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## **Playing “guess who?”: When an episodic specificity induction increases trace distinctiveness and reduces memory errors during event reconstruction**

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**Playing "Guess who?": When an Episodic Specificity Induction increases trace distinctiveness and reduces memory errors during event reconstruction.**

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**Abstract:**

The constructive nature of memory implies a possible confusion between details of similar events. Memory interventions should thus target the reduction of memory errors. We postulate that a brief intervention called Episodic Specificity Induction (ESI) facilitates the sensorimotor simulation of event-related details by improving the distinctiveness of the event memory trace. As such, ESI should reduce memory errors only when event memory traces are strongly overlapping based on their sensorimotor features. Participants memorized videos showing characters performing an action on a given object. The characters were either visually very similar to each other or very distinct (low vs. high distinctiveness condition). Next, participants performed either an imagination version of the ESI or a control induction. Finally, a voice announced one of the actions seen and a character was then briefly displayed. The participants had to indicate whether the association was correct. For incorrect associations, in the low distinctiveness condition, false alarms were more likely than in the high distinctiveness condition and were reduced after the ESI. It suggests that facilitating the simulation of specific details through the ESI increased trace distinctiveness and reduced memory errors at the critical time of event reconstruction. Future clinical applications might be possible.

**Keywords:** *episodic specificity induction, constructive memory, memory errors, sensorimotor simulation, trace distinctiveness.*

## INTRODUCTION

Less than a century ago, Bartlett (1932) rejected the idea that episodic memory passively and faithfully replays memories of past events, leading to the development of a more dynamic and constructive conception of memory. This conception is now widely accepted and suggests that episodic memory dynamically reconstructs memories of past events (see Schacter & Addis, 2007a, 2007b; Surprenant & Neath, 2009; Versace et al., 2009, 2014) by recombining specific pieces of information (or details) about the event (see the Constructive Episodic Simulation Hypothesis, Schacter & Addis, 2007a, 2007b). Nevertheless, the downside of a flexible and dynamic recombination of memories is that memory distortions become an inherent part of memory (i.e., the details of different events become confused; see Schacter et al., 2011; Schacter & Coyle, 1995). Memory distortions can have serious consequences in everyday life as well as in eyewitness testimony (e.g., Loftus & Palmer, 1996; see also Loftus & Palmer, 1974). For instance, an eyewitness can confuse a criminal with an innocent. Consequently, in a dynamic conception, memory performance depends on how accurate the reconstruction of memories is, and thus on the specificity of the details recalled in relation to the event, more than on the quantity of details recalled. It is therefore vitally important to develop effective interventions to reduce memory distortions and to improve the ability to access specific and correct details during reconstruction (for similar concerns, see Thakral et al., 2019). A constructive conception implies that such interventions can subsequently act not only at the time the memories are created but, above all, at the time they are accessed and reconstructed. The present study tests whether the benefits of such interventions occur only when the memory trace of the event to be reconstructed strongly overlap with the memory traces of similar events at the level of their sensorimotor features, as overlapping features (or details) do not contribute to the specific reconstruction of the event and may cause memory distortion.

### *Episodic Specificity Induction*

A recently developed intervention called the *Episodic Specificity Induction* (ESI; Madore et al., 2014, 2019) has been shown to improve the (re)construction of past and future events. This intervention is based on a procedure known as the Cognitive Interview (Fisher & Geiselman, 1992; for a review, see Memon et al., 2010). In the study conducted by Madore et al. (2019), participants began by generating five experienced specific events (that took place in one place on one day) and giving each event a setting, a person, an object, and a title. After a filler task, participants were given one of three inductions before performing the main task. The 'memory' version of the ESI consisted of giving participants the title and three details (i.e., a setting, person, and object) of one of their generated events and helping them to remember the event by encouraging them to form a clear mental picture of the scene with eyes closed and to describe the event in as much detail as possible (what people looked like and did, how objects were arranged and looked, and so on). The 'imagination' version of the ESI consisted of giving participants three details from different generated events and helping them to imagine a new event that could happen to them in the near future with the three details, using the same instructions as the 'memory' induction. The control induction consisted of giving participants math problems to complete. After the induction phase, participants completed the main task which was an adapted version of the Autobiographical Interview (see Gaesser et al., 2011; Madore et al., 2014; see also Levine et al., 2002) and consisted of asking participants to 1) remember and describe in detail an actual past event related to a picture cue (memory task); 2) imagine and describe in detail a plausible future event related to a picture cue (imagination task); or 3) describe in detail the content of a picture cue (picture description task). It was shown that compared to the control induction, both the memory and imagination versions of the ESI induced an increase in the number of specific details (e.g., sensorimotor and phenomenological details specific to the described event) produced in the subsequent memory and imagination

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3 tasks but not in the picture description task. Accordingly, these results suggests that the ESI  
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5 affect primarily the process of (re)constructing an event (past or future) rather than a  
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7 reproductive retrieval process that require remembering the details of an actual past event. Such  
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9 a constructive process is thought to be involved both when remembering and imagining an  
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11 event (see Schacter & Addis, 2007a, 2007b) and to ensure the recombination of the details of a  
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13 past event to construct it, or of several past events to construct an imaginary one. Consistently,  
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15 several studies report evidence of overlapping neural and cognitive processes that support  
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17 remembering past events and imagining future events (Mullally & Maguire, 2014; Schacter et  
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19 al., 2012) thereby claiming the constructive nature of memory. However, the basic mechanisms  
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21 underlying the event (re)construction process that are targeted and facilitated by the ESI remain  
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23 elusive. Among the candidates is the sensorimotor simulation mechanism.  
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### 31 *Sensorimotor simulation*

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33 Recently, Purkart et al. (2019) proposed that sensorimotor simulation could be a key  
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35 mechanism underpinning the event (re)construction targeted and facilitated by the ESI.  
36  
37 Simulation is a reenactment of the brain states that occur while experiencing events (Barsalou,  
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39 2008, 2009). For instance, when we see a picture of our 18th birthday cake, the brain areas  
40  
41 specifically activated at the time of blowing out the candles during our 18th birthday party can  
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43 be activated and sensorimotor features specific to this event can be simulated (e.g., the smell of  
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45 the candles, the birthday song, etc.). Thus, reconstructing a specific past event would mean  
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47 simulating its specific sensorimotor features. As simulation takes place in the sensorimotor  
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49 areas of the brain, occupying these areas at the time of simulation (e.g., by displaying an  
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51 interfering visual stimulus) interferes with the simulation and preactivating these areas  
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53 facilitates the simulation (for related evidences in different sensorial modalities, see Brunel,  
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55 2013; Brunel et al., 2010, 2013; Dabic et al., 2018; Rey et al., 2015; Riou et al., 2015; Vallet et  
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3 al., 2010; Vallet, Hudon, et al., 2013; Vallet, Simard, et al., 2013; Yee et al., 2013).  
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5 Consequently, if the ESI targets and facilitates sensorimotor simulation, displaying an  
6  
7 interfering visual stimulus should reduce the ESI-related benefits on event construction. Purkart  
8  
9 et al. (2019) used a dynamic visual noise (DVN; McConnell & Quinn, 2004) as an interfering  
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11 stimulus during a video recall task which was preceded by an ESI or a control induction. The  
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13 DVN was supposed to occupy the visual areas solicited by the simulation of the specific visual  
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15 features of the videos to be recalled and disrupt this simulation. They found that the benefits of  
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17 the ESI for the generation of specific details in the subsequent video recall task were suppressed  
18  
19 when the DVN was presented during recall, unlike the presentation of a visual control stimulus.  
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21 This suggests that the ESI induces a facilitation of sensorimotor simulation of event-specific  
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23 features, thus resulting in an increased solicitation of sensorimotor areas involved in this  
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25 simulation (in this case, the visual areas in particular), except when these areas are already  
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27 occupied by the processing of the DVN. Sensorimotor simulation therefore appears to be a key  
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29 mechanism in event reconstruction that is targeted by the ESI. This hypothesis is not  
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31 inconsistent with the hypothesis proposed by Madore et al. (2019) that if the ESI primarily  
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33 reflects an influence on constructive retrieval processes, the downstream effects of the ESI  
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35 should be observed on memory and imagination tasks (but not on a picture description task)  
36  
37 after constructing an imagined future event during the ESI. Indeed, these tasks are both thought  
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39 to rely on the (re)construction of an event notably through access to event-specific details, as  
40  
41 opposed to the picture description task. However, multiple trace memory models (e.g.,  
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43 Activation-Integration model ; Versace et al., 2009, 2014) argue that access to event-specific  
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45 details proceeds from the simulation of event-specific sensorimotor features and is just as  
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47 necessary when imagining an event as when remembering it. To our knowledge there is no  
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49 sufficient evidence to rule out either hypothesis, but the observation reported by Purkart et al.  
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51 (2019) that an interfering visual stimulus suppresses the ESI-related benefits is sufficient to  
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3 suggest that sensorimotor simulation could be one of the key mechanisms underpinning the  
4 event (re)construction targeted and facilitated by the ESI. The dynamics of this mechanism have  
5 been described in detail in the Activation-Integration model (Act-In; Versace et al., 2009, 2014)  
6 as a function of the similarity of the events. This model helps to understand the simulation  
7 dynamic involved in inaccurate reconstructions and memory distortions and points the way to  
8 the use of appropriate palliative interventions.  
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### 10 11 12 13 14 15 16 17 18 19 *Act-In: a multiple trace model*

