UNIVERSIDADE DE LISBOA

Faculdade de Psicologia

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Tese especialmente elaborada para obtenção do grau de Doutor em Psicologia, especialidade de Cognição Social

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Resumo

Um dos pressupostos subjacentes às falsas memórias produzidas pela apresentação de listas de palavras relacionadas é o de que estas listas compartilham associações preexistentes e representações semânticas estáveis na memória de longo prazo. A presente tese tem como objetivo explorar a possibilidade de produção de falsas memórias com listas de palavras que não possuem associações preexistentes, sendo que sua relação semântica é condicionada por um contexto específico. Para tal, foram utilizadas listas de exemplares de categorias ad hoc, que são categorias orientadas para objetivos que tendem a ter natureza efêmera e condicionada por contextos específicos.

Em três capítulos empíricos é descrita investigação realizada sobre este tema, começando pela obtenção e pre-teste do material a ser usado para os estudos de falsas memórias ad hoc e passando depois para a produção e estudo de ilusões de memória para dois tipos de categorias ad hoc: inter e intra-taxonómicas. Categorias ad hoc inter-taxonómicas são caracterizadas por serem compostas por exemplares de diferentes categorias taxonómicas e por terem menos (ou nenhuma) associação preexistente entre si; Categorias ad hoc intra-taxonómicas são compostas por exemplares de uma mesma categoria taxonómica comum (sendo assim um tipo de subcategoria pouco usual). Em categorias ad hoc inter-taxonómicas, foi encontrada produção de falsos reconhecimentos mesmo sem a explicitação do seu tema (o nome da categoria), efeito que apresentou correlação positiva com a capacidade dos participantes de identificar o tema das categorias ad hoc. Em categorias ad hoc intra-taxonómicas o efeito foi mais limitado e falsas memórias resultantes da representação ad hoc surgem com maior frequência do que falsas memórias da representação taxonómica comum apenas quando a estrutura da lista e o tema apresentados fazem referência à categoria ad hoc (e, neste caso, os resultados sugerem que o efeito ocorre pela representação consistente da categoria ad hoc, e não por uma

distintividade do item crítico da representação taxonómica comum neste contexto ad hoc). Esta condicionante indica que a representação taxonómica preexistente e subjacente às categorias ad hoc intra-taxonómicas exerce considerável influência na produção de falsos reconhecimentos.

A produção de falsas memórias em listas de categorias ad hoc expande a abrangência deste fenómeno para um novo tipo de representação categórica com múltiplas utilizações em situações do dia-a-dia e pode contribuir para a revisão e melhoria das principais atuais teorias explicativas das falsas memórias.

Abstract

One of the assumptions behind false memories produced by presentation of lists of related words is that they share preexistent associations and stable representations in long-term memory. The goal of this thesis is to explore the production of false memories for lists of words that do not share preexistent associations and whose semantic relatedness is set by a specific context. For this end it was used lists of exemplars from ad hoc categories, which are goal-oriented categories with an ephemeral nature and generated by specific contexts.

Three empirical chapters present experiments aimed at developing the material to be used and towards testing the occurrence of memory illusions in two types of ad hoc categories: inter and intra-taxonomic. Inter-taxonomic ad hoc categories are characterized by being composed of exemplars from different common taxonomic categories and, thus, having few (if any) preexistent associations among them; Intra-taxonomic ad hoc categories are composed of exemplars from the same common taxonomic category (making it an unusual subcategory). Inter-taxonomic ad hoc categories show production of false recognitions even when its theme (the category's name) is not presented. These false recognitions showed a positive correlation with the participants' capacity of identifying the themes of the ad hoc categories. In intra-taxonomic ad hoc categories the false recognition from ad hoc representations were only more frequent than false recognitions from common taxonomic representations when both the list structure and the category name presented referred to the ad hoc category (and, in this case, results suggest that the effect stem from the consistent representation of the ad hoc category and not because of the distinctiveness of the critical item of the common taxonomic representation in the ad hoc context). These limiting conditions for the false memory effect suggest that the preexistent taxonomic representation that underlies the intra-taxonomic ad hoc categories exerts considerable influence in the production of false recognitions.

The production of false memories in lists of ad hoc categories expands the scope of this phenomenon to a new type of category representation with multiple uses in daily situations and may contribute to the revision and improvement of current theories of false memories.

Resumo alargado

Investigações sobre falsas memórias com apresentação de listas de palavras criaram uma consistente área de estudo científico no qual são exploradas a natureza construtiva da memória, sua suscetibilidade a erros por associação conceptual e os padrões de ocorrência destes erros. Nesta área de investigação é comum o uso de listas de palavras fortemente associadas obtidas através de normas de associação livre (Deese, 1959; Roediger & McDermott, 1995). Outro tipo de material usado, embora apareça com menos frequência em estudos nesta área, são listas de exemplares de categorias taxonómicas (Dewhurst, Bould, Knott & Thorley, 2009: Smith, Ward, Tindell, Sifonis & Wilkenfeld, 2000). Nos dois casos, as palavras envolvidas nos estudos (as que compõem as listas e os itens críticos designados a serem alvo de falsas memórias) compartilham associações preexistentes e estáveis na memória de longo prazo. Neste sentido, o efeito de falsas memórias obtido através de listas de palavras é tido como uma marcante característica destas representações semânticas preexistentes. A presente tese tem como objetivo questionar esta assunção ao investigar a produção de falsas memórias com palavras que não possuem associações preexistentes. Nestas condições, este efeito teria sua abrangência ampliada para conceitos associados em função de um contexto específico (o que se aproxima de um cenário mais próximo de situações da realidade) e levanta questões relevantes para teorias frequentemente referidas de falsas memórias.

Para este fim, foram utilizadas listas de palavras compostas por exemplares de categorias ad hoc, que são categorias criadas em contextos específicos e orientadas por objetivos (Barsalou, 1983; 1985). O facto de serem criadas para fins específicos implica em que seus exemplares não compartilhem, por via de regra, associações preexistentes estáveis em memória de longo prazo (o que não significa que não possam tornar-se

estáveis se houver uso continuado da categoria). Esta característica é evidenciada em sua tendência de terem uma produção menos consistente de exemplares e uma maior dificuldade na identificação da categoria a partir de seus exemplares (Barsalou, 1983). Ainda assim, seus exemplares são organizados em estruturas gradativas, nas quais os mesmos variam em quão representativos são da categoria, assim como ocorre em categorias taxonómicas comuns. Isto é verificado pela observação de consistência na variação da frequência de produção e em julgamentos de tipicidade associados aos exemplares de categorias ad hoc.

Categorias ad hoc, no seu sentido original, são caracterizadas por serem uma categorização de exemplares que não pertencem, necessariamente, à mesma categoria taxonómica, o que implica em que prescindam de estrutura correlacional. Ou seja, exemplares de categorias ad hoc apresentam características e atributos diferentes entre si, de maneira que não há grupos de atributos que ocorrem em conjunto com frequência. Algumas categorias consideradas ad hoc, entretanto, são subcategorias muito específicas de categorias taxonómicas comuns (Barsalou, 1985). Neste caso elas retêm algum nível da estrutura correlacional da categoria taxonómica de origem, ainda que haja alguma disrupção por serem organizadas não em torno de suas semelhanças, mas do objetivo implicado no tema da categoria ad hoc em questão.

Nos estudos aqui apresentados os dois tipos de categorias ad hoc são contemplados. O primeiro tipo de categoria ad hoc, nomeado aqui como inter-taxonómica, servirá como a primeira aproximação para observação de falsas memórias geradas por palavras não-associadas. O segundo tipo, nomeado como categorias ad hoc intra-taxonómicas, permitirá explorar os limites deste efeito em estruturas categóricas dinâmicas e contextualizadas com categorias ad hoc que, além de não possuírem associações preexistentes ligadas à sua organização ad hoc, “concorrem” com associações preexistentes referentes à categoria taxonómica subjacente.

No Capítulo II desta tese é descrita a recolha de normas de frequência de produção para diversas categorias ad hoc inter e intra-taxonómicas (assim como categorias taxonómicas comuns subjacentes às intra-taxonómicas ad hoc) e são discutidas as diferenças de padrões de frequência de produção entre elas. No Capítulo III são apresentadas três experiências onde foi explorada a produção de falsos reconhecimentos para categorias ad hoc inter-taxonómicas com ou sem a presença do contexto organizador da categoria (o seu nome). Foi observada produção de falsas memórias mesmo na ausência do nome da categoria. Metade dos participantes que estudaram listas de categorias ad hoc sem seus respetivos nomes foram orientados a tentar identificar o tema de cada categoria apresentada, como forma de obter uma medida de identificabilidade dos temas das categorias utilizadas e explorar a sua relação com o efeito encontrado em listas apresentadas sem tema. De facto, foi observado que a ocorrência de falsos reconhecimentos está positivamente correlacionada com a capacidade do participante de identificar o tema da categoria ad hoc. No segundo estudo foram utilizadas novas categorias ad hoc (em inglês) para as quais foi possível controlar para a presença de associações preexistentes entre exemplares da lista e o item crítico a ser falsamente reconhecido com o uso de normas de associação livre. Os resultados replicaram o encontrado no primeiro estudo, porém a correlação entre falsos reconhecimentos e identificação de temas deixou de ser significativa. Num terceiro estudo palavras não-relacionadas às categorias ad hoc foram substituídas na tarefa de reconhecimento por palavras pouco relacionadas, de forma a eliminar uma potencial inflação dos falsos reconhecimentos de categorias ad hoc pela saliência de palavras não-relacionadas. Entretanto, esta manipulação não alterou os níveis do efeito encontrado nos estudos anteriores.

No Capítulo IV são apresentadas 3 experiências sobre falsos reconhecimentos que utilizam como material categorias ad hoc intra-taxonómicas (ou subcategorias ad hoc) e comparam falsas memórias produzidas por representações taxonómicas condicionadas por um contexto ad hoc e falsas memórias produzidas por representações taxonómicas comuns. No primeiro estudo foram apresentadas listas de palavras nas quais metade das palavras eram exemplares frequentemente produzidos em subcategorias ad hoc e a outra metade eram exemplares frequentemente produzidos nas suas categorias taxonómicas subjacentes. As listas vinham acompanhadas do tema ad hoc, do tema taxonómico ou de nenhum tema. Os resultados mostram uma tendência a gerar representações taxonómicas comuns quando o tema é taxonómico e quando não há tema. Entretanto, mesmo na presença do tema ad hoc a representação ad hoc não é consistente o suficiente para levar a uma produção significativa de falsos reconhecimentos de palavras ligadas a essa representação (itens críticos ad hoc), possivelmente por uma disrupção causada pela composição mista das listas. Numa segunda experiência as listas mistas foram substituídas por listas compostas unicamente por exemplares frequentemente produzidos em subcategorias ad hoc ou em categorias taxonómicas. Nas diversas condições do cruzamento entre tipo de lista (ad hoc ou taxonómica) e tipo de tema (ad hoc, taxonómico ou nenhum), a única em que parece haver uma representação consistente da subcategoria ad hoc é quando tanto a lista quanto o tema são ad hoc, levando a mais falsos reconhecimentos de itens críticos ad hoc do que de itens críticos taxonómicos. A possibilidade de que este resultado seja decorrente de uma distintividade dos itens críticos taxonómicos num contexto fortemente ad hoc foi testada numa terceira experiência. As mesmas listas de subcategorias ad hoc foram utilizadas e, numa condição adicional, a tarefa de reconhecimento foi realizada com pressão de tempo, o que diminui a possibilidade de monitorização de distintividade de palavras (Carneiro, Fernandez, Diez, Garcia-Marques, Ramos & Ferreira, 2012; Dodson & Hege, 2005). Os resultados do estudo anterior foram replicados e o mesmo padrão foi encontrado na condição com pressão de tempo, o que sugere que o maior nível de falsos reconhecimentos de itens críticos ad hoc decorre de uma representação consistente da subcategoria ad hoc.

A produção de falsas memórias para categorias ad hoc levanta questões sobre a assunção de que falsas memórias são baseadas em associações preexistentes em memória de longo-prazo ou por conteúdo semântico fortemente associado. Entretanto, as ilusões de memória criadas por estas representações categóricas mostram-se naturalmente mais dependentes de contexto e instáveis, quando comparadas com representações categóricas mais comuns. Ainda assim, estes resultados desafiam algumas teorias sobre o fenómeno e expandem a abrangência do mesmo, sugerindo uma suscetibilidade a falsas memórias de representações novas e possibilitando o estudo deste fenómeno com um material mais ligado a contextos e, por isso, mais próximo de situações da realidade.

