Contenuto archiviato il 2024-06-18

Cognitive and neural representations of action in temporally coordinated behaviour

Rendicontazione

Informazioni relative al progetto

ACTION COORDINATION

ID dell’accordo di sovvenzione: 254419

Progetto chiuso

Data di avvio
1 Settembre 2010

Data di completamento
31 Agosto 2012

Finanziato da
Specific programme "People" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)

Costo totale
€ 162 248,80

Contributo UE
€ 162 248,80

Coordinato da
STICHTING RADBOUD UNIVERSITEIT
Netherlands

Final Report Summary - ACTION COORDINATION (Cognitive and neural representations of action in temporally coordinated behaviour)

Project Summary

Cognitive and neural representations of action in temporally coordinated behaviour.

Marie Curie Incoming International Fellowship, Project No. 254419

Many common behaviours such as moving a table, rowing a boat, or producing music require people to coordinate their actions with each other. Researchers have only begun to investigate the mechanisms of perception, action, and cognition that support these types of joint action. It has been suggested that the activation of mental representations of others’ actions may underlie successful joint action (Knoblich, Butterfill, & Sebanz, 2011). Researchers have demonstrated the activation of common representational structures when two people take turns acting or work together to reach a common goal. However, it has also been argued that common representational structures need not be activated for successful joint action in which movements are coordinated in time. Instead, coordination in time may be explained by general dynamical principles that govern coordination between oscillating systems (Marsh, Richardson, & Schmidt, 2009). The research program had two major objectives: first, to determine whether representations of a partner’s actions are activated in temporally coordinated action, and second, to determine which specific components of partners’ actions are represented during coordinated action.

Three studies were carried out over the course of the project. The first two used experimental analogs of duet music performance, which requires precise temporal coordination between performers, each of whom produces a separate musical sequence, to address the project’s major objectives. Study 1 (Loehr, Vesper, Kourtis, Sebanz, & Knoblich, 2013) investigated whether people engaged in duet music performance represent their co-performer’s part of the performance. Pairs of experienced pianists were recruited to perform musical duets together. During the performances, the pitches produced by each pianist’s keystrokes were occasionally altered so that an incorrect (unexpected) pitch was produced. Both performers’ brain activity was recorded using electroencephalography (EEG). Participants’ brain responses to the incorrect pitches showed that they monitored both their own and their partner’s parts of the performance. Importantly, incorrect pitches that affected the shared goal of the joint action (i.e. the musical harmony created by the performers’ combined pitches) elicited stronger brain responses than incorrect pitches that did not affect the shared goal. These findings indicate that people do indeed form representations of their partner’s part of a joint action, and suggest that the shared goal of a joint action is perceived as more significant than either person’s individual part of the joint action.

Study 2 (Loehr & Vesper, in preparation) investigated whether novices form representations of the shared goal of a joint action (e.g. a musical duet) or only of their individual goals (e.g. their part of the duet). Ninety-six novices with no piano performance experience participated in three experiments. Each experiment employed a transfer-of-learning paradigm in which the novices first learned to perform simple melodies while coordinating with an accompanist to produce musical duets. They then performed their previously-learned actions while hearing either the shared goal (the duet) or their individual goal (the melody). Participants made fewer errors when transferring to conditions in which the shared goal was heard, indicating that representations of the shared goal are stronger than representations of individual goals.

Study 3 (Loehr, 2013) addressed a novel research question stemming from the results of Study 1: how do people who represent both their own and their partner’s part of a joint action nevertheless maintain a distinction between their own and their partner’s parts? One mechanism thought to underlie a self-other distinction is sensory attention, whereby brain responses to the sensory consequences of one’s own actions are reduced compared to other sensory events. In Study 3, 24 pairs of participants coordinated their button presses with a partner to produce single tones. Brain responses, recorded using EEG, were attenuated only when there was no delay between the participant’s button press and tone onset. These findings indicate that people use information about the timing of their actions to differentiate between their own and another person’s contributions to a joint action at the sensorimotor level.

Taken together, these findings contribute significantly to our understanding of the cognitive and neural mechanisms that support joint action. This has implications for researchers and innovators in fields such as human-computer interaction and artificial intelligence, which rely on knowledge about the mechanisms underlying interpersonal coordination to create more naturalistic human-robot interactions. More generally, an increased understanding of the mechanisms underlying joint action has the potential to enhance people’s ability to coordinate goals and work well together, both of which are critical to the healthy functioning of society.

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Ultimo aggiornamento: 8 Luglio 2014

Permalink: https://cordis.europa.eu/project/id/254419/reporting/it

European Union, 2025