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FALSE MEMORIES IN ONLINE MISINFORMATION EXPERIMENTAL CONTEXT

Andreea HOROIȚĂ[1], Adrian OPRE[2*]

ABSTRACT. In times of pandemic and afterwards, online platforms and settings have been intensively used. With the purpose of investigating how this setting affected our memory, recent studies have found that memory distortions are present in online environments as well. Therefore, the objective of the present research was to assess misinformation effect in online context, more specifically to assess misinformation effect using leading questions and suggestibility techniques in online format. Our results indicate the presence of misinformation effect through suggestibility, but not through leading questions. Theoretical and practical implications are discussed.

Keywords: misinformation effect; leading questions; suggestibility; false memories; eyewitness testimony; online context.

Introduction

Memory volatility has been explored for a long time and in various forms. Memory errors, also known as memory illusions or memory reconstructions, are now proven facts (Loftus, 1996; Deese, 1959; Roediger & McDermott, 1995) and state that our memory, as dependent as we all are of it, is not always accurate. A form of memory distortion, which was intensively studied, is misinformation effect, and some of the techniques used to explore this particular effect on memory were leading questions and suggestibility. Implications of memory

[1] Doctoral School of Applied Cognitive Psychology, Department of Psychology, Faculty of Psychology and Educational Sciences, Babes-Bolyai University, Republicii Street No. 37, 400015, Cluj-Napoca, Romania, andreeahoroita@gmail.com
[2] Department of Psychology, Faculty of Psychology and Educational Sciences, Babes-Bolyai University, Republicii Street No. 37, 400015, Cluj-Napoca, Romania, adrianopre@psychology.ro
* Corresponding author: adrianopre@psychology.com

research are always meaningful, as long as everyday functioning depends on memory use. Remembering is a psychological mechanism with important practical implications in a number of fields - psychology, education, law, social sciences, public health, healthcare, to name a few (Ecker et al., 2022). In the legal system, more specifically in the eyewitness testimony area, which is based entirely on memory, the testimony could impact the decision of 'guilty' or 'not guilty' of the accused or defendant, therefore impacts a person's course of life.

The misinformation effect refers to post-event information that alters the original memory of a specific event (Pickrell, Bernstein & Loftus, 2016). In the classical paradigm, participants first assist to an event, then they receive an incorrect information about the event they saw, through questions, photographs, suggestions etc, and afterwards they participate in a memory test regarding the event they initially saw. The effect is that the incorrect information is incorporated into the initial memory of the event (Loftus, 2005). In the original development of misinformation effect paradigm in a laboratory setting, the influence of the wording was used in post-event questions, which ultimately changed perception of the event and affected its original memory (Berkowitz & Loftus, 2018). After viewing videos or slides of an event, usually a car crash accident, participants asked in different wording about the event responded differently at specific questions regarding the initially presented slides or video (Loftus & Palmer, 1974). This technique is called leading questions (Loftus, 1996; Wells & Olson, 2003) and refers to questions asked by investigators, with content made of specific verbs, prepositions or specific words, which may lead to a desirable or leading witness's answer (Loftus, 1996). Experiments on leading questions mainly address the relation between verbs or prepositions and participants answers. In Loftus & Palmer experiment (1974), participants view a car crash short movie, and estimated a higher speed if the question was addressed with the verb "Smashed", than if the question was addressed with the verb "Hit". The effect of verbal labels on directions of change in memory, when visual stimuli are presented, has gained proves in other scientific studies as well (Daniel, 1972; Santa & Ranken, 1972; Lindauer, 1970; Loftus, Miller & Burns, 1978; Doyle & Lindquist, 2018; Huang & Awg, 2018). Therefore, wording can influence participants' answers (Loftus, 1975). How questions are formed counts in a series of answers, with high implications in the legal system. For example, the wording of a question can be accountable in people's answers through the use of prepositions (Loftus, 1974; Loftus & Zanni, 1975). In a research of Loftus and colleagues (1974, 1975), when participants were asked if they have seen 'the' broken headlight, in reverse with 'a' broken headlight, the preposition 'the' increased by almost 50% the false assumption that a broken headlight existed. In fact, no broken headlight was presented in the scene, but the question

leads to a false assumption that there was, and consequently to a false answer (Loftus, 1975). The replication of how specific different words from a question can lead to a specific different answer was also investigated by numerous researchers (Harris, 1973; Dodd & Bradshaw, 1980), which raised awareness among legal and non-legal researchers and a challenge to find solutions to this 'problem' (Swan, Giulianni & Weber, 1982; Geiselman et al., 1986; Pahre, 1999).

Suggestibility is also a technique used in misinformation effect research. Our memory becomes vulnerable and malleable at the influence of suggestions, and false or misinformed memories are stated from external suggestion (Nichols & Loftus, 2019). Misinformation paradigm contains three phases, and the second one implies suggestion or imagination of the incorrect information (Nichols & Loftus, 2019). Individual differences on suggestibility state that people who are prone to develop false memory from their past due to imagination or suggestibility, are also prone to present more false memories in a laboratory setting as well. The studies on repressed memories confirms this idea, for example women who recovered repressed memories had higher scores on false DRM memories in laboratory context (Clancy et al., 2000; Geraerts et al., 2005; Geraerts et al., 2009; as cited in Nichols & Loftus, 2019). Divided attention is also a factor to consider in suggested false memories in misinformation paradigm, for instance participants who have divided attention at encoding (Lane, 2006; as cited in Nichols & Loftus, 2019) and also at retrieval (Zaragoza & Lane, 1998; as cited in Nichols & Loftus, 2019), are more likely to incorporate misleading suggestions into their memory (Nichols & Loftus, 2019). Moreover, suggestion is harder to correct than directly stated misinformation (Reynolds, 2020). The latest studies presents suggestibility to be stronger in the case of false additive information than false contradictory information, older adults enabling fewer false contradictory misinformation than younger adults (Huff & Umanath, 2018).

