Immediate action-effects facilitate response speed via stimulus-response association

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Introduction

Immediate action-effects to response could motivate the same response in the following trials. This effect depends on contiguity[1,2] and contingency[3] between action and effect.

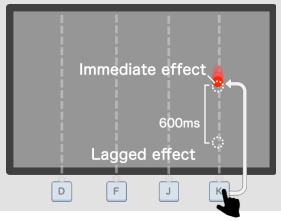
➡ **The underlying mechanism of these faciliatory effects remain unclear.**

Previous studies suggested the presence of action-effects reinforce an action because it has value as control feedback evidencing control over the environment.

◎ Response task in Eitam et al. (2013)

Participants pressed key corresponding to the location of cue stimuli, presented at random intervals, as quickly as possible.

Participants reacted faster when perceptual effects (disappearance of the cue) followed keypresses immediately, rather than 600 ms after.



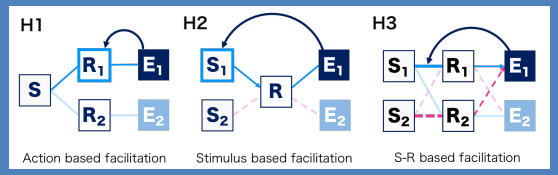
Research Question & Hypotheses

What process is reinforced by action effects?

H1 : Action based facilitation
Action-effects facilitate the execution of specific motor movements which caused the effects.

H2 : Stimulus based facilitation
Action-effects facilitate responses to specific stimuli associated with the effects (i.e., predictors of effects).

H3 : S-R based facilitation
Action-effects facilitate the responses involved in specific stimulus-response combinations associated with the effects.



Conclusion | Results support H3

In Exp. 4, the identical actions were performed faster when driven by stimuli associated with immediate effects, than when driven by stimuli associated with lagged effects.

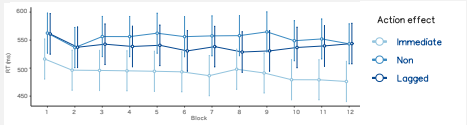
➡ This result could not be explained by changes in motor parameters to execute specific actions.

Given Exp. 2 rejected the stimulus based facilitation as well, immediate action-effects might facilitate response via S-R, but not via independent processes of actions or stimuli.

Exp. 1 The replication of Eitam et al. (2013)

Between-participants design (N = 72, M_{age}=21.3±2.7)
Participants' key presses caused immediate, 600 ms lagged, or no feedbacks (action effects) after actions. Effects occurred regardless of the accuracy of the keypress.
Exp. 1 consisted of 12 blocks of 40 trials.

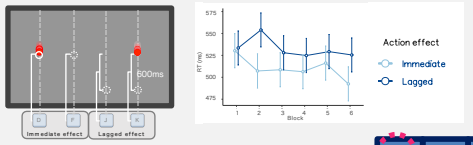
A 3 (immediate vs. lagged vs. no) × 12 (blocks) two-way mixed ANOVA revealed **shorter RTs in immediate condition.**
(F[2, 65] = 4.514, p = .015, partial η^2 = 0.122, BF_{10} = 3.868)



Exp. 2 Are effect-associated actions facilitated?

Within-participants design (N = 24, M_{age}= 20.75 ± 1.66)
The target disappeared immediately after pressing two out of four response keys, and 600 ms after pressing other keys.
Exp. 2-4 consisted of 6 blocks of 80 trials.

A 2 (immediate vs. lagged) × 6 (blocks) two-way mixed ANOVA revealed **shorter RTs in immediate condition.**
(F[1, 19] = 5.343, p = .032, partial η^2 = 0.220, BF_{10} = 147.437)



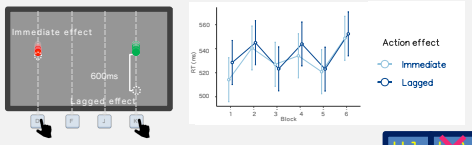
* The cues appeared one by one in the task.

H1 H2 H3

Exp. 3 Are responses to effect-associated cue facilitated?

Within-participants design (N = 24, M_{age}= 20.79 ± 1.89)
Red or green cue stimuli randomly appeared. Keypresses for the cues with one color caused immediate effects, and those for the other color caused lagged effects.

A 2 (immediate vs. lagged) × 6 (blocks) two-way mixed ANOVA revealed **no effect of action effect cues.**
(F[1, 19] = 1.040, p = .321, partial η^2 = 0.052, BF_{10} = 0.187)

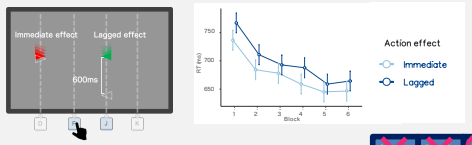


H1 ~~H2~~ H3

Exp. 4 Are effect-associated S-R facilitated?

Within-participants design (N = 24, M_{age}= 21.08 ± 4.59)
Participants pressed keys corresponded to the *next* location, in the direction from which right or left arrows appeared. Responses to cues in one direction caused immediate effects, whereas those in the other direction caused lagged effects.

A 2 (immediate vs. lagged) × 6 (blocks) two-way mixed ANOVA revealed **shorter RTs in immediate condition.**
(F[1, 21] = 4.718, p = .042, partial η^2 = 0.191, BF_{10}= 58.940)



Identical actions were executed.

~~H1~~ ~~H2~~ H3

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