20  
21 According to the Act-In model (Versace et al., 2009, 2014), all sensorimotor experiences  
22 are accumulated in the form of memory traces in our cognitive system. These traces reflect the  
23 brain states specific to each experience and their different sensorimotor features (or details).  
24 The more overlapping the memory traces are, the more likely it is that the overlapping features  
25 will be simulated at the expense of their specific features. This would reduce the weight of  
26 specific features and would therefore be detrimental for specific reconstruction and  
27 consequently increase memory errors (e.g., simulating a detail that is not specific to the memory  
28 being reconstructed; see Howe, 1998; Lyle & Johnson, 2006). Conversely, when memory traces  
29 are highly distinct from one another (i.e., when they share very few details), the simulation of  
30 features specific to a single trace should be facilitated, and the reconstruction should therefore  
31 be more accurate. The proportions of memory errors should therefore be lower in this situation.  
32 The probability of committing memory errors is therefore a function of the distinctiveness of  
33 the memory traces, which is itself determined by the degree of overlap between memory traces  
34 (see Brown et al., 2007; Ekstrom & Yonelinas, 2020; Surprenant & Neath, 2009). As a result,  
35 facilitating the simulation of features specific to a given trace by means of the ESI should  
36 increase the distinctiveness of the trace. This should reduce the probability of committing  
37 memory errors. However, this benefit should only be observed when the traces strongly overlap  
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3 than when they are very distinct. Therefore, manipulating the similarity between events to be  
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5 reconstructed (i.e., the degree of overlap between memory traces) should reveal whether  
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7 facilitating the simulation of trace-specific features (by the ESI) reduces memory errors in the  
8  
9 low distinctiveness (or strong overlap) condition.  
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12 However, it is noteworthy that the ESI has been shown to increase memory errors  
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14 (recall of critical lures) in the DRM paradigm (Deese-Roediger-McDermott; Deese, 1959;  
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16 Roediger & McDermott, 1995; see Thakral et al., 2019). But although this paradigm is central  
17  
18 to the study of memory errors, the memory errors produced in this paradigm are not related to  
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20 some other memory errors produced in other paradigms (e.g., in misinformation paradigm, see  
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22 Calvillo & Parong, 2016; Ost et al., 2013; in semi-autobiographical false news story tasks, see  
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24 Patihis, 2016; for relation between DRM false memories and autobiographical rich false  
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26 memories, see Clancy et al., 2000; Meyersburg et al., 2009). Furthermore, the ESI has never  
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28 been applied, to the best of our knowledge, in paradigms other than DRM to determine whether  
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30 or not it could influence memory errors. Therefore, studying the effects of the ESI on memory  
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32 errors produced by the perceptual similarity between novel events to be reconstructed (in a  
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34 different paradigm, richer and more ecological material than in the DRM) should be informative  
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36 and provide insight to whether facilitating the simulation of specific details (by the ESI  
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38 according to our hypothesis) reduces the memory errors elicited in a high similarity condition.  
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### 47 **The present study**

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49 Memory trace distinctiveness was manipulated in the present study by creating several videos  
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51 showing characters performing an action on a given object. Perceptual similarity varied  
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53 between the characters in a block of 4 videos (one character per video): for half of the blocks,  
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55 the characters in each block shared a large number of features (LOW DISTINCTIVENESS  
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57 condition), and for the other half they shared very few features (HIGH DISTINCTIVENESS  
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3 condition). Each video was associated with an audio track of a voice describing the action on  
4 the object performed by the filmed character (e.g., “Sitting on a chair”). Participants took part  
5 in each of the two sessions of the experiment, which were identical except for the material  
6 studied and the induction received. Each session included a study phase, an induction phase,  
7 and a test phase. In the study phase, participants had to watch and memorize the videos (who  
8 did what action with what object). Each participant watched as many blocks of the LOW  
9 DISTINCTIVENESS condition as of the HIGH DISTINCTIVENESS condition, in order to  
10 manipulate the « Distinctiveness » factor (i.e., the first independent variable) as a within-subject  
11 factor. After the study phase, in the induction phase, participants performed an ESI or a control  
12 induction in a counterbalanced manner, in order to manipulate the « Induction » factor (the  
13 second independent variable) as a within-subject factor. In the subsequent test phase, only the  
14 audio tracks of the videos were played again, each of them being followed by a photograph of  
15 a character that the participants had to judge, as quickly and accurately as possible, if it matches  
16 exactly the character who performed the action (for MATCH trials), or if it does not match (for  
17 MISMATCH trials). Each participant completed as many MATCH trials as MISMATCH trials.  
18 The dependent variables were hit rates (i.e., correct responses rates for MATCH trials), false  
19 alarm rates (i.e., errors rate for MISMATCH trials), and response times.

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42 In accordance with Act-In (and with other models, see for instance the SIMPLE model,  
43 e.g., Surprenant & Neath, 2009) highly similar events should lead to strongly overlapping  
44 memory traces and should be associated with more memory errors. Listening to the audio track  
45 should trigger a simulation of the action in question on the object associated with a character,  
46 and this simulation should be all the more specific to a character, the more distinct it is from  
47 the others. Thus, if the test character is different from the simulated character (MISMATCH  
48 trials), the responses should be more accurate (and quicker) in the HIGH DISTINCTIVENESS,  
49 because this trial type require to access distinctive features to avoid false alarms. If the test  
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3 character is identical to the simulated character (MATCH trials), then its distinctiveness should  
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5 not matter, because this trial type does not require to discriminate the characters from each  
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7 other, but instead require finding a match between the test character and the simulated character.  
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10 In addition, if the ESI, by facilitating the simulation of trace-specific features, increases trace  
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12 distinctiveness, it should only be beneficial in reducing memory errors (i.e., false alarms) in  
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14 MISMATCH trials. However, since the overlap between traces is already low in the HIGH  
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16 DISTINCTIVENESS condition, the ESI should only reduce false alarms in the low  
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18 distinctiveness condition.  
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## 24 **EXPERIMENT**

### 25 **Materials and Method**

#### 26 *Participants*

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31 Prior to the experiment, we decided that at least 24 participants would be sufficient for  
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33 observing a medium-sized effect (i.e.,  $f=0.25$ ) if it exists (power  $> .80$ , two-tailed, for a within-  
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35 subjects design; see Faul, Erdfelder, Lang, & Buchner, 2007). This sample size is consistent  
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37 with prior ESI-related studies that have used this number (e.g., Madore et al., 2014, 2015). In  
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39 order to anticipate possible exclusions, data collection was stopped at 38 participants. As no  
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41 participants were excluded, 38 young adults ( $M_{\text{age}} = 21.02$  years,  $SD_{\text{age}} = 1.55$ ,  $\text{range}_{\text{age}} = 19-$   
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43 27, 35 female) took part in the study. They were recruited by means of advertisements at Lyon  
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45 2 University. All the participants had normal or corrected-to-normal vision and audition, and  
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47 no history of neurological or psychiatric disorders. All the participants were French native  
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49 speakers.  
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56 This study was carried out in accordance with the recommendations of French Law (Loi Jardé  
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58 n°2012- 300), with written informed consent being obtained from all the subjects in accordance  
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3 with the Declaration of Helsinki. An ethics approval was issued for the current study by the  
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5 ethics committee of Clermont Auvergne University (IRB00011540-2019-43). This study was  
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7 not pre-registered. Materials are available on demand.  
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## 10 11 12 ***Material***

### 13 14 Character/Action Videos

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16 *Characters* – Fourteen blocks (2 practice blocks, 12 experimental blocks) of 4 characters each  
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18 were created using The Sims 4™ video game (Figure 1). For half of the blocks assigned to the  
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20 "LOW DISTINCTIVENESS" condition, the characters in each block were designed to be  
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22 "LOW DISTINCTIVENESS" condition, the characters in each block were designed to be  
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24 visually lowly distinct from each other. For the other half of the blocks assigned to the "HIGH  
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26 DISTINCTIVENESS" condition, the characters in each block were designed to be visually  
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28 highly distinct from each other. The distinctiveness of the characters in each block was  
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30 configured on the basis of 11 dimensions: gender (man vs woman), build (heavy vs light), skin  
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32 color (blue, red, green, or yellow), age (child vs adult), hair color (blond, brown, ginger, or  
33  
34 white), head covering (beanie, beret, cap, or hat), glasses (with vs. without), sleeve length (short  
35  
36 vs long), pant length (short vs long), shoes (sneakers vs flip-flops), and faces. Within each block  
37  
38 in the LOW DISTINCTIVENESS condition, the modalities of 5 dimensions (gender, build,  
39  
40 skin color, age, hair color) were identical for the 4 characters of a given block. For the 6  
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42 remaining dimensions, the modalities were pseudorandomized across the 4 characters within  
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44 the block as follows: for a 2-modality dimension, two characters shared the same modality,  
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46 while for a 4-modality dimension, one character was assigned to each modality. Within each  
47  
48 block in the HIGH DISTINCTIVENESS condition, the modalities of all 11 dimensions were  
49  
50 pseudorandomized across the 4 characters within the block. In this condition, only two (not  
51  
52 four) modalities of the skin color dimension were assigned in each block. The face of each  
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54 character was systematically different in both conditions. No character had the same  
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3 configuration of modalities as any another character (out of the 260 possible configurations).  
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5 Of the 14 blocks created, two blocks (one in each condition) were selected for practice after  
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7 changing their skin color modality to black, white, and brown. A photograph was taken of each  
8  
9 character.  
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15 **[Insert Figure 1.]**