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1. Chapter I – Introduction

Experimental methods for observing associative and semantic intrusions in memory tasks have been applied for decades in studies aimed at exploring the memory processes and structures. One of the most well achieved methods for observing false memory in laboratory (responsible for a dramatic increase in investigations on false memory in the 90s) is the DRM (Deese/Roediger-McDermott), which is based on the studies described in Deese (1959), and Roediger and McDermott (1995). In this experimental paradigm words are selected according to their associative strength towards a critical word and are presented in lists that do not include the critical word. The relatedness of the critical word with the presented list increases the chances of it being later falsely recalled or recognized as having been presented in the list. In this paradigm, the related words to be presented are selected through free-association norms, which entails associations of many different sources.

Using a similar experimental method, some studies have explored false memories in which the presented lists are composed of words belonging to the same taxonomic category (Dewhurst, 2001; Dewhurst, Bould, Knott &Thorley, 2009; Park, Shobe & Kihlstrom, 2005; Smith, Ward, Tindell, Sifonis & Wilkenfeld, 2000). In this case, the criterion for the probability of occurrence of false memory is the words frequency of production, with the critical word being the most frequently produced exemplar from the category in question. One common feature between the memory intrusions observed in both methods is that the word lists presented tap into preexistent associative and/or semantic networks. Theories proposed for explaining the effect typically entail the assumption that this feature is necessary for the production of memory intrusions in this type of experimental paradigm. In other words, false memories obtained through associative or categorical lists work as one of the hallmarks of stable associations in long-term memory. However, conceptual relations, in general, are not static, and some degree of flexibility is obviously necessary for them to serve their functions in our interaction with our environment. Indeed, this flexibility has been shown experimentally to be part of semantic relations involved in the representation of category structures (Barsalou, 1982; Ross & Murphy, 1999; Roth & Shoben, 1983).

This dynamic nature of knowledge structures raises questions about the assumption that false memories in categorical knowledge necessarily stem from preexisting stable category representations. The goal of the research project presented in this thesis is thus to broaden the scope of investigation on false memories based on word list presentations by exploring the possibility of semantic memory intrusions with material that does not share preexistent associations in long-term memory. In sum, to what extent the development and processing of new conceptual representations of categorical knowledge could lead to memory intrusions? By empirically exploring such a possibility, the aim of the present thesis is to expand the implications of false memories for research in the intersection of memory and categorization, challenging the notion that false memories stem from the use of stable, preexisting categorical knowledge.

To this end, the choice approach was to make use of ad hoc categories, which are categorical organizations that are goal-oriented and created online for specific goals. Being goal-oriented, these categories can be organized around an unusual characteristic or specific goal, increasing the chances that they will not correspond to a preexistent conceptual structure for most people. In this case, relevant semantic associations are assumed to be established on the spot between the exemplars. Even without a preexistent structure in long-term memory, ad hoc categories are organized as common taxonomic categories, with exemplars composing a graded structure, with different frequencies of production. This allows for the identification of exemplars with a higher likelihood of producing false memories.

Following Barsalou (1985)'s characterization of ad hoc categories, in the present work, memory illusions for two types of ad hoc categories are explored: intra-taxonomic and inter-taxonomic. Inter-taxonomic refers to ad hoc categories composed of exemplars from different common categories (e.g., “Things to take from a burning house”, with items such as “children”, “animals”, “computer”, “documents” …), while intra-taxonomic refers to ad hoc categories composed of exemplars from the same common category, akin to a subcategory (e.g., “Sports practiced by rich people”). In inter-taxonomic ad hoc categories there is a low chance of exemplars sharing semantic relations because, for the most part, the categories lack correlational structure, meaning that their exemplars usually do not share clusters of co-occurring attributes. Intra-taxonomic ad hoc categories maintain to a greater and more general degree the correlational structure from their original taxonomic category and the semantic associations derived from it, although some level of disruption of the original correlational structure is also observed. This disruption occurs because of differences in how common and ad hoc categories are organized. In common categories, exemplars are organized according to their similarities, which means that an exemplar will be more representative of the category the more it shares attributes and features with other exemplars. In intra-taxonomic ad hoc categories, an exemplar representativeness is also determined by the presence of the specific attributes relevant to the attainment of the goal, which can alter significantly the default representativeness of the exemplars (their representativeness in the common category out of context).

The experiments presented here explored false memories for both aforementioned types of ad hoc categories. The original definition of ad hoc categories refers to (and is based on examples of) inter-taxonomic ad hoc categories. In this sense they can be considered the “classic” ad hoc categories. They will provide a first observation of the effects of conceptual flexibility in false memories. Intra-taxonomic ad hoc categories (Barsalou, 1985), have been more rarely used in experimental research. This type of ad hoc categories is used in the experiments presented in Chapter IV. They provide a way to explore potential boundary conditions for category malleability and the extent with which it can lead to new intra-categorical representations that, although having some degree of convergence with the preexistent representation of the common taxonomic category (in which they are embedded), are robust enough to produce distinguished false memories.

However, before describing the experimental research and in order to better contextualize the present methodological approach, I begin by considering different research methods of false memories that vary in the materials used, their narrative nature, and dependency on preexistent relations among the presented concepts. For this, in the next section, I will describe briefly a tentative taxonomy of experiments on false memories, based on 3 research contributions to the field (including the one in which the experiments presented here can be included).

1.1. Methodological approaches to the false memory phenomena

For most part of the history of experimental studies with memory, the focus of investigation was mostly on memory’s capacity and performance, with intrusions usually relegated as being random error caused by individual differences. Some exceptions, however, recognized the existence of consistent patterns of semantic intrusions and focused attention and developed experimental manipulations to study these memory intrusions, providing valuable insights about the processing of mental representations of concepts and their retrieval from memory.

Experimental developments regarding the study of memory distortions and intrusions can be organized in three main research contributions with respect to the theoretical background and methodological paradigms involved.

1.1.1. Schema theory and pragmatic inferences

The first contribution concerns the approach that explores memory as being schema-driven, and dates back to the studies of Sir Frederick Bartlett (1932), referred as the first to address false memories (e.g., Roediger & McDermott, 1995). In Bartlett's studies, participants were presented with an unfamiliar story and asked to reproduce it, sometimes more than once in time lapses varying from minutes to years, after the initial presentation of the story. The unfamiliar aspects of the story (e.g., references to a foreign culture and supernatural events, lack of explicit connection between actions and events) provided fertile ground for participants to produce considerable alterations in the subsequent reproductions of the story, adding or removing information to create better connection between events and substituting elements with more familiar ones. These memory distortions were interpreted as rationalization processes to "render material acceptable, understandable, comfortable, straightforward; to rob it of all puzzling elements" (Bartlett, 1932, p. 89). In interpreting these results, Bartlett characterized remembering as a constructive process that is based on existing schemas, or active organization of past reactions or perceptions.

In the same vein, other studies explored memory distortions linked to basic principles of schema theory, like *integration* and *interpretation*. Bransford and Franks

(1971), for instance, showed how segments of semantically related information produce an integrated mental representation. This is observed when the presentation of phrases containing semantic relations (all fragments of a broader phrase entailing all the semantic relations from the presented phrases) produce a representation of the broader complete phrase that is later falsely recognized more frequently (and more confidently) than the presented phrase fragments. The principle of interpretation from schema theory is evidenced in studies where participants are shown phrases that induce a pragmatic implication that is not explicitly described in them (e.g., “The hungry python caught the mouse” carries a pragmatic implication that the mouse was eaten by the python, though this is not explicit in the phrase). The inference produced when interpreting the information to be stored becomes part of the representation of the information and it is falsely recalled as presented more often than the actual presented phrases (Brewer, 1977; McDermott & Chan, 2006; Singer & Spear, 2015). These inferential memory errors were also found for visual narratives (Magliano, Kopp, Higgs & Rapp, 2017) and for episodic events that are not linked in a narrative that taps into an existing schema (Carpenter & Schacter, 2017). Evidence of inferential memory errors can also be found in studies focusing on script theory (Schank & Abelson, 1977), where participants produce false memories in free recall and recognition by filling gaps from presented texts that describe familiar or routine events that can be translated into general scripts (Bower, Black & Turner, 1979; Hannigan & Reinitz, 2001).

1.1.2. Memory distortion, implantation of false memories and Eyewitness suggestibility

The second contribution to the study of memory errors came about in a surge of studies with false memory effects in the 70’s that explored the suggestibility of participants during recovery of information. This line of research focus on applied consequences of memory distortions, more specifically on the sincere but imprecise testimonials in trials. In what has become known as the “misinformation paradigm”, participants are presented with information in the form of a film (e.g., Loftus & Palmer, 1974) or pictures (e.g., Loftus, 1977; Loftus, Miller, & Burns, 1978; Nash, 2018) and are later asked about details of the information presented. During this questioning, one of the details of the information previously presented is altered. This alteration can be direct (e.g., the previously seen “stop sign” is referred in an unrelated question as a “yield sign” and later it is questioned which sign was presented) or indirect (e.g., the impact between two cars is referred to as “two cars that hit each other” or as “two cars that smashed into each other”, when the information to be remembered is the cars’ speed). This captious questioning or suggestive wording causes participants to update their initial representation of the event, thus distorting their memory of it (see Zaragoza, Belli & Payment, 2007, for a review).

At a more extreme end of a dimension of experiments with memory suggestibility there is the paradigm of memory implantation (Hyman, Husband & Billings, 1995; Loftus & Pickrell, 1995), in which false memories are not merely small deviations and distortions from real episodic events, but whole fabricated events, sometimes with intense emotional content (e.g., witnessing a demonic possession; Mazzoni, Loftus & Kirscht, 2001) or regarding illegal acts (e.g., assault and theft; Shaw & Porter, 2015) that are confabulated upon by the participants but accepted as real. As in the misinformation paradigm, there is a social component affecting the implantation of false memories, in the sense that the fabricated episodic events must be corroborated by some external source of evidence. In fact, while in the misinformation paradigm the corroboration can be implicit in a word choice (e.g., mention of “smashed” instead of “hit”), in the memory implantation paradigm the false episodic event needs to be corroborated, in many cases several times, by trusted others (e.g., a relative) and/or by an specialized source of information (e.g., pictures portraying the false episode; Bernstein, Laney, Morris & Loftus, 2005a, 2005b).

1.1.3. Associative and semantic memory intrusions in lists of words

The third contribution to research on false memories refers to a methodology that allows more control over the recollection process and the material processed. It concerns experiments of semantic and associative intrusions with presentation of lists of words. The first experiments showing associative memory intrusions using such method can be traced to Deese's (1959) investigation with predictions of verbal intrusions in free recall[1]. In his study, Deese managed to obtain a high frequency of false memories for specific critical words by presenting words that were strongly associated to them, which were selected from free-association norms as the most frequently produced words from the critical words. The results suggested that this strong association was responsible for the occurrence of false recall for the critical words. Underwood (1965) also obtained significant false memories using pairs of word that shared one type of association (antonyms, words frequently produced from free-association norms, superordinates or attributes). The results showed that repeated presentations of one word tended to produce false recognitions of its paired word, especially between antonyms and strongly associated words. The author theorized that the repeated activation of one word would lead to automatic activation of the related associate in what was coined as *implicit associative responses* (IAR), much in line with Deese (1959) interpretation of his results. However, experiments with semantic and associative intrusions only began triggering an increased interest among researchers from the 90's

[1] However, it is worth mentioning that Kirkpatrick (1894) referred to patterns of associative intrusions in his experiments with presentation of word lists, although these were not the focus of his experiments.

on, with the revamping of Deese's method by Roediger and McDermott (1995; establishing the DRM paradigm – **D**eese, **R**oediger & **M**cDermott) that served as inspiration for many manipulations of the paradigm in procedure and material.

One characteristic that distinguishes this methodological contribution to false memory research from the first two described above is the narrative nature of the experimental material. This is especially evident in Bartlett's experiments with story reproduction and in Loftus et al. (1974; 1978) experiments with eyewitness of sequences of events depicted in images. This narrative aspect fosters processes of interpretation of the material that underlie the reconstruction and distortions of memories. In the third contribution, the material is simpler (just lists of words) with no narrative aspect to it, which precludes narrative interpretation processes making it easier to identify the fundamental underlying cognitive processes involved. Differently from the other two contributions, experiments in the spirit of the last contribution (DRM paradigm) usually run under the assumption that the words presented in the lists share stable preexistent associations and semantic relations in long-term memory, which ultimately lead to the memory intrusions found in the experiments. By questioning this assumption of stability and particularly by exploring how malleable and adaptive cognitive processes may be (in order to adapt to our daily situations in an variable and stimuli rich environment) the present work has not only the possibility to advance fundamental research (by broadening the conditions under which false memories may occur) but also the potential to shorten the gap between associative and semantic intrusions in memory and events in real life.

