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Efeitos da contaminação na memória prospetiva: Um estudo exploratório

Contamination effects in prospective memory: An exploratory study

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Psicologia da Saúde e Reabilitação Neuropsicológica, realizada sob a orientação científica da Doutora Josefa N. S. Pandeirada, equiparada a investigadora principal do Departamento de Educação e Psicologia da Universidade de Aveiro

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agradecimentos

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palavras-chave

memória, memória prospetiva, memória adaptativa, contaminação, sistema imunitário comportamental

resumo

O sistema imunológico comportamental é um sistema adaptativo que promove a prevenção de doenças. Envolve três tipos diferentes de respostas: emocional, comportamental e cognitiva. Este estudo investigou este último tipo de resposta, com foco na memória. Estudos prévios revelaram que tendemos a memorizar mais facilmente estímulos relacionados com aspetos de contaminação, focando-se essencialmente na memória retrospetiva. Neste estudo, focamo-nos noutro tipo de memória: a memória prospetiva, que nos permite lembrar de realizar ações que necessitam de ser realizadas no futuro. Assim, tentámos perceber se os humanos tendem a ter um desempenho de memória prospetiva mais alto quando os estímulos prospetivos são processados como podendo ser fontes de contaminação, tal como acontece na memória retrospetiva. Durante a realização da tarefa, os participantes responderam a uma tarefa decorrente, onde lhes eram apresentados uma face e um objeto, tendo de identificar a categoria do objeto, premindo uma de três possíveis teclas. Em alguns dos ensaios, eram apresentados os estímulos prospetivos (um com e outro sem pistas de doença), devendo o participante premir a tecla espaço nestes casos, simulando a entrega de um envelope. Os resultados revelaram a ausência de diferenças significativas na performance e nos tempos de resposta das tarefas (tarefa decorrente e prospetiva) entre os estímulos de contaminação e de não contaminação. Contudo, revelaram valores significativamente maiores de taxa de acerto e de tempo de resposta na tarefa decorrente (comparando com a tarefa de memória prospetiva). Este foi o primeiro estudo que explora os efeitos da contaminação na memória prospetiva. Apesar deste caracter inovador, apontamos algumas limitações que poderão inspirar estudos futuros.

keywords memory, prospective memory, adaptive memory, contamination, behavioural immune system

abstract

The behavioural immune system is an adaptive disease avoidance system. It involves three different types of responses: emotional, behavioural, and cognitive. This study investigated this last type of response, focusing on memory. Previous studies have shown that we tend to memorize easier stimuli related to aspects of contamination, which focused essentially on retrospective memory. In this study, we focused on another type of memory: prospective memory, which allows us to remember to perform actions that need to be performed in the future. Thus, we tried to understand if humans tend to have a higher prospective memory performance when prospective stimuli are processed as sources of contamination, as happens in retrospective memory. During the experiment, participants responded to an ongoing task, in which they were presented with a face and an object, and had to indicate the category of the object, by pressing one of three possible keys. In some of the trials, prospective stimuli were presented (one with and the other without disease cues), and participants had to press the space key in these cases, simulating the delivery of an envelope. Results showed no significant differences in performance and response time values in both tasks (ongoing and PM task) between contaminated and non-contamination conditions. However, they showed significant higher ongoing task hit rate and response time values than in the PM task. This study was the first one to explore the contamination effects in prospective memory. Despite this, we point some limitation that can inspire future studies.

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Introduction

For millions of years, several infectious diseases have pressured living beings to natural selection processes. Due to that reason, the biological immune system evolved to defend the body against infections (Schaller et al., 2021). However, this system encompasses some disadvantages like the increase of body temperature in response to infections, the consumption of substantial metabolic resources and the debilitation of the body with symptoms like fever and fatigue. Furthermore, this system is simply reactive, being activated only after the pathogenic agents have entered the body and started to create damage. These limitations led to the development of a proactive defence system, the Behavioural Immune System (BIS) (Schaller & Duncan, 2016).

The BIS involves psychological mechanisms that create behavioural responses which help to reduce the chances of infection, and it is seen as a motivational system (Schaller et al., 2021). Motivational systems tend to be associated with affective experiences and emotions, like rage, angry, fear and disgust. This last affective experience has a great correlation with the BIC and it was important to increase the chances to survive by, for example, expelling products from an organism's oral cavity which may be contaminated in reaction to the activation of such emotion. However, disgust experiences are not only present in the sense of taste, but also in all the five senses (Schaller & Duncan, 2016): 1) sight, such as when we see someone with disease cues who can contaminate us; 2) smell, as when we smell someone with perspiration smell which may indicate a poor hygiene from that person; 3) hearing, like when we listen to someone vomiting since it may contain pathogens; and 4) touch, as when we touch something that seems grubby and may contaminate our hands.

Disgust has an adaptative value and it is not just to preventing the ingestion of contaminated substances, but also to play a disease-avoidance function, being crucial to the BIS functioning (Curtis, 2011). Some studies have shown that neutral objects that have been in contact or close to something that is perceived as disgusting are seen as contaminated objects (Rozin & Fallon, 1987); such phenomenon is known as the "law of contagion", one of the laws of sympathetic magic (Frazer, 1959, as cited in Rozin et al., 1989). This is even more interesting because this seems to happen with disgust, but not with other emotions, and contributes to the effectiveness of the BIS (Inbar & Pizarro, 2016). People also tend to negatively evaluate objects that have been in contact with disgusting things and, for example, tend to refuse to drink a juice that has briefly contacted a sterilized dead cockroach (Rozin et al., 1986). It is also interesting that neutral objects perceived as similar to disgusting things tend to be perceived as disgusting, a law known as the "law of similarity" (Nemeroff & Rozin, 2000). For example, a study showed that people tend to refuse to eat safe aliments, such us chocolate fudge, which are shaped like dog feces (Rozin et al., 1986).

However, people cannot know, with total assurance, if something has a pathogen contamination risk or not. This dilemma can end in various ways: 1) the organism may make a correct assessment of the situation, that is, 1a) it considers that something may be infectious and indeed it is a threat, or 1b) it considers that there is no risk of infection and, in fact, the risk is absent; or 2) may make an incorrect assessment of the reality, 2a) making a false positive error, judging that something poses an infection risk when it actually does not, or 2b) committing a false negative error, judging that something does not pose an infection risk, when it does. In the past (as in the present), the costs of a false positive error are usually not significant. However, false negative errors could be problematic, ending in physical debilities or even death. These unequal costs likely gave rise to an adaptive bias in peoples' analyses of infection risks, leading them to commit more false positive errors than false negative errors (Haselton & Nettle, 2006). This bias in BIS functioning has also social implications. There are two main social consequences: 1) high aversion and avoidance levels of unfamiliar and outgroup people, and 2) strong connections with familiar and ingroup people (Ackerman et al., 2018). For example, people who have a higher perceived vulnerability to diseases (i.e. individuals' beliefs about personal susceptibility to illness) tend to have more xenophobic behaviours (Faulkner et al., 2004). Other studies have showed that humans tend to overgeneralize disease cues in other people, to depreciate stimuli associated with unfamiliar people and to stigmatize and avoid outgroup members, particularly when they are associated with dirtiness and disease (Ackerman et al. 2018). However, with ingroup members, people tend to promote collectivism and social conservatism (Ackerman et al. 2018). Furthermore, during the COVID-19 pandemic, some studies have reported an increase of some individual characteristics, namely of germ aversion (i.e., people's affective and behavioural responses to potential pathogens) and perceived infectability (i.e., the act of perceiving oneself as susceptible to infectious diseases) (Karlsson et al., 2022; Makhanova & Shepherd, 2020). For example, a study from Karlsson and collaborators (2022) suggested that a higher germ aversion and perceived infectability related to a greater acceptation to vaccines against SARS-CoV-2.