16  
17 **Figure 1.** Photographs of the characters in a block in each distinctiveness condition.  
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21 *Actions* – Twelve different types of action were selected (e.g., sitting on, playing, etc.) using  
22  
23 The Sims 4™ video game. For each type of action, 4 objects were selected on which the  
24  
25 corresponding actions were performed (e.g., a chair, a stool, a bench, an armchair). Within each  
26  
27 block, the four characters performed the same action but on a different object. The association  
28  
29 between actions and distinctiveness condition (high vs. low) was counterbalanced in a between-  
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31 subjects manner across two lists (A vs. B). For instance, the "Sitting on\_\_" action was presented  
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33 in the LOW DISTINCTIVENESS condition for half of the participants, while this action was  
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35 presented in the HIGH DISTINCTIVENESS condition for the other half. Two additional action  
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37 types and 8 matching objects were added for the practice blocks. List of actions and objects  
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39 available in the Appendix section (Table 2).  
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48 *Videos* – Using The Sims 4™ video game, 48 videos were generated and recorded for action  
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50 list A (one for each character) and 48 were recorded for action list B. Eight additional videos  
51  
52 were recorded for the practice blocks. Each video started with a full shot of the motionless  
53  
54 character presented in front of the camera for approximately 1 second. Then the character  
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56 moved towards the spectator in the direction of the object, currently out of the camera's range.  
57  
58 The camera tracked the character's movement, while remaining in front of it, for approximately  
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3 3 seconds. The object appeared in the camera's range at the end of the character's movement  
4 and to the right of it. Finally, the character performed the action on the object for approximately  
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7 3 seconds. The scene took place in an empty room with gray walls and floor. On the floor, a  
8  
9 path between two blue stripes was systematically visible and used by the character. The average  
10  
11 length of the videos was 7.52 seconds ( $SD = 1.20$ ).  
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17 *Audio* – For each object, an audio recording was created using Balabolka 2.11 in which a virtual  
18 female voice pronounced the type of action followed, after a short pause, by the name of the  
19 object (e.g., "Sitting on\_\_a CHAIR"). Forty-eight audio tracks were recorded. Eight additional  
20 audio tracks were recorded for the practice blocks.  
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### 28 Inductions

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30 *Stimulus Collection Task* – Five familiar places, persons and objects were collected on a piece  
31 of paper for each participant. The familiarity of each item was evaluated by the participants on  
32 a scale going from 1 (not familiar at all) to 9 (very familiar). Next, the most familiar place,  
33 person and object were selected for the ESI.  
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42 *Episodic Specificity Induction* – The ESI used was a French version of the imagination  
43 specificity induction designed by Madore et al. (2019). It consists of a script with the help of  
44 which the experimenter uses various techniques to help the participant imagine an event  
45 involving the most familiar place, person and object selected during the stimulus collection  
46 task. This script is divided into three phases of imagination and detailed description, which  
47 focus respectively on the environment (the objects in the environment, their appearances, their  
48 locations, etc.), the people, and the actions performed in the imagined event. In each phase,  
49 participants are asked to close their eyes and mentally visualized the elements as clearly as  
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3 possible. After forming the clearest possible picture in their mind, participants then described  
4 these elements in as much details as possible. At the end of each phase, the experimenter asked  
5 the participants to provide more details on the elements that have been superficially described.  
6  
7 For a more detailed description of the ESI, see Madore et al. (2019). The imagination version  
8 was chosen over the standard version (which involved memorizing and recalling a video in  
9 detail as in Madore et al., 2014) to reduce the likelihood that participants would comply by  
10 guessing that the ESI was to help them remember the videos being studied, and/or consciously  
11 re-using the ESI techniques to remember the videos being studied.  
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24 *Control Induction* – This consisted of several short, simple mathematical exercises including  
25 addition, subtraction, multiplication and division.  
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### 33 *Procedure*

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35 The participants were asked to sit in front of a laptop (LENOVO ThinkPad L470 - Windows  
36 10 Pro 64 bits - 16GB RAM - 464 GB DD). After signing the consent form indicating their  
37 agreement to take part in an experiment designed to test their memory, they completed the  
38 Stimulus Collection Task sheet by specifying 5 familiar places, people and objects and rating  
39 their familiarity on a scale going from 1 (not at all familiar) to 9 (very familiar). The participants  
40 were then told that the experiment would begin with a practice session, followed by two  
41 sessions (approx. 25 min. each) separated by a break (approx. 5 min.). Each session started with  
42 a study phase (approx. 8 min.), followed by a filler task (which actually corresponded to the  
43 induction phase; approx. 10 min.) and finally a test phase (approx. 8 min.). Each session is  
44 described below. The total duration of the experiment was approximately one hour. Figure 2  
45 illustrates the experimental procedure.  
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5 *Session one*  
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8 For the study phase, the participants were told that, in each trial, they would first see a fixation  
9 cross (400 ms) and then hear, via their headphones, a voice saying an action and an object name,  
10 while they simultaneously watched a video featuring a character performing the action on the  
11 object. The participants were asked to pay attention during each trial and to memorize what the  
12 voice said, the appearance of the character, the type of action performed, and the object on  
13 which the character performed the action, as they would need to remember this information  
14 later in the test phase. They were warned that some characters may look very similar, but that  
15 each video would involve a different character. They were encouraged to press the space bar  
16 within 3 seconds of the end of each video in order to move on to the next one. The participants  
17 saw the videos of 3 LOW and 3 HIGH DISTINCTIVENESS blocks (24 videos in total) and  
18 simultaneously heard the corresponding audio track for each video. Two blocks from the same  
19 condition never followed each other. The presentation order of the blocks and the association  
20 between the actions and the distinctiveness conditions (list A vs. B) were counterbalanced  
21 across participants. After the study phase, the participants started the induction phase (instead  
22 of the filler task).  
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45 In the induction phase, the participants were assigned to the ESI or Control condition based on  
46 the odd or even number attributed to them. In the ESI condition, they were told that they were  
47 taking part in an imagination exercise. The experimenter asked them to imagine an event that  
48 would take place in the selected familiar place, in the company of the selected familiar person,  
49 and where they would interact with the selected familiar object. They were told that the  
50 experimenter would help them in this exercise by giving them some instructions and that they  
51 would proceed in stages, focusing first on the description of the place, then on the person, and  
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3 finally on the imagined actions (see Madore et al., 2019 for full instructions). In the Control  
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5 condition, the participants were asked to complete a series of simple mathematical exercises as  
6  
7 quickly as possible, while making as few errors as possible. The duration of each induction  
8  
9 phase for each participant was identical from one session to another (10 minutes). After the  
10  
11 induction phase, the participants started the test.  
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17 For the test phase, the participants were told that in each trial, one of the audio tracks from the  
18  
19 study phase (a voice saying an action and an object name) would be replayed while a neutral  
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21 gray background was displayed on the screen for 3,000 ms. They were told that this would be  
22  
23 followed by a photograph of a character from the study phase displayed in the center of the  
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25 screen for 1,000 ms on a black background before the gray background was displayed again,  
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27 with this then remaining on screen until the participant responded (or until the 4,000 ms  
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29 timeout). The Inter-Trial Interval (ITI) was set to 2,000 ms. The participants were told to  
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31 indicate as soon as the character was displayed, and as quickly and accurately as possible,  
32  
33 whether the character displayed matched exactly the character who had performed the action  
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35 on the specific object they had previously seen (in the study phase). To do this they had to press  
36  
37 one key to answer MATCH, or press another key to answer MISMATCH. They were told that  
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39 none of the characters displayed were new and that they had all been seen in the study phase.  
40  
41 For the MISMATCH trials, the displayed character was from the same block and had performed  
42  
43 the same action, but not on the same object, as the target character who had performed the  
44  
45 action on the object mentioned in the audio track. For the MATCH trials, the character was the  
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47 same as the character who had performed the action on the object mentioned in the audio  
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49 description. The characters were presented only once either in MISMATCH trials or in  
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51 MATCH trials. For the 24 trials, the correctness of the association between the audio track and  
52  
53 the following character in each distinctiveness condition was pseudo-randomized. The  
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3 presentation order of these associations was randomized for each participant. For half of the  
4 trials, the associations were correct and required a MATCH response (i.e., the MATCH trials),  
5 while for the other half, the associations were incorrect and required a MISMATCH response  
6 (i.e., the MISMATCH trials). Accuracy and response times for each trial were collected. After  
7 the test phase, there was a 5-minute break before starting the second session. The participants  
8 discussed their academic background with the experimenter during this break to prevent them  
9 from thinking about the experiment.  
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### 21 *Session two*

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23 The second session was strictly identical to the first, except that the participants saw the videos  
24 that they had not seen in the first session and performed the induction that they had not already  
25 been subjected to (ESI or Control). The material used was counterbalanced across sessions and  
26 inductions, and the order of inductions was counterbalanced across the participants and the  
27 sessions.  
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### 37 *Practice session*

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39 The first session was preceded by a practice session which consisted of a practice study phase  
40 of 8 practice trials (with the dedicated material), immediately followed by a practice test phase.  
41 There was no interval between the two practice phases as no induction was performed, unlike  
42 in sessions one and two. For the practice "study phase", the first 4 practice trials consisted in  
43 successively presenting the videos of the 4 characters from the LOW DISTINCTIVENESS  
44 practice block together with the corresponding audio tracks, while the next 4 practice trials  
45 consisted in presenting the videos of the 4 characters from the HIGH DISTINCTIVENESS  
46 practice block. The instructions and the trial procedure for the practice study and test phase  
47 were identical to those of the study and test phase of the experiment. Feedback (green circle or  
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3 red cross) indicating the participant's performance was only given for the practice test phase  
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5 and provided information as to whether the response was correct or not.  
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10 **[Insert Figure 2.]**

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12 **Figure 2.** Schematic procedure of the experiment.  
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## 17 **Results**