In the next section, I will further describe the research contribution of associative and semantic intrusions in lists of words. I will begin with a description of the DRM paradigm, which is the most prolific research paradigm in the field, followed by a description of a similar method that utilizes material of a specific semantic nature: exemplars of categories.

1.2. Characteristics of associative and semantic intrusions in lists of words

As aforesaid, the DRM paradigm is the most prolific (and arguably the most successful) method of observing associative and semantic memory intrusions in lists of words. It has its origins in a method implemented in Deese (1959) and aimed at identifying predictors of memory intrusions in free recall. Later, this method was picked up by Roediger and McDermott (1995; but see also Read, 1996), and expanded to include recognition tasks as well as questions about the level of certainty and phenomenological experience when recognizing the words.

The DRM paradigm produces considerably strong effects, where false recall of the critical words is sometimes as frequent as recall of presented words and false recognition of the critical words occurs sometimes more frequently than true recognition of presented words (Roediger & McDermott, 1995). These effects are also robust and enduring in varying conditions. Manipulations aimed at hindering the production of false memories, such as previous warning of the false memory effect (Gallo, Roberts & Seamon, 1997; McDermott & Roediger, 1998), shorter speed of presentation (Gallo & Seamon, 2004; Seamon, Luo & Gallo, 1998), item-specific processing of lists (McCabe, Presmanes, Robertson & Smith, 2004), different study modality with increased perceptual distinctiveness (Schacter, Israel & Racine, 1999), frequently decrease the frequency of false memories in varying levels, but usually do not eliminate the effect.

Some aspects of the procedure involved in the DRM paradigm differ little from common memory experiments methods, in the sense that a material is first presented for study, it is followed by a distractor task to decrease the chances that the studied material is kept active in working memory and finally a memory task (recall or recognition) is performed. The distinctive aspect leading to production of false memories is the selection of the material to be studied. In most instantiations of the paradigm (including in the original studies in Deese, 1959) the studied lists are composed of words that are frequently produced in free association norms from critical words, which are not presented with their respective lists. This method of list creation, however, does not ensure a high frequency of false memories of the critical word, as it is evidenced by a considerable variation found in false memories frequencies across various lists produced through free association norms. Taking an example from Deese (1959), the list of associates of the word “sleep” produced 44% of false recall for this word, while the list for the word “butterfly” produce no false recall of butterfly. As it was identified by Deese and further explored by Roediger, Watson, McDermott and Gallo (2001), the variable that seems to be the strongest predictor of this variability is the associative strength from list item to critical item, named Backward Associative Strength (BAS). This variable accounts for about half of the variability in false memories and has been one of the main points in favor of theories that support associative activation of the critical word as basis for the phenomena, such as the Activation Monitoring Framework (AMF).

Other investigations showed that semantic relations between list words and critical words from DRM lists, as well as semantic variables of the words, have significant positive correlations with frequency of false recall and recognition (Brainerd, Yang, Reyna, Howe & Mills, 2008), which goes in line with theories that support semantic links and meaning processing as underlying the false memory phenomena, such as the Fuzzy-Trace Theory (FTT). Another evidence for the impact of semantic relations in false memories of DRM lists is its persistence over time. Semantic information is known to persist in memory for longer than verbatim information (i.e., the form in which it was conveyed, or the actual sequence of words used; Sachs, 1967). The same is observed for false memories of critical lures (Seamon, Luo, Kopecky, Rothschild, Fung & Schwartz 2002; Toglia, Neuschatz, & Goodwin, 1999), which can be interpreted as being the result of a convergence of meaning from the list words to the critical word, making it available for retrieval for longer. Semantic influence in false memories is also evident in manipulations leading to relational processing of the words in the lists, with more attention to the meanings of the words, produces more false memories than item-specific processing (McCabe et al, 2004).

DRM lists contain associative relations between list and critical words that rely on different kinds of information sources including semantic knowledge as well as others (e.g., phonological similarity; Sommers & Lewis, 1999). A similar but alternative method to study memory intrusions in lists of words uses lists of exemplars from the same taxonomic category, a material that favors specific semantic associations. In this method, the critical word is not the one from which the list words are produced, as it is the case in associative DRM lists, but the most frequently produced exemplar of the category. This entails a different relation between critical word and list words. As a consequence, it usually shows lower average BAS (MBAS) from the lists to the critical word. Although the low MBAS is considered one reason as to why false memories for categorical lists tend to be less frequent than for associative lists (Howe, Wimmer & Blease, 2009; Knott, Dewhurst & Howe, 2012), MBAS alone cannot fully account for the phenomenon in categorical lists. There are instances where significantly high levels of false memories are observed with categorical lists with low to non-existent MBAS Dewhurst, Bould, Knott & Thorley, 2009), suggesting significant influence of (other) semantic relations in the lists. Indeed, type of semantic relation was found to interfere with production of false memories even when MBAS is controlled. Semantic relations of a superordinate nature (when the critical word is the name of the category), are shown to produce low levels of false memories compared to associative lists with comparable MBAS (Park, Shobe & Kihlstrom, 2005; but see Pansky & Koriat, 2004, for instances of false recognition of the superordinate categorization level with a different method). Because of this interference, categorical lists for false memory studies are not obtained in the same way as DRM associative lists, since the words in a category list are necessarily generated from the category's name. In fact, false memories tend to be greater for coordinate words, more specifically the ones with highest production frequency from the category's name (DeSoto & Roediger, 2014; Smith, Ward, Tindell, Sifonis & Wilkenfeld, 2000).

The false memories evoked by both types of material described above are derived from preexistent associations between concepts in long-term memory. As mentioned previously, the goal of the present work is to test for, and explore, the occurrence of false memories with concepts that do not share preexistent semantic associations. For this effect, it was applied the method used for category lists using ad hoc categories.

1.3. Ad hoc categories

Ad hoc categories were first described and explored by Barsalou (1983) as "highly specialized and unusual" categories, whose use "pervades everyday living" (Barsalou, 1983, p. 211). These are categories that organize exemplars under a specific and explicit goal (e.g., Things to take on a camping trip) or under a specific feature that can serve a goal (e.g., Things that float). In this sense, they can be more broadly characterized as goal-derived categories (Barsalou, 1985; 1991; 1999; 2003; 2010).

What characterizes some goal-derived categories as ad hoc is the fact that they are conceptual representations not well established in long-term memory, being developed when necessary (although this status can change according to the frequency with which these structures are called into use).

Ad hoc and common categories seem to have different underlying functions. Common categories may serve a better purpose in organizing the stimuli around us into groups of similar exemplars, simplifying the representation of new exemplars by allowing deduction of its attributes from the ones normally found in the category. In this sense, the processing of similarities and differences between attributes of the exemplars of the category is central to the mental representation of common categories. Ad hoc categories, on the other hand, serve specific and somewhat objective goals, so the focus seems to be more in the presence of one or more key attributes that makes the exemplar useful for the goal at hand (Barsalou, 1985; 1991). Similarity among exemplars exists as a secondary aspect, and as a consequence of the fact that exemplars may share these key attributes.

These different underlying functions are evident in the processes proposed to be involved in the creation and inclusion of exemplars in both types of categories. Barsalou (1991) describes two extremes of a continuum from which categories are created: Exemplar learning and conceptual combination. Exemplar learning is a bottom up process, in which exemplars are integrated in representations of categories as they are encountered and dealt with in the environment. Conceptual combination, on the other hand, is more of a top down process, in which existing knowledge is combined to generate or identify new exemplars or categories with tailored characteristics. While exemplar learning seems to be more directed to acquiring new information from the environment and organizing input from reality, conceptual combination seems to be more directed to action and changing of the environment into a desired (and idealized) state.

Both processes may well be involved simultaneously in processing of categorical knowledge, but each may have a more central role depending on the type of conceptual organization. In the case in question, it seems natural to assume that exemplar learning would have a more central role when organizing exemplars into common categories, while conceptual combination would play a bigger part in representations of ad hoc categories.

Another difference is found regarding the internal structure of both types of categories, but before delving into the differences between the categories, I will first describe the conception of internal structures and its characteristics according to prototype views of categorization.

1.3.1. Categories internal structure

As aforementioned, in common categories, one important aspect of the formation of the category (and inclusion of further exemplars) is the similarities between (attributes of) exemplars, as evidenced by the propositions of prototype theories of categorization. Prototype views of categorization characterize categories as having graded structures with fuzzy boundaries meaning that (contrary to Aristotelian conceptions of categorization) some exemplars are better examples of the category than others and there are no sufficient and necessary attributes that exemplars must have to belong to a category (McCloskey & Glucksberg, 1978; Rosch, 1973, 1975; Rosch & Mervis, 1975). Instead, the occurrence of (relevant) similar attributes among exemplars both defines the category and determines the likelihood of an exemplar being included in it. The frequency of attributes and their averaged values compose a central tendency (akin to a category's prototype) to which new exemplars are compared to when evaluating if they belong or not to the category (Smith, Shoben & Rips, 1974). Comparison to central tendencies of other categories are also considered, so an exemplar that shares many similarities with the central tendency of a category and few with central tendency of other categories is more readily categorized in the former. As similarity to the central tendency of the category in question decreases and/or similarity to central tendency of other categories increases, the categorization of the exemplar becomes more ambiguous and uncertain. The comparison of similarities within and between-categories for exemplars is referred to as *family resemblance* (Rosch & Mervis, 1975).

The organization of exemplars around similarities of attributes leads to the fact that common categories have correlational structure. This means that not only some attributes occur more frequently than others (among exemplars of a category), but clusters of attributes also co-occur frequently. For instance, in exemplars of the category "Birds", "has feathers" is an attribute that frequently occurs along with "has wings" and "can fly", meaning that when one of these attributes is present, the other co-occurring ones have a high probability of occurring as well (Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976).

The different degrees of similarity between exemplars and the category's prototype translates in the fact that mental representations of common categories present a graded structure, meaning that exemplars are not equally "good" members of a category; some are "better examples" of the category than others. This is usually referred to as the *typicality* of exemplars in a category. Typicality has often been used as a measure of internal structure of categories and is found to be positively correlated with speed of categorization of exemplars (Loftus, 1973; McCloskey & Glucksberg, 1979), frequency of free recall (Bousfield, Cohen & Whitmarsch, 1958; Greenberg & Bjorklund, 1981) and ease of category learning (Mervis & Pani, 1980; Rosch, Simpson & Miller, 1976). Another measure used to access a category's internal structure is frequency of production, which is found to be positively correlated with typicality (Mervis, Catlin, & Rosch, 1976).

1.3.2. Comparing ad hoc and common categories

Returning to the comparison between common and ad hoc categories, one of the points of considerable difference between them is the aforementioned correlational structure. As described, the presence of correlational structure in common categories is linked to the core aspect of its construction, that is, the fact that common categories are built around similarities between exemplars, which reflects the natural co-occurrences of attributes in nature. In ad hoc categories, however, similarity of attributes is not central to their construction. Because they focus on the achievement of specific goals, exemplars of ad hoc categories can vary greatly depending on the goal. Taking the category "things to take from one's home during a fire" as example, mentioned in Barsalou (1983) to illustrate the same point, one can find exemplars as diverse as "children", "dog", "computer", "money" all of which are perceptually very different from one another.

Even so, there are examples of ad hoc and goal-derived categories in the scientific literature whose exemplars share an underlying correlational structure. These are ad hoc categories which are also a subcategory of a common category, like "foods not to eat on a diet" (Barsalou, 1985), or "animals found on the Galapagos" (Vallée-Tourangeau, Anthony & Austin, 1998). In these cases, all exemplars belong to the same common category, meaning that some degree of the original correlational structure can be maintained. Still, this structure is secondary to the goal of the ad hoc category, and thus potentially disturbed in the creation of the category (Barsalou, 1985). For instance, if one is creating a representation for the category "birds that are dangerous and can outrun a person", it is quite likely that the most representative exemplars of the category will not necessarily fly, albeit having wings, which would go against the expected co-occurrence of these two attributes. This distinction will be addressed in the experiments presented here (Chapter IV). As aforesaid, the ad hoc categories composed of exemplars from different common categories are named here as inter-taxonomic ad hoc category, while ad hoc subcategories, composed of exemplars from the same common categories, are named intra-taxonomic ad hoc categories.