The BIS involves three different types of responses: emotional (correlated with disgust), behavioural (like avoidance and escape behaviours), and cognitive (involving cognitive processes) (Schaller, 2011). Memory is one of these cognitive processes and, like the BIS, it has also an adaptive function modelled by natural selection. According to the adaptive memory view, we tend to encode and store more easily fitness-related information, which is information related to survival and reproduction, than non-fitness-related information. This can be explained by the survival advantage conferred to our ancestors by a mnemonic tuning to fitness-related information. So, if our memory operations are a product of a natural and evolutionary process, it makes sense that nowadays some of its operational characteristics remain in memory (Nairne et al., 2017). Indeed, several studies have revealed phenomenon that agree with such assertion. It has been shown that people tend to remember information better when it is processed in survival-related scenarios (Nairne & Pandeirada, 2008); for example, it would be adaptive to remember better food names at the beginning of a meal than at the end of the meal because the survival value of food is higher before a meal than at the end (Nairne & Pandeirada, 2008). We also tend to remember better words of animate beings than non-animate things (Félix et al, 2019), because animate beings have a higher impact on the individual's chances of survival and reproduction, since they can be predators, preys, sexual partners, enemies, and friends, important for social interaction (Nairne et al., 2017). People tend to remember better information also in mating-relevant events; for example, women tend to remember male faces better when these were processed in a long-term mating context than a long-term worker context (Pandeirada et al., 2017); high attractive faces (typically associated with a higher mate value) are also easier to remember than medium/low attractive and unattractive faces (Marzi & Viggiano, 2010). In this context, disgust precludes people from mating with low-quality mates, which indicates low-quality genes (Tybur, Lieberman & Griskevicius, 2009). We also now know that humans tend to remember better information related to potential contamination than information that has no association with contamination (Fernandes et al., 2017), which relates more directly with the focus of this study.

Disgusting stimuli should be remembered well to help people to prevent being contaminated. Some studies have explored this memory retention advantage of disgusting items and have showed that disgusting words and images are easier to memorize than scary and neutral ones (Charash & McKay, 2002); people with disgusting behaviours also tend to be well remembered (Bell & Buchner, 2010). Additionally, objects associated with a sick person descriptor tend to be better remembered than those associated with a non-sick person descriptor (Fernandes et al., 2017). In this last study, the investigators conducted four experiments. In the first and second experiments, participants were shown everyday object pictures along with a sick person or a healthy person descriptor. After every third item, the three preceding items were shown, and participants needed to classify whether each had been in contact with a sick or healthy person, just to make sure participants were encoding the stimuli as intended. After a series of these presentations and a distractor period, participants responded to a surprise free recall test for all the previously presented objects. The results showed a significant higher proportion of correct recall of the objects previously associated with the sick descriptors than of those previously associated with the healthy descriptors. The third experiment was similar but, instead of showing descriptors, they associated the objects with faces displaying some cues indicative of contagious diseases, and others without such cues. The results also showed a significant higher proportion of correct recall of the objects previously associated with the sick faces (vs. the healthy faces). The fourth experiment was like the third experiment, changing an instructions' detail. It was said that the faces were from actresses who were cast members of a medical television series and were using makeup to look like a patient. The results showed no significant differences, which indicate that the fitness-component of the context has a crucial importance on the mnemonic value of contamination. A set of experiments from Bonin et al. (2019) also presents results that are consistent with the adaptative view of memory. In their first experiment, participants needed to imagine that they had been infected in the grasslands of a foreign land, they had been infected during a trip in a foreign country or, they had to organize a trip as the tour guide. They found that participants remembered better words processed in a contamination scenario than in the control one. In the second and third studies, participants saw objects that had been touched by someone who had washed his/her hands after using the bathroom or by someone who had not washed his/her hands in the same situation. However, they found no significant differences between the two conditions. In the fourth study, objects were presented, associated with a face of a sick or healthy person. The performance from a surprise recall test was higher in the sick face condition than in the healthy one. The fifth study had included two experiments. In both, faces of people with and without disease cues were presented, next to objects. However, in one experiment, participants were asked to indicate on a scale their perceived level of discomfort by imagining touching and handling the object next to the face; in the other experiment participants were just told to pay attention to remember the association between the object and the face. In both studies, participants remembered objects associated with sick faces better than the others. In a recent study (Fernandes et al., 2021), across four experiments, participants were shown photographs of real objects being held by hands. They associated objects with descriptors (which indicated that the object was touched by a sick or healthy person) in one experiment and with faces in another (with the same function that descriptors had in the last experiment). In the last two experiments, objects were on hands that could be clean or covered with vomit/diarrhoea in one, covered with vomit/diarrhoea or chocolate in the other one. Results showed a higher performance for objects associated with potential sources of contamination (Fernandes et al., 2021). However, a lot of the mentioned work has focused on retrospective memory and memory also plays a crucial role in thinking about and acting on future events.

Usually, when we think about memory, we tend to associate it with the ability to remember information from the past, like a memory store of the past. However, memory also has an adaptive function for the future, as already mentioned. For example, our ability to simulate future scenarios depends on some retrospective memory functions (Nairne et al., 2017). There is a memory system responsible to remembering some content somewhen. Prospective Memory (PM) is the memory that allows us to remember actions that need to be performed in the future (Einstein et al., 2005). The process model of complex PM was developed to capture the complexity of PM demands (Kliegel et al., 2002). It has four phases: 1) Intention Formation, when we plan some task to do later; 2) Intention Retention, which corresponds to the delay between forming the intention and performing the task; 3) Intention Initiation, when we are required to initiate the performance; and 4) Intention Execution, when we start to execute the task (Kliegel et al., 2002). PM errors, tend to occur when we have an intention to do some task in the future, become engaged in other tasks, and lose focus on the task we intended to do at the beginning; these can have negative consequences in different areas, like managing work activities (e.g., remembering to send an email to our boss in the morning), coordinating social relations (e.g., remember to take children to parties) and handling health-related needs (e.g., remember to take medication) (Einstein & McDaniel, 2005).

There are some theories which try to describe the processes involved in prospective memory. One of them is the monitoring theory, which assumes that, when establishing an intention, people tend to initiate a monitoring process and put themselves in a retrieval mode, maintaining it until the prospective target appears (Einstein &

McDaniel, 2005). This theory is supported by studies that show prospective memory negatively influences the performance on the tasks which we engaged in since we encoded the PM target. On the other hand, these results are inconsistent with a view of prospective memory that proposes that intentions are retrieved automatically, called the spontaneous retrieval theory (McDaniel & Einstein, 2000; Smith, 2003). This last theory was suggested because it would be advantageous for people to rely on less capacity-demanding and more spontaneous retrieval processes. It also would be maladaptive to rely only on monitoring processes which could interfere with our daily ongoing tasks, since people have a limited capacity for conscious behaviour; this justifies why some behaviours are automatically activated by environmental stimuli (Einstein & McDaniel, 2005). However, neither of these theories can perfectly explain the results obtained in all prospective memory tasks and behaviours. Thus, a multi-process account was proposed which tries to integrate both theories. According to this account, people tend to use spontaneous retrieval in many prospective memory daily tasks (McDaniel & Einstein, 2000). However, there are some factors that can influence the method used to perform the PM behaviour. Some of them are individual differences, target event characteristics, the focal processing of the PM target and the importance that such target has (Einstein & McDaniel, 2005).

When experimenters started to investigate PM, participants needed to return postcards to the experimenter, remember to call someone at the end of the experiment or call on specific schedules, for example (Harris, 1984, as cited in Dismukes, 2010). These methods did not allow a rigorous assessment of the memory strategies that participants used. Einstein and McDaniel (1990) developed a paradigm that can be implemented in the laboratory method to study PM. The main characteristics of this paradigm include participants responding actively to a task named ongoing task, while at the same time they need to perform a specific task at future specified times, named the PM task. There are also two different ways to implement laboratory prospective memory tasks, depending on whether the ongoing task encourages processing of the prospective target. If the ongoing task encourages the accomplishment of the PM task, we are facing a focal PM task. If it does not encourage the fulfilment of the PM task, we are facing a non-focal PM task (McDaniel & Einstein, 2000; McDaniel et al., 2015). For example, if we have a lexical-decision task as the ongoing task (that is, participants needs to decide, as quickly and as accurately as possible, whether a string of letters corresponds to a real word or not), and we ask them to press the space key when an animal name is presented, we are facing a focal PM task; because participants need to read the word to respond to the ongoing task, the identification of the PM target is facilitated. However, if with the same ongoing task, participants need to press the space key when they are facing a word with three syllables, we are facing a non-focal PM task. This happens because, when we read a word, we do not tend to count how many syllables it has, forcing us to use other strategies, different from the ones used in the ongoing task.

