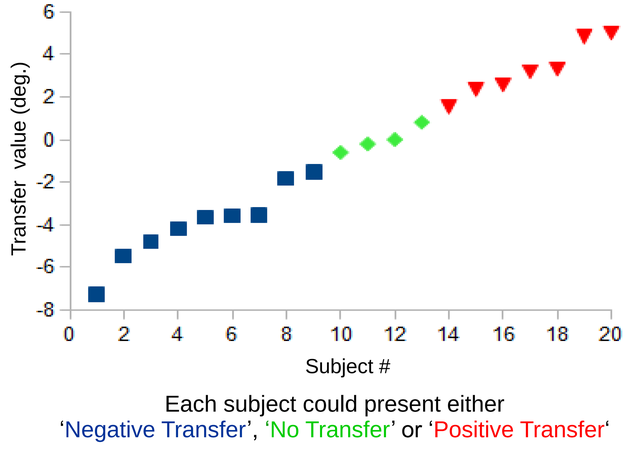
Initial reach direction at peak velocity across the experiment

3- Interlimb transfer (Non Dominant Arm)

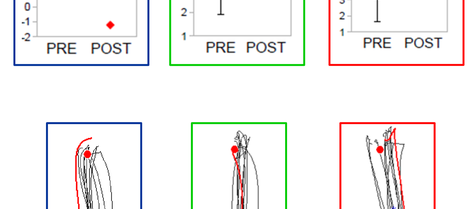


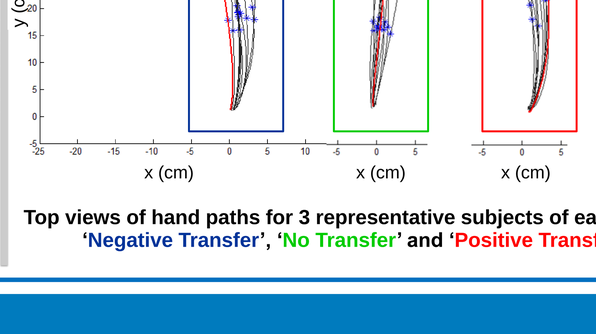
No significant transfer on average (t=0.8; p=0.43) but large heterogeneity across subjects

Transfer value = initial direction POST-1 – initial direction PRE



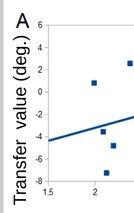
Each subject could present either
'Negative Transfer', 'No Transfer' or 'Positive Transfer'





Top views of hand paths for 3 representative subjects of each class: 'Negative Transfer', 'No Transfer' and 'Positive Transfer'

4- Predi



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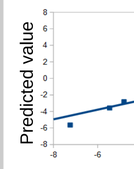

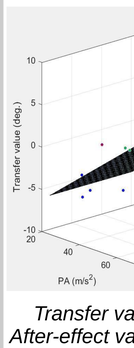

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