As in common categories, ad hoc categories also have graded structure with similar characteristics. In Barsalou's (1983) studies exploring the structure of ad hoc categories, results suggest that subjects show significant agreement when selecting exemplars of ad hoc categories from a list of options as well as ranking them from best to worst example of the category. Uncertain cases also exist in ad hoc categories and when they are included in the list of options the general agreement across participants decreases, indicating fuzzy-boundaries. Another evidence of graded structure is that production frequencies of exemplars of ad hoc categories show a clear variability where some exemplars are more dominant and readily accessible than others.

However, the lack of stable representations in long-term memory has consequences that produce some impact in the processing and organization of ad hoc categories. One of them is that the representation of an ad hoc category is not well established (in contrast to the representation of a common category). This is evidenced by differences found in free recall for ad hoc and common categories where the first were less often accessed than the latter (i.e., when at least one exemplar of the category is recalled) and had less exemplars recalled in average (Barsalou, 1983).

Another consequence of ad hoc categories having no preexistent associations in long-term memory is that concept-to-instance associations (i.e., the association from the category's name to the exemplars) are rather weak compared to common categories. This is observed in participants' production of exemplars, which is less consistent in ad hoc categories than it is in common categories (evidenced by the lower frequency of production for the most frequently produced exemplars in ad hoc categories compared to common categories), as well as in more exemplars of common categories being produced by many subjects (Barsalou, 1983).

The third consequence of lack of stable representations in long-term memory is weak instance-to-concept associations, which are the associations from the exemplars to the category. This consequence is more self-evident, especially considering that similarity of exemplars is not key in most ad hoc categories and does not define the category. Even if a common attribute is identified between exemplars of ad hoc categories, its specific use may still be elusive, making it difficult to reach the concept from the exemplars alone. Indeed, participants presented with exemplars from ad hoc categories found it harder to generate a category for them and presented less between-subjects agreement in their responses then participants presented with exemplars from common categories (Barsalou, 1983).

1.4. False memories from ad hoc categories

Considering the characteristics of ad hoc categories, and its similarities and differences with common taxonomic categories, the former provides the possibility of exploring false memories conditioned by context cues and without preexistent associations and representations in long-term memory.

The presence of graded structure in ad hoc categories allows for the identification of the exemplars that are more representative of the category, which, in the case of common categories, tend to be the exemplars with the highest rates of false memories. This makes it possible to include ad hoc categories in the same false memory methodology typically used with common categories, which in turn allows for the comparison of results between both types of categories.

As aforesaid, ad hoc categories can be inter-taxonomic (if its exemplars come from different common categories) or intra-taxonomic (if its exemplars come from the same common category). In the work presented here, experiments were conducted focusing on these different types of ad hoc categories, separately. In inter-taxonomic ad hoc categories, the exemplars share little to no previous semantic associations, presenting a more straightforward scenario to test the hypothesis that new categorical semantic structures created online (ad hoc) are cohesive enough to produce memory illusions.

Intra-taxonomic ad hoc categories, on the other hand, carry the underlying semantic relations pertaining to the common category from which they are derived. Still, they are characterized as ad hoc because the specific representation containing exemplars of the common category and generated by the goal of the ad hoc category is new, developed online. This presents a potential boundary condition to the occurrence of ad hoc false memories in the sense that the new semantic relations derived from the ad hoc subcategory would “compete” with the preexistent ones from the common category. The production of ad hoc false memories in this scenario would then be evidence of highly flexible generation of semantic relations, consistent enough to cause memory intrusions. In other words, rather than merely filling voids of meaning, memory illusions would be the result of reassigning significance to existent structures in pursuit of goals.

As already discussed, common categories tend to have lower rates of false memory when compared to associative DRM lists, which some investigations attribute to the low MBAS usually found for those lists (Howe, Wimmer & Blease, 2009; Knott, Dewhurst & Howe, 2012). Ad hoc categories are expected to have even lower rates of BAS than common categories; a less clear representational structure; and a weaker instance-to-concept and concept-to-instance associations. Given these characteristics, rates of false memories for ad hoc categories are expected to be lower than the ones found for common categories.

With a prediction of low MBAS and weaker (or nonexistent) representations in long-term memory predicting the occurrence of false memories for ad hoc categories may even seem unwarranted. However, not only false memories have been found using other methodologies with complex and contextualized semantic material generated during the task (e.g., Bartlett, 1932; Loftus & Palmer, 1974), but also studies in category representation find considerable flexibility of category structures, suggesting this to be an integral part in the process of category representation (e.g., Barsalou & Sewell, 1984; Roth & Shoben, 1983). Such conceptual flexibility is likely to be used to navigate our dynamic environment and to think creatively. It is thus worth questioning if the resulting new representations would be cohesive and consistent enough to create semantic intrusions in memory. To better argue for this point, I will next discuss in more detail some investigation evidencing flexibility in the representation of categories.

1.5. Category malleability

Initial research with graded structure and typicality in common categories consistently showed the robustness of these structures. When giving ratings of typicality for exemplars of multiple categories, subjects show a very high level of agreement in their ratings (close to .9; Armstrong, Gleitman & Gleitman, 1983; Rosch, 1973, 1975). The other evidence of graded structure stability concerns studies showing a myriad of cognitive processes that are consistently affected by gradients of typicality. Some examples of this impact of typicality in cognitive processes were already discussed when describing the existence of graded structure in common categories (pp 16-17). Among other examples there is evidence that a new characteristic of a target exemplar is more frequently generalized to other exemplars of the same category if the target exemplar is more typical (Rips, 1975). Also, when learning new artificial perceptual categories, typical exemplars are more easily learned than atypical ones (Mervis & Pani, 1980; Rosch, Simpson & Miller, 1976), and categories are more quickly learned when more typical than atypical exemplars are presented (Mervis & Pani, 1980).

These results show that graded structures are robust across subjects leading to consistent effects in their cognitive processes. In fact, some theories go as far as to propose that this happens because the graded structure of a category reflects the correlational structure of attributes found in the environment, suggesting a naturalistic origin for this mental construct (Rosch & Mervis, 1975). However, as it will be discussed next, there is also evidence indicating context dependent variation in these structures, which may put into question reports of high levels of between-subjects agreement for graded structures of categories.

In fact, the finding that agreement of typicality ratings between participants is extremely high has been questioned from a statistical point of view. In the experiments where this high agreement was observed (e.g., Armstrong et al., 1983; Rosch, 1975), the agreement was established through split group correlations, that is, comparing means of typicality ratings between groups of subjects split randomly from the whole sample. This method of analyzing agreement between subjects is questionable because of its dependence on sample size, meaning that higher levels of agreement can be achieved with larger samples (Barsalou & Sewell, 1984), which can lead to an overestimation of the agreement between participants. Barsalou (1987) argued that a more appropriate subject agreement measure might be obtained by calculating the average correlation between all possible pairs of participants in a sample. Such measure consistently leads to lower levels of agreement in common categories (around .5, which is almost half the original level of agreement found in previous studies).

Evidence of variability in graded structure is also found for the influence that typicality has on cognitive processes. One evidence of this variability is the differences found in typicality ratings of participants that approached the task actively taking culturally different points of view (Barsalou & Sewell, 1984). The graded structures derived from these ratings were significantly different between them and when compared to the structure obtained out of context. It can be argued, though, that this could be a consequence of deliberation, where participants may have purposefully applied changes on their own (stable) graded structure aiming at imposing a "cultural twist" to it.

A less explicit measure that evidences variability in graded structures can be observed in the studies of Roth & Shoben (1983). These authors used anaphoric relations to observe differences in representativeness of category exemplars under specific contexts evoked in the anaphors. For instance, in the anaphor created by the sequence of phrases "The bird walked across the barnyard. The chicken was larger than average", the first phrase evokes the common category and activates the context of "farm", while the second phrase presents the exemplar to which the previous category refers. In this context, chicken is a highly representative exemplar of the category "Birds", even if out of this context the same exemplar shows low typicality. Utilizing contextualized anaphors like in the example, the study showed that the activated context changes the representativeness of exemplars by restructuring the graded structure of the common categories[2]. This change in exemplar representativeness was evidenced by shorter reading times when the anaphor contained the exemplar more representative of the context evoked, as well as in more explicit measures, like direct typicality ratings of the typical and atypical (out of context) exemplars and reaction times for their category membership verification in the contexts evoked in the anaphors.

Other studies have shown how attributes of exemplars from a category may become more or less salient depending on the context (Barsalou, 1985) or may only become active in specific contexts (Barsalou, 1982), which can produce differences in the categories' graded structure. Barsalou (1985) showed that for the same set of exemplars, each with varying values in the same attributes, different ratings of typicality were obtained under contexts either related or unrelated to the attributes.

Recent theories of categorization processes are more explicit in characterizing them with an intrinsic flexible nature. The *perceptual symbol systems,* developed by Barsalou (1999), proposes that accruing perceptual information from exemplars of a category compose a frame which contains a large set of information from previous encounters with exemplars of the category (a process akin to the exemplar learning process of categorization). This frame of information is referred to as a simulator.

[2] But see McKoon and Ratcliff (1989) for instances where context evokes specific exemplars and not a different graded structure in a common category.

Information built into the simulator is used to create simulations of exemplars of the category, to be processed in working memory. Thus, a frame or simulator is never accessed directly, but only through simulations instantiated by them. These simulations can vary greatly, being produced accordingly to the objective of the processing, which accounts for the great variability empirically found in category representations.

In a similar vein, but in a rather more radical approach, Casasanto and Lupyan (2015) describe an *ad hoc cognition framework*, which proposes that all categories, concepts and word meanings are created and assigned online, meaning that all common categories are ad hoc categories. The authors argue that the difference between ad hoc and common categories (Barsalou, 1983) or between context dependent and independent features of exemplars (Barsalou, 1982) are misleading mostly because they are mere artifacts of experimental designs that elicit dichotomic responses.

Summing up, categories conceptual flexibility and instability in category graded structures have been shown across several studies and the phenomena have been included in recent theoretical approaches to categorization processes. Inspired by these approaches, the goal of the present thesis was to explore the possibility of semantic intrusions that may occur for new category representations via mere presentation of lists of words. False memories for ad hoc representations (even if to a lesser degree than found in common taxonomic categories) are expected to occur in conditions that facilitate the active integration of meaning from the exemplars (when context is evident by presentation of the category name).

1.6. Overview of chapters

The next chapters will present the work developed in exploring ad hoc memory illusions. In this work it was explored false memories stemming from the study of lists of exemplars of ad hoc categories (i.e., with no preexistent semantic relations). Each chapter is largely based on papers (two published, one invited to resubmit) that compose the bulk of investigation produced towards the goal of this work[3].

Chapter II focus on norms obtained for several ad hoc categories (both inter and intra-taxonomic), as well as common taxonomic categories in which the intra-taxonomic ad hoc categories are embedded. These norms were the basis for the subsequent false memories' experiments. In this chapter, the different processes of categorization are readdressed, as well as the organization of categories in graded structures, and measures of typicality and production frequency (normally used to access these structures) are compared. Characteristics of ad hoc categories are further addressed and compared to common categories in terms of structure and composition. Finally, recent uses of ad hoc categories in research designed to tap into the context-dependent, goal-derived characteristics of these categories are highlighted, evidencing their importance for cognitive sciences.

Chapter III describes 3 experiments in which the methodology for obtaining memory intrusions with lists of categories was applied with lists of inter-taxonomic ad hoc categories. In Experiment 1, lists were presented either with or without the category name, manipulating the accessibility of the categories' concept. This accessibility was also measured in theme-identification tasks (when the lists were presented without name). The fact that representations of ad hoc categories are less stable (or stunted) in long-term memory suggests that they should produce less semantic memory intrusions in recognition tasks than common categories. Besides, the fact that they have weaker

[3] For this reason, the chapters in which the experiments are presented have a somewhat autonomous structure which result in some measure of overlap and redundancy of contents, both among them and compared to Chapters I and V.

instance-to-concept association further suggests that semantic memory intrusions from ad hoc representations should be less frequent when the category concept (its name) is not presented with the list. Experiment 2 repeated the same procedure using ad hoc categories with low to inexistent MBAS, to better control for the presence of preexistent associations between list and critical words. Experiment 3 manipulated the exemplars presented in the recognition phase to test a potential inflation of the false memory effect due to salience of unrelated lures presented in the previous two experiments.