Although prospective memory has not received as much research attention as retrospective memory, it has a huge importance in our lives. It allows us to structure our time and have an autonomous life (Walter & Meier, 2014). Furthermore, memory is fundamentally oriented to the future and allow us to have the ability to plan, predict and prepare for future events, being not just a box of memories (Klein, 2013). As mentioned previously, PM errors can end badly for those who commit them (Einstein & McDaniel, 2005) and it is one of the main memory complaints, presented both in clinical and other contexts, is the PM failures (Matos & Albuquerque, 2014). So, it would be arguable that, like the BIS and retrospective memory, the PM should work in a way as to increase our chances of survival and has an adaptive function. For example, if we experienced the presence of a predator around a specific tree, when going back to the area of that tree, we would need to remember to dress up a disguise to avoid being seen by the predator. A study by Schaper et al. (2021) explored PM for faces of cheaters and co-operators; they concluded that people tend to better remember the faces of cheaters than those of cooperators. This shows the importance of PM for adaptive decision making in social exchange and it suggests that PM should be highly sensitive to exchange information with high social relevance. Although the prospective function of memory is theoretically sound in the adaptive-memory literature, there are not many studies which have explored it empirically, and no one (as far as we know) has investigated the effect of contamination in PM.

Since there are no studies which investigated the effect of contamination in PM, this study is the first that aimed to explore if potential sources of contamination could influence PM performance. We used faces with cues which indicated a potential contagious disease and faces without such cues. An initial pilot study was designed to select these faces. In the main study, we asked participants to imagine they needed to give an envelope to two different and specific people: one containing disease cues (contamination PM cue) and another without them (non-contamination PM cue), as a PM task. Assuming PM should be sensitive to fitness-related information (in this case, the potential for contamination), we predicted participants would have better performance when the PM cue is of contamination (vs. of non-contamination). Also, we predicted that participants would not be significantly faster in a given condition at responding to any task, since previous studies showed no significant differences between contamination and non-contamination primed conditions in an attentional task (Magalhães et al., 2018). In the ongoing task, we predicted participants would have better performance with clean faces, because the disease cues could interfere with the objects' classification. However, as no previous data exist with this procedure, our predictions are exploratory.

Pilot Study

With this pilot study, we aimed to create two groups with ten faces each that did not differ on arousal, discomfort, disgust, and disease perception. In each group, we also intended to select a face with similar values to the medium values of the group that would then be used as a PM cue. These two groups allowed us to counterbalance the faces that would be presented with and without the disease cues across participants.

Participants

We recruited 39 female participants for this study. The participants were all females because all the stimuli were female faces and we intended to run the main study with females only. However, three participants were excluded since they did not indicate their age. So, we analysed the data from 36 participants with an age range of 18-26 years (M = 19.42; SD = 1.78).

Material

In this pilot study, we used 23 faces. We used 11 faces from the Karolinska Directed Emotional Faces (KDEF; Lundqvist, Flykt, & Öhman, 1998) and 12 faces from the Radbound Facial Database (RaFD; Langner et al., 2010); authorization for their use and manipulation has been previously obtained by our research group. These faces were chosen because they have been used in other studies related with contamination (Bonin et al., 2019; Fernandes et al., 2021). We manipulated all the faces with Photoshop to display signs of a Sweet Syndrome. In total, we used 46 images in this study: 23 faces without cues (the original ones) and those same 23 faces but now including Sweet Syndrome cues (the ones we manipulated).

Procedure

At the beginning, groups between 1 and 6 participants entered the laboratory and seated in front of a computer. They read the informed consent form (Appendix A) and moved on to the task upon its acceptance. Then, they were asked to indicate their age and sex, and read the following task instructions:

> WELCOME! In this task we ask you to evaluate a set of faces on several dimensions. Each question will be responded to using a scale from 0 (which corresponds to "not at all") to 100 (which corresponds to "a lot"); you must respond by dragging the cursor to the position corresponding to the value of your choice. The order in which the questions will be presented will vary between faces. Please pay attention! You have the time you need to answer each question; however, we ask that you respond quickly and intuitively so that you register your first impression.

Each participant saw 23 faces, about half from each condition, and the same face was not presented in the two conditions to a given participant. There were two sets with 23 faces each, with half of the participants seeing one set of faces and the other half seeing the other. Faces also appeared in a random order with the constraint that no two faces with/without disease cues were presented in a row. All images were shown the same number of times across participants. Participants were asked to answer four questions regarding each face, by using an analogic scale ranging between 1 and 100. The questions aimed to evaluate the following factors, like in the study by Fernandes et al. (2017): arousal (How much do you feel activated watching this image?), discomfort [How much would you feel uncomfortable being around this person? (e.g., on a public transportation or talking)], disgust (How disgusted are you when you see this image?), and disease perception (How much do you think this person is sick?). All these questions appeared one at a time while the face was being displayed, but in a random order for each participant.

Results

From the initial pool of pictures, we selected 40 images because we needed two groups with 20 images each for the experimental study. The X group was constituted by 10 faces with disease cues (from now on named "sick faces") and 10 faces without disease cues (from now on named "clean faces"). In the Y group, the sick faces from the X group were now in its clean condition, and the opposite for its clean faces. These groups of faces did not differ on the values of arousal, discomfort, disgust, and disease perception within each condition (lowest $p = 0.59$, for the comparison on disease perception for the clean faces). The groups' characteristics values are in Table 1. There was a significant difference between the clean and sick faces in all four factors, with the highest $p < 0.01$. Three of the six excluded stimulus (three sick faces and the same three clean faces) were used in the training trials of the main study.

We chose two faces from each of these groups (one clean and one sick face) containing values similar to those of the group condition mean. These 2 faces were used in the main study as the PM targets. The characteristics values from these faces are presented in Table 1.

Table 1

Mean (and standard deviations) values of arousal, discomfort, disgust and disease perception per group (X and Y), per condition (clean and sick faces) and per PM cue

		Group X			**Group Y**		
		All faces		PM cue	All faces		PM cue
	Characteristics	M	SD	M	M	SD	M
Clean Faces	Arousal	7.66	4.33	6.89	7.61	3.20	9.22
	Discomfort	6.97	3.16	7.50	6.64	2.21	5.28
	Disgust	4.02	3.34	4.50	3.76	1.20	3.94
	Disease Perception	8.00	8.46	2.72	6.40	3.54	8.44
Sick Faces	Arousal	64.01	7.99	62.78	62.54	6.68	65.78
	Discomfort	63.22	7.05	64.04	62.52	6.68	67.67
	Disgust	63.69	4.52	63.72	64.39	6.00	64.22
	Disease Perception	75.06	4.32	72.06	74.98	5.92	76.22

Experimental Study

Here we present the main study, which aimed to explore the contamination effect in prospective memory. Specifically, while performing an ongoing task of object classification, participants were asked to provide an alternative response whenever one of two target faces (one sick and one clean) were presented.

