Action verbs understanding are slowdown by sensorimotor restriction

Sophie-Anne Beauprez
University of Poitiers

Introduction

Following an embodied view of cognition (Barsalou, 1999), several experiments have shown a cross-talk between action and action-words processing (see Fischer & Zwaan 2008 for review). A dominant hypothesis to explain the link between action and action words processing is related to the fact that both activities could be based on the activation of similar motor representations (Bidet-Ildei, Sparrow, & Coello, 2011). Thus, if language and action are related because of the evocation of common sensorimotor representations, one might think that sensorimotor restriction will affect action words processing. Indeed, by using short-term upper-limb immobilization recent studies have shown that a brief period of sensorimotor restriction (12 to 48 hours) is sufficient to obtain cortical plastic changes as well as functional or behavioral alterations (Bassolino, Bove, Jacono, Fadiga & Pozzo, 2012). For example, 24 hours of hand immobilization affected the cognitive representations of upper limb movements, as confirmed by delayed response times in a hand mental rotation task, which is known to trigger sensorimotor memories of hand movements (Toussaint & Meugnot, 2013). Therefore, given that sensorimotor representations are affected by short-term limb immobilization, we can hypothesized that action words processing should be disrupted by a brief period of sensorimotor restriction. To assess this assumption, we tested whether upper limb immobilization affects the performance of a semantic decision task consisting of action verbs that mainly involve movements of the hands or feet.

Method

We compared performances on thirty-two participants during 2 experimental sessions with a 24-hr interval between sessions (pre-test and post-test). They were divided in two groups of sixteen participants: a control group and an immobilized group. The immobilized group performed the task before (pre-test) and immediately after (post-test) the immobilization of the right upper-limb of the participants whereas the control group did not undergo the immobilization procedure. Each session consisted on a semantic decision task. A verb appeared on a screen and participants had to decide whether it described movements performed mainly with the upper-limbs (e.g., write, cut, clap) or with the lower-limbs (e.g., pedal, run, jump). Accuracy and response time were recorded for each trial.

We made the assumption that the effector-induced effects of short-term upper limb immobilization (Meugnot, Agbangla & Toussaint, 2016; Meugnot, Almecija & Toussaint, 2014) should manifest specifically for judgments of hand-action verbs without disrupting judgments of foot-action verbs. Thus, we expected delayed response times for hand-action verbs for the immobilized group

compared with the control group.

Results

The analysis of accuracy only revealed an improvement from pre-test to post-test. However, the analysis of response times showed shorter response times for the hand-action verbs than for the foot-action verbs for the control group both in pre-test and post-test as well as for the immobilized group in pre-test. However, this difference between the judgments of hand and

foot action verbs disappeared for the immobilized group in post-test. Moreover, the performance improvement between the pre-test and post-test (IPI = [response time in pre-test – response time in post-test/response time in pre-test) was equivalent for hand and foot action verbs in the control group whereas performance improvement was lower for the hand-action verbs than for the foot-action verbs in the immobilized group (see figure 1).

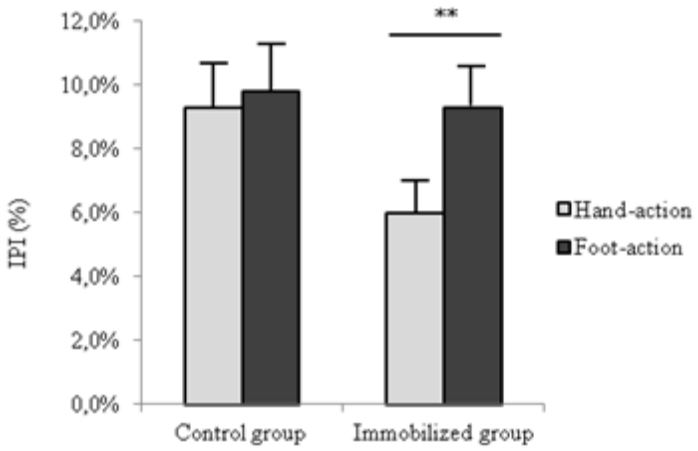

Fig. 1 – Index of Performance Improvement (%) according to group (control / immobilized) and action verbs (hand-action / foot-action). The error bars indicate the standard error of the mean. Asterisks** indicate a significant difference with $p<0.01$.

Conclusion

Overall, this study showed that sensorimotor restriction disturbs action verbs processing. Importantly, our findings show that short-term upper limb immobilization specifically affect the processing of hand-action verbs with less progress between pre-test and post-test. This confirms that 24 hours of sensorimotor restriction has an effect on specific body parts (Meugnot et al., 2016).

These findings clearly corroborated previous studies which show that sensorimotor representations are directly involved during action words processing relating with an activation of “mirror system” (Andres, Finocchiaro, Buiatti, & Piazza, 2015). Moreover, it demonstrates for the first time that 24 hours of limb immobilization is sufficient to modify action verbs processing confirming the embodied view of cognition.

References

Andres, M., Finocchiaro, C., Buiatti, M. & Piazza, M. (2015). Contribution of motor representations to action verb processing. *Cognition*, 134, 174–84. http://doi.org/10.1016/j.cognition.2014.10.004

Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral Brain Sciences,* 22(4), 577–609; discussion 610–60.

Bassolino, M., Bove, M., Jacono, M., Fadiga, L. & Pozzo, T. (2012). Functional effect of short-term immobilization: kinematic changes and recovery on reaching-to-grasp. *Neuroscience,* 215, 127–34. http://doi.org/10.1016/j.neuroscience.2012.04.019

Bidet-Ildei, C., Sparrow, L. & Coello, Y. (2011). Reading action word affects the visual perception of biological motion. *Acta Psychologica (Amst),* 137(3), 330–4. http://doi.org/10.1016/j.actpsy.2011.04.001

Fischer, M. H., & Zwaan, R. A. (2008). Embodied language: a review of the role of the motor system in language comprehension. *Quarterly Journal of Experimental Psychology (Colchester),* 61(6), 825–50.

Meugnot, A., Agbangla, N.F. & Toussaint, L. (2016). Selective impairment of sensorimotor representations following short-term upper-limb immobilization. *Quarterly Journal of Experimental Psychology* (2006), 1–9. http://doi.org/10.1080/17470218.2015.1125376

Meugnot, A., Almecija, Y. & Toussaint, L. (2014). The embodied nature of motor imagery processes highlighted by short-term limb immobilization. *Exp Psychol,* 61(3), 180–6. http://doi.org/10.1027/1618-3169/a000237

Toussaint, L. & Meugnot, A. (2013). Short-term limb immobilization affects cognitive motor processes. *Journal of Experimental Psychology: Learning Memory & Cognition,* 39(2), 623–32. http://doi.org/10.1037/a0028942