Chapter IV describes 3 additional experiments that further investigate the false memory effect with the same procedure as in the previous experiments using intra-taxonomic ad hoc categories. Since intra-taxonomic ad hoc categories are subcategories of common taxonomic categories, both categories representations may be active during encoding and retrieval phases and both may cause semantic memory intrusions in recognition. The occurrence of false memories generated from representations of ad hoc subcategories would suggest that novel category representations are consistent enough to produce semantic memory intrusions, even in the presence of preexistent category representations. To explore this issue, Experiment 1 presents the same lists of exemplars (all exemplars of the same common category) in association with common category names or ad hoc subcategory names. In Experiment 2 the same procedure was applied, but two types of lists were used: lists composed of frequently produced exemplars from common category representations or from ad hoc subcategory representations. In Experiment 3 potential effects of lure distinctiveness and retrieval monitoring were tested with the inclusion of a speeded recognition task.

2. Chapter II - Production frequency norms for inter and intra-taxonomic ad hoc categories in Portuguese[4]

Production norms for taxonomic categories (e.g., fruits, animals, sports) are a valuable resource for research in cognitive psychology providing a measure of associative strength between concepts in different hierarchical levels. This information has an important role in investigation of specific mental processes as it allows for the manipulation and control of the associative strength between concepts' stimuli. These associative structures also occur among highly specific, non-taxonomic categories that are unlikely to have stable representations in long-term memory, such as ad hoc categories. These are categories created spontaneously for the attainment of specific goals relevant to the individual's situation (Barsalou, 1983). There has been increasing research interest in ad hoc categories as a suitable material to explore flexible concept representations from specific contexts. However, the norms for ad hoc categories are scarce. This paper seeks to address this limitation by presenting production frequency norms for a relatively large number of ad hoc categories potentially facilitating the development of research in this area in Portuguese.

We will begin by establishing the theoretical framework for presentation of the norms, characterizing the hierarchic graded structure of categories, presenting and explaining two measures frequently used to access categories' graded structure and two main processes of categorization.

[4] This chapter is based on the paper (freely translated from Portuguese) Soro, J. C., & M. B., Ferreira, (2017). Normas de categorias ad hoc para língua Portuguesa. *Psicologia*, 31, 59-68.

Afterwards we will characterize ad hoc categories, focusing in their graded structure and comparing them to taxonomic categories in terms of their underlying categorization processes.

We will further develop the concept of ad hoc categories as a special case of goal-derived categories (Barsalou, 1991) briefly considering the use of ad hoc categories in research about flexible concept representations. Finally, we will describe the method we used to obtain production frequency norms for exemplars from ad hoc categories and report the obtained norms.

2.1. Graded structures in categories

Upon encountering a species of bird for the first time one can easily deduce a series of characteristics that stem from including it in the category of “birds”, such as “flies”, “lay eggs”, “it is warm-blooded”. Categorization of elements of reality allows us to establish an identity relation between different elements, deducing characteristics of one from another. In this way, classification and category identification improve the efficiency of other cognitive processes (e.g., better performance in free recall for items that belong to the same category; Puff, 1970) and informs us about the best way to interact with new elements in reality, which would be a very demanding (if at all feasible) task otherwise. By categorizing a new exemplar, characteristics can be attributed to it from the category in question without further empirical evidence (Rips, 1975).

In this categorization process, however, exemplars do not share the same prominence or representativeness in the same category. Some exemplars are more strongly related to the categories’ concept than others (Rosch, 1973) and this translates into graded structures. For example, even if we consider “sparrow”, “penguin” and “ostrich” as exemplars of the same category (Birds), “sparrow” is clearly a more typical exemplar than “penguin” and “ostrich”.

2.2. Measures of graded structure

Several measures can be used to access graded structures of categories, such as central tendency, ideals (Barsalou, 1985) and familiarity (Casey, 1992; Hampton & Gardiner, 1983), however, the two more frequently used for this end are typicality and production frequency (Mervis, Catlin, & Rosch, 1976). Typicality is usually obtained by presenting exemplars of a category and asking participants to order them from more to less typical, or to evaluate, using a rating scale, to which point it can be considered a good example of the category in question (or how close it is to the concept of the category). Production frequency is obtained by presenting participants with the name of a category and asking them to name exemplars of the category, thus providing a measure of how frequently exemplars are produced.

Norms for production frequency were one of the first ways to access (and to provide evidence of) graded structures of categories. Originally, this measure came about in the context of associative theories of semantic organization, based in the idea that concepts, represented by nodules, are linked to one another in a conceptual network by associative links of different strengths (Collins & Loftus, 1975). Measures of production frequency would indicate the associative strength between the category and its exemplars in this conceptual network. Exemplars with stronger associative links are predicted to be more frequently produced from the category concept. The importance of this measure is evidenced in studies that show the relation between production frequency and category processing and representation. Specifically, exemplars with higher frequency of production a) are more quickly identified as members of the category (Loftus, 1973; Wilkins, 1971); b) have a tendency for being recalled in clusters (i.e., appear in contiguity in free recall tasks, while exemplars with lower frequency of production tend appear among exemplars of other categories; Bousfield, Cohen & Whitmarsch, 1958); c) are falsely recognized more frequently (Smith, Ward, Tindell, Sifonis & Wilkenfeld, 2000); and d) are more frequently used as a starting point to generate creative ideas (Ward & Wickes, 2009).

Measures of typicality were, from its inception, used to research graded structure in taxonomic categories, thus contesting empirically the Aristotelian perspective that membership in a category is defined by presence of necessary and sufficient attributes (Rosch, 1973). Indeed, in opposition to this theoretical point of view, Rosch and Mervis (1975) showed that typicality is positively correlated with the number of attributes it shares with other exemplars of the same category as well as negatively correlated with attributes shared with exemplars of other categories (a measure named *family resemblance*). An underlying idea regarding this attribute comparison is that exemplars of a category have a graded organization in which they are compared to a category prototype composed of ideal attributes (or attributes that correspond to the average attributes of the categories' exemplars). The more an exemplar is similar to this prototype, the more typical it will be considered. Further research showed that typical exemplars are more quickly identified as members of a category (McCloskey & Glucksberg, 1978); more quickly learned when learning a new category (Rosch, Simpson & Miller, 1976); and that characteristics attributed to more typical exemplars are more easily inferred in new exemplars of the category (Rips, 1975).

Although there are differences in the underlying aspects leading to measures of typicality and production frequency as well as some variation in the correlations found between these measures and different cognitive processes, both tend to be positively correlated one to another (Mervis et al., 1976). In fact, it is quite difficult to create lists of categories in which these measures are dissociated, which makes it hard to more clearly define which one is better in capturing a category's graded structure[5].

Summing up, although efforts of dissociation between both measures have a theorical interest, the strong positive correlation between them suggests that there is no clear precedence of one over another in terms of accessing a categories' graded structure.

2.3. Categorization processes

The development and organization of mental representations of categories can occur via two main processes: exemplar learning and conceptual combination (Barsalou, 1991). In categorization via exemplar learning, upon encountering a new element in the environment, its attributes are extracted, compared to prevalent attributes in existent category representations and integrated into an appropriate one or used to develop a new category representation (Medin & Schaffer, 1978; Rosch & Mervis, 1975). In categorization via conceptual combination, existent mental representations are used to create a new category concept that is usually more complex than the original ones (Murphy, 1988). By using mainly existent mental representations this process does not need input coming from encountering existing exemplars. For instance, existing knowledge for pollution effects and natural phenomena can be combined to produce concepts such as "acid rain" and "ocean garbage".

[5] Hampton (1997, Experiment 2) attempted to dissociate typicality from production frequency in a manipulation affecting the form in which a task is processed, favoring processes more related to the typicality or the production frequency of exemplars from categories (verifying similarities of characteristics or associative activation of concepts, respectively). Although the results showed different effects in each condition, they also suggested that this was caused by participants' strategic use of different processes. Another, more successful, example of dissociation between these measures was obtained by Keller and Kellas (1978). These authors showed decrease of release of proactive interference in categories when exemplars went from more to less typical, but not when they went from more to less frequently produced.

Categorization through exemplar learning is assumed to be the predominantly involved in the development of taxonomic categories (e.g., “fruits”, “animals”, “professions”, “sports”). This type of category has been largely used in research on categorization processes for the simplicity of the concepts involved and because its exemplars are frequently encountered and recognized by most people. Categorization via conceptual combination favors the creation of more complex categories that may be common (e.g., “heavy animals”), uncommon (e.g., “comfortable stairs”), or even imaginary (e.g., “talking flowers”). Taxonomic categories play a central role in the organization of our environment and help us infer attributes of new elements. Categories mainly originated through conceptual combination, however, can serve more variable purposes (Barsalou, 1991; Wisniewski, 1997), such as promoting a more specific organization of existing representations (e.g., shelters for animals), producing idealized knowledge (e.g., extraterrestrial life), or developing complex representations oriented towards a specific goal (e.g., foods low on calories). Akin to the latter, one type of category mainly derived from conceptual combination are ad hoc categories, which are a specific case of goal-derived categories (Barsalou, 1983, 1991).

2.4. Ad hoc categories as a specific case of goal-derived categories

Goal-derived categories differentiate themselves from taxonomic categories by having goal achievement as an organizing theme. Among possible goal-derived categories ad hoc categories are the most ephemeral. They are created to respond to specific and transitory goals. Its *ad hoc* nature implies that they do not have stable representations in long-term memory. One example of an ad hoc category would be “things to save from home during a fire”, an important category to be created during a fire in our homes, but that most of us, hopefully, will not have to ever create.

Representation of an ad hoc category, however, can become stable in long-term memory if created frequently enough, leading to the progressive loss of its ad hoc nature (which may happen to those of us who choose to work as a firefighter).

The lack of stability in mental representations of ad hoc categories is evidenced by the weaker associative strength found between its exemplars and the category concept, in comparison to taxonomic categories (Barsalou, 1983). Another difference between ad hoc and taxonomic categories is that ad hoc categories are often composed of exemplars from different taxonomic categories. Take for instance the ad hoc category previously mentioned ("things to save from home during a fire"), which may include exemplars coming from several other taxonomic categories such as "people", "animals", "money" and "computer". This variety of exemplars means that ad hoc categories may not have a correlational structure. In other words, in contrast to taxonomic categories where exemplars' attributes tend co-occur (e.g., "have feathers" and "flies" are attributes that frequently co-occur in the category "birds"), ad hoc categories' exemplars may not have attributes that frequently occur in other exemplars.

Even with the existence of these differences between ad hoc and taxonomic categories and the ephemeral nature of the former, ad hoc categories are nevertheless considered categories because they have graded structure. Barsalou (1983, 1985) showed that, when participants are instructed to produce exemplars from ad hoc categories, they differ in how frequently they are produced. Besides that, typicality judgments of exemplars from ad hoc categories are consistent among participants and are positively correlated to production frequency. These results show that it is possible to obtain production frequency norms for ad hoc categories.

2.5. Ad hoc category norms

Research on the structure and underlying processes related to ad hoc categories is important in cognitive psychology given its role in exploring the flexibility of mental representations (e.g., Barsalou, 1991). In fact, there seems to be increasing interest on the dynamic nature of conceptual organization (Barsalou, 1999; Casasanto & Lupyan, 2015). Norms for ad hoc categories can serve this purpose and can also be useful as material for research, which involves manipulation of contexts or goals. Knowing which exemplars are evoked by these categories and how they are organized allows researchers to observe changes in their representation (both at an individual or group level) depending on how the contexts or goals related to the ad hoc category are presented (e.g., explicitly or inferred), as well as to access their impact in different cognitive processes, like memory, attention and judgment. However, norms for ad hoc categories are few, which makes research on this domain more difficult. There are no ad hoc categories in the largely referenced norms for production frequency from Battig and Montague (1969). When these norms were updated by Van Overschelde, Rawson and Dunlosky (2004), only 7 ad hoc categories were included, which suggests that this material is being acknowledged as relevant for research but also points to a demand for more extensive norms concerning these categories.

The goal of this paper is to fulfill the aforementioned demand, even if partially, by presenting Portuguese norms of production frequency for 63 ad hoc categories. From this total, 14 (22.2%) were originally created (or inspired by) previous papers (Barsalou, 1983, 1985; Valleé-Torangeau, Anthony & Austin, 1998); the remaining were created by the first author. Categories are divided in two groups: Inter- and intra-taxonomic ad hoc categories. Inter-taxonomic categories do not possess correlational structure (i.e., are composed of exemplars that share few, if any, attributes that co-occur frequently).