Method

Participants

As no prior studies with a similar procedure have been reported, we made an a priori determination of the needed sample size expecting to obtain a small to medium effect size. A power analysis using G*Power (Version 3.1.9.4; Faul et al., 2007) indicated that a sample size of 76 participants had sufficient power (1-β = .85) at a significance level of α = .05 to detect a small to medium effect size (*dz* = 0.35). To achieve this sample of valid participants, we had to recruit 97 female participants. We excluded 31 participants since they did not respond to any PM target (*n* = 14), failed the recognition of the two PM targets (*n* = 13), or had an ongoing task performance three standard deviations below the mean (*n* = 4). Thus, our final sample includes 76 participants aged between 18-20 (*n* = 21), between 21-23 (*n* = 45), between 24-26 (*n* = 7), and between 30-32 years old (*n* = 3).

Material

The 43 images selected from the pilot study were used; more precisely 40 images from groups X and Y were used in the main task and three additional faces used in the pilot study were used in practice trials. We also used 66 pictures of objects being held by hands (Fernandes et al. 2019). More precisely, 60 of these pictures were used in the main task and 6 additional ones were used in the practice trials. Regarding the objects used in the main task, we used 20 images from each of the following categories: toys, women's accessories, and office supplies. The selected images had high name agreement and high levels of familiarity, as described in Table 2.

Table 2

Characteristics from the Objects

	Toys		**Women Accessory**		**Office Supplies**	
	M	*SD*	*M*	*SD*	*M*	*SD*
Familiarity	4.31	0.41	4.43	0.27	4.72	0.21
Name Agreement	87.27%	15.10%	83,99%	15.35%	85.73%	18.51%

Note: Familiarity was rated on a 1-5 scale. Data from Fernandes et al. (2019)

The objects were divided into three different groups (with an equal number of objects from each category) to be used in each third of the task. No significant differences existed among these three subsets of objects on familiarity and name agreement values (lowest $p = 0.15$).

Stimulus

Each stimulus corresponded to a combination between a face and an object creating a scenario in which that person (represented by the face) was delivering an object to the participant. The face and object associations were the same for all the participants; in this way we ensured there were no significant differences between the ongoing task objects and the prospective memory objects, between the objects associated to the sick faces and those associated with the clean faces, and between thirds and categories (in ongoing task and PM task), with the lowest $p = 0.08$.We used faces from X and Y groups, wherein half of participants watched the sick faces from group X and the clean faces from group Y, and the other half saw the opposite. In each group there was a specific face, named as XP and YP (see pilot study description), wherein half of participants saw the sick XP face (XPS) and the clean YP face (YPC), and the other half of participants saw the opposite (XPC and YPS).

Procedure

This experiment was programmed using the FormsUA platform, which was also used for the experiment presentation and data collection. Participants made the experiment in the EvoCogLab room at the Aveiro University, using individual computers, and in sessions with one to 6 people at a time. Participants joined the experiment (all presented in European Portuguese) and read the informed consent (Appendix B). After consenting to participate in the study, the instructions for the ongoing task were presented (Appendix C); these explained that participants would see a face at the top of the screen and an object under the face. There was a backstory that described that these faces were from people who were delivering an object to the participant, and that the participant should categorize the object that person was delivering to them; they should respond by pressing a key that corresponded to each object category (press the letter E if it was an office supply, F if it was a women accessory, and B if it was a toy) in order to “store” the object in the corresponding box (see Appendix D for an illustration of the task). Participants were also told that some faces would have some disease cues, but they were instructed to categorize the objects, irrespectively of the presented face, as fast and accurately as they could. After that, the practice phase with six trials began, with stimuli (faces + objects) that did not appear in the experimental phase. Two specific clean faces and one specific sick face were used in the practice trials and each appeared twice. One of the clean faces was associated with a toy and an office supply and the other one with a toy and a women accessory. The sick face was associated with a women accessory and a toy. The order of the stimulus appearance was the same for all the participants; only the type of face (sick or healthy) varied across participants in a counterbalanced manner. The practice phase took, on average, 38 seconds.

Afterword, the prospective memory task instructions were given: participants were warned that, every time they saw two specific faces (XPC and YPS or XPS and YPC, depending on the counterbalancing version of the experiment), they should give a different response: to press the space key. The backstory informed participants that these specific people needed to receive a message on an envelope. So, when they appeared, the participant should not categorize the object (as they should do for the remaining ongoing trials) but rather press the space key, symbolizing the envelope delivery. Then, the two prospective targets were shown at the same time, side by side, for 60 seconds, and participants were told to memorize them during that entire period (as depicted in Appendix E).

Then the retention phase started. Participants were asked to perform a task in which they had 50 seconds to identify differences between two images; this was repeated three times with different pairs of images, totalling about two minutes and thirty seconds to finish this task. (Appendix F). They were told that they should find 10 differences, even though there were only six differences between each pair of pictures, to force participants to be focused on the task during the entire period. A second distractor task followed, in which they had ten seconds to find the result of the sum between two numbers in ten seconds; this was repeated five times (Appendix G). The numbers appeared in the centre of the screen and participants wrote their answers with the keyboard. In total, the retention phase lasted four minutes, an interval established in other studies (Grundgeiger et al., 2014; Marsh et al., 2009; Strickland et al., 2018).

Next, the experimental task began; only a short instruction was given indicating the task had begun. No other information was given at this point. Participants were shown 60 trials, 6 of which were the prospective trials. The 60 stimuli were divided in three thirds; in each third 18 ongoing stimuli were shown (9 sick stimuli and 9 clean stimuli) in random positions, as well as two prospective trials. These last trials were shown in specific positions for all participants (10th, 17th, 26th, 36th, 44th and 53rd positions), so they were separated by about six and ten ongoing trials, like it was done in other studies (Schaper et al, 2021). In each third, one of the PM trials contained a sick face and the other a healthy face. In the three thirds the same 20 faces were presented, but the object category associated with each face differed. In the ongoing trials of each third, a similar number of objects from each category was presented. In the PM task, the clean face was presented with an office supply in the first third, with a women accessory in the second, and a toy in the third. The sick face was associated with a toy in the first third, an office supply in the second, and a women accessory in the third. The order of the prospective targets was counterbalanced across participants; half of the participants saw the prospective targets in the order sick | clean | clean | sick | clean | sick, and the other half saw them in the opposite ordering (see Table 3). Participants took about 5 minutes to respond to these 60 trials.

Table 3

Trials Schedule

	Version			
Trial	**A1**	**A2**	**B1**	**B2**
1-9	GX1	GX1	GY1	GY1
10	XPS	XPC	YPC	YPS
11-16	GX1	GX1	GY1	GY1
17	XPC	XPS	YPS	YPC
18-20	GX1	GX1	GY1	GY1
21-25	GX2	GX2	GY2	GY2
26	XPC	XPS	YPS	YPC
27-35	GX2	GX2	GY2	GY2
46	XPS	XPC	YPC	YPS
37-40	GX2	GX2	GY2	GY2
41-43	GX3	GX3	GY3	GY3
44	XPC	XPS	YPS	YPC
45-52	GX3	GX3	GY3	GY3
53	XPS	XPC	YPC	YPS
54-60	GX3	GX3	GY3	GY3

Note: GX1 / GY1: first time the ongoing-task faces from Group X / Y were randomized; GX2 / GY2: second time the ongoing-ask faces from Group X / Y were randomized; GX3 / GY3: third time the ongoing-task faces from Group X / Y were randomized; XPS / YPS: sick face PM target from Group X / Y; XPC / YPC: clean face PM target from Group X / Y

Finally, participants were asked to write and explain what they were asked to do in the experimental task. Also, they performed a recognition task in which they were shown six faces in a random order; two were the PM faces and the remaining four were from the ongoing task. Participants were instructed to identify which faces were the PM targets (Appendix H). They were also asked to indicate if they knew those faces from previous studies. Finally, they were asked to indicate their age group by selecting one of the age-range intervals provided (18-20; 21-23; 24-26; 27-29; 30-32). In the last page they were presented with the debriefing information.

Statistical Analyses

The statistical analyses were performed using the software IBM SPSS, version 28 (IBM Corp., 2021). The independent variable was the type of face/condition (clean face and sick face), and type of task (PM and ongoing). We also explored if there were differences among the thirds of the task. The dependent variables were the proportion of correct responses and response times. The statistical test used for the analyses was repeated-measures ANOVA.