Misinformation effect is a very robust phenomenon, which has been demonstrated in numerous studies, on various ages – infants, children, adults and elderly- and animal samples -gorillas, pigeons (Harper & Gary, 2000; Poole & Lindsay, 2001; Rovee-Collier, Borza, Adler & Booler, 1993; Schwartz, Meissner, Hoffman, Evans & Frazier, 2004; Wylie et al., 2014; as cited in Berkowitz & Loftus, 2018). Furthermore, misinformation effect appears even in the case of people with *highly superior autobiographical memory* (HSAM) (Parker, Cahill & McGaugh, 2006; as cited in Berkowitz & Loftus, 2018). The HSAM individuals correctly remembers details from their past with 97% accuracy (LePort et al., 2012, as cited in Berkowitz & Loftus, 2018). Nevertheless, they are not immune to misinformation effect, which also appears into their memories, as scientific experiments show (Patihis et al., 2013, as cited in Berkowitz & Loftus, 2018).

Authors explained this phenomenon as a memory-bias, memory impairment or memory reconstruction mechanism (Loftus, 2005). But how exactly does memory reconstruct reality?

The explanations provided for the misinformation effect includes theoretical framework. Initial explanation is that the first encoded memory trace is altered or overwritten by the false information given after the initial encoding process (Loftus, 1975, 1979; Loftus et al., 1978, apud Ayers & Reder, 1998). This assumption would imply that the first encoded trace disappears, and it's replaced with the false memory trace. But what if participants remember both informations, the first true one and the second misinformed one? Then we could argue, as cognitive psychologists also argue, the debate between single-trace versus multiple-trace memory, with more scientific arguments and proves for the multiple-trace memory theory (Chandler, 1991; Chandler & Gargano, 1995; Windschitl, 1996, apud Ayers & Reder, 1998). Participants encode the first true information about the event, but also the second false information, therefore multiple traces of one single event are created. McCloskey & Zaragoza (1985) strongly debates the single-trace explanation by arguing that if participants rewrite the first memory trace, then it would disappear or be forgotten, and participants wouldn't choose it at all. Their studies focused on a modified procedure, where participants had to choose in the recognition test between the first presented information and a new one. The false information was presented in the encoding phase, but wasn't an option in the recognition test. If the false information had altered the first correct encoded trace, consequently the first trace would have disappeared and would have been replaced with the second, false information. As a result, participants wouldn't have chosen the first trace, because of its replacement with the second trace stored in their memory. Results showed instead a major preference for the first, correct, information, both in control and the experimental, misinformed, group. Researchers strongly concluded that 'misleading information neither erases the original information, neither it renders it inaccessible' (McCloskey & Zaragoza, 1985). Secondly, misinformation effect is further explained with the activation-memory trace framework, which stipulates that multiple-activation in memory of the first or second, created, information is possible, and memory bias is given by the activation of the second, false information. The misleading information is easier to activate, because it was the last one encoded and stored, so the participants could choose it faster than the first trace, less activated in memory. Other participants could activate stronger the first information, which could explain participant's choice answers, who aren't always for the misleading response (Ayers & Reder, 1998).

This framework is consisted with Kelly and Jacoby (1996) findings, regarding source activation theory, which stipulates that when the source of the activation in memory is confusing, this could result in memory errors (as cited in Pickrell et al., 2016). Other possible explanations of the misinformation effect are task demands or strategic effects (Pickrell et al., 2016). Moreover, situational factors- for example the time given between the original event and the misleading information and the time between the misleading information and test- and internal factors – different psychological states, the level of intelligence of the subjects, the level of sleep deprivation, or the level of being sober- are definitely variables which lead to moderation of the misinformation effect (Zhu et al., 2010; Frenda, Patihis, Loftus, Lewis & Fenn, 2014; Assefi & Garry, 2003; as cited in Berkowitz & Loftus, 2018).

In real life settings, misinformation effects can occur through conversations, stories, mass-media, and also through social media or other online instruments. Nowdays, the effect of misinformation on memory is present also in virtual reality. The Pandemic has created an unprecedent situation, the one in which every social activity was moved online, and where misinformation was also present. Social media use was positively associated with misinformations belief regarding Covid-19 Pandemic (Su, 2021). The effects on memory in online setting still remain to be scientifically explored, but one thing is for certain: the created infodemic (abundance of correct and incorrect information) had consequences on memory also, after exposure to online misinformation, for example it could have changed our memory about how we feel like with the mask on after reading an article that showed how effective the masks are in protecting us from the virus (Greenspan & Loftus, 2020).

Research on misinformation effect in online context has just started to explore its consequences on memory. Sievwright and collaborators (2021) found misinformation effect in an online context, after participants have been exposed to a traumatic video online, and later were exposed to misinformed content regarding the traumatic video watched before. Their results demonstrate that misinformation effect appears also in online setting, in this particular case using exposure to traumatic video.

