

# Motor simulation induced by the semantic context modulates the relationship between action verbs and the perception of biological human movements

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## Introduction

Embodied theories argue that language, abstract and symbol processing emerge from sensorimotor experience (Barsalou, 1999). A growing amount of evidence supports this theoretical framework by demonstrating clear cross-talk between action words understanding and production or visual perception of human movements. For example, several studies have shown that the presentation of an action word or an action sentence influences motor control (e.g., Boulenger et al., 2006) or the detection of a human movement (Bidet-Ildei, Sparrow & Coello, 2011). Moreover, concerning the relationship between action perception and action language processing, several experiments have shown that brain regions involved in perception of human movements are also recruited to process action words (Khader, Jost, Mertens, Bien & Rosler, 2010; Tettamanti et al., 2005). This finding suggests that the activation of common motor representations is at work in both tasks (Andres, Finocchiaro, Buiatti & Piazza, 2015; Bidet-Ildei *et al.*, 2011; Bidet-Ildei & Toussaint, 2015). However, to date the cognitive mechanism connecting the judgment of action-words and the observation of human movements has not been clearly identified. Specifically, an unresolved question is whether possibility of motor simulation can influence the relationship between action words understanding and perception of human movements. To our knowledge no behavioral study has specifically tested this hypothesis and it is the aim of the present work. We addressed this question by investigating how the visual judgments of point-light human actions varied with the action-verbs semantic context that implies either possible (e.g., “the football player is running on the field”) or impossible (e.g., “the field is running on the football player”) actions.

## Method

Twenty-five participants had to judge the presence or absence of a point-light human action in a whole image of moving dots (detection task) as quickly and accurately as possible. The visual stimulus contained either a human action (running, throwing) or only scrambled moving dots (scrambled running, or scrambled throwing) embedded in a dynamic mask of 55 dots. Before the stimuli presentation, participants had to listen to a sentence that contained an action-verb presented in a motor possible or impossible semantic context.

## Results

In accordance with previous works, analysis of detection capacities (i.e.,  $d'$  prime values) demonstrated that the oral presentation of congruent action verbs facilitates the subsequent detection of point-light human movements. However, this effect decreased when action verbs were embedded in a motor impossible semantic context. Moreover, analysis of response times revealed that time differences between congruent and incongruent conditions appear only when action verbs were presented in motor possible sentences.

## Discussion

The present findings confirm that the semantic context associated with the action verb affects the relationship between action verbs understanding and human action perception (Troyer, Curley, Miller, Saygin & Bergen, 2014). More importantly, this study demonstrates for the first time that the possibility to engage motor simulation emphasizes the relationship existing between action verbs processing and perception of human movements. The action verb presentation activates automatically an action representation that can improve the subsequent perception of human movement. However, action observation and action verbs understanding are also related through a mechanism of motor simulation that is dependent on the semantic context associated with the presentation of action words. These findings emphasize embodied theories by revealing that action perception and action verbs processing share common motor mechanisms through the involvement of linguistic context.

## References

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