Results

The descriptive data (mean values and SD) regarding the performance and response times (the last just for the correct answers) for the ongoing trials and the PM trials are presented in Figure 1 and Figure 2, respectively. Regarding the percentage of correct responses, we found a significant main effect of the type of trial, $F(1, 75) = 10.03$, $MSE = .36$, $p < .01$, $\eta_p^2 = .12$. This effect reflects a better performance for the ongoing trials over the PM trials condition. However, we did not find a significant main effect for the type of condition (sick or clean), $F(1, 75) = .58$, $MSE < .01$, $p = .81$, $\eta_p^2 < .01$, neither a significant interaction between the type of trial and the type of condition, $F(1, 75) = .73$, $MSE = .01$, $p = .40$, $\eta_p^2 = .01$ (Figure 1). Regarding the response times, we found a significant main effect of the type of trial, $F(1,72) = 69.43$, $MSE = 27.60$, $p < .01$, $\eta_p^2 = .49$. This effect reflects longer response times for the ongoing trials over the PM trials condition. However, we did not find a significant main effect of type of condition (sick or clean), $F(1,72) = 2.32$, $MSE = .45$, $p = .13$, $\eta_p^2 = .03$, nether a significant interaction between the type of trial and type of condition, $F(1,72) = .06$, $MSE = .01$, $p = .81$, $\eta_p^2 < .01$ (Figure 2).

Figure 1

Overall mean percentage (and SEM) of correct responses on the ongoing and PM trials, for the sick and clean stimuli (the Y axis starts at 0.80).

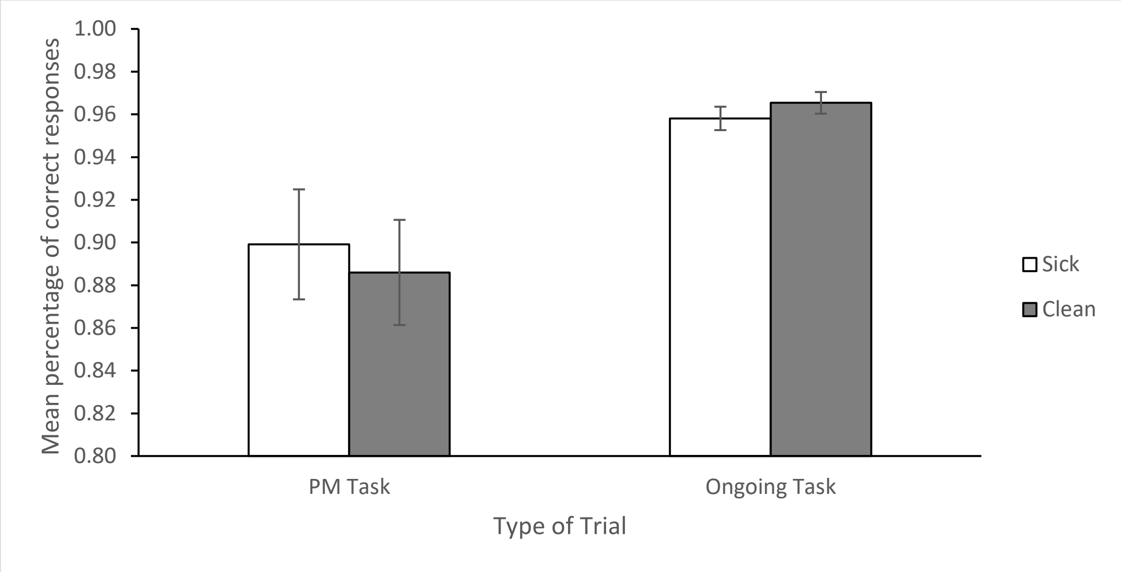
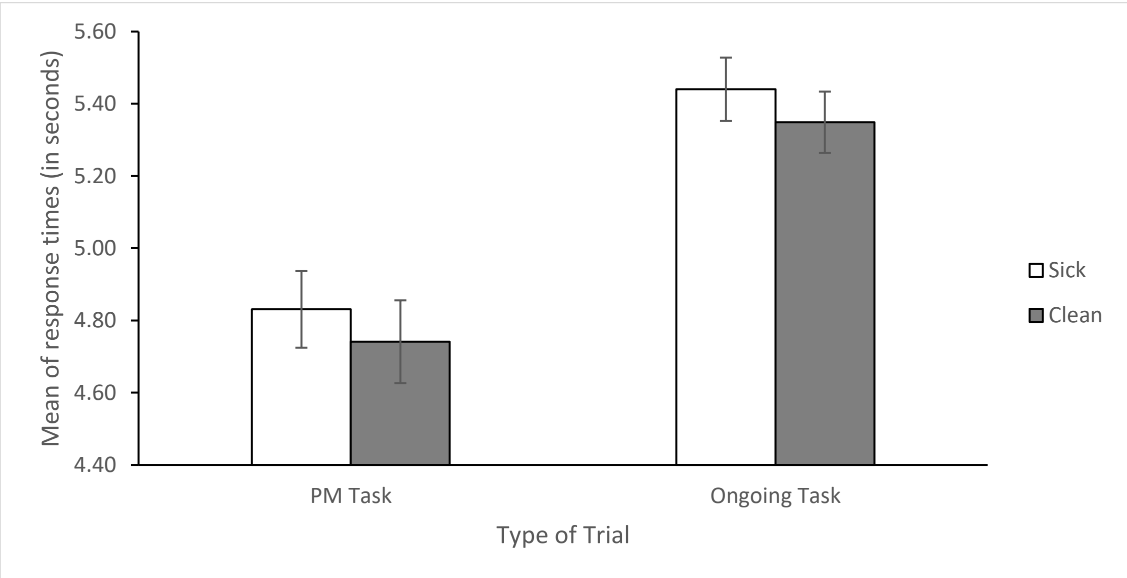


Figure 2

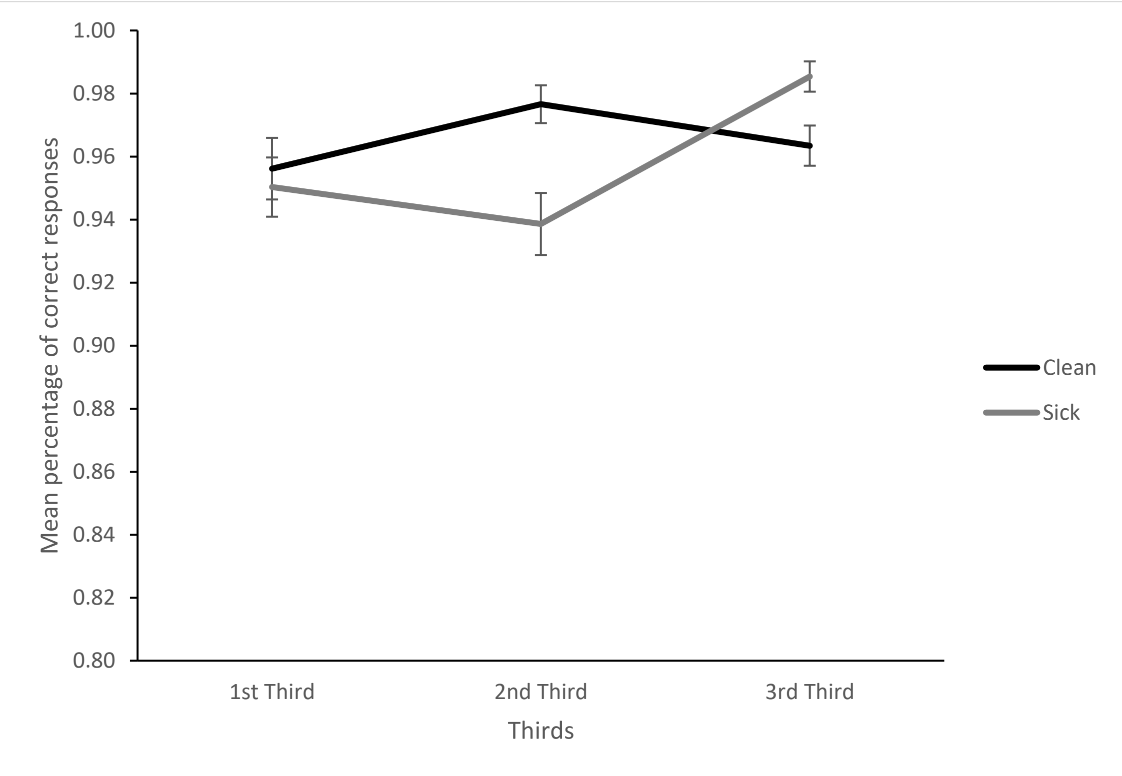
Overall mean (and SEM) of response times (in seconds) on the ongoing and PM trials, for the correct answers, for the sick and clean stimuli (the Y axis starts at 4.40).



