



A commentary on Eaves et al. with a special focus on clinical neurorehabilitation

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Received: 21 June 2023 / Accepted: 20 November 2023
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Abstract

We very much appreciate the theoretical foundations and considerations of AO, MI, and their combination AO+MI by Eaves et al. In their exploratory review, the authors highlight the beneficial effects of the combined use of AO and MI, with a particular focus on synchronous AO and MI. From a neurorehabilitation perspective, different processes may apply to patients, particularly after a stroke. As suggested by Eaves et al., the cognitive load might prevent the use of synchronous AO+MI and the asynchronous application of AO and MI might be indicated. Furthermore, some aspects should be considered when applying AO+MI in rehabilitation: screening for the patients' cognitive capabilities and MI ability, and a familiarisation programme for AO and MI, before starting with an AO+MI training. With their review, Eaves et al. propose a number of research questions in the field of neurorehabilitation that urgently need to be addressed: the use of asynchronous vs. synchronous AOMI, observation and imagination with or without errors, or use of different MI perspectives and modes in different learning stages. This commentary provides some additional suggestions on patients' MI ability and cognitive level, MI familiarisation and detailed reporting recommendations to transfer Eaves et al. findings into clinical practice.

In their recently published comprehensive and informative review, Eaves et al. (2022) highlight the beneficial effects of the combined use of action observation (AO) and motor imagery (MI) in healthy individuals or athletes and in rehabilitation. We very much appreciate the theoretical foundations and considerations with a particular focus on synchronous AO and MI in light of the current state of research in this field. Since previous reviews about MI during AO (Eaves et al., 2016; Vogt et al., 2013), there has been an encouraging increase in the number of publications on the various possible applications of the combination of the two methods. The current review also covers a variety of examples of how MI and AO can complement and interact with each other across different user groups: be they beginners

of a motor skill to be acquired, advanced learners, or in the course of rehabilitation. The authors additionally review empirical evidence for the advantage of AO+MI, different forms of applications and models of AO+MI with regard to observing errors and mixed-skill models, the potential effectiveness of variable AO+MI scenarios, using AO as surrogate in MI in case a visual feedback is not available, factors moderating the effectiveness of AO+MI, the spectrum of AO+MI states and the differences and similarities in the underlying neurocognitive processes: the Dual Action Simulation hypothesis with regard to AO+MI. However, coming from a more clinical background, we would like to add some thoughts from that perspective.

An almost incidental mention, but a very important tool is indeed the glossary that Eaves and colleagues have compiled. It supports the correct and consistent use of terminology related to AO, MI and AOMI and aims to help clinicians more easily understand research findings and translate it into everyday practice. As part of our efforts in the latter, we also could find a positive effect of combined AOMI on motor learning in patients and healthy individuals in our own ongoing systematic review and meta-analysis. The studies analysed so far support a beneficial effect on the acquisition of motor skills, for example in children with Developmental Coordination Disorders (Marshall et al., 2020; Scott et al.,

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2019, 2020) and patients after a stroke (Binks et al., 2023). There is also first evidence for patients with Parkinson's disease indicating that home-based AO + MI training using mobile technology is feasible and may have a beneficial effect (Bek et al., 2021).

Treatments in neurorehabilitation often involve a series of activities and exercises that the therapist presents to the patient one or more times before the patient performs them physically. In their Cochrane Review, Borges et al. (2018) found only a very small effect of pure AO on upper limb motor function that even did not persist after a 6 month follow-up period in stroke survivors. Here, real and video presentations were used as the AO method, with one or more trials in various combinations with physical performance, e.g. 1 min of observation combined with 2 min of physical performance for a total of 5–10 min. Indeed, it would be helpful to have some form of MI component available as an option for treatment to potentially enhance the effect. It is likely that some patients will spontaneously use MI during AO. However, MI instruction certainly has the potential to positively influence the therapy of those patients, who do not spontaneously use MI.

Certainly, as suggested by Eaves et al. (2022), it should be considered that the increased cognitive load may limit the use of synchronous AO + MI in certain user groups (Di Rienzo et al., 2019; Emerson et al., 2022) arguing for an asynchronous application of AO and MI in certain cases. Depending on MI ability and experience, it might moreover be beneficial to use AO alone or followed by MI in the first phase of rehabilitation, as it is less cognitively demanding (Emerson et al., 2018). Furthermore, age is certainly an important factor to consider in this context. (de Vries & Mulder, 2007) and (Gäumann et al., 2021) investigated age as a factor influencing MI ability and in both papers, the authors stated that with higher age (65 years or older), MI ability might decrease. Thus, in relation to age or as a consequence of brain injury, healthy older individuals and patients should be screened for cognitive decline. Further, from a neurorehabilitation perspective, assessment of MI ability is also essential before MI intervention begins. Recent evidence supports the benefits of assessing it in advance (Yasui et al., 2019). In our patient studies, we always apply a battery of MI ability assessments with our patients, e.g. the Body Rotation Task, Mental Chronometry, and a subjective MI questionnaire (Suica et al., 2022). Here, the subjective MI questionnaires already use AO as part of the evaluation process. To assess the different components of MI ability, such as generation, maintenance and manipulation, and to decide how to proceed with treatment, it is advisable to use multiple measures (Krautner et al., 2020).

There are two further important aspects to consider when using combined AO + MI: First, depending on the cognitive status, one or more familiarisation sessions might be

conducted to familiarise healthy individuals or especially patients with the interventions (Wondrusch & Schuster-Amft, 2013). In our experience, this procedure can help patients learn about the interventions' mechanisms of action, its effect, and how it could be used with or without supervision. Second, structured reporting of intervention methodology would facilitate the transition from research to clinical rehabilitation routine. Here, the suggested PETTLEP model (Holmes & Collins, 2001) or the overview of training elements by Schuster et al. (2011) could provide a reporting guide, e.g., position, location, perspective, mode, presenting angles. In addition, a detailed reporting would help to verify research findings. Possible tools to assess the cognitive status would be the Mini-Mental Status Exam (Folstein et al., 1975) and the Montreal Cognitive Assessment (Nasreddine et al., 2005).

Finally, Eaves and colleagues propose a portfolio of research questions in the field of neurorehabilitation that urgently need to be addressed: the use of asynchronous vs. synchronous AOMI, the observation and imagination with or without errors, or the use of different MI perspectives and modes in different learning stages. We look forward to the results of methodologically sound randomised controlled trials that address the above examples of AOMI in clinical neurorehabilitation, particularly in stroke rehabilitation. In our view, AO + MI has the potential to be part of routine treatment in neurorehabilitation, but it has not yet found its way into clinical practice. Screening of patients' cognitive level, MI ability and familiarisation and, more importantly for reproducibility, structured reporting of all aspects of the AOMI sessions or training are strongly recommended.

Author contributions The manuscript text was written by both CSA and FB.

Funding Open access funding provided by University of Basel. No funding was received to assist with the preparation of this manuscript.

Availability of data and materials Not applicable.

Declarations

Conflict of interest Both authors have no competing interests to declare that are relevant to the content of this article.

Ethical approval Not applicable.

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