Our present study focuses on the same idea of context dependence factor. The general objective is to assess false memories in online setting, using misinformation effect paradigm as a theoretical background design, with no interviewer and demand pressure. More specifically, the objective is to assess, in an online setting, the misinformation effect using the classicals techniques- leading questions technique (Loftus & Palmer, 1974) and the suggestibility technique (Loftus, 2005) – through online format. Therefore, the first specific objective is to assess false memories through leading questions in online setting,

and the second specific objective is to assess false misinformed memories through suggestibility in online setting. Our hypothesis is that false memories will also be present in online misinformed setting, for both techniques.

Method

Participants

Participants were randomly divided in two groups. The total number of participants were N=201. For the first Group, N=102, the Mean age was M_{age}=23.19, SD=5.83, and for the second group, N=99, the Mean age was M_{age}=22.04, SD=6.56. They all signed the Informed Consent form, which was created according to the International Ethical Standards in research field. They were told that this is a research study and if they participate, they have the chance to gain 50 euros at the end of the study. When the collected data were finished, a participant was chosen, using the site random.org, to collect the promised reward.

Instruments

The study was done through online access, and was distributed via social networks, especially via students groups from Facebook. All participants had to access a Google link, where they have been presented with a video of a car crash, made after a replication of the initial car crash video from Loftus & Palmer (1974), and pictures of two random damaged cars. All the leading questions and the suggested descriptions were presented in the Google Link. Their answers were recorded in the same Google link.

Procedure

In the first section participants were briefly informed about the study, and they were asked to read and agree to the Informed Consent form. After their agreement, they were asked questions regarding their age and e-mail address. The next section in the Google link asked the participants to carefully watch a video. The video was a car crash replication video from the main car crash experiment (Loftus & Palmer, 1974), with a duration of 14 seconds. The video replicated a car crash in which a blue car ignored an intersection and collided with a gray car. The main road where the accident occurred in the video had also a Yield sign. Those 14 seconds show only the collision between the blue car and the gray car, with a Yield sign in the intersection, on the main road.

After watching the video, in a separate section, the participants were asked several questions. Group 1 of participants was asked 'Which is the approximated speed of the blue car when it SMASHED into the gray car?', and participants from Group 2 were asked 'Which is the approximated speed of the blue car when it HIT the gray car?'. The separate sections in a Google form doesn't allow the participant to go back and watch the video film again. The method of collecting the answers for the leading questions was a force-choice option. Both groups of participants were offered the option to choose from 30km/h, 40km/h and 50 km/h. A second question for each group, in the same Google section, was 'Did you see The Stop Sign in the video?', even though there wasn't a Stop sign in the video, but a Yield sign. Both groups answered through a force-choice method, with YES or NO as options for this particular question.

In the next phase, we have introduced a misinformed suggestion to asses for misinformation effect. Two Pictures of two blue crashed cars, that had no connection with the car crash from the previous video, were presented in a separate Google section. The first Picture, A, was composed of a slightly crashed blue car, with accident marks on the frontal side of the car. The second Picture, B, presented a seriously damaged crashed blue car, with visible marks in the same frontal side of the car. The two cars were different in brands, but for the second car the brand wasn't visible because of the damages. Participants were asked to describe the pictures. A suggestive example was offered. Group 1 received the following question: 'Please describe the next Pictures. For example "Picture 1 –smashing the blue car with the gray one" ', and for Group 2 the same example, but the verb 'smashing' was replaced with the verb 'hitting'. Participants had to describe each Picture through a short text.

We had expected to find a slightly different misinformation effect between the two groups and the two pictures, for Group 1 to find a more pronounced effect in Picture B (where the car was more damaged, considering they received the suggestion containing the verb 'smashed') and for Group 2 a higher misinformation effect in Picture A (where the car was slightly damaged, and they received the suggestion containing the verb 'hitting').

Results

Each section was analyzed independently, therefore the misinformation effect was analyzed separately for the leading questions and for the suggestibility technique, in online context.

Leading questions

Results for the car crash experiment were analyzed using an independent t-test analysis. The independent variable consisted in the bias verbs ('Smashed' and 'Hit'), and the dependent variable was the speed chosen by the participants. Results showed no statistical differences for the speed between the two groups (p=.517, significant at p≤0. 05). Table 1 shows the speed means and standard deviations for both verbs. Fig.1 shows the graphic mean proportions for each of the three options of speed. The middle position, 40km/h, had the most chosen answer in both groups, especially in the 'Smashed' group.

Table 1. Means and Standard Deviations of Chosen Speed for Each Group

Verb	M	SD
Smashed	40.58	7.28
Hit	39.89	7.75

M=Mean; SD= Standard Deviation.

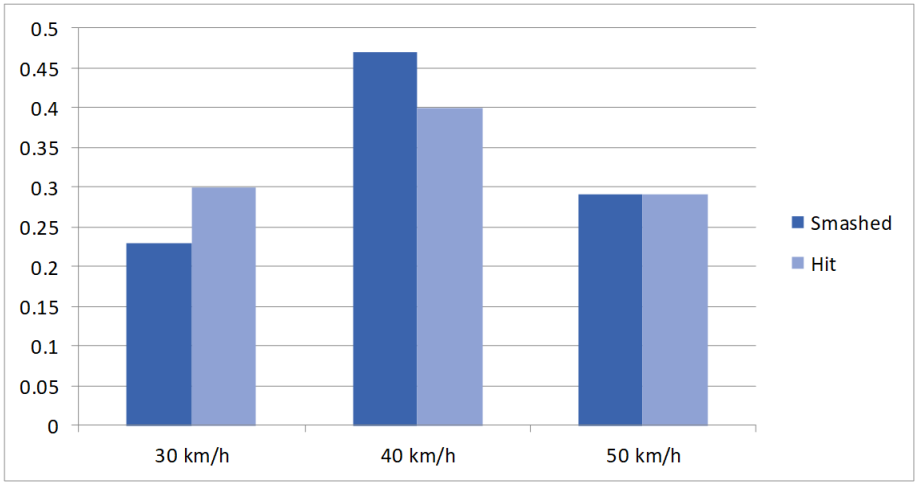

Fig. 1 – Mean proportions for each speed in both groups.