Intra-taxonomic ad hoc categories (Barsalou, 1985) are embedded in taxonomic categories. As such, an intra-taxonomic category is composed of exemplars from one taxonomic category, to which a goal was associated changing its graded structure (e.g., “fruits that are good for throwing at people”). As a result, intra-taxonomic categories possess some measure of correlational structure. To the best of our knowledge previous published work on production frequency norms did not differentiate between these two types of ad hoc categories. However, norms for intra-taxonomic categories are relevant because they allow for experiments with categories that have preexistent semantic associations related to its taxonomic origin, but have new organizations based on a goal-oriented context.

In order to facilitate comparison between taxonomic and intra-taxonomic ad hoc category structures we also present production frequency norms for the taxonomic categories form which the intra-taxonomic ad hoc ones originate.

2.5.1. Method

Participants. Four hundred and twenty-five undergraduate psychology students form Lisbon University participated in the experiment in exchange for course credit.

Material. Sixty-three ad hoc categories were presented for exemplar production. From these, 35 are inter-taxonomic (without correlational structure) and 28 are intra-taxonomic (composed of exemplars from the same taxonomic category). Ten taxonomic categories (from which the intra-taxonomic ad hoc categories are derived) were also presented. The number of participants that generated exemplars for each category varied between 20 and 69.

Table 1 shows the categories, along with the paper from which they originated (when it is the case), the number of participants that produced exemplars for it and a measure of category potency. This measure refers to the average of exemplars produced in each category from each participant and it is calculated by dividing the total of exemplars produced for a category by the number of participants that responded to that category. The category with less individual productions (“musical instruments with two or more physically separated parts”) has an average of 1.77 exemplar productions and the category with more individual productions (“clothes”) has an average of 8.51 exemplar productions.

Taxonomic categories tend to have more productions in average (M = 6.66, SD = 1.23) than ad hoc categories. Inter-taxonomic ad hoc categories tend to have more productions in average than intra-taxonomic categories (M = 5.63, SD = 0.91 and M = 4.12, SD = 0.94, respectively).

Table 1

Categories listed in the present norms (divided by type), number of participants that responded to each category and production potency for each category

	N	Potency
Inter-taxonomic ad hoc categories		
Things used to take a cat down from a tree	48	3,92
Things that are flammable[a]	41	4,80
Birthday presents[b]	41	7,00
Things to take to a camping trip[b]	41	6,95
Things to carry in a hand luggage[a]	41	6,07
Things that can be bought in a flea market[c]	40	5,70
Things that can be found in “lost and found"	41	5,68
Things to have on a nuclear shelter	40	4,73
Things that serve as “mementos"	41	5,27
Things that can be used as support surface for writing	41	5,46
Objects that can be used to get the attention of a person in a distant building during the day	40	5,13
Objects that can be used to soften the fall of a small statuette	40	5,13
Heavy things that can be bought in a grocery store	39	5,44

Objects that can be used to smash an orange	39	4,90
Cheap and quick things that can be ordered at a restaurant	38	5,71
Things that can scare a cow	38	5,05
Dangerous things that babies risk putting in their mouths	38	5,32
Things that can be used to stop a door from closing	45	5,62
Objects that can serve as support for a hot pan	45	5,18
Objects that can be used to remove dirt from under one's nails	45	5,40
Objects that can serve as chew-toy for dogs	45	5,36
Objects that can be used as pretend drumsticks	44	5,23
Actions that can be easily identified through mimic	20	6,50
Objects that can be used to protect one's face from the wind	44	5,23
Things that can be used to flatten a vine leaf without ruining it	42	4,52
Things that can be used to break a computer	44	5,27
Things built by humans[a]	30	7,97
Things composed mostly of plastic[c]	29	5,69
Things people carry in their pockets[c]	31	6,97
Things that float on water[a]	29	5,07
Things that dogs chase[c]	30	6,30
Things that can attack others[a]	29	5,28
Things that can fall on your head[a]	28	4,86
Things that have a smell[a]	31	8,19
Things that can be walked upon[a]	30	6,03
Intra-taxonomic ad hoc categories		
Foods that one takes to winter holiday parties (X-mas or New Year's Eve)	69	5,20
Foods that have a strong smell	43	4.12
Clothes one takes when mountain climbing	29	5,90
Clothes considered as "accessories"	26	2,65
Clothes to put on a basket for a pet to sleep on	60	3,90
Clothes frequently used to compose costumes for a costume party	28	4.64
Sports that are good for backache	31	3,71
Sports usually played by rich people	67	3,82
Sports that required plenty of clothes and/or equipment	41	4.32
Musical instruments that can be used to contain dripping from the ceiling	56	3,38
Musical instruments that can fit in a travel luggage	30	6,37
Musical instruments with 2 or more physically separated parts	26	1,77

Musical instruments that would require an extra plane ticket to board with the owner	42	4.52
Beverages used in exotic cocktails	61	3,38
Beverages usually consumed mixed with other ingredients	43	4.42
Professions for people who enjoy travelling	63	3,62
Professions with more chances of getting our clothes dirt	43	4.91
Vegetables eaten raw	26	3,19
Vegetables that can hide the flavor of other foods	61	3,79
Vegetables that can be used to fan the face in a hot day	41	3.07
Animals that can be used to scare other people	24	3,25
Animals that can be used to fight a man on a fighting ring	58	4,09
Animals that can be heard in a mountain area	43	4.49
Fruits that can be played as marbles	29	4,97
Fruits that can be thrown in other people	61	4,52
Fruits that go well with salty food	42	4.48
Kitchen objects that can be used as torture tools	60	4,52
Kitchen objects that can be used to hunt a fly	41	4.32
Taxonomic categories		
Foods	69	7,28
Clothes	49	8,51
Sports	48	5,44
Musical instruments	55	8,16
Beverages	62	4,98
Professions	63	6,54
Vegetables	65	5,23
Animals	60	6,15
Fruits	69	7,67
Kitchen objects	64	6,66

[a] List originally in Barsalou (1983). [b] List originally in Barsalou (1985). [c] List originally in Valleé-Tourangeau, Anthony & Austen (1998).

Procedure. The production frequencies were obtained through 11 different questionnaires presented either in paper form or via a computer. Four were composed of taxonomic categories and intra-taxonomic ad hoc categories and two questionnaires were composed of taxonomic categories, intra- and inter-taxonomic ad hoc categories. In these six questionnaires, intra-taxonomic ad hoc categories were never presented with its originating taxonomic category in the same questionnaire. Three questionnaires were composed only of inter-taxonomic ad hoc categories and other two were composed only of intra-taxonomic ad hoc categories. Questionnaires had between 8 and 10 categories and in their paper version were responded during class whereas their computer versions were responded in the laboratory. From a total of 425 questionnaires, 321 were on paper and 104 were on computer. In the instructions, participants were asked to write down exemplars for the presented categories, giving preference to the exemplars that first came to their minds and trying to name them using only one word. It was not established a limit of exemplar production for each category. Because producing exemplars for ad hoc categories can be a somewhat complex task, especially when compared to producing exemplars for taxonomic categories, the instructions included an example of an ad hoc category (that bared no relation to the categories to which participants were then requested to generate exemplars) with some exemplars to make sure participants understood the task correctly.

2.5.2. Results

The lists of exemplars and associated information are displayed as supplementary material[6]. The exemplars were ordered by production frequency. The first column (Production) indicates the number of times that the exemplar was produced; the second column (Production Frequency) indicates the production frequency of the exemplar relative to the number of participants that responded to the category; the third column (Classification) indicates the average order rank of production of the exemplar, calculated by summing the position in the order of each

[6] This material may be obtained by request via email: jeronimo.soro@gmail.com

production of the exemplar and dividing it by the number of times it was produced; and the fourth column (First) indicates the number of times an exemplar was produced before any other divided by the number of times it was produced.

Exemplars with grammatical errors were altered to their correct form. Exemplars were presented in their singular form and when there was at least one production in its plural form we included its plural ending in parenthesis. Some exemplars were aggregated when they represented the same idea in a category (e.g., instances of "wood" and "log" were aggregated as "wood" in the category "things that are flammable"). Whenever this is the case, the different variations are displayed below the aggregating term. Exemplars that could not be deciphered in the paper questionnaires (less than 1% of the total) were eliminated. In some cases, the exemplars produced did not belong to the category, but seemed to have been produced in free association (e.g., responses like "life", "wild" and "domestic" to the category "animals"). In these cases (.016% of the total of sets of exemplars produced for individual categories), all exemplars produced for the category were removed. Four participants were fully removed from the data for having responded in that way to all categories.

The average production frequency of the exemplars with the highest production frequency in taxonomic categories (M = .79) was higher and less dispersed (SD = .10). than in ad hoc categories. Inter-taxonomic (M = .71, SD = .18) and intra-taxonomic ad hoc categories (M = .65, SD = .18) had similar averages and standard deviations. The difference in the variation of highest production frequencies between taxonomic and ad hoc categories becomes very apparent when comparing minimum and maximum values in taxonomic categories (.65 and .92), inter-taxonomic ad hoc (.34 and 1.00) and intra-taxonomic categories (.35 and 1.00).

Comparison of production potency between types of categories show that mean production potency for taxonomic categories (*M* = 6.66, SD = 1.23) is higher than for inter-taxonomic ad hoc categories (*M* = 5.62, *SD* = .91), *t*(43) = 2.92, *p* = .005, which in turn is higher than for intra-taxonomic ad hoc categories (*M* = 4.11, *SD* = .91), t(61) = 6.42, $p < .001$. Another difference was observed in the levels of production frequency between types of category (Table 2 shows the mean production frequency for the 5 most produced exemplars for each type of category). Taxonomic categories show, for all 5 exemplars, higher frequencies of production than inter-taxonomic ad hoc categories, which in turn tend to have higher frequencies of production than intra-taxonomic ad hoc categories (repeating the results pattern found for production potency). These differences among common categories, intra and inter-taxonomic ad hoc categories are significant only in the 4^{th} and 5^{th} levels (for the production frequency of the 4^{th} and 5^{th} most produced exemplars), meaning that the consistency of exemplar activation decreased rapidly in inter-taxonomic ad hoc categories and even more so in intra-taxonomic ones[7].

Table 2

Mean frequency of production for the five most frequently produced exemplars by type of category

	Taxonomic categories		Inter-taxonomic ad hoc categories		Intra-taxonomic ad hoc categories	
Exemplar position	*M*	*SD*	*M*	*SD*	*M*	*SD*
1st	.79	.10	.70	.18	.65	.18
2nd	.67	.07	.53	.15	.51	.13
3rd	.54	.09	.45	.15	.37	.12
4th	.49	.12	.37	.12	.28	.10
5th	.42	.14	.30	.07	.23	.08

[7] The results displayed in Table 2 were not presented in the published paper in which the current chapter is based.

2.5.3. Discussion

Production frequency norms are a valuable material for research on mental representation of categories. They enable research on how these representations are accessed and organized and on the characteristics of exemplars found in different levels of the category's graded structure. The goal of this paper was to present production frequency norms for ad hoc categories, providing tools for research on the graded structure of categories that are organized in a similar way as taxonomic categories, but have two important differences: they do not possess preexistent representations in long-term memory and they are oriented towards goals. One aspect worth noticing are the differences between participants, in the sense that a goal-derived category which is assumed to be created ad hoc during the task may have preexistent and stable representation in long-term memory for some participants, depending on their personal history (e.g., "things that are flammable" to a fireman).

Recent studies have used ad hoc categories to explore the malleable, dynamic and context dependent nature of these categories' representations in comparison to representations of taxonomic categories. Next, we present some examples of research that focus on the difference between these two conceptual structures.

Abdel Rahman and Melinger (2011) found semantic interference in picture naming tasks using images of exemplars from different taxonomic categories but belonging to the same ad hoc category. The effect was smaller than what is found for pictures of exemplars belonging to the same taxonomic category and it was dependent of the presentation of the ad hoc category's name. The authors concluded that lexical activation of semantic groups is a dynamic process that can be contextually conditioned.

Soro, Ferreira, Semin, Mata and Carneiro (2017; see also Chapter III of the present thesis) showed that lists of ad hoc categories lead to false recognitions of non-presented exemplars with high production frequency. The effect was smaller than what is usually found in taxonomic categories, but it occurred in the presence and in the absence of contextual cues (in this case, the categories' names) suggesting high contextual flexibility and sensitivity when recognizing ad hoc categories' exemplars.

Previous studies have shown that taxonomic category processing tends to be relational whereas ad hoc category processing tends to be specific. Grimaldi, Poston and Karpicke (2015) used these processing differences between both types of categories to identify which type of processing (relational or specific) plays a bigger role in different learning tasks (specifically using conceptual mapping tasks).