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19 Data were analyzed using RStudio version 1.2 (R Foundation for Statistical Computing). The  
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21 mean response times for correct responses (RT), the mean rates of hits (HITS; for the MATCH  
22  
23 trials) and the mean rates of false alarms (FA; for the MISMATCH trials) were computed across  
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25 participants for each experimental condition. RT exceeding 2,500 ms and 2.5 standard  
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27 deviations above each participant's mean in each condition and RT less than 300 ms and 2.5  
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29 standard deviations below each participant's mean per condition were considered as outliers  
30  
31 and removed from the analyses (less than 5%, see Vallet et al., 2010 for a similar procedure).  
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33 Because the expected results focus on the participants' ability to correctly reject incorrect  
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35 character-action associations (or to avoid false alarms) in the "MISMATCH" trials, separate  
36  
37 analyses were conducted for each trial type, one for MATCH trials and one for MISMATCH  
38  
39 trials. For each trial type, two ANOVAs were performed, one on FA (or HITS) and the other  
40  
41 on RT. Each analysis was performed with "Induction" (ESI vs. Control) and "Distinctiveness"  
42  
43 (LOW DISTINCTIVENESS vs. HIGH DISTINCTIVENESS) as within-subject factors. Post-  
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45 hoc tests were performed using Tukey's method. The threshold of statistical significance for all  
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47 analyses was set to  $p < .05$ . Table 1 displays the descriptive statistics.  
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3 **Table 1.** Descriptive statistics (mean with standard deviation in parentheses) for each trial type  
4 (match vs. mismatch) on the recognition task as a function of induction (ISE vs. control) and  
5  
6 distinctiveness (high vs. low).  
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12 **[Insert Table 1.]**  
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14 *Note. SD: standard deviation; ESI: Episodic Specificity Induction; RT are in milliseconds.*  
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### 17 18 19 **Hits.**

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21 For the MATCH trials, the analysis only revealed a significant main effect of Distinctiveness  
22 ( $F(1, 37) = 8.51, p < .01, \eta^2_g = .05$ ), with lower HITS in the HIGH DISTINCTIVENESS  
23 condition than in the LOW DISTINCTIVENESS condition. The main effect of Induction and  
24 the interaction between these two factors were not significant ( $F < 1$ ).  
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### 30 31 32 **False alarms.**

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34 For MISMATCH trials, there was no main effect of Induction ( $F < 1$ ) but a significant main  
35 effect of Distinctiveness ( $F(1, 37) = 48.96, p < .0001, \eta^2_g = .264$ ) with a large effect size, with  
36 lower FA being observed in the HIGH DISTINCTIVENESS condition than in the LOW  
37 DISTINCTIVENESS condition. The analysis also revealed a significant interaction between  
38 Induction and Distinctiveness ( $F(1, 37) = 6.35, p < .02, \eta^2_g = .022$ ). Post-hoc comparisons  
39 showed lower FA after the ESI than after the Control Induction in the LOW  
40 DISTINCTIVENESS condition ( $t(73.1) = 2.08, p < .05, d = .40$ ), but not in the HIGH  
41 DISTINCTIVENESS condition ( $t(73.1) = -1.27, p = .21, d = .22$ )(Figure 3).  
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56 **[Insert Figure 3.]**  
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3 **Figure 3.** Comparison of the mean rates of false alarms for the different Induction types  
4 (Control vs. ESI) in each Distinctiveness condition (HIGH vs. LOW) for MISMATCH trials  
5 (incorrectly endorsing the test character as the one who performed the action on the object  
6 enounced). Gray bars represent standard errors corrected for the within-participant design.  
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#### 14 *Response times.*

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16 For the MATCH trials, the analysis only revealed a significant main effect of Distinctiveness  
17 ( $F(1, 37) = 6.48, p < .02, \eta^2_g = .02$ ), indicating that RT were faster in the HIGH  
18 DISTINCTIVENESS condition than in the LOW DISTINCTIVENESS condition. The main  
19 effect of Induction ( $F(1, 37) = 1.94, p > .05, \eta^2_g = .006$ ) and the interaction ( $F < 1$ ) were not  
20 significant.  
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30 For the MISMATCH trials, the analysis only revealed a significant main effect of  
31 Distinctiveness ( $F(1, 33) = 7.92, p < .01, \eta^2_g = .03$ ), indicating that RT were faster in the HIGH  
32 DISTINCTIVENESS condition than in the LOW DISTINCTIVENESS condition. The main  
33 effect of Induction ( $F(1, 33) = 1.53, p > .05, \eta^2_g = .006$ ) and the interaction ( $F < 1$ ) were not  
34 significant.  
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#### 45 *Carryover.*

46 An additional ANOVA was conducted with the “Induction Order” as between-subject factor to  
47 determine whether the false alarms rate differed as function of whether participants received  
48 the ESI in the first session or in the second session (using the same parameters as the previous  
49 analyses). The analysis revealed no significant main effects or interactions associated with  
50 Induction Order on Hits ( $F_s < 1$ ), FAs ( $F_s < 1$ ), and RTs for MATCH trials ( $F_s < 1$ ) and  
51 MISMATCH trials ( $F_s < 1$ ). The lack of any carryover effect is consistent with previous ESI-  
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3 related studies (e.g., Madore & Schacter, 2015; Purkart et al., 2019) and indicate that  
4 participants performed similarly in the study irrespective of whether they received the ESI in  
5 the first session or second session.”  
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## 10 11 12 **DISCUSSION**

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14 The aim of the study was to determine situations in which the ESI, which is thought to  
15 facilitate the access of trace-specific features (see Purkart et al., 2019) and increase trace  
16 distinctiveness, might be effective in reducing memory errors. We predicted that the probability  
17 of memory errors would be a function of trace distinctiveness. Specifically, for the  
18 MISMATCH trials, correct responses should be slower and false alarms higher when the  
19 distinctiveness between traces is low than when the distinctiveness is high. Therefore, we  
20 expected to find that the beneficial effect of the ESI would only occur when distinctiveness was  
21 low for the MISMATCH trials, because this trial type requires to access the specific features  
22 that distinguish the correct character from the test character, unlike the MATCH trials in which  
23 a simple matching procedure is required. Thus, neither the ESI nor trace distinctiveness should  
24 play a role with regard to the MATCH trials.  
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### 42 *Distinctiveness and induction effects for MISMATCH trials*

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44 As predicted, the participants responded more accurately and quickly in the high  
45 distinctiveness condition than in the low distinctiveness condition when the test character was  
46 different from the correct character (for the MISMATCH trials). When the characters were very  
47 distinct (HIGH DISTINCTIVENESS condition), hearing the action sentence triggered the  
48 activation of the specific features of the character who performed the action in question.  
49 Therefore, since a large number of features differed between the correct character and the test  
50 character in this condition, the participants were more likely to correctly judge the test character  
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3 as not being the character who performed the action in question (and to do so more quickly).  
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5 On the other hand, when the characters were very similar (LOW DISTINCTIVENESS  
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7 condition), hearing the action sentence triggered the activation of the overlapping features  
8  
9 (shared between the characters) at the expense of the specific features of the character who  
10  
11 performed the action in question. Therefore, since only a few features differed between the  
12  
13 correct character and the test character in this condition, the participants were more likely to  
14  
15 incorrectly judge the test character as being the character who performed the action in question.  
16  
17 Thus, the participants failed to identify the features of the test character that differed from those  
18  
19 of the character who actually performed the action. As a result, the inability to identify these  
20  
21 features made verification of the properties more time-consuming and slower in this  
22  
23 distinctiveness condition. The participants therefore responded less accurately and quickly in  
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25 the LOW than in the HIGH DISTINCTIVENESS condition.  
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33 Crucially, in the LOW DISTINCTIVENESS condition, the participants responded  
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35 more accurately after the ESI than after the control induction in the MISMATCH trials. The  
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37 access of the specific features of a given character appears to be facilitated by the ESI (see  
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39 Purkart et al., 2019). This effect is thought, in turn, to increase the distinctiveness of the trace  
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41 of the character performing the action, thereby increasing the participants' ability to reject the  
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43 proposed incorrect character. This result is noteworthy since it shows a reduction in memory  
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45 errors (expressed by false alarms) in a condition in which these errors were highly probable,  
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47 and thus points to improved memory efficiency. As such (and as expected), in the HIGH  
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49 DISTINCTIVENESS condition, in which the characters' memory traces were already  
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51 sufficiently distinct to make it possible to reject or recognize the character on the basis of its  
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53 specific features, the ESI did not prove to be beneficial.  
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3 One might ask why would ESI not improve the overall memory performance  
4 independently of the distinctiveness condition? The rationale is that, as explained above,  
5 participants responded less accurately and less quickly in the LOW than in the HIGH  
6 DISTINCTIVENESS condition where the number of specific features is greater. As the  
7 discrimination between an incorrect test character and a correct character is based on the  
8 activation of the specific features that distinguish them, having many specific features to  
9 activate facilitates discrimination. As such, since there are a low number of overlapping features  
10 between characters in the HIGH DISTINCTIVENESS condition, the activation of specific  
11 features is less limited than in the LOW DISTINCTIVENESS condition (which is consistent  
12 with the Act-In model). The activation of specific features is therefore sufficiently important  
13 for the ESI not to be of decisive help in the HIGH DISTINCTIVENESS condition. Reversely,  
14 as there are many overlapping features between the characters in the LOW  
15 DISTINCTIVENESS condition, the activation of specific features is more limited than in the  
16 HIGH DISTINCTIVENESS condition. The activation of specific features is therefore  
17 sufficiently affected for the ESI to be of decisive help in the LOW DISTINCTIVENESS  
18 condition. Consequently, if the ESI improves trace distinctiveness, it is consistent that the ESI  
19 has a beneficial effect in the LOW DISTINCTIVENESS condition and has no effect when the  
20 distinctiveness is already high.  
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#### 47 *Distinctiveness and induction effects for MATCH trials*