Participants tend to choose the middle speed estimation, 40 km/h, not the highest -50 km/h- or the lowest -30 km/h- speed estimation, regardless of the verb used in the question.

The Stop sign was seen by 0.09% of participants in the 'Smashed' group and 0.07% of participants in the 'Hit' group. So the probability, P (Y), to answer Yes to the question 'Did you see The Stop Sign when the cars smashed/hit each other?' is .09 for the verb 'Smashed', and .07 for the verb 'Hit'. An independent Chi-Square test indicated no significant results between the two groups, *Smashed* and *Hit*, for the participants that answer with Yes and No to the questions 'Did you see The Stop Sign in the car crash video?'.

Misinformation effect

In this part of the experiment, we wanted to assess if a misinformed suggestion example will lead to a false response in describing the photos, or a misinformation effect, in online setting. Participants from each group described first Picture A, then Picture B. The design was 2 (picture A X picture B) X 2 (group 1 X group 2). In order to have a quantitative analysis, responses were marked with 1 for false responses, 2 for neutral responses and 3 for correct responses. Means and standard deviations for responses are presented in Table 2. Fig 2 displays the chart representations of the responses.

Table 2. Mean proportions of the answers for each Picture and each Group

	Group 1 ('Smashed' as a verb')				**Group 2 ('Hit as a verb')**					
	Picture A		**Picture B**		**Picture A**		**Picture B**		**Total Responses**	
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
False Responses	.19	.40	.19	.40	.22	.42	.19	.40	.19	.01
Neutral Responses	.33	.47	.36	.48	.31	.47	.30	.46	.32	.02
Correct Responses	.47	.50	.44	.50	.46	.50	.50	.50	.46	.02
Total Average	.33	.14	.33	.13	.33	.12	.33	.15	.32	.13

M= Mean; SD= Standard Deviation; *in brackets: Standard Deviations*

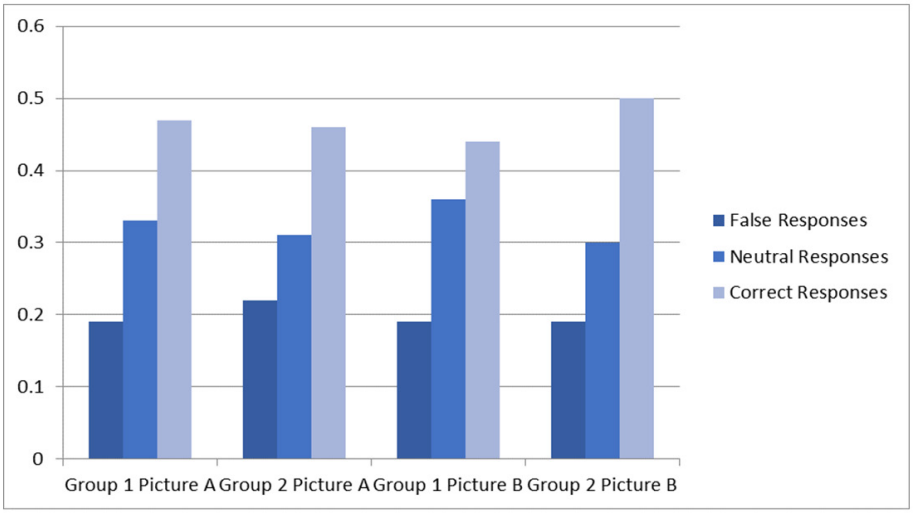

Fig. 2: Graphical representation of mean proportion of false, neutral and correct responses, for each Picture and Each Group.

A repeated measures two way Anova indicated a non-significant difference between the within-subjects variable, Picture A and B, and for between-subjects factor, Group 1 and 2 (1- 'Smashed', 2- 'Hit'), as a result of suggestive examples.

However, a One-way Anova resulted in a statistical significance effect between mean proportions of false, neutral and correct responses, F (2,9) = 141.242, p=.000, significant at p≤0. 01. Post-Hoc Tukey test indicates significant mean differences between neutral and false responses (M= .13, SD= .01), correct and neutral responses (M= .14, SD= .02), and correct and false responses (M= .27, SD= .02), p= .000, significant at p≤0. 01.

Results indicate no misinformation effect in leading questions through online setting/instruments. However, misinformation effect was present in the participants answers in describing the pictures, which in fact weren't part of the car crashed they watched before. The hypothesis that a higher effect will appear in Picture B for Group 1 and Picture A for Group 2 wasn't confirmed.

In conclusion, the results suggests than when given a certain suggestive example for a specific description, that suggestion, often false, becomes incorporated in people's responses, even in online context.

