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IS ENACTMENT A POTENTIAL MEDIATOR OF FALSE MEMORY CREATION CAUSED BY OBSERVATION INFLATION?

J. Talawanich*, B. Martín-Luengo, A. Dolgoarshinnaia
jakkarin.tala@gmail.com
Centre for Cognition and Decision Making, Institute for Cognitive Neuroscience, HSE University, Moscow

Abstract. Observing the actions of other people may lead to the false memories of having performed the action oneself. One potential way to mitigate this phenomenon is enactment, in which people perform physical actions along with the information to be learned. This study explores whether the enactment effect moderates the false memories created by the observation inflation effect. Participants had to read sentences, mimic the actions, and then watch videos of actors performing those or other actions. One expectation was that the false memories created by the observation inflation effect would decrease when the action simulation to be performed differed from the video's content. Another was that the accuracy of the source monitoring test would be better for the performed actions compared to the actions which participants only read in a statement. We found significant differences between simulating the same action shown in videos and different ones. For the read condition, participants gave erroneous answer "I performed it" less frequently when they performed the action that was different from the one they were observing. Moreover, the enactment effect increased memory performance. This research highlights the importance of the enactment effect in mitigating observation inflation and improving memory performance, which has implications for the fields of neuroscience and psychology.

Keywords: false memory, observation inflation paradigm, action memory, enactment effect, action simulation

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Introduction

The phenomenon known as observation inflation occurs when people incorrectly remember performing actions that they actually only witnessed being performed by someone else (Lindner et al., 2010), leading to the creation of false memories. A proposed solution to reduce observation inflation is for a person to perform movements that are different from what is observed (Wang et al., 2021). This action simulation during observation may help individuals to distinguish between their own actions and those being observed (Lindner et al., 2010). It has been suggested that the enactment effect will lead people to remember actions that they have performed better than those they have simply watched (Lindner

et al., 2010). This effect might also improve memory performance in source monitoring, which involves remembering the origin of information (Hornstein, Mulligan, 2004). It is not simply the motor or sensory processes involved in physically enacting an event that contribute to the enactment effect, but also the cognitive processes involved in integrating and binding various components of the event in memory. These processes involve executive control, which helps individuals to allocate their attention and resources strategically to different aspects of the task (Kuhlmann, Bayen, 2016; Hornstein, Mulligan, 2004; Mulligan et al., 2022). In the present research, we tested the hypothesis that false memories created by the observation inflation paradigm would be reduced when people perform an action different from that observed in the video. Also, the accuracy of the source monitoring test (participants have to determine the source of the memory, in our case whether they performed the action or simply read the action statement) would be better for statements of actions that were performed compared to statements that were only read. This study used an experiment based upon Lindner et al.'s (2010) "observation inflation effect" experiment, but including testing conditions for both performing the same action and performing different actions. Additionally, we also explored the impact of the enactment effect on memory performance for both performed statements and read statements.

Method

Thirty-three participants (27 females; M_{age} = 21, SD = 2 years) who were recruited through social media took part in the study. The experiment was programmed in E-Prime 2.0 software. A prior analysis based on the experiment by Wang et al. (2021) was conducted in GPower (version 3.1) and determined the sample size to be twenty-six people (medium effect size = .38, power = .95, and alpha = .05).

The experiment used a within-subject design of 2 "Encoding methods" (Read vs. Perform) × 4 "Observing methods" (same vs. different vs. only observation vs. nothing given). For the observing methods, participants watched a video and did or did not perform various actions. "Same" involved participants performing the same action as in the video; "different" referred to them performing an action from the one in the video, "only observation" involved participants performing no action and no reading while watching the video, and "nothing given" referred to no videos being presented.

The procedure designed for the observation inflation effect comprises three phases and requires prior preparation (see Figure 1). On the table where participants completed the experiment, in addition to the computer, a range of different items was displayed. In Phase 1 (encoding phase), participants were asked to watch a fixation mark "+" on the computer screen for 500 ms followed by a statement presented for 10 s which asked participants to pick up a particular item. Next, the screen showed statements (10 s) instructing participants to read or enact an action (for example: "please read: open the book"; "please enact: open the book"). A total of 40 statements were randomly shown on the screen, from which 20 actions had to be performed, and 20 had to be read. The statements were counterbalanced across the two conditions in Phase 1. After each statement was

shown, the participant was asked to rate his or her Judgment of Learning (JOL). JOL referred to how confident the participant was about being able to recall the statement later, and specifically if they thought they would be able to remember that they "read" or "read and enacted" the action statement.