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49 Nevertheless, and contrary to our predictions, the participants responded more  
50 accurately in the low distinctiveness condition than in the high distinctiveness condition for the  
51 MATCH trials (in contrast to the inverse result pattern observed for the MISMATCH trials).  
52 Similar patterns of results were reported by Ozubko & Joordens (2008) who found a higher  
53 proportion of correct recognitions (hits) and memory errors (false alarms) in a condition in  
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3 which the perceptual distinctiveness between characters was at its lowest (minimal feature  
4 characters) compared to a condition in which perceptual distinctiveness between characters was  
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6 at its highest (normal feature characters). Our result could be attributed to a "generalization"  
7  
8 effect similar to that observed by Brunel et al., (2013). In this study, the authors showed that  
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10 the activation of a specific feature of a target item (e.g., its sound) during its recollection was  
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12 impeded if the target item was studied along with other items that are perceptually very similar  
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14 (in shape and color). This generalization effect was not observed when the other items were  
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16 more perceptually different. In our study, although the characters in the LOW  
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18 DISTINCTIVENESS condition were confronted with different objects (e.g., chair, stool,  
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20 armchair, bench), they nevertheless performed the same action (e.g., sitting on) and shared  
21  
22 many features (e.g., skin color, age, gender, build). The overlapping features of the characters  
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24 and the similarity of the action performed could have impeded the access of the distinctive  
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26 features, thus indicating a generalization effect. As a result, access to distinctive features was  
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28 still impeded and their verification was slower. However, contrary to the MISMATCH trials,  
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30 the responses in the MATCH trials were based on the similarities between the test and correct  
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32 characters. Since the participants found it more difficult and took longer to verify distinctive  
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34 features because the access of overlapping features was reinforced by the generalization effect,  
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36 the match between the test character and the correct character was enhanced, but only on the  
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38 basis of their overlapping features. Consequently, this generalization effect was beneficial in  
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40 this trial type because it facilitated the access of overlapping features and the judgment of  
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42 similarity between the simulated character and the test character. This would explain why, for  
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44 the MATCH trials, the participants responded more accurately, but still slowly, in the LOW  
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46 than in the HIGH DISTINCTIVENESS condition. However, and consistent with our  
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48 hypotheses, the ESI had no significant effect for the MATCH trials because facilitating the  
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3 access of specific features is unlikely to be beneficial in a condition in which the response is  
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5 based on a matching principle.  
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10 Reversely, since MISMATCH trials require access to distinctive features particularly in  
11 the LOW DISTINCTIVENESS condition, it is consistent to found that the generalization effect  
12 was detrimental, and the ESI beneficial in this trial type. Indeed, the ESI would have increased  
13 trace distinctiveness by facilitating the access of specific features at the expense of overlapping  
14 features. It would therefore be interesting to adapt the paradigm used by Brunel et al., (2013)  
15 by isolating a character, who would perform an action different from that performed by the  
16 other characters in a given block, and observing whether the ability to recognize the correct  
17 action for the isolated character is negatively impacted by a condition of low distinctiveness  
18 between characters compared to a condition of high distinctiveness. The generalization effect  
19 should lead to the access of the action performed by non-isolated characters at the expense of  
20 the action performed by isolated characters when they are perceptually similar, but not when  
21 they are different. If the ESI does promote trace distinctiveness and reduce the generalization  
22 effect, simulation of the action performed by the isolated character should be facilitated in the  
23 low distinctiveness condition. This interpretation suggests that trace distinctiveness and  
24 generalization can be seen as the two plates of a scale where the rise of one plate leads to the  
25 fall of the other, which is consistent with the predictions of the Act-In model (Versace et al.,  
26 2009, 2014).  
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### 51 *Back to Act-In*

52 Act-In is a multiple trace model which states that all sensorimotor experiences are  
53 accumulated in the form of memory traces in our cognitive system. These traces reflect the  
54 brain states specific to each experience and their different sensorimotor features (or details).  
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3 Knowledge would emerge from a continuum according to the number of traces involved in the  
4 simulation. For instance, the emergence of categorical knowledge (e.g., categorizing an animal  
5 as a dog) is possible by simulating (or activating) the sensorimotor overlapping features of all  
6 the traces where the individual has been confronted with a dog (high inter-trace activation  
7 diffusion and intra-trace activation diffusion to overlapping features). The more the traces  
8 overlap, the easier the diffusion of inter-trace activation would be (and the more limited the  
9 diffusion of intra-trace activation would be). On the other hand, the emergence of specific  
10 knowledge (e.g., the memory of the day I adopted my dog) is possible through the  
11 simulation/activation of the features specific to the trace of the adoption event (low inter-trace  
12 activation diffusion and intra-trace activation diffusion to the trace-specific features). The more  
13 distinct the traces are, the easier the diffusion of intra-trace activation would be (and the more  
14 limited the diffusion of inter-trace activation would be). Thus, according to Act-In, there is an  
15 activation “scale” between inter-trace and intra-trace diffusion, and inter-trace diffusion would  
16 be detrimental for intra-trace diffusion and vice versa. The generalization effect (observed in  
17 the LOW DISTINCTIVENESS condition in the present study) would emerge from an inter-  
18 trace diffusion facilitated by the overlap between the traces, which limits intra-trace diffusion  
19 to the specific components. In this case, participants are not able to discriminate the test  
20 character from the simulated character on the basis of its specificities. Thus, according to Act-  
21 In, the ESI facilitates the simulation of the specific features of the simulated character by  
22 facilitating intra-trace diffusion, which reduces the diffusion of inter-trace activation and thus  
23 limits the detrimental generalization effect for MISMATCH trials.

#### 24 *Alternative interpretation and potential caveats*

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26 An alternative interpretation would be that the ESI does not facilitate sensorimotor  
27 simulation of trace-specific features, but instead bias the retrieval orientation (Madore et al.,  
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3 2019; see also Herron & Rugg, 2003; Morcom & Rugg, 2012). The ESI may focus the  
4 participants' retrieval attempts on the specific details highlighted during the ESI (e.g., the  
5 clothes of the people imagined). This orientation would be actively maintained (if sufficient  
6 cognitive resources are available) until the subsequent memory task (see Herron, 2018). This  
7 focus induced by the ESI would benefit to the subsequent task in the condition where the  
8 distinctive details are limited (i.e., in the LOW DISTINCTIVENESS condition) and crucial  
9 (i.e., for the MISMATCH trials), but not in the condition where the distinctive details are more  
10 numerous (i.e., in the HIGH DISTINCTIVENESS condition). The present study data cannot  
11 support an Act-In interpretation over a retrieval orientation interpretation. It would therefore be  
12 interesting for future studies to provide more evidence regarding the precise mechanisms  
13 underlying the ESI.  
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28 The benefits of the ESI on the reduction of memory errors may seem contradictory with  
29 the results reported by Thakral et al. (2019) using the DRM paradigm, as they observed that the  
30 ESI increased the recall of critical lures. However, the DRM paradigm is very different from  
31 the paradigm used in the present study in several aspects. Indeed, whereas our paradigm  
32 proposes to recognize the correct associations between previously unknown characters and  
33 specific actions, the DRM consists in recalling well-known target words semantically related  
34 to a critical lure. According to the Act-In model, this semantic relationship is formed by the  
35 accumulation of experiences where target words and critical lures co-occurred. This  
36 accumulation strengthens the binding between them and increases the likelihood that the  
37 presentation of the target words triggers both the simulation of their own features, and those of  
38 the critical lure, during the DRM study phase, through an extended diffusion of inter-trace  
39 activation (see also the activation-monitoring hypothesis, Roediger & McDermott, 2000;  
40 Roediger, Watson, McDermott, & Gallo, 2001). In turn, the study phase will leave memory  
41 traces that reflect these simulations. Subsequently in the recall phase, when the target words are  
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3 recalled, the critical lure will most likely be erroneously recalled because the memory trace of  
4 the study phase includes the simulation of its features, albeit unperceived. This likelihood would  
5 increase with the amount of perceptual detail of the lure simulated during the study phase (see  
6 also Johnson and Raye's (1981) reality monitoring model) but also during the recall. Thus, if  
7 the ESI induces a facilitation of sensorimotor simulation of event-specific features, it can  
8 therefore facilitate the simulation, not only of the features of the memory trace of the DRM  
9 study phase that correspond to the features of the target words that were actually perceived, but  
10 of all the features of the trace, including those that correspond to the features of the critical  
11 lures. This can in turn results in more erroneous recall of critical lures after the ESI. As in our  
12 paradigm the characters are new, there is no such extended diffusion of inter-trace activation  
13 during the study phase, and it is logical to find a reduction in false alarms after the ESI rather  
14 than an increase

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31 This explanation is consistent with the Source Monitoring Framework (SMF) which  
32 also assumes that cues (e.g., the studied words of the DRM list) evoke memory information  
33 from multiple episodes combined with more general knowledge, and that this evocation itself  
34 leaves traces (see Lindsay, 2008). A faulty monitoring during the study phase produces source  
35 confusions at the recall phase, and participants mistakenly remember the critical item as having  
36 been presented, instead of merely cognitively activated (or simulated), at study (Nichols &  
37 Loftus, 2019). Regarding the effect of the ESI in the DRM, one might suppose that the ESI  
38 increases the confidence that the critical lure has also been studied, and this confidence-boosting  
39 effect results in a sort of imagination inflation (Garry & Polaschek, 2000).

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54 One potential caveat is that it remains to be determined whether similar results would  
55 be observed using another form of specificity induction, and/or another form of control  
56 induction. Although our study was not aimed at determining the essential components of the  
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3 ESI to observe beneficial effects on a subsequent given task, it is important that future studies  
4 address this issue. As mentioned, comparable behavioral effects have been reported whether an  
5 imagination specificity induction or a memory specificity induction is compared to a math  
6 control induction (see Madore et al., 2019). We argue that simulation of trace-specific  
7 sensorimotor features is at least one of the essential components to observe beneficial induction  
8 effect on the retrieval of specific perceptual information (for a related topic, see Sheldon et al.,  
9 2019). But is the construction of a mental scene (setting, characters, actions) also an essential  
10 component? Does the subsequent task have to include the same components as the ESI? These  
11 issues may warrant further investigation. In addition, comparable behavioral effects have also  
12 been frequently reported whether a math control induction or a general impressions control  
13 induction (asking questions about participant's general impressions of the content of a video  
14 they viewed) is compared to the classic ESI on several tasks (e.g., Madore et al., 2014).  
15 However, the math control induction is known to provide a more neutral baseline. There is  
16 therefore no reason to believe that using the impression control induction instead of the math  
17 control induction would have yielded different relevant results in our study, as both inductions  
18 do not involve simulating trace-specific sensorimotor features. But the choice of control  
19 induction will be much more important for any study that aims to determine the essential  
20 components of the ESI, a work that we strongly encourage.