Discussions

Results indicate that in virtual or online setting, no influence of the verb on speed estimation exists. There is also no influence of the preposition 'the' on false memory of a Stop sign. In conclusion, in an online setting, a leading question could, indeed, not produce a leading effect. A possible explanation for the lack of any significant differences could also be the given estimated speed choices, 30-40-50km/h, which were too close in values and resulted in a median value of 40km/h. Maybe in the case of longer estimated speed distance value (for example 30-60-80 km/h), results would have been different. In the original study of Loftus & Palmer (1974), which took place in laboratory setting, open-ended responses of the participants were used, allowing the participants to estimate the speed, therefore the group for 'Smashed' verb has estimated a higher speed (40.8mph) than the participants in the 'Hit, Collied, Bumped, Contacted' verb group (31.8mph).

An online setting requires the absence of an interviewer, the absence of a spoken demand to answer the question. For our experiment, no spoken verbal label was addressed, participants read the verbal label (cars 'smashed', cars 'hit') and estimated the speed based on the memory of the collision, which they saw in the video. Another possible explanations for a lack of significant results could be the simplified procedure used in online setting, versus the slides presentation, more detailed procedure, used in normal setting (Loftus & Palmer, 1974; Loftus, 1975).

A verbal label directs attention of subjects and can produce changes in memory (Daniel, 1972), but for significant changes there is also a need of suitable sets of alternative labels or forms, and a delay time between the encoding and the memory test (Daniel, 1972; Santa & Ranken, 1972). Loftus and Palmer's experiment (1974) presents sets of alternative verbal labels, four types of verbs –smashed, collided, bumped, hit, contacted- which all participants were exposed to. The lack of spoken verbal label, the lack of sets of alternative forms of verbal label and the lack of time delay could be possible explanations for insignificant differences in online verb-speed estimation. Therefore, the change of independent variables opens the possibility to find significant misinformation effect in online context as well.

Another possible explanation could be that all participants responded through a force-choice test. If a free answer test were to be given instead, would that change the results? The difference between force-choice and free test in scientific literature is that force-choice test can lead to more correct responses (Macmillan & Creelman, 2004).

The demand characteristics of the experimental situation is another suitable explanation for the present results. In the present context, participants were in front of a virtual reality, with no spoken demand, reading by themselves all the instructions and answering as a result of reading instructions. In previous leading questions's experiments (Loftus & Palmer, 1974; Loftus, 1975; Loftus, Miller & Burns, 1978), participants were read aloud the instructions by an experimenter, and asked to answer the questions by an experimenter as well, therefore the influence of a social actor had been noticed. In online setting, there is no social need to confirm the interviewer beliefs, in order to obtain a social reward, because there is no interviewer. Also, in virtual setting no 'relatively high-speed answer' is required or indirectly perceived as required, for the purpose of being seen as a 'perceptive observer' by the interviewer, because there is no interviewer. Those demand explanations were observed by Loftus & Loftus (1980) as well. The present experiment, with online experimental characteristics, excludes demand characteristics as perceived social pressure, which could also be a possible cause for the lack of any found influnce of verbs on speed estimation.

Results also indicate that misinformation effect is possible in online setting as well, even though there is no interviewer and no demand pressure. The suggestive examples, primed with verbs 'Smashed' and 'Hit', mislead the participants to falsely describe Pictures A and B as beeing part of the online car crash previously presented. The Pictures had no real connection with the car crash presented in the video, but participants were mislead to think that they are connected through the suggested example used by the experimenter. The verbs, 'Smashed' and 'Hit', also appeared in their responses. Results indicated, however, no significant difference between misinformation effect of the interaction of groups and pictures, which can be interpreted that the wording didn't had a significant impact on participants false memory, and this is consistent with the no effect of wording found in section 1 -leading questions- of the present study. However, the tendency was for the misinformation effect to be higher in the pictures which better described the priming verb, Picture B for Group 1 ('Smashed' verb) and Picture A for Group 2 ('Hit' verb). Therefore, more research is need it to investigate the influence of wording in online setting for the misinformation effect.

Our study's results indicate misinformation effect in online setting throughout suggestive examples, and is concordant with multiple-trace theory (Nadel & Moscovitch, 1997), activation-based framework (Ayers & Reder, 1998) and source-monitoring framework (Kelly & Jacoby, 1996). The first trace, car crash video, activated through priming verbs ('Smashed' and 'Hit'), is incorporated in participants free answers, as well as the second trace, the false

suggested example that 'Pictures represents the cars from previous video'. Both traces are activated in the example given by the experimenter, 'the blue car smashed/hit the gray car'. Some participants falsely choose freely to express in pictures' description both traces, some of the participants expresses only one trace or some participants none. The majority of their answers are correct, or neutral, but between false and correct or neutral response there is a statistically significant differences, which means that false suggestive example were indeed incorporated in subjects answers, but still the majority of them did not falsely remembered the suggestive examples. A possible explanation is that maybe both traces are encoded and stored in memory, both traces were activated through the suggestive example, and confusion of activated sources (the pictures or the video primed with suggestive example) leads to memory errors. Nevertheless, the proportion of participants that gave the false responses is the smallest from the sample, and this is an aspect that is important to take into consideration when interpreting results in misinformation effect, because misinformation effect, although present, occurs in the smallest proportion from the sample.

Limits of the present study concern the lack of a control group. Groups were formed according to verbs, 'smashed' and 'hit', in order to asses false memories effect as a consequence of leading questions and suggestibility in misinformation paradigm. The present research focus on evaluating leading questions, and misinformation effect in an online setting, with no interviewer present and no verbal demand. Results clearly show the presence of misinformation effect, but the lack of distorted responses on leading questions.