Given this is a first study exploring this topic, we explored our data regarding possible differences across the time course of the task which could reflect possible effects of habituation. Thus, we analysed the performance among the thirds (Figure 3), just for the ongoing trials, and found a significant main effect of the thirds, $F(2,150) = 4.14$, $MSE = 0.02$, $p = .02$, $\eta_p^2 = .05$, and a significant interaction between condition and third of the task, $F(2,150) = 9.71$, $MSE = 0.03$, $p < .01$, $\eta_p^2 = .12$. The first effect reflects the finding that the hit rate values changed from third to third and the second reflects the fact that the pattern of changes differed between conditions. Whereas in the clean condition the mean percentage of correct response increases from the first to the second third and decreases from the second to the third, in the sick condition it decreases from the first to the second and increases from the second to the third. However, we did not find a significant main effect of type of condition (sick or clean), $F(1,75) = .98$, $MSE = .01$, $p = .33$, $\eta_p^2 = .01$.

Figure 3

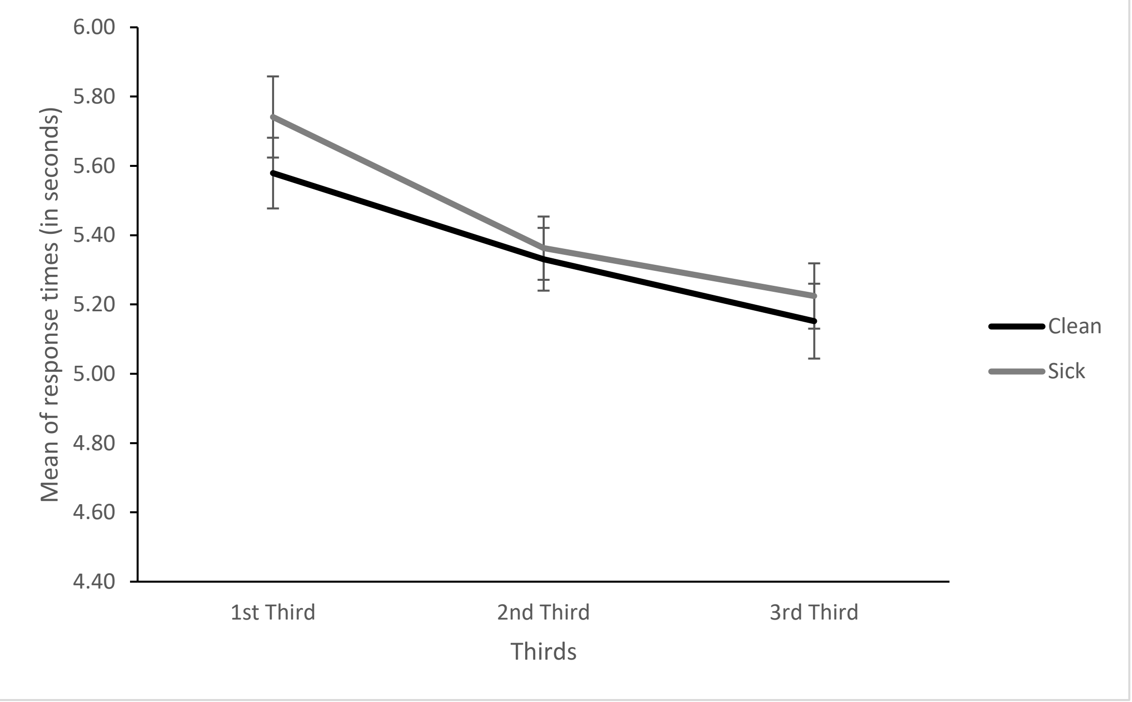
Overall mean percentage (and SEM) of correct responses on the ongoing trials in each third, for the sick and clean stimuli (the Y axis starts at 0.80).



About the time response values (Figure 4), we found a significant main effect of the type of condition, $F(1,75) = 4.29$, $MSE = 0.90$, $p = .04$, $\eta_p^2 = .05$, and of the third of task, $F(2,150) = 22.01$, $MSE = 8.77$, $p < .01$, $\eta_p^2 = .0.23$. The first effect reflects the finding that the sick condition (vs. the clean condition) had higher response time values in all the thirds, and the second effect reflects the finding that the mean of the thirds is decreasing from third to third. However, we did not find a significant interaction between them, $F(2,150) = .83$, $MSE = .17$, $p = .44$, $\eta_p^2 = .01$.

Figure 4

Overall mean (and SEM) of response time (in seconds) on the ongoing trials in each third, for the sick and clean stimuli (the Y axis starts at 4.40).



Discussion

In the present work we explored if a manipulation of the contamination level of the PM targets would influence performance on a PM task. We expected that participants' performance would be higher when the PM target was a sick face than when it was a clean face. Such result would mimic, now in PM, what is typically reported in retrospective memory studies (Fernandes et al., 2017): people tend to remember easier potential contamination information than non-contamination information. However, the results from this experiment did not reveal significant differences in the PM task between the two conditions, neither in the ongoing task. When we analysed performance throughout the task, results showed significant differences in hit rate values among the thirds. However, these differences were inconsistent across the two conditions, as denoted by the reliable interaction. There were significant differences in the hit rate values in the interaction between the condition (clean or sick) and the thirds. This can be explained because participants, as time went by, for the habituation they may have had to sick faces.

Participants were fastest in the PM trials than in the ongoing trials for both conditions. Additionally, the results showed no significant main effect of condition, like we expected by the results from previous studies (Magalhães et al., 2018) nor a significant interaction between conditions and type of trial. When we analysed performance throughout the task, results showed significant differences response time values among the thirds. Response times tended to decrease from the first to the second and from the second to the last third, in both condition, which may be explained by the participants' habituation to the task. However, there were no significant differences in the time response values in the interaction between the condition (clean or sick) and the thirds, which may explain that the participants got used to the task regardless of the condition. Nonetheless, the response times were always higher in the sick condition, irrespective of the moment of the task.

Given this is the first study exploring a possible contamination effect in PM, it is hard to relate them to previous studies. As memory has an adaptive function and tends to store and retrieve more easily fitness-related information that increases our chance of survival (Fernandes et al., 2017), we expected a higher PM performance in the contaminated condition than in non-contaminated condition, a result we did not obtain. However, we can identify some limitations in our results that prevent us from drawing strong conclusions. For example, both hit rates values were close to ceiling which could have prevented us from obtaining clearer results. It is also interesting that participants tended to be slowest in the ongoing task as compared to the PM task. Probably, in the last type of trials, participants focussed immediately in the face and responded more promptly. This result suggests that participants were not engaged in the ongoing task, as intended, and were (possibly) more actively looking for the PM target faces. What seems to have happened was that the participants were committed to identifying the PM target faces and, if it was one of them, they pressed the space key; but, if it was not, they proceeded to the ongoing task (i.e., classification of the objects' category), which ended up taking more time to respond. In this case, the task cannot be considered a proper PM task but more a recognition task (regarding the PM faces), which relates to retrospective memory.