Before starting Phase 2, participants were asked to leave the experiment room for five minuntes to allow the experimenter to remove all items from the table. During the second phase, participants were required to mimic the actions, without any items, while watching a video. First, a fixation mark "+" was shown on the screen for 500 ms, and then the participants read a statement for the action they needed to perform during the video presentation for another 500 ms. Following this, a video demonstrating the full action was shown on the screen for 20 s. The videos that were shown in each condition included five videos depicting actions that had been enacted in Phase 1 and another five depicting actions that had been read in Phase 1. Under the "same" condition, participants were presented with ten action statements followed by videos of the action statements. All of the statements had to be performed while watching the videos, with the statement describing the same action as in the video. Under the "different" condition, the participants were presented with ten action statements, followed by videos of the action statements; in this case, the statements to be performed were different from the actions in the videos. For example, the action statement in the video might be "fold the paper", but participants had to "rotate their hands around each other". Under the "only observation" condition, participants were presented with ten videos and were only required to watch the video without performing any action. Under the "nothing given" condition, no action statements or videos were given to the participants, and participants did not experience any stimuli. All conditions were counterbalanced to control for order effects.

Two weeks later, the participants engaged in Phase 3 (recognition phase). In this phase, 80 action statements were presented. These included 40 statements presented in the first phase and 40 new statements that were added as distractors. Participants were first presented with a statement and asked to answer whether they had only read about the action or both read and performed the action in the first phase, or whether the statement was a new one. The action statements were dictated in the first-person perspective (e.g., I read / I read it and performed / I have never seen; statements e.g. "Roll the dice"). Then, they were asked to rate the confidence they had about the correctness of their answers on a scale from 1 (not confident at all) to 10 (totally confident). Once finished with Phase 3, all participants were thanked for their time, debriefed about the experiment and rewarded with 250 rubles as monetary compensation.

As we were mostly interested in the enactment effect on observation inflation, here we report only the data related to this research question, leaving JOLs and confidence measures outside of the scope of the present paper. Typically, the observation inflation effect occurs when participants incorrectly respond that they had performed an action under the read only condition. Therefore, we calculated the observation inflation effect from the proportion of 'I read it and performed it' responses to actions that they had only read about in Phase 1 (i.e., participants answered that they did perform the action, when in fact they did not perform it).

Results

We used repeated measures ANOVA and two-tailed pairwise comparisons with the Student's *t*-tests, both corrected for multiple comparisons. Partial-eta squared (η_p^2) and Cohen's *d* are also reported as measures of effect size.

A *t*-test on the correct proportions of source monitoring revealed that the proportion of answers for the "Perform" condition ($M = .82$, $SD = .14$) was significantly higher than the proportion for the "Read" condition ($M = .49$, $SD = .24$, $t(32) = 7.82$, $p < .001$, $d = 1.36$). From this result, we conclude that the enactment effect was present on accuracy of recall.

The descriptive statistics for proportions of "I performed it" answers are shown in Table 1. A 2 × 4 repeated measures ANOVA revealed that there were significant differences between *encoding* conditions ($F(1, 32) = 309.49$, $p < .001$, $\eta_p^2 = .91$) and *observing* conditions ($F(3, 96) = 5.33$, $p = .002$, $\eta_p^2 = .14$).

Post-hoc analysis showed that all of the "Read" conditions were significantly different from all "Perform" observing conditions, with "Perform" being significantly higher than "Read" paired conditions (for Read, same and perform, same, $t(32) = -12.221$, $p < .001$, $d = -3.05$; for "Read", different and perform, different, $t(32) = -12.57$, $p < .001$, $d = -3.14$; for read, only observation and perform, only observation $t(32) = -12.69$, $p < .001$, $d = -3.17$; and for "Read", nothing given and "Perform", nothing given, $t(32) = -13.28$, $p < .001$, $d = -3.31$).

Table 1: Proportion of "I performed it" Answers Under Different Observation Conditions

Phase 1: Encoding	Phase 2: Observing							
	Same action		Different action		Only observation		Nothing given	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Read	.12	.12	.07	.09	.09	.11	.05	.08
Perform	.43	.10	.39	.11	.42	.09	.39	.12

To further investigate the interpretation of observation inflation, separate *t*-tests were computed for each "Read" condition. The analysis showed significant differences between "Read-same" and "Read-different" conditions ($t(32) = 2.69$, $p = .01$, $d = 0.47$). Moreover, the proportion of false "I performed it" responses under "Read-same" was significantly higher than "Read-nothing" given: ($t(32) = 3.31$, $p = .002$, $d = 0.58$). However, there was no significant difference between "Read-same" and "Read-only" observation ($t(32) = 1.33$, $p = .19$). Also, no other significant differences were found between "Read-different" and "Read-only" observation ($t(32) = -1.07$, $p = .29$), "Read-different" and "Read-nothing" given ($t(32) = 1.42$, $p = .17$), and "Read-only" observation and "Read-nothing" given ($t(32) = 1.99$, $p = .06$). Separate *t*-tests were also conducted for each "Perform" condition; however, no other significant differences were found ($p > .05$).