Misinformation effect in online context gained attention and was also observed in other studies as well. Our results are consistent with results found in Del Vicario et al (2016), Nguyen et al (2012), Nguyen et al (2013), Shao et al (2018), Siewright et al. (2021), to name a few. Online media and social media, through rumor spreading, can create misleading information and divert any news in misleading information (Greenspan & Loftus, 2020). Some authors stipulate that homogeneity and polarization are the main determinants in predicting cascade's size in a misinformation effect (Del Vicario et al., 2016).

The impact of misinformation effect can be observed in real life context. As a practical implication, The Innocence Project, for example, estimated around 60% of false eyewitness identifications. The consequence was around 60% of erronated convictions (Innocence Project, 2021, as cited in Stoll, 2021). However, misleading informations are around us nowadays frequently, the internet and social media has become an exponential challenge because the increase in misinformation is higher and the audience is particularly targeted (Ecker et al., 2022). Therefore, misinformation effect has great

impact and implications, not only in the legal field, but also in everyday social interaction, that can result in everyday eronated decisions or poor communication. If a perception is formed through a false assumption, for example, which was created by a misleading information, the misinformation effect has great impact on that specific perception, which could lead to a specific eronated decision or to a spread of the misinformation effect. People's attention when sharing information is not focused on accuracy, which is the main reason of sharing misinformation (Pennycook et al., 2021). Moreover, misinformation effect is very persistent, especially if it's communicated implicitly (Reynolds, 2020).

Conclusions and future research directions

Implications of memory errors assessment for online communication address the role and impact of highly used online and media tools for learning purposes or for simple communication use. Nowdays, online setting has proved highly usefull in large domains, including in therapeutical interventions. Therefore, it is important to explore and know the effects or the implications for memory when working with online methods.

In conclusion, can we stipulate that online leading questions are, in fact, not misleading? More research is required in this type of experimental context, with the same variables involved, and maybe the same procedure. Future research could also investigate the effect of changing procedures in online leading questions experiments.

Implicit memory for altered memory events is a genuine fact to consider in further research as well, through online tools, because it raises doubts about unintentional altered effects of human memory. Source-monitoring framework displays source memory as an attribution, which consists of both conscious and unconscious processes (Zaragoza, Belli & Payment, 2007). Cognitive unconscious, defined as a failure of introspection (Opre, 2012), can and does confound memory sources, or activate memory traces.

Future research could also explore the adaptive role of implicit memory distortions, and the mechanism underlying misinformation effect and implicit memory distortions in online setting. Moreover, how misinformation contributes in the decision-making process could also be a line of future research, given that scientific quest on decisions implies emotional, cognitive, contextual and hormonal approach (Heilman, 2006). Memory distortions can also be investigated in further reasearch of short-term memory effect or metamemory effects (Visu-Petra, Cheie & Benga, 2008) or in assesing the effects of perceived well-beeing in school (Opre, Pintea, Opre & Bertea, 2018).

Future reasearch could also investigate the role of implicit memory distortions in information-processing mechanism (David, Miclea & Opre, 2004). However, implicit memory distortions could also have a possible cause or effect in expressing implicit emotional traits and behaviours (Jurchis, Costea, Dienes, Miclea & Opre, 2018), and in evaluating the perceived effect of cognitive-behvioral therapies (Jurchis & Opre, 2016; 2018; Jurchis, 2018), which are using online methods. Assesing the distinction between implicit and explicit memory distortions, in virtual reality or online learning, could also be a future line of reasearch (Voinescu & David, 2019).

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REFERENCES

Berkowitz, S. R., & Loftus, E. F. (2018). Misinformation il the Courtron. In Otgaar, H., & Howe, M. L. (Eds). Finding the truth in the courtroom: Dealing with deception, lies, and memories. (pp. 11-30). New York, NY: Oxford University Press.

Chandler, C. C. (1991). How memory for an event is influenced by related events: Interference in modified recognition tests. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *17*(1), 115. DOI: https://doi.org/10.1037/0278-7393.17.1.115

Chandler, C. C., & Gargano, G. J. (1995). Item-specific interference caused by cue-dependent forgetting. *Memory & cognition*, *23*(6), 701-708. DOI: https://doi.org/10.3758/BF03200923

Daniel, T. C. (1972). Nature of the effect of verbal labels on recognition memory for form. *Journal of Experimental Psychology*, *96*(1), 152. DOI: https://doi.org/10.1037/h0033486

David, D., Miclea, M., & Opre, A. (2004). The information-processing approach to the human mind: Basics and beyond. *Journal of Clinical Psychology*, *60*(4), 353-368. DOI: https://doi.org/10.1002/jclp.10250

Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of experimental psychology*, *58*(1), 17. DOI: https://doi.org/10.1037/h0046671

Deese, J. (1959). Influence of inter-item associative strength upon immediate free recall. *Psychological Reports*, *5*(3), 305-312. DOI: https://doi.org/10.2466/pr0.1959.5.3.305

Del Vicario, M., Bessi, A., Zollo, F., Petroni, F., Scala, A., Caldarelli, G., ... & Quattrociocchi, W. (2016). The spreading of misinformation online. *Proceedings of the National Academy of Sciences*, *113*(3), 554-559. DOI: https://doi.org/10.1073/pnas.1517441113

Dodd, D. H., & Bradshaw, J. M. (1980). Leading questions and memory: Pragmatic constraints. *Journal of Verbal Learning and Verbal Behavior*, *19*(6), 695-704. DOI: https://doi.org/10.1016/S0022-5371(80)90379-5

Doyle, C. M., & Lindquist, K. A. (2018). When a word is worth a thousand pictures: Language shapes perceptual memory for emotion. *Journal of Experimental Psychology: General*, *147*(1), 62. DOI: https://doi.org/10.1037/xge0000361

Ecker, U. K., Lewandowsky, S., Cook, J., Schmid, P., Fazio, L. K., Brashier, N., ... & Amazeen, M. A. (2022). The psychological drivers of misinformation belief and its resistance to correction. *Nature Reviews Psychology*, *1*(1), 13-29.