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47 Finally, it is worth noting as a limitation of the current data that the present study only  
48 reports one experiment with a single demonstration of the critical effects. These effects should  
49 be taken with caution before future studies replicate them. These studies could also test some  
50 hypotheses more thoroughly, such as whether or not the ESI targets sensorimotor simulation.  
51 For instance, one could address this hypothesis by observing whether the benefits of the ESI on  
52 memory errors in the low distinctiveness condition are suppressed if a dynamic visual noise  
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(DVN) is displayed during the test phase (see Purkart et al., 2019). The DVN should also have a detrimental or beneficial effect depending on the distinctiveness condition and the trial type in the control induction condition if access to distinctive trace-specific features is reduced by the DVN. We also strongly encourage such a study.

## CONCLUSION

There is growing empirical support for the dynamic and constructive conception of memory (see Schacter & Addis, 2007a, 2007b; Surprenant & Neath, 2009; Versace et al., 2009, 2014). This vision of an emergent and dynamic memory that reconstructs our past experiences makes it possible to consider ways of improving not only the memorization of an event but, above all, the reconstruction of that event. The constructive nature of memory requires a focus on the fidelity and accuracy of reconstruction (see Koriat et al., 2000). This focus is all the more necessary in ecological situations such as eyewitness testimony. Can witnesses be considered to have a good memory of an aggressor if they can remember some features of the aggressor but not those that distinguish him from an innocent person who looks like him? An effective memory is one that produces few errors. As such, interventions should aim to facilitate accurate reconstruction and reduce memory errors in order to improve memory efficiency. To our knowledge, the present study is the first to show a beneficial effect of the ESI on memory errors in a recognition task. However, caution must be exercised and other studies showing similar results are needed. We suggest that the beneficial effect of the ESI in a recognition task could be observed by taking trace distinctiveness into account, in particular when the traces do not already benefit from high distinctiveness. Although the ESI appears to be an intervention that can improve memory efficiency, the mechanisms underlying it still have to be precisely determined. The data from the present study suggest that the ESI targets the sensorimotor simulation mechanism by facilitating the simulation/activation of trace-specific features (intra-

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3 trace diffusion). The activation of these specific features would increase trace distinctiveness  
4 and reduce the observed generalization effect (i.e., reduce inter-trace activation diffusion).  
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6 Further studies are needed to confirm this interpretation. For instance, by using a DVN in  
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8 addition to the ESI (as Purkart et al., 2019) while manipulating trace distinctiveness. Similar  
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10 findings in future studies would suggest that it is possible to reduce memory errors through  
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12 interventions such as the ESI. This would make it possible to consider psycho-legal and clinical  
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14 applications in populations where memory accuracy is impacted, such as the elderly (Greene &  
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16 Naveh-Benjamin, 2020; Korkki et al., 2020).  
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## 24 **ETHICS STATEMENT**

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26 This study was carried out in accordance with the recommendations of the French Law (Loi  
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28 Jardé n°2012-300) with written informed consent being obtained from all the subjects in  
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30 accordance with the Declaration of Helsinki. An ethics approval was issued for the current study  
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32 by the ethics committee of Clermont Auvergne University (IRB00011540-2019-43).  
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## 38 **AUTHOR CONTRIBUTIONS**

39  
40 RP and JM participated in all the aspects of the study (design of the experiments, conduct of  
41  
42 the experiments, analysis and interpretation of the data, and redaction of the manuscript). RV  
43  
44 and GV participated in the design of the experiments, interpretation of the data, and redaction  
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46 of the manuscript.  
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## 51 **DECLARATION OF CONFLICTING INTERESTS**

52  
53 The Author(s) declare(s) that there is no conflict of interest.  
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## 24 REFERENCES

- 25  
26 Barsalou, L. W. (2008). Grounded Cognition. *Annual Review of Psychology*, *59*(1), 617–645.  
27  
28 <https://doi.org/10.1146/annurev.psych.59.103006.093639>  
29  
30 Barsalou, L. W. (2009). Simulation, situated conceptualization, and prediction. *Philosophical*  
31 *Transactions of the Royal Society B: Biological Sciences*, *364*(1521), 1281–1289.  
32  
33 <https://doi.org/10.1098/rstb.2008.0319>  
34  
35  
36  
37 Bartlett, F. C. (1932). *Remembering*. Cambridge. Cambridge University Press England.  
38  
39  
40 Brown, G. D. A., Neath, I., & Chater, N. (2007). A temporal ratio model of memory.  
41  
42 *Psychological Review*, *114*(3), 539–576. <https://doi.org/10.1037/0033-295X.114.3.539>  
43  
44  
45 Brunel, L. (2013). Does bigger mean louder? Crossmodal congruency and memory judgment.  
46  
47 *Multisensory Research*, *26*(0), 67–68. <https://doi.org/10.1163/22134808-000S0045>  
48  
49  
50 Brunel, L., Goldstone, R. L., Vallet, G., Riou, B., & Versace, R. (2013). When Seeing a Dog  
51  
52 Activates the Bark. *Experimental Psychology*, *60*(2), 100–112.  
53  
54 <https://doi.org/10.1027/1618-3169/a000176>  
55  
56  
57 Brunel, L., Lesourd, M., Labeye, E., & Versace, R. (2010). The sensory nature of knowledge:  
58  
59 Sensory priming effects in semantic categorization. *The Quarterly Journal of*  
60

1  
2  
3 *Experimental Psychology*, 63(5), 955–964.

4  
5 <https://doi.org/10.1080/17470210903134369>

6  
7  
8 Calvillo, D. P., & Parong, J. A. (2016). The misinformation effect is unrelated to the DRM

9  
10 effect with and without a DRM warning. *Memory*, 24(3), 324–333.

11  
12 <https://doi.org/10.1080/09658211.2015.1005633>

13  
14 Clancy, S. A., Schacter, D. L., McNally, R. J., & Pitman, R. K. (2000). False Recognition in

15  
16 Women Reporting Recovered Memories of Sexual Abuse. *Psychological Science*,

17  
18 11(1), 26–31. <https://doi.org/10.1111/1467-9280.00210>

19  
20  
21 Dabic, S., Rey, A. E., Navarro, J., & Versace, R. (2018). Haptic modality takes its time:

22  
23 Dynamic of activations of sensory modalities in perceptual and memory processes.

24  
25 *International Journal of Psychology*, 53(3), 237–242.

26  
27 <https://doi.org/10.1002/ijop.12368>

28  
29  
30 Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate

31  
32 recall. *Journal of Experimental Psychology*, 58(1), 17–22.

33  
34 <https://doi.org/10.1037/h0046671>

35  
36  
37 Ekstrom, A. D., & Yonelinas, A. P. (2020). Precision, binding, and the hippocampus:

38  
39 Precisely what are we talking about? *Neuropsychologia*, 138, 107341.

40  
41 <https://doi.org/10.1016/j.neuropsychologia.2020.107341>

42  
43  
44 Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G\*Power 3: A flexible statistical

45  
46 power analysis program for the social, behavioral, and biomedical sciences. *Behavior*

47  
48 *Research Methods*, 39(2), 175–191. <https://doi.org/10.3758/BF03193146>

49  
50  
51 Fisher, R. P., & Geiselman, R. E. (1992). *Memory enhancing techniques for investigative*

52  
53 *interviewing: The cognitive interview*. Charles C Thomas Publisher.