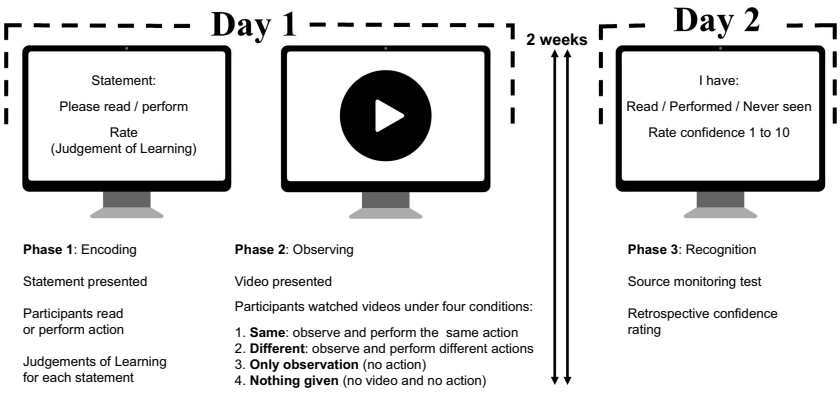

Figure 1. Schematic procedure of the experiment

Discussion

Consistent with previous research, our data support the notion that enactment improves memory performance (Heil et al., 1999; Hornstein, Mulligan, 2004; Ianì, Bucciarelli, 2017; Mulligan et al., 2022). Moreover, we only found the observation inflation effect in the higher rate of false "I performed it" responses for the conditions with video viewing compared to the condition without it. Also, when performing an action that differed from the video, the rate of false "I performed it" responses was reduced. This seems to indicate that performing a secondary motor task during watching a video can mitigate the observation inflation effect (Lindner et al., 2010; Wang et al., 2021). Thus, we can conclude that the enactment of one action increases its memory encoding and also helps participants to differentiate between self-performed and other-performed actions.

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ЯВЛЯЕТСЯ ЛИ «ЭФФЕКТ ИМИТАЦИИ» ПОТЕНЦИАЛЬНЫМ МЕДИАТОРОМ ЛОЖНЫХ ВОСПОМИНАНИЙ? ЛОЖНЫЕ ВОСПОМИНАНИЯ, ВЫЗВАННЫЕ ЭФФЕКТОМ ИНФЛЯЦИИ НАБЛЮДЕНИЯ, МОГУТ БЫТЬ УМЕНЬШЕНЫ С ПОМОЩЬЮ «ЭФФЕКТА ИМИТАЦИИ»

Дж. Талаванич*, Б. Мартин-Луенго, А. Долгоаршинная
jakkarin.tala@gmail.com
Центр нейроэкономики и когнитивных исследований,
Институт когнитивных нейронаук, Высшая школа экономики, Москва

Аннотация. Наблюдение за действиями других людей может приводить к ложным воспоминаниям. Одним из возможных решений этой проблемы является «эффект имитации», при котором люди во время получения информации выполняют физические действия. Цель настоящего исследования — изучить, влияет ли «эффект имитации» на ложные воспоминания, созданные в парадигме инфляции наблюдения. Участники исследования должны были или только прочитать предложения, или имитировать действия, описанные в предложениях, а затем просмотреть видео, на котором другой человек выполнял это действие. Мы ожидали, что ложные воспоминания, вызванные парадигмой инфляции наблюдения, уменьшатся при имитации действия, отличного от выполненного в видео. Также мы ожидали, что точность выполнения теста на мониторинг источника информации будет выше для выполненных действий по сравнению с прочитанными. Исследование выявило значительные различия между имитацией движений, совпадающих и не совпадающих с видео: в частности, в условии, когда участники только читали предложения, в тесте на память они давали меньше ошибочных ответов «выполнял», когда участники выполняли действие, отличное от того, которое они наблюдали на видео. Более того, «эффект имитации» улучшал результаты в тесте на память. В заключение, это исследование подчеркивает важность «эффекта имитации» в нивелировании эффекта инфляции наблюдения и для улучшения памяти, что имеет особое значение для исследований в области нейробиологии и психологии.

Ключевые слова: ложные воспоминания, эффект инфляции наблюдения, память о действиях, «эффект имитации», симуляция действия

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