Another potential use of ad hoc categories in research is related to its dependency on context and goals. Some theories of construction and comprehension of metaphors propose that metaphors are organized as ad hoc categories and that the term of comparison not only defines the desired characteristics in the category but also works as the prototypical exemplar. In the phrase "My work is a prison" the ad hoc category is composed of exemplars with the characteristic of limiting one's freedom. "Prison", in this case, is the prototypical exemplar and "my work" is another possible exemplar of the ad hoc category. Once it is included in the category, its characteristics of freedom limitation are highlighted leading to the comprehension of the metaphor. Based on this theory, Terai and Nagakawa (2012) used ad hoc categories in the development of a computational model of metaphor comprehension.

The examples above evidence the relevance of ad hoc categories for cognitive research and the variable ways in which it can be applied in experimental psychology.

We expect to contribute, with the present work, to research developed in Portuguese speaking countries or with Portuguese speaking samples, leading to the development of related areas of research.

3. Chapter III - Ad Hoc Categories and False Memories: Memory Illusions for Categories Created On-the-Spot[8]

Illusions of memory have been a central focus of research in cognitive and social– cognitive psychology mainly because such memory distortions and errors provide important information concerning the underlying representational structures and cognitive processes that cause them. A fertile research tradition inspired by Deese (1959) was established with Roediger and McDermott's (1995) work on false memories with the DRM (Deese, Roediger, McDermott) paradigm, which revealed that when presented with a list of words that participants had to recall, they falsely recalled the single nonpresented word (critical word) to which the words in the presented list converged associatively. Similar results were observed for categorical lists (Smith, Ward, Tindell, Sifonis, & Wilkenfeld, 2000), with false recall and recognition for the nonpresented words with the highest output dominance (i.e., frequency of exemplar production for a category). According to classic theories of knowledge representation (e.g., Collins & Loftus, 1975; Medin & Schaffer, 1978; Rumelhart, Hinton, & Williams, 1986), such illusions of memory stem from the preexisting and stable conceptual systems that represent knowledge about the world. In fact, the study of errors of memory has been claimed to produce important insights into the organization of categorical knowledge (Park, Shobe, & Kihlstrom, 2005; Smith et al., 2000).

However, categorical knowledge does not always stem from stable conceptual systems. Instead, it is often constructed ad hoc by conceptual combination. Such ad hoc

[8] This chapter is based on the paper: Soro, J. C., Ferreira, M. B., Semin, G. R., Mata, A., & Carneiro, P. (2017). Ad hoc categories and false memories: Memory illusions for categories created on-the-spot. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, Vol. 43, 1779–1792. http://doi.org/10.1037/xlm0000401

categories (e.g., Barsalou, 1983, 1985, 1991) do not reside as knowledge structures in long-term memory waiting to be retrieved but instead are spontaneously constructed on the fly to achieve a goal that is relevant in the current context.

In this article we test for the possibility that ad hoc categories created on the spot via the mere presentation of its exemplars may also induce false memories. The presentation of exemplars will be performed under the same experimental circumstances that give rise to associative/semantic (Roediger & McDermott, 1995) and in particular categorical (Dewhurst & Anderson, 1999) false memories. The false recognition of exemplars of ad hoc categories would indicate that semantic illusions, supposed to be the hallmark of preestablished knowledge, could be produced in the processing of more dynamic, cognitively situated structures.

Initial research on ad hoc categories (Barsalou, 1983) indicated that these categories are not well established in memory and do not become apparent without context. Once constructed, however, they function as coherent categories, exhibiting internal structures as those in familiar taxonomic categories (Barsalou, 1985, 1987). Using false memories as mnesic traces of concept activation via instance-to-concept associations allows us to readdress the role of context in the construction of ad hoc categories, and to better understand how people use these flexible categorical representations regardless of their phenomenological awareness of the categories.

3.1. False Memories in Taxonomic and Ad Hoc Categories and the Assumption of Stable Representations

Buchanan, Brown, Cabeza, and Maitson (1999; see also, Dewhurst, Bould, Knott, & Thorley, 2009; Park et al., 2005) showed robust false memory effects with lists of exemplars from common taxonomic categories. In categorized lists generated from a category name (e.g., “fruits”) and composed of the most frequent exemplars for the category (e.g., “apple, orange, banana, grape...”), the word that has more chances of being falsely recalled is not the category name that generated the list (in fact, subordinate items seldom generate false memories for superordinate concepts, Park et al., 2005; however see Pansky & Koriat, 2004, regarding memory illusions for basic level category terms), but rather the exemplar with higher output dominance (i.e., the most frequently generated word; e.g., “apple”) of the category. Indeed, Smith, Ward, Tindell, Sifonis, and Wilkenfeld (2000) found a high correlation between output dominance and false memories for categorical lists.

Among the theories proposed to explain the false memory phenomenon in the DRM paradigm, two are prominent: The activation-monitoring framework (AMF) and fuzzy-trace theory (FTT). The AMF builds on the notion that memory is organized in a network of conceptual nodes sharing semantic/associative links (with variable degrees of strength) to posit that during the list study phase the activation that each word receives upon presentation spreads to neighboring conceptual nodes. Given that the critical lure is closely associated to all items on the list, it receives cumulative indirect activation to a point where it can be interpreted as a memory signal and becomes hard to be dismissed by monitoring processes during recall and recognition tasks (Roediger, Balota, & Watson, 2001; Roediger, McDermott, & Robinson, 1998). In the case of categorical lists the same process of accruing activation could be involved, considering the semantic proximity between exemplars of each category and its critical lure so that studying a list of words composed of fruits like “banana,” “orange,” “pear,” and so on, would lead to the indirect activation of the word “apple.” In fact, manipulations designed to affect the critical lure activation during list study were found to have similar effects for both associative and categorical lists (Dewhurst et al., 2009).

The FTT in turn proposes that acquisition, processing, and retrieval of information all happen in two forms of representation: verbatim and gist. Verbatim information refers to the surface and more concrete aspects of the stimuli while gist information refers to the more abstract and conceptual aspects of the stimuli, more related to its meaning. Participants extract both kinds of representations while studying lists and they are later used as cues to guide recollection. The list gist, derived from the converging gists from each presented word, is assumed to be closely related to the critical lure's gist (if not the same), which leads to false memories when used as a memory cue (Brainerd & Reyna, 2001, 2002). The idea of gist here seems more closely related to semantic aspects of concepts than to associative ones, even if considered to explain false memory for associative lists. Considering the semantic similarity between exemplars of a taxonomic category and the existence of an explicit theme for them (the name of the category), it would seem plausible to assume that the same processes could underlie false memory for category lists. In this case, from a list composed of "banana," "orange," "pear," and so on, the gist "fruits" could be extracted and used as cue in the recognition task, increasing the possibility of "apple" being falsely recognized because of its proximity with the list's gist.

Regardless of the theory used to explain the phenomenon, it is assumed that preexisting relations between exemplars of a category promote false memories, perhaps in a more explicit way in the AMF than in FTT, where this idea would be implied by the semantic similarity between concepts that is characteristic of taxonomic categories.

Common taxonomic categories tend to reflect the correlational structure of the environment because their acquisition results from exemplar learning in which categorical knowledge accrues slowly through experience with exemplars in a passive and mostly bottom-up way (Collins & Loftus, 1975; Medin & Schaffer, 1978). False memories stemming from categorical materials may be seen as a side effect of this process of exemplar learning.

In contrast, ad hoc categories are constructed to achieve novel goals by conceptual combination of existing knowledge (Barsalou, 1991). Members of ad hoc categories normally cut across the correlational structure of the environment, meaning that there are no clusters of co-occurring features among its members. For instance, exemplars of an ad hoc category such as “Things you take from home during a fire” (e.g., “child,” “dog,” “computer,” “blanket”) may come from several different taxonomic categories, are often quite dissimilar to each other and very similar to many nonmembers (Barsalou, 1985).

Ad hoc categories also lack stable associations, which is evidenced by weak “instance-to-concept” associations. When presented only with exemplars of categories, participants show considerably less consistency when inferring the category concept (Barsalou, 1983), and they perceive less similarity between the exemplars (Ross & Murphy, 1999) for ad hoc categories than they do for common categories. Moreover, ad hoc categories’ exemplars are less successfully recalled than common categories’ exemplars in both free recall and cued-recall tasks (Barsalou, 1983, 1985).

Ad hoc categories are nonetheless categories because they possess structural characteristics similar to those of common categories. They show graded hierarchical structure (i.e., members differ in how typical exemplars they are of the category); there is a clear difference between exemplars of ad hoc categories in terms of output dominance (although less consistently than for common categories); and typicality rankings and ratings of ad hoc categories’ exemplars correlate with the categories output dominance (Barsalou, 1983).

In sum, categorical false memories seem to be the result of the activation of the mental representation of a concept via strong preexisting associations between its category members. This makes typical (but nonpresented) members more accessible in memory and eventually falsely recalled or recognized as previously studied. An important question that remains to be answered is whether newly established associations during the presentation of ad hoc category exemplars are strong enough to produce false memories. And if so, to what extent would such false memories depend on the instantiation of a context (e.g., the ad hoc category name), and what consequences would they have for extant theories of false memories? To explore these issues, we used the DRM false memory paradigm with lists of ad hoc categories.

Three of the aforementioned characteristics of ad hoc categories are relevant for the experiments reported here. First, the hierarchical structure allows us to include ad hoc categories as material in the DRM paradigm in the same way that common categories are included. The differences in output dominance means that there are exemplars that are more easily generated for the category and, following what has been observed for common categories, the exemplar with the highest output dominance should be the one with most chances of being falsely recognized. The lack of stable representations in memory and their context dependency constitute the second and third characteristics of ad hoc categories that serve as ways of exploring the strength of the false memories phenomenon with material that has more flexible associations.

3.2. Overview

The main question that we investigated was whether ad hoc categories produce false memories, and how the presence or absence of their theme impacts that effect. To this end, we presented lists of members of ad hoc categories either with or without the categories' original themes (between-participants). The first experiment, designed to examine false memory effects for ad hoc categories, compared these conditions with another condition where participants were presented with standard common categories. This first experiment also sought to investigate what drives false memory effects for ad hoc categories by including an additional condition where, instead of receiving memory instructions, participants were requested to try to identify a theme for each category based only on each category's exemplars. The goal was to clarify the role of the theme extraction in the production of false recognition. This identification task was followed by a surprise recognition task to look for correlations between theme identification and false memories. The second experiment was designed to replicate the first experiment with an improved control for the backward associative strength between list words and critical words. The third experiment intended to replicate the previously found false recognition results manipulating the lures presented in the recognition task to eliminate a possible inflation of false memories due to the use of gist as a diagnostic cue for recognition.

3.3. Experiment 1

The goal of the first experiment was to observe whether it is indeed possible to obtain false recognition with lists of words derived from ad hoc categories. Our first hypothesis is derived from the assumption that the occurrence of false memories in categorical lists depends on the activation of the categories' concept (i.e., the categories' themes). Ad hoc categories are not expected to be well represented in long-term memory (as suggested by weak instance-to-concept associations). Thus, our hypothesis was that false memories for ad hoc lists, if they occur, should depend on the category exemplars being presented along with the category concept or at least should be stronger when the category concept is explicitly presented. That is, the presence of a unifying theme is expected to help associations during study (and eventually the generation of the critical item), and also to serve as a cue for recognition, increasing the chances of falsely recognizing the critical word. Considering that common categories have the “advantage” of sharing stronger associations, we expect to observe a higher frequency of false memories for these categories when compared with ad hoc categories.

If false recognitions occur for ad hoc lists presented without themes, then we expect them to be correlated with the theme’s identifiability. That is, the higher the frequency of theme extraction, the higher the frequency of false recognition. To that end, we included an identification condition where participants performed a theme identification task instead of a memorization one. This prediction may seem to be at odds with previous research in which highly identifiable associate lists produced lower levels of false recognitions (e.g., Carneiro, Fernandez, & Dias, 2009; Neuschatz, Benoit, & Payne, 2003). However, these results were obtained for DRM lists with highly identifiable critical words that were often identified during encoding of the study items, mentally tagged as “not presented” and thus easily rejected at test (Carneiro et al., 2012). In categorical lists (including ad hoc lists) the same process could hardly occur because “theme identification” refers to the category’s name and not to its critical item. So, in Experiment 1, the identification of the lists’ themes during encoding and the consequent indirect increase in activation of the corresponding critical items could lead to an increase of false recognitions of these items at test.