- 1  
2  
3 Gaesser, B., Sacchetti, D. C., Addis, D. R., & Schacter, D. L. (2011). Characterizing age-  
4 related changes in remembering the past and imagining the future. *Psychology and*  
5 *Aging, 26*(1), 80–84. <https://doi.org/10.1037/a0021054>  
6  
7  
8  
9  
10 Garry, M., & Polaschek, D. L. L. (2000). Imagination and Memory. *Current Directions in*  
11 *Psychological Science, 9*(1), 6–10. <https://doi.org/10.1111/1467-8721.00048>  
12  
13  
14 Greene, N. R., & Naveh-Benjamin, M. (2020). A Specificity Principle of Memory: Evidence  
15 From Aging and Associative Memory. *Psychological Science, 31*(3), 316–331.  
16  
17 <https://doi.org/10.1177/0956797620901760>  
18  
19  
20  
21 Herron, J. E. (2018). Direct electrophysiological evidence for the maintenance of retrieval  
22 orientations and the role of cognitive control. *NeuroImage, 172*, 228.  
23  
24  
25  
26 Herron, J. E., & Rugg, M. D. (2003). Retrieval Orientation and the Control of Recollection.  
27 *Journal of Cognitive Neuroscience, 15*(6), 843–854.  
28  
29 <https://doi.org/10.1162/089892903322370762>  
30  
31  
32  
33 Howe, M. L. (1998). When Distinctiveness Fails, False Memories Prevail. *Journal of*  
34 *Experimental Child Psychology, 71*(2), 170–177.  
35  
36 <https://doi.org/10.1006/jecp.1998.2469>  
37  
38  
39  
40 Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review, 88*(1), 67–  
41 85. <https://doi.org/10.1037/0033-295X.88.1.67>  
42  
43  
44 Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy.  
45 *Annual Review of Psychology, 51*, 481–537.  
46  
47 <https://doi.org/10.1146/annurev.psych.51.1.481>  
48  
49  
50  
51 Korkki, S. M., Richter, F. R., Jeyarathnarajah, P., & Simons, J. S. (2020). Healthy ageing  
52 reduces the precision of episodic memory retrieval. *Psychology and Aging, 35*(1),  
53 124–142. <https://doi.org/10.1037/pag0000432>  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 Levine, B., Svoboda, E., Hay, J. F., Winocur, G., & Moscovitch, M. (2002). Aging and  
4 autobiographical memory: Dissociating episodic from semantic retrieval. *Psychology*  
5 *and Aging, 17*(4), 677–689. <https://doi.org/10.1037/0882-7974.17.4.677>  
6  
7  
8  
9  
10 Lindsay, D. S. (2008). 2.19—Source Monitoring. In J. H. Byrne (Ed.), *Learning and Memory:*  
11 *A Comprehensive Reference* (pp. 325–347). Academic Press.  
12  
13 <https://doi.org/10.1016/B978-012370509-9.00175-3>  
14  
15  
16  
17 Loftus, E. F., & Palmer, J. C. (1996). Eyewitness Testimony. In P. Banyard & A. Grayson  
18 (Eds.), *Introducing Psychological Research: Sixty Studies that Shape Psychology* (pp.  
19 305–309). Macmillan Education UK. [https://doi.org/10.1007/978-1-349-24483-6\\_46](https://doi.org/10.1007/978-1-349-24483-6_46)  
20  
21  
22  
23  
24 Loftus, Elizabeth F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An  
25 example of the interaction between language and memory. *Journal of Verbal Learning*  
26 *and Verbal Behavior, 13*(5), 585–589. [https://doi.org/10.1016/S0022-5371\(74\)80011-](https://doi.org/10.1016/S0022-5371(74)80011-3)  
27  
28  
29  
30  
31  
32  
33  
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35  
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48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
- Lyle, K., & Johnson, M. (2006). Importing perceived features into false memories. *Memory, 14*(2), 197–213. <https://doi.org/10.1080/09658210544000060>
- Madore, K. P., Gaesser, B., & Schacter, D. L. (2014). Constructive episodic simulation: Dissociable effects of a specificity induction on remembering, imagining, and describing in young and older adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 40*(3), 609–622. <https://doi.org/10.1037/a0034885>
- Madore, K. P., & Schacter, D. L. (2015). Remembering the past and imagining the future: Selective effects of an episodic specificity induction on detail generation. *The Quarterly Journal of Experimental Psychology, 69*(2), 285–298. <https://doi.org/10.1080/17470218.2014.999097>
- Madore, K. P., Jing, H. G., & Schacter, D. L. (2019). Selective effects of specificity inductions on episodic details: Evidence for an event construction account. *Memory,*

- 1  
2  
3 0(0), 1–11. <https://doi.org/10.1080/09658211.2018.1502322>  
4  
5 McConnell, J., & Quinn, J. G. (2004). Complexity factors in visuo-spatial working memory.  
6  
7 *Memory*, 12(3), 338–350. <https://doi.org/10.1080/09658210344000035>  
8  
9  
10 Morcom, A. M., & Rugg, M. D. (2012). Retrieval Orientation and the Control of Recollection  
11  
12 : An fMRI Study. *Journal of Cognitive Neuroscience*, 24(12), 2372–2384.  
13  
14 [https://doi.org/10.1162/jocn\\_a\\_00299](https://doi.org/10.1162/jocn_a_00299)  
15  
16  
17 Memon, A., Meissner, C. A., & Fraser, J. (2010). The Cognitive Interview: A meta-analytic  
18  
19 review and study space analysis of the past 25 years. *Psychology, Public Policy, and*  
20  
21 *Law*, 16(4), 340–372. <https://doi.org/10.1037/a0020518>  
22  
23  
24 Meyersburg, C. A., Bogdan, R., Gallo, D. A., & McNally, R. J. (2009). False memory  
25  
26 propensity in people reporting recovered memories of past lives. *Journal of Abnormal*  
27  
28 *Psychology*, 118(2), 399–404. <https://doi.org/10.1037/a0015371>  
29  
30  
31 Mullally, S. L., & Maguire, E. A. (2014). Memory, Imagination, and Predicting the Future: A  
32  
33 Common Brain Mechanism? *The Neuroscientist*, 20(3), 220–234.  
34  
35 <https://doi.org/10.1177/1073858413495091>  
36  
37  
38 Nichols, R. M., & Loftus, E. F. (2019). Who is susceptible in three false memory tasks?  
39  
40 *Memory*, 27(7), 962–984. <https://doi.org/10.1080/09658211.2019.1611862>  
41  
42  
43 Ost, J., Blank, H., Davies, J., Jones, G., Lambert, K., & Salmon, K. (2013). False Memory ≠  
44  
45 False Memory: DRM Errors Are Unrelated to the Misinformation Effect. *PLOS ONE*,  
46  
47 8(4), e57939. <https://doi.org/10.1371/journal.pone.0057939>  
48  
49  
50 Ozubko, J. D., & Joordens, S. (2008). Super Memory Bros.: Going from mirror patterns to  
51  
52 concordant patterns via similarity enhancements. *Memory & Cognition*, 36(8), 1391–  
53  
54 1402. <https://doi.org/10.3758/MC.36.8.1391>  
55  
56  
57 Patihis, L. (2016). Individual differences and correlates of highly superior autobiographical  
58  
59 memory. *Memory*, 24(7), 961–978. <https://doi.org/10.1080/09658211.2015.1061011>  
60

- 1  
2  
3 Purkart, R., Versace, R., & Vallet, G. T. (2019). “Does it improve the mind’s eye?”:  
4  
5       Sensorimotor simulation in episodic event construction. *Frontiers in Psychology, 10*,  
6  
7       1403.  
8  
9  
10 Rey, A. E., Riou, B., Muller, D., Dabic, S., & Versace, R. (2015). “The mask who wasn’t  
11  
12       there”: Visual masking effect with the perceptual absence of the mask. *Journal of*  
13  
14       *Experimental Psychology: Learning, Memory, and Cognition, 41*(2), 567.  
15  
16  
17 Riou, B., Rey, A. E., Vallet, G. T., Cuny, C., & Versace, R. (2015). Perceptual processing  
18  
19       affects the reactivation of a sensory dimension during a categorization task. *Quarterly*  
20  
21       *Journal of Experimental Psychology, 68*(6), 1223–1230.  
22  
23       <https://doi.org/10.1080/17470218.2014.978876>  
24  
25  
26 Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words  
27  
28       not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and*  
29  
30       *Cognition, 21*(4), 803.  
31  
32  
33 Roediger, H. L., & McDermott, K. B. (2000a). Distortions of memory. In *The Oxford*  
34  
35       *handbook of memory* (pp. 149–162). Oxford University Press.  
36  
37  
38 Roediger, H. L., & McDermott, K. B. (2000b). Tricks of Memory. *Current Directions in*  
39  
40       *Psychological Science, 9*(4), 123–127. <https://doi.org/10.1111/1467-8721.00075>  
41  
42  
43 Roediger, H. L., Watson, J. M., McDermott, K. B., & Gallo, D. A. (2001). Factors that  
44  
45       determine false recall: A multiple regression analysis. *Psychonomic Bulletin &*  
46  
47       *Review, 8*(3), 385–407. <https://doi.org/10.3758/BF03196177>  
48  
49  
50 Romero, K., & Moscovitch, M. (2012). Episodic memory and event construction in aging and  
51  
52       amnesia. *Journal of Memory and Language, 67*(2), 270–284.  
53  
54  
55 Schacter, D. L., & Addis, D. R. (2007a). Constructive memory: The ghosts of past and future.  
56  
57       *Nature, 445*(7123), 27–27. <https://doi.org/10.1038/445027a>  
58  
59  
60 Schacter, D. L., & Addis, D. R. (2007b). The cognitive neuroscience of constructive memory:

1  
2  
3 Remembering the past and imagining the future. *Philosophical Transactions of the*  
4 *Royal Society of London B: Biological Sciences*, 362(1481), 773–786.

5  
6  
7 <https://doi.org/10.1098/rstb.2007.2087>

8  
9  
10 Schacter, D. L., Addis, D. R., Hassabis, D., Martin, V. C., Spreng, R. N., & Szpunar, K. K.  
11  
12 (2012). The Future of Memory: Remembering, Imagining, and the Brain. *Neuron*,  
13  
14 76(4), 677–694. <https://doi.org/10.1016/j.neuron.2012.11.001>

15  
16  
17 Schacter, D. L., & Coyle, J. T. (1995). *Memory Distortion: How Minds, Brains, and Societies*  
18  
19 *Reconstruct the Past*. Harvard University Press.

20  
21 Schacter, D. L., Guerin, S. A., & St. Jacques, P. L. (2011). Memory distortion: An adaptive  
22  
23 perspective. *Trends in Cognitive Sciences*, 15(10), 467–474.  
24  
25 <https://doi.org/10.1016/j.tics.2011.08.004>

26  
27  
28 Sheldon, S., Gurguryan, L., Madore, K. P., & Schacter, D. L. (2019). Constructing  
29  
30 autobiographical events within a spatial or temporal context: A comparison of two  
31  
32 targeted episodic induction techniques. *Memory*, 27(7), 881–893.  
33  
34 <https://doi.org/10.1080/09658211.2019.1586952>

35  
36  
37 Snodgrass, J. G., & Corwin, J. (1988). Pragmatics of measuring recognition memory:  
38  
39 Applications to dementia and amnesia. *Journal of Experimental Psychology: General*,  
40  
41 117(1), 34–50.

42  
43  
44 Surprenant, A. M., & Neath, I. (2009). *Principles of Memory*. Psychology Press.