The obtained data also suggest some aspects of the procedure that need to be improved in future work. For example, participants did not have a limited time to answer to the trials. So, they saw the face and the object and took as much time as they wanted to decide and provide their answers. However, this allowed them to adopt a strategy where (possibly) they first saw the face and then, if the face was not one of the PM targets, they categorized the object. One conceivable way of reducing the likelihood of using such strategy would be to limit their time to respond or to present the face for a shorter period of time. This would also, possibly, lower the performance to more acceptable levels and allow for any differences between conditions to be more noticeable. Additionally, the use of complementary measures could prove useful to understand how participants were responding to the task. For example, if we had used an eyetracking record, we probably would be able to trace which aspects of the stimuli participants are attending to and possibly confirm the suggestion we present above: participants are engaged in an active recognition task of the PM faces. We used the platform Forms UA (https://forms.ua.pt) to program and implement this experiment. However, sometimes the Forms UA servers' performance was slow, and so some participants experienced different interval times between the trials. Therefore, the response times from the participants cannot be considered of high trust, neither the conclusions drawn from them. In future studies we need to have a better programme, which could precisely indicate the response times from participants, and we can secure that time between the targets is the same. Another limitation of our procedure might have been in the PM task instruction. We told participants they needed to give a letter to that person (the PM faces), which have an assumed contact. However, many participants probably did not imagine this contact, which might have prevented the creation of a significant contagious context and may also explain some of the non-significant results found. In the next studies, we should create a scenario that clearly states that some person/face has a high risk of contamination and increase the potential for interaction with that person.

Being this a first study on this topic, it leaves open many other interesting variables to be explored in future studies. For example, it would be interesting to explore the differences between focal and non-focal PM tasks in contamination conditions. Typically, the performance in PM tasks and ongoing tasks tends to be higher in focal PM tasks than in non-focal (McDaniel & Einstein, 2000; McDaniel et al., 2015). If a contamination context does increase the hit rate in a PM task, will there be significant differences between a focal and non-focal task, both being in a contamination context? It would be also interesting to explore if a contamination condition decreases the ongoing task performance considering it has an associated risk, as compared to a non-contamination context. It would be interesting to vary the contamination context without varying the PM target image. For example, one could explore if people would be more effective in their PM responses when they need to forbid the entrance in a bar to a man who is identified as having a contagious disease (contamination condition) or when this man tends to drink without paying. It would also be interesting to vary the importance of the task. Usually, when the experimenter says that the ongoing task is more important than the PM task, people tend to have a worse performance in the PM task than if the PM task had more importance (Kiegel et al., 2001; Smith et al., 2014). In our case, it would be interesting to manipulate this importance, since participants probably tended to look first to the face and then to the object. If the ongoing task had a bigger importance, it would be easier to find values which could indicate an automatic PM response.

In conclusion, this study was a good exercise to start exploring the effect of contamination in prospective memory. We did not obtain significant differences in the PM task performance between the contamination and non-contamination conditions; however, this does not mean that there is no such effect. Future studies should try to accommodate the limitations here identified to provide more reliable data on this topic. It makes sense that people tend to remember fitness-relevant information than standard information more easily in retrospective memory (Bonin et al., 2019), and we expect that it also happens in PM processes. Although this study does not provide a direct answer to the effects of contamination in PM, it was innovative and suggests limitations that should be transformed into opportunities to improve future studies.

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Appendix

Appendix A – Informed Consent (Pilot Study)

Por favor, leia cuidadosamente toda a informação apresentada:

Este estudo faz parte de um projeto de investigação científica. A sua participação neste estudo é voluntária, o que significa que pode desistir do mesmo em qualquer altura, sem qualquer penalização para si. Caso pretenda participar deverá ler atentamente o consentimento abaixo. Assegure-se de que compreende que tarefas deve realizar, bem como possíveis riscos e benefícios associados à sua participação neste estudo.

Consentimento Informado

Objetivo: O presente estudo é da responsabilidade do Rui Pedro Martins de Almeida (aluno do Mestrado em Psicologia da Saúde e Reabilitação Neuropsicológica, do Departamento de Educação e Psicologia da Universidade de Aveiro), sob supervisão da Doutora Josefa Pandeirada (da mesma Instituição). Pretendemos, com este estudo, avaliar um conjunto de faces

Procedimento: Neste estudo terá de avaliar um conjunto de faces. Para cada face, ser-lhe-á pedido que responda a quatro questões diferentes.

Duração: Este estudo ocorre numa única sessão, com a duração prevista de 10 minutos.

Vantagens e Riscos: Ao participar neste estudo, terá oportunidade de contribuir para o desenvolvimento do conhecimento de uma nova área da Psicologia e de saber como se processa uma investigação em Psicologia. A sua participação poderá ser considerada para obtenção de créditos a uma Unidade Curricular (se aplicável). No final do estudo serão dadas informações adicionais sobre estes aspetos. A sua participação não acarreta riscos acrescidos aos normalmente encontrados no seu dia-a-dia.

Confidencialidade: Todos os dados aqui recolhidos serão tratados de forma anónima e confidencial, e apresentados apenas no âmbito de trabalhos académicos e científicos. Apenas os investigadores implicados neste estudo, ou outros investigadores devidamente identificados, procederão à análise dos dados aqui recolhidos.

Conservação e acesso aos dados recolhidos: Os dados que fornecer serão armazenados em bases de dados computorizadas anonimizadas e protegidas por *password*. Por este motivo, não poderá posteriormente aceder aos seus dados e/ou alterá-los de alguma forma. Não se prevê a destruição dos dados recolhidos, para que possam ser transmitidos (sempre de forma anónima) à comunidade científica dando cumprimento às diretrizes da transparência científica.

Participação: A sua participação é voluntária. Pode desistir a qualquer momento, sem qualquer prejuízo para si. Para tal, basta fechar dar essa indicação ao experimentador para que ele feche o programa. Nesse caso, todos os dados recolhidos até esse momento serão posteriormente eliminados.

Esclarecimentos: Caso deseje obter informações adicionais, ou esclarecer qualquer questão relacionada com esta investigação, contacte a responsável pelo mesmo: Rui Pedro Martins de Almeida (ruipedroalmeida99@ua.pt). O estudo dá cumprimento ao estipulado no Regulamento Geral de Proteção de Dados, garantindo o anonimato e confidencialidade de todos os dados facultados pelos participantes, em todas as fases do processo. Este estudo segue ainda as recomendações éticas emanadas na Declaração de Helsínquia e no Código de Conduta da FCT para a investigação científica.

Eu, ____, declaro ter 18 anos ou mais, que li integralmente o presente consentimento informado, que compreendi as condições de participação neste estudo e os procedimentos nele envolvidos. Declaro ainda que participo de livre e espontânea vontade, e que concordo que os dados sejam apresentados de forma completamente anónima em trabalhos académicos, apresentações públicas, congressos científicos e publicações. Fui informado/a que tenho o direito de recusar participar em qualquer momento do estudo, sem quaisquer consequências para mim. Aceito o tratamento dos dados pessoais subjacente a este estudo, em obediência ao Regulamento Geral de Proteção de Dados e à sua Lei de execução Nacional.

Experimentador: ____

Assinatura do(a) participante: ____

Data: ____

Appendix B – Informed Consent (Main Study)

* **Consentimento Informado**

<u>Objetivo</u>: O presente estudo é da responsabilidade de Rui Pedro Martins de Almeida (aluno do Mestrado em Psicologia da Saúde e Reabilitação Neuropsicológica, do Departamento de Educação e Psicologia da Universidade de Aveiro), sob supervisão da Doutora Josefa Pandeirada (da mesma Instituição). Pretendemos, com este estudo, investigar a forma como as pessoas memorizam a informação.