Geiselman, R. E., Fisher, R. P., Cohen, G., Holland, H., et al. (1986). Eyewitness responses to leading and misleading questions under the cognitive interview. *Journal of Police Science & Administration, 14*(1), 31–39.

Graf, P., & Schacter, D. L. (1985). Implicit and explicit memory for new associations in normal and amnesic subjects. *Journal of Experimental Psychology: Learning, memory, and cognition*, *11*(3), 501. DOI: https://doi.org/10.1037/0278-7393.11.3.501

Greenspan, R. L., & Loftus, E. F. (2021). Pandemics and infodemics: Research on the effects of misinformation on memory. *Human Behavior and Emerging Technologies*, *3*(1), 8-12.

Harris, R. J. (1973). Answering questions containing marked and unmarked adjectives and adverbs. *Journal of Experimental Psychology*, *97*(3), 399. DOI: https://doi.org/10.1037/h0034165

Heilman, R. M. (2006). The impact of emotions and individual differences upon economic decision-making: a review of experimental literature. *Cognitie, Creier, Comportament/Cognition, Brain, Behavior*, *10*(3).

Huang, L., & Awh, E. (2018). Chunking in working memory via content-free labels. *Scientific reports*, *8*(1), 1-10. DOI: https://doi.org/10.1038/s41598-017-18157-5

Huff, M. J., & Umanath, S. (2018). Evaluating suggestibility to additive and contradictory misinformation following explicit error detection in younger and older adults. *Journal of experimental psychology: applied*, *24*(2), 180. DOI: https://doi.org/10.1037/xap000013

Jurchiș, R., Costea, A., Dienes, Z., Miclea, M., & Opre, A. (2018). Evaluative conditioning of artificial grammars: Evidence that non-conscious structures bias affective evaluations of novel stimuli. DOI: 10.31234/osf.io/jkfu5

Jurchiș, R., & Opre, A. (2016). Unconscious learning of cognitive structures with emotional components: Implications for cognitive behavior psychotherapies. *Cognitive Therapy and Research*, *40*(2), 230-244. DOI https://doi.org/10.1007/s10608-015-9743-z

Jurchiș, R., & Opre, A. (2018). A dual process approach to current issues from cognitive behavior therapies: An integrative perspective. *International Journal of Cognitive Therapy*, *11*(4), 374-409. DOI https://doi.org/10.1007/s41811-018-0023-z

Jurchiș, R. (2018). Fundamental properties of implicit knowledge structures: Implications for Cognitive Behavior Therapies. *Journal of Evidence-Based Psychotherapies*, *18*(2).

Kelley, C. M., & Jacoby, L. L. (2014). Memory attributions: Remembering, knowing, and feeling of knowing. In *Implicit memory and metacognition* (pp. 299-320). Psychology Press.

Lindauer, M. S. (1970). Unambiguity of forms and inequality of labels in studies of effect of language on memory for form. *Perceptual and Motor Skills, 30*(1), 175–181. DOI: https://doi.org/10.2466/pms.1970.30.1.175

Loftus, E. F. (1974). Reconstructiong memory: Incredible eyewitness. *Psychology today*, *1974*, 116-119.

Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive psychology*, *7*(4), 560-572. DOI: https://doi.org/10.1016/0010-0285(75)90023-7

Loftus, E. F., & Loftus, G. R. (1980). On the permanence of stored information in the human brain. *American Psychologist*, *35*(5), 409. DOI: https://doi.org/10.1037/0003-066X.35.5.409

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information into a visual memory. *Journal of experimental psychology: Human learning and memory*, *4*(1), 19. DOI: https://doi.org/10.1037/0278-7393.4.1.19

Loftus, E. F. (1979). Reactions to blatantly contradictory information. *Memory & Cognition*, *7*(5), 368-374. DOI: https://doi.org/10.3758/BF03196941

Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of verbal learning and verbal behavior*, *13*(5), 585-589. DOI: https://doi.org/10.1016/S0022-5371(74)80011-3

Loftus, E. F. (1991). Made in memory: Distortions in recollection after misleading information. In *Psychology of learning and motivation* (Vol. 27, pp. 187-215). Academic Press. DOI: https://doi.org/10.1016/S0079-7421(08)60124-3

Loftus, E. F. (1991). Memory distortions. *Canadian Psychology/Psychologie canadienne*, *32*(4), 645. DOI: https://doi.org/10.1037/h0084648

Loftus, E. F., & Palmer, J. C. (1996). *Eyewitness Testimony. Introducing Psychological Research, 305–309.* DOI: http://doi.org/10.1007/978-1-349-24483-6_46

Loftus, E. F., & Zanni, G. (1975). Eyewitness testimony: The influence of the wording of a question. *Bulletin of the Psychonomic Society*, *5*(1), 86-88. DOI: https://doi.org/10.3758/BF03336715.