45  
46  
47 Thakral, P. P., Madore, K. P., Devitt, A. L., & Schacter, D. L. (2019). Adaptive constructive  
48  
49 processes : An episodic specificity induction impacts false recall in the Deese-  
50  
51 Roediger- McDermott paradigm. *Journal of Experimental Psychology : General*,  
52  
53 148(9), 1480–1493. <https://doi.org/10.1037/xge0000577>

54  
55  
56 Vallet, G., Brunel, L., & Versace, R. (2010). The Perceptual Nature of the Cross-Modal  
57  
58 Priming Effect. *Experimental Psychology*, 57(5), 376–382.

1  
2  
3 <https://doi.org/10.1027/1618-3169/a000045>

4  
5 Vallet, G. T., Hudon, C., Simard, M., & Versace, R. (2013). The disconnection syndrome in  
6  
7 the Alzheimer's disease: The cross-modal priming example. *Cortex*, *49*(9), 2402–  
8  
9 2415. <https://doi.org/10.1016/j.cortex.2012.10.010>

10  
11 Vallet, G. T., Simard, M., Versace, R., & Mazza, S. (2013). The perceptual nature of  
12  
13 audiovisual interactions for semantic knowledge in young and elderly adults. *Acta*  
14  
15 *Psychologica*, *143*(3), 253–260. <https://doi.org/10.1016/j.actpsy.2013.04.009>

16  
17 Versace, R., Labeye, E., Badard, G., & Rose, M. (2009). The contents of long-term memory  
18  
19 and the emergence of knowledge. *European Journal of Cognitive Psychology*, *21*(4),  
20  
21 522–560.

22  
23 Versace, R., Vallet, G. T., Riou, B., Lesourd, M., Labeye, É., & Brunel, L. (2014). Act-In: An  
24  
25 integrated view of memory mechanisms. *Journal of Cognitive Psychology*, *26*(3),  
26  
27 280–306.

28  
29 Yee, E., Chrysikou, E. G., Hoffman, E., & Thompson-Schill, S. L. (2013). Manual Experience  
30  
31 Shapes Object Representations. *Psychological Science*, *24*(6), 909–919.  
32  
33 <https://doi.org/10.1177/0956797612464658>

## 34 35 36 37 38 39 40 41 42 43 44 **APPENDIX**

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46 **Table 2.** List of actions and objects used in the memory task (translated from French).

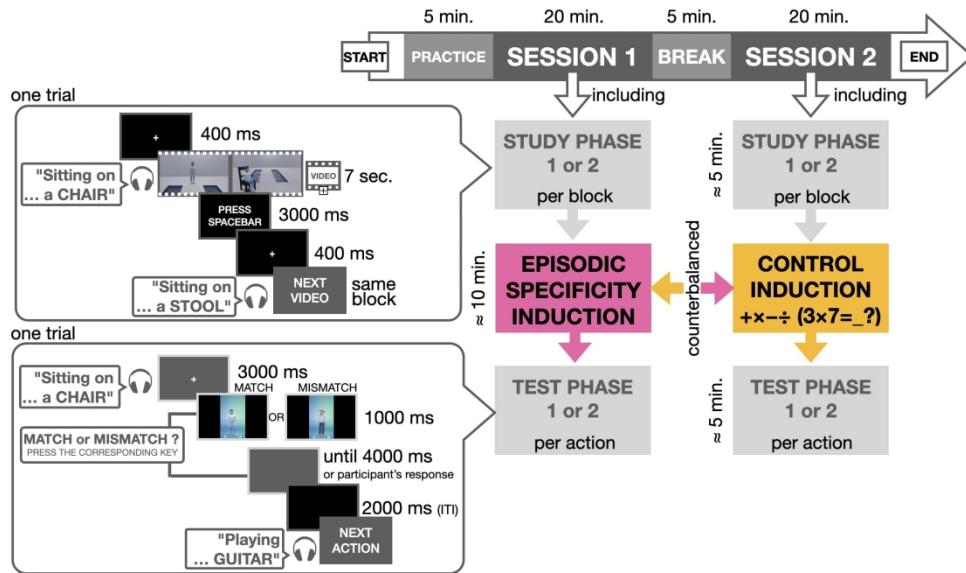
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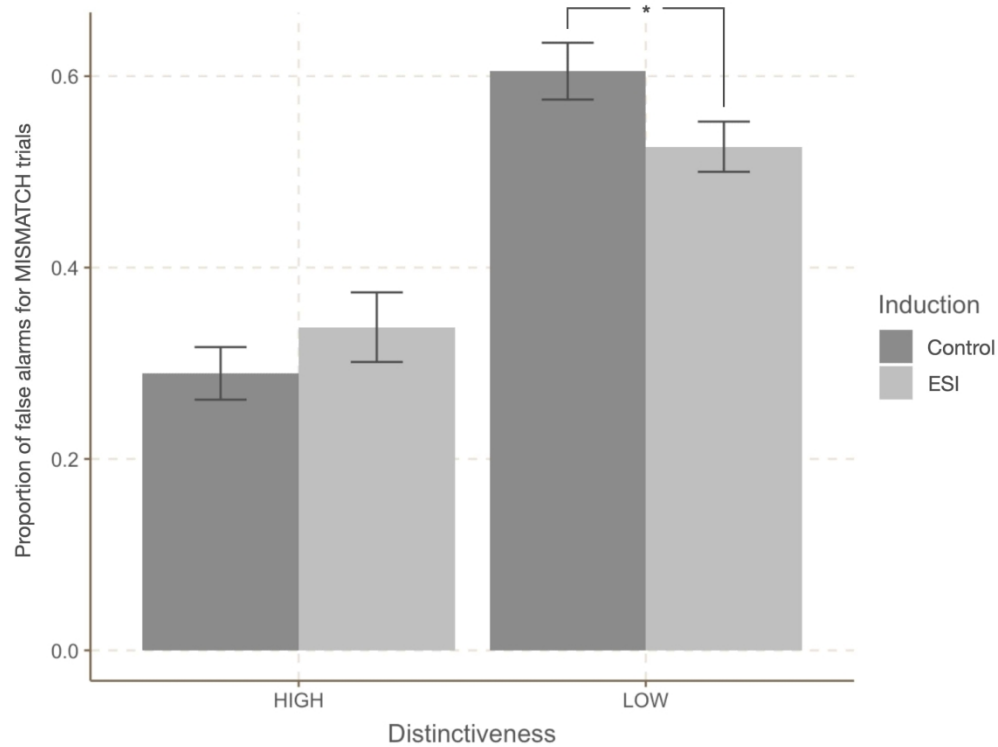
Photographs of the characters in a block in each distinctiveness condition.

1159x287mm (72 x 72 DPI)



Schematic procedure of the experiment.

885x522mm (72 x 72 DPI)



Comparison of the mean rates of false alarms for the different Induction types (Control vs. ESI) in each Distinctiveness condition (HIGH vs. LOW) for MISMATCH trials (incorrectly endorsing the test character as the one who performed the action on the object enounced). Gray bars represent standard errors corrected for the within-participant design.

927x721mm (72 x 72 DPI)

| TRIALS   | DISTINCTIVENESS | INDUCTION | HITS     |        | FA          |
|----------|-----------------|-----------|----------|--------|-------------|
|          |                 |           | <i>M</i> | (SD)   | <i>M</i>    |
| MISMATCH | HIGH            | CONTROL   | -        | -      | 0.29        |
|          |                 | ESI       | -        | -      | 0.34        |
|          | LOW             | CONTROL   | -        | -      | <u>0.61</u> |
|          |                 | ESI       | -        | -      | <u>0.53</u> |
| MATCH    | HIGH            | CONTROL   | 0.59     | (0.23) | -           |
|          |                 | ESI       | 0.56     | (0.23) | -           |
|          | LOW             | CONTROL   | 0.68     | (0.20) | -           |
|          |                 | ESI       | 0.68     | (0.21) | -           |

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| RT (on correct responses) |                 |             |
|---------------------------|-----------------|-------------|
| <b>(SD)</b>               | <b><i>M</i></b> | <b>(SD)</b> |
| (0.17)                    | 935             | (240)       |
| (0.22)                    | 1032            | (291)       |
| (0.18)                    | 1091            | (342)       |
| (0.16)                    | 1136            | (450)       |
| -                         | 944             | (353)       |
| -                         | 958             | (294)       |
| -                         | 1007            | (326)       |
| -                         | 1074            | (349)       |

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| <b>LIST A</b>   | <b>LIST B</b>   |
|---|---|
| <b>Sit on:</b><br>a chair<br>an armchair<br>a park bench<br>a stool                       | <b>Play:</b><br>the violin<br>the piano<br>the guitar<br>the drums                        |
| <b>Water:</b><br>a flowerpot<br>a tree<br>a bush<br>a cactus                              | <b>Put:</b><br>a robot toy<br>a dinosaur toy<br>a horse toy<br>a cat toy                  |
| <b>Utilize:</b><br>a computer<br>a television<br>a hi-fi system<br>a jukebox              | <b>Cooking with:</b><br>a barbecue<br>a gas cooker<br>a coffee machine<br>a microwave     |
| <b>Boarding:</b><br>a car<br>a bus<br>a motorbike<br>an aeroplane                         | <b>Use:</b><br>a shower<br>a bathtub<br>a sink<br>a toilet                                |
| <b>Lie down on:</b><br>a bed<br>a sofa<br>a deckchair<br>a bench                          | <b>Contemplate:</b><br>a statue<br>an armour<br>a painting<br>a fountain                  |
| <b>Pick up:</b><br>a superhero toy<br>a dragon toy<br>a helicopter toy<br>a butterfly toy | <b>Do sports with:</b><br>a treadmill<br>a punching bag<br>a weight bench<br>a basketball |