<u>Procedimento</u>: Neste estudo serão realizadas várias tarefas onde serão apresentadas faces associadas a objetos; ser-lhe-á pedido que identifique a categoria a que pertence o objeto. Realizará ainda outras tarefas tais como identificar diferenças entre duas imagens e identificar o item que não pertence a um certo grupo. Também lhe será pedido que identifique o grupo etário a que pertence para caracterização da amostra. Todos os dados serão recolhidos através desta plataforma online (https://forms.ua.pt/).

<u>Duração</u>: Este estudo ocorre numa única sessão, com a duração prevista de 20 a 30 minutos.

<u>Vantagens e Riscos</u>: Ao participar neste estudo, terá oportunidade de contribuir para o desenvolvimento do conhecimento de uma nova área da Psicologia e de saber como se processa uma investigação em Psicologia. A sua participação poderá ser considerada para obtenção de créditos a uma Unidade Curricular (se aplicável). No final do estudo serão dadas informações adicionais sobre estes aspetos. A sua participação não acarreta riscos acrescidos aos normalmente encontrados no seu dia-a-dia.

<u>Confidencialidade</u>: Todos os dados aqui recolhidos serão tratados de forma anónima e confidencial, e apresentados apenas no âmbito de trabalhos académicos e científicos. Apenas o investigador responsável por este estudo terá acesso aos dados relativos ao grupo etário. Os restantes dados poderão ser partilhados com a orientadora científica e outros investigadores do grupo, para efeitos da sua análise, sempre já anonimizados.

<u>Conservação e acesso aos dados recolhidos</u>: Os dados que fornecer serão armazenados em bases de dados computorizadas anonimizadas e protegidas por *password*. Por este motivo, não poderá posteriormente aceder aos seus dados e/ou alterá-los de alguma forma. Não se prevê a destruição dos dados recolhidos, para que possam ser transmitidos (sempre de forma anónima) à comunidade científica dando cumprimento às diretrizes da transparência científica.

<u>Participação</u>: A sua participação é voluntária. Pode desistir a qualquer momento, sem qualquer prejuízo para si. Para tal, basta fechar este questionário sem o terminar. Nesse caso, todos os dados recolhidos a seu respeito serão posteriormente eliminados.

<u>Esclarecimentos</u>: Caso deseje obter informações adicionais, ou esclarecer qualquer questão relacionada com esta investigação, contacte o responsável pela mesma: Rui Pedro Martins de Almeida (<u>ruipedroalmeida99@ua.pt</u>). O estudo dá cumprimento ao estipulado no Regulamento Geral de Proteção de Dados, garantindo o anonimato e confidencialidade de todos os dados facultados pelos participantes, em todas as fases do processo. Este estudo segue ainda as recomendações éticas emanadas na Declaração de Helsínquia e no Código de Conduta da FCT para a investigação científica.

<u>DECLARAÇÃO DE CONSENTIMENTO INFORMADO</u>

Declaro que tenho 18 anos ou mais, que sou do sexo feminino, que li integralmente o presente consentimento informado, que compreendi as condições de participação neste estudo e os procedimentos nele envolvidos. Declaro ainda que participo de livre e espontânea vontade, e que concordo que os dados sejam apresentados de forma completamente anónima em trabalhos académicos, apresentações públicas, congressos científicos e publicações. Fui informada que tenho o direito de recusar participar em qualquer momento do estudo, sem quaisquer consequências para mim. Aceito o tratamento dos dados pessoais subjacente a este estudo, em obediência ao Regulamento Geral de Proteção de Dados e à sua Lei de execução Nacional. Ao selecionar "SIM", abaixo, declaro que aceito participar neste estudo. Se escolher "NÃO", a sua participação terminará aqui.

✔ Sim | ⊘ Não

Appendix C – Ongoing Task Instructions

Leia, por favor, a seguinte instrução

Nesta tarefa serão apresentadas faces juntamente com objetos. Deve imaginar que as pessoas lhe estão a entregar em mãos os objetos apresentados e lhe pedem que os guarde durante algum tempo. Os objetos pertencem a diferentes categorias: Material de Escritório, Acessórios Femininos e Brinquedos. Estes deverão ser guardados em caixas separadas de acordo com a categoria a que pertencem. Assim, à medida que lhe vão entregando os objetos, deve identificar qual a sua categoria, permitindo o seu correto armazenamento. Algumas das pessoas que lhe vão entregar em mãos os objetos parecem estar doentes e outras não. No entanto, a sua resposta deverá ser a mesma em todos os casos: identificar a categoria do objeto para que seja corretamente armazenado.

As opções de categoria serão apresentadas no ecrã. Deve responder, premindo a tecla correspondente à categoria a que pertence o objeto:

E - Escritório **F** - Femininos **B** – Brinquedos

Tem o tempo que precisar para responder a cada objeto. No entanto, pedimos que responda de forma rápida e intuitiva.

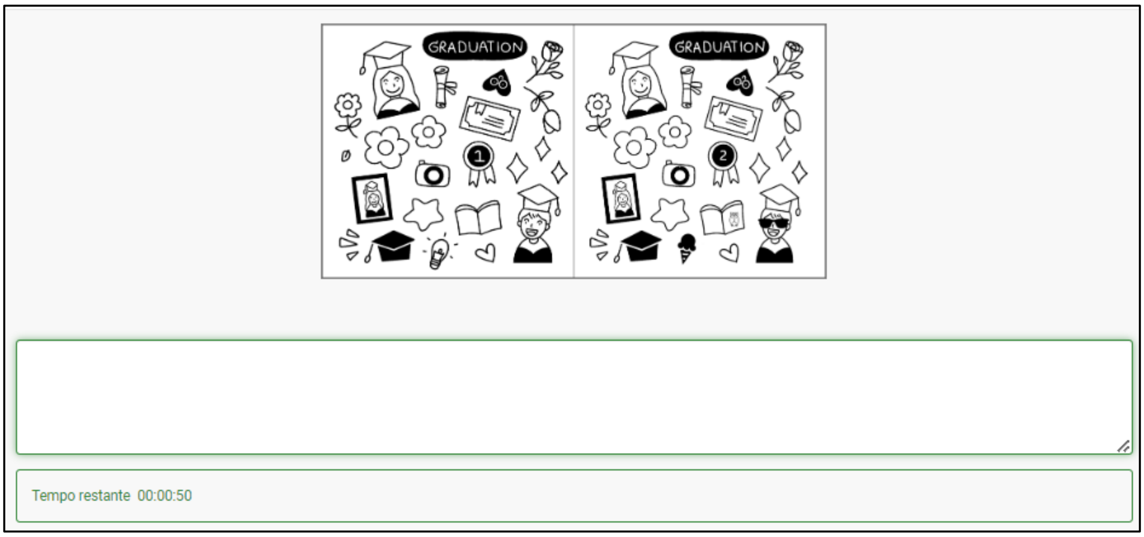
Vamos começar com alguns ensaios de treino para que possa praticar a tarefa. Prepare a localização dos seus dedos no teclado antes de iniciar a tarefa.

Quando estiver pronta, prima "Seguinte" para iniciar a tarefa.

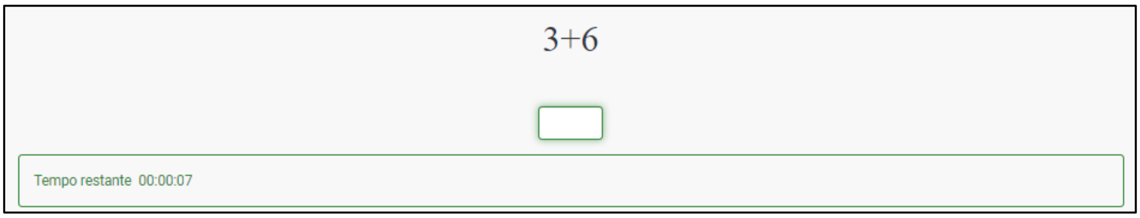
Appendix D – Stimulus

Appendix E – Codification Phase

Appendix F – Differences (Retention Time Task)



Appendix G – Sums (Retention Time Task)



Appendix H - Recognition Test