McCloskey, M., & Zaragoza, M. (1985). Misleading postevent information and memory for events: Arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology: General*, *114*(1), 1. DOI: https://doi.org/10.1037/0096-3445.114.1.1

Macmillan, N. A., & Creelman, C. D. (2004). *Detection theory: A user's guide*. Psychology press.

Nadel, L., & Moscovitch, M. (1997). Memory consolidation, retrograde amnesia and the hippocampal complex. *Current opinion in neurobiology*, *7*(2), 217-227. DOI: https://doi.org/10.1016/S0959-4388(97)80010-4

Nguyen, N. P., Yan, G., Thai, M. T., & Eidenbenz, S. (2012, June). Containment of misinformation spread in online social networks. In *Proceedings of the 4th Annual ACM Web Science Conference* (pp. 213-222). DOI: https://doi.org/10.1145/2380718.2380746

Nguyen, N. P., Yan, G., & Thai, M. T. (2013). Analysis of misinformation containment in online social networks. *Computer Networks*, *57*(10), 2133-2146. DOI: https://doi.org/10.1016/j.comnet.2013.04.002

Opre, A. (2012). *Inconstientul Cognitiv*. Polirom.

Opre, D., Pintea, S., Opre, A., & Bertea, M. (2018). Measuring Adolescents'subjective Well-Being in Educational Context: Development and Validation of a Multidimensional Instrument. *Journal of Evidence-Based Psychotherapies*, *18*(2), 161.

Pennycook, G., Epstein, Z., Mosleh, M., Arechar, A. A., Eckles, D., & Rand, D. G. (2021). Shifting attention to accuracy can reduce misinformation online. *Nature*, *592*(7855), 590-595.

Pickrell, J. E., McDonald, D., Bernstein, D. M., & Loftus, E. F. (2016). Misinformation effect. *Cognitive illusions: Intriguing phenomena in judgement, thinking and memory*, 406-423.

Pahre, R. (1999). *Leading questions: How hegemony affects the international political economy*. University of Michigan Press.

Reynolds, R. M. (2020). *Why Does Misinformation Persist? Cognitive Explanations of the Implicit Message Effect*. Michigan State University.

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of experimental psychology: Learning, Memory, and Cognition*, *21*(4), 803.

Roediger, H. L. (2003). Reconsidering implicit memory. In J,S, Bowers, C,J, Marsolek, *Rethinking implicit memory*, 3-18. Oxford University Press.

Russo, R., Nichelli, P., Gibertoni, M., & Cornia, C. (1995). Developmental trends in implicit and explicit memory: A picture completion study. *Journal of Experimental Child Psychology*, *59*(3), 566-578.

Santa, J. L., & Ranken, H. B. (1972). Effects of verbal coding on recognition memory. *Journal of Experimental Psychology, 93*(2), 268–278. DOI: https://doi.org/10.1037/h0032514

Sievwright, O., Philipp, M., Drummond, A., Knapp, K., & Ross, K. (2021). Misinformation effects in an online sample: results of an experimental study with a five day retention interval. *PeerJ*, *9*, e12299.

Schacter, D. L. (2002). *The seven sins of memory: How the mind forgets and remembers*. HMH

Shao, C., Hui, P. M., Wang, L., Jiang, X., Flammini, A., Menczer, F., & Ciampaglia, G. L. (2018). Anatomy of an online misinformation network. *PloS one*, *13*(4), e0196087. DOI: https://doi.org/10.1371/journal.pone.0196087

Stoll, E. M. (2021). Misinformation modality and its effects on memory.

Swann, W. B., Giuliano, T., & Wegner, D. M. (1982). Where leading questions can lead: The power of conjecture in social interaction. *Journal of Personality and Social Psychology*, *42*(6), 1025. DOI: https://doi.org/10.1037/0022-3514.42.6.1025

Su, Y. (2021). It doesn't take a village to fall for misinformation: Social media use, discussion heterogeneity preference, worry of the virus, faith in scientists, and COVID-19-related misinformation beliefs. *Telematics and Informatics*, *58*, 101547.

Zaragoza, M. S., Belli, R. F., & Payment, K. E. (2007). Misinformation effects and the suggestibility of eyewitness memory. *Do justice and let the sky fall: Elizabeth Loftus and her contributions to science, law, and academic freedom*, 35-63.

Weinberg, H.I., Wadsworth, J. & Baron, R.S. (1983). Demand and the impact of leading questions on eyewitness testimony. *Memory & Cognition* **11,** 101–104. DOI: https://doi.org/10.3758/BF03197667

Wells, G. L., & Olson, E. A. (2003). Eyewitness testimony. *Annual Review of Psychology*, *54*(1), 277-295. DOI: 10.1146/annurev.psych.54.101601.145028

Windschitl, P. D. (1996). Memory for faces: Evidence of retrieval-based impairment. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*(5), 1101. DOI: https://doi.org/10.1037/0278-7393.22.5.1101

Visu-Petra, L., Cheie, L., & Benga, O. (2008). Short-term memory performance and metamemory judgments in preschool and early school-age children: A quantitative and qualitative analysis. *Cognitie, Creier, Comportament/Cognition, Brain, Behavior*, *12*(1)

Voinescu, A., & David, D. (2019). The effect of learning in a virtual environment on explicit and implicit memory by applying a process dissociation procedure. *International Journal of Human–Computer Interaction*, *35*(1), 27-37.