doi:10.1093/brain/awy309 BRAIN 2019: 142; 1–2 | e2

BRAIN
A JOURNAL OF NEUROLOGY

LETTER TO THE EDITOR

Reply: Further evidence for a non-cortical origin of mirror movements after stroke

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Sir,

In their letter, Calautti *et al.* (2018) quantify post-stroke mirror movements in the affected and unaffected hands in a cohort of patients with subcortical damage. The authors provide complementary evidence to that provided by Ejaz *et al.* (2018), who showed that post-stroke mirror movements are uncorrelated with activities in the contra- and ipsilateral sensorimotor hemispheres, and thus suggested that mirror movements might have a subcortical origin. Post-stroke mirror movements have previously been conjectured to arise due to changes in transcallosal interactions between sensorimotor areas. Interhemispheric competition models have been prominent as an explanatory framework for hemiparesis and its recovery. Mirror movements provide an alternate behavioural measure that can be used to test and challenge this framework. As authors of the original article (Ejaz *et al.*, 2018), we welcome the independent evidence provided here in support of our argument for a subcortical origin of mirror movements. We only have a few minor comments.

In their paradigm, the authors only tested the index fingers on either hand. While only testing homologous fingers across hands is sufficient to quantify mirror movements, we would suggest that authors point out to the reader that mirror movements do in fact appear in both homologous and non-homologous fingers (see Figs 4 and 5 in Ejaz *et al.*, 2018). As we point out in our original article, the notion that mirroring primarily appears on homologous fingers is a misconception that consistently appears in existing literature.

While mirror movements are typically studied in the non-paretic hand during paretic hand movement, we are glad that the authors tested mirroring in paretic hand during non-paretic hand movements as well. This is another important point that is rather ignored in the literature. Mirroring in the paretic hand was previously reported by Nelles *et al.* (1998), where they found it slightly reduced. We also quantified mirror movements in the paretic hand and found that they were reduced in comparison to both the non-paretic hand, as well as healthy controls. While the results are available in the original preprint (https://www.biorxiv.org/content/early/2017/04/22/129510), we chose not to include it in the published article because of lack of space. Interestingly, the results in this study are slightly at odds with what both we and Nelles *et al.* report.

Overall, the authors provide further evidence that mirror movements reflect the disruption of a bilaterally organized subcortical system after stroke. While we agree that such a system could in theory exist at the level of the spinal cord,

we argue that the bilaterally organized pathways in the brainstem are the most likely candidates.

Data availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Funding

No funding was received towards this work.

Competing interests

The authors report no competing interests.

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