The AMF would not predict the occurrence of false memories for ad hoc lists on account of their lack of strong preexisting associations, although the presence of a theme could induce associations between exemplars (triggered on the spot) strong enough to activate the critical lure to a point of it being falsely recognized later. The FTT would predict the occurrence of false memories in ad hoc lists when the theme is presented with or inferred from the list. Only in these cases could a representation of the gist of the category occur with the aforementioned downstream effects leading to false memories.

Furthermore, the remember/know task was used to access the phenomenological memory experience. Illusory recollection, as measured by remember responses, seems to be caused by strong associations to and between a category's exemplars (e.g., Dewhurst & Farrand, 2004). Assuming that associations made online between exemplars of ad hoc categories are weaker than preexisting associations between exemplars of common categories, remember responses for ad hoc lists (if they occur at all) should be less frequent, compared with know responses, and to remember responses for common categories.

3.3.1. Method

Participants. Seventy-six psychology undergraduates from the University of Lisbon (49 females, M_{age} = 23.07, *SD* = 5.08), participated in the experiment in exchange for course credit. The distribution of participants between conditions is presented in Table 3. The experiment was approved by the research ethics committee of the Faculty of Psychology.

Material. Two kinds of lists were used: ad hoc categories and common categories (11 lists for each one). For lists of ad hoc categories, exemplars were generated through pretesting. The pretest was a paper and pencil questionnaire carried out with psychology undergraduates from the University of Lisbon. Participants were presented with categories names and asked to write down the first exemplars that came to mind and to try to convey them in one word. The norms for the lists used in this experiment are presented in the Appendix A (Table A1). Of the 11 ad hoc lists used, eight were Portuguese versions of lists used or mentioned in other studies (“Things that can be walked upon,” “Things that can fall on your head,” “Things that float on water,” “Things that are flammable,” Barsalou, 1983; “Things to take on a camping trip,” Barsalou, 1985; “Things dogs chase,” “Things people carry in their pockets,” “Things that can be bought in a flea market,” Vallée-Tourangeau, Anthony, & Austin, 1998), and three were created by the authors (“Things used to take a cat out of a tree,” “Things that serve as mementos,” and “Things that can be used as support surface for writing”). Lists that shared a great number of words with other categories were not used in the experiment, and words that appeared in more than one list were removed in order to avoid word repetitions during presentation.

Eleven ad hoc lists were included in the study phase, each composed of the 10 words with the highest production frequency and ordered by output dominance. The most frequently produced exemplar of each list was removed from the list and used as the critical word in the recognition test. For comparison purposes, 11 common categories were selected from Pinto’s (1992) Portuguese norms of categories.

The recognition task was comprised of 22 targets (studied words taken from the first and the fifth position of the presented lists), 11 critical lures (the critical words from the studied lists), and 11 unrelated lures, which were the critical words from the nonstudied lists (i.e., words used as critical lures for ad hoc lists are the unrelated lures for the common categories’ lists and vice versa).

Design. List type was manipulated between subjects so that participants either studied (a) ad hoc lists with a theme (i.e., each list was preceded by the respective ad hoc theme); (b) ad hoc lists without a theme (i.e., the lists’ themes were not presented); or (c) common categories without a theme. In one additional condition (the identification condition), participants studied ad hoc lists without a theme under instructions to try to identify the lists' themes (instead of memory instructions). The dependent variables were the frequencies of correct and false recognition and remember, know, and guess responses.

Procedure. Both the study and the recognition tasks were performed on computers. Participants were instructed to memorize the words for a subsequent memory task. A screen announcing the beginning of a new list for 5 s preceded each list. When an ad hoc category was to be preceded by its theme, that screen also contained the name of the list to be presented. Each word was presented individually in the center of the screen for 1.5 s, with a 1-s blank screen between words. The order of the words was the same for every list (from higher to lower output dominance), but the order of the lists was randomized. After presentation of the lists, participants performed a distractor task for 5 min (Sudoku) followed by the instructions for the recognition task.

In the identification condition, participants were presented the 11 ad hoc lists without a theme and were instructed to, after each list, answer (a) if they thought the list had an underlying theme; (b) if they could name this theme and, if so; (c) to write the name of theme. These questions were included so that the participants did not feel obliged to associate a theme to each list. Nothing was said at this stage about the later recognition task, which came up as a surprise memory test for these participants. Before beginning the presentation of the 11 ad hoc lists, two lists were presented as examples of the material to familiarize participants with the task. One was a list with an easy to identify theme (i.e., most participants would generally be able to assign the list's theme). The other one was an example of a list with a hard to identify theme (i.e., most people would not be able to identify the theme).

In the recognition task the words were presented individually, as in the study phase, and for each word, participants had to answer if it was old (appeared in the studied lists) or new (did not appear in the studied lists). When answering old, participants were additionally presented with the choices to respond remember, know, or guess. Before the beginning of the task, instructions on the screen informed about the remember/know/guess task and what each response meant (see Appendix B). Participants were provided with a sheet of paper containing detailed instructions for each phenomenological response in case they wanted to clarify any doubts during the task.

3.3.2. Results

Mean frequencies for recognition of targets, critical and unrelated lures are presented in the first three columns of Table 3. Following Dewhurst, Bould, Knott, and Thorley (2009), mean frequencies of guess responses were not considered in the analysis since these responses may often not be based on memory markers (Gardiner, Ramponi, & Richardson-Klavehn, 2002).

Table 3

Mean proportions of phenomenological responses (remember, know and guess) for Critical Lures, Targets and Unrelated Lures as a function of list type, theme presentation and study condition

	Common categories presented without theme[a] (*n* = 19)	Ad hoc categories presented with theme[a] (*n* = 20)	Ad hoc categories presented without theme[a] (*n* = 17)	Ad hoc categories presented without theme[b] (*n* = 20)
	M (SE)	*M (SE)*	*M (SE)*	*M (SE)*
Targets				
Remember	.56 (.06)	.55 (.06)	.55 (.05)	.70 (.06)
Know	.21 (.04)	.16 (.05)	.14 (.05)	.15 (.05)
Guess	.10 (.02)	.08 (.02)	.11 (.02)	.05 (.01)
Total	.86 (.03)	.78 (.03)	.80 (.03)	.90 (.02)
Critical Lures				
Remember	.24 (.04)	.14 (.02)	.13 (.04)	.14 (.03)
Know	.13 (.03)	.12 (.03)	.10 (.03)	.10 (.02)
Guess	.26 (.04)	.15 (.04)	.18 (.04)	.16 (.03)
Total	.64 (.05)	.41 (.04)	.42 (.06)	.41 (.05)
Unrelated Lures				
Remember	.06 (.01)	.00 (.00)	.02 (.01)	.01 (.01)
Know	.02 (.01)	.01 (.01)	.03 (.02)	.02 (.01)
Guess	.05 (.02)	.01 (.01)	.07 (.02)	.05 (.02)
Total	.12 (.03)	.03 (.01)	.12 (.03)	.08 (.02)

[a] Lists presented under memorization instructions. [b] Lists presented under theme identification instructions.

False recognition of related lures was significantly higher than recognition of unrelated lures for ad hoc lists presented with theme, $t(19) = 8.10$, $p = .001$, for ad hoc lists presented without theme, $t(16) = 3.92$, $p = .001$, and for taxonomic lists, $t(18) = 8.18$, $p = .001$.

Recognition frequencies of targets and related lures were corrected by subtracting from them the frequencies of recognition of unrelated lures[9], and they were

[9] We thank Charles Brainerd for suggesting the analysis of this measure and reinforcing its importance. Ideally this type of recognition correction for target recognition should be made with rates of false recognition of standard lures (instead of critical lures) from lists not presented. However, our focus was not to make direct comparisons between false recognition and target recognition, so any differences of

included in a 2 X 3 ANOVA with word (recognition of targets and related lures) as a within-participants factor and list (ad hoc presented with theme, ad hoc presented without theme and taxonomic) as a between-participants factor. There was no main effect for list, $F(2, 53) = 2.09$, $p = .133$, $\eta_p^2 = .07$, but there was a main effect for word, $F(1, 53) = 264.84$, $p = .001$, $\eta_p^2 = .82$ (targets had higher frequency of recognition than related lures). There was no significant interaction. Related lure recognition was significantly higher for taxonomic lists than for ad hoc lists without theme, $F(1, 53) = 4.33$, $p = .042$, $\eta_p^2 = .07$, but not for ad hoc lists with theme, $F(1, 53) = 1.13$, $p = .292$, $\eta_p^2 = .02$. There was no significant difference between ad hoc lists with and without theme for false recognition, $F(1, 53) = 1.15$, $p = .287$, $\eta_p^2 = .02$.

Regarding the remember/know task, a 2 X 3 ANOVA for critical lures with response (remember or know) as a within-participants variable and list (common categories, ad hoc with and without theme) as a between-participants variable showed a trend for list, $F(2, 53) = 2.74$, $p = .073$, $\eta_p^2 = .09$, such that common categories had more recognitions in general, and a marginally significant main effect of response, $F(1, 53) = 3.77$, $p = .057$, $\eta_p^2 = .06$, indicating a higher frequency of remember responses. There was no interaction, $F(2, 53) = 1.25$, $p = .292$, $\eta_p^2 = .04$. Planned comparisons showed that remember responses were more frequent than know responses for common categories, $F(1, 53) = 5.77$, $p = .019$, $\eta_p^2 = .10$, but not for ad hoc lists presented either with, $F(1, 53) = .09$, $p = .761$, $\eta_p^2 = .001$, or without a theme, $F(1, 53) = 0.43$, $p = .510$ $\eta_p^2 = .01$.

Themes' Identifiability. Mean frequencies of recognition of targets, critical and unrelated lures, as well as mean frequencies of remember and know responses, are

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false-alarm rates between standard and critical lures do not seriously affect the data analysis and interpretation of the results.

presented in the fourth column of Table 3 for the identification condition. The difference between false recognition of critical lures and unrelated lures was significant, $t(19) = 4.44$, $p = .001$, $d = 2.03$. As in the memorization conditions, there was no significant difference between remember and know responses, $t(19) = 1.05$, $p = .305$, $d = 0.48$ for critical lures.

Two criteria of identifiability were taken into account: the exact identifiability, that is, if the participants identified the original theme of the lists, or at least a theme that contained the core idea of the original one (e.g., “Things/materials that cover the ground” for the category “Things that can be walked upon”); and a comprehensive identifiability where, in addition to the exact theme, we considered as correct the identification of themes that could contain the critical word as an exemplar (e.g., “Things that can be found/seen when riding on a road” that although being different from “Things that can be walked upon” may as well include the selected critical word “grass”). Two independent judges examined the responses for the identifiability criteria. There was disagreement in 8.63% of the cases. These were settled by discussion between the two judges.

Identifiability was averaged across participants for each list as well as across lists for each participant to compute the correlations with false recognition by list and by participant, respectively.

Correlations by list. The mean exact identifiability of the themes was .25 (*SD* = .33), and comprehensive identifiability was .47 (*SD* = .27). Two themes were considerably more identifiable than the others, averaging .95 and .85 for exact identifiability while the others varied between 0 and .30 (see Table 4). Correlations between the lists’ identifiability and false recognition of critical words, although relatively strong were not significant for either exact identifiability, $r(9) = .48$, $p = .134$; or comprehensive identifiability, $r(9) = .41$, $p = .204$. If identifiability is considered to be an intrinsic characteristic of the lists, we can compute the correlations between both types of identifiability and false recognition frequency for the "no theme" list memorization condition. Exact identifiability in this case is marginally significant and strong, $r(9) = .53$, $p = .094$, while comprehensive identifiability is nonsignificant, $r(9) = .38$, $p = .236$.

Table 4
Mean exact and comprehensive identifiability and false recognition frequency for each list ad hoc category's exemplars presented without theme and under memorization or identification instructions

Lists' themes[a]	Exact ID	Comprehensive ID	False Recognition - identification instructions	False Recognition - memorization instructions (exp. 1)
Things that can be walked upon ($n = 36$)	.30	.45	.10	.12
Things that dogs chase ($n = 36$)	0	.45	.15	.12
Things that can fall on your head ($n = 33$)	0	.05	.15	.24
Things that float on water ($n = 33$)	.10	.45	.20	.18
Things people carry in their pockets ($n = 33$)	.85	.90	.25	.29
Things that can be used to take a cat down from a tree ($n = 48$)	0	.35	.25	.29
Things that are inflammable ($n = 41$)	.30	.65	.25	.24
Things to take to a camping trip ($n = 41$)	.95	.95	.50	.41
Things that can be bought at a "garage sale" ($n = 40$)	.15	.35	.25	.18
Things that serve as mementos ($n = 41$)	.05	.30	.15	.18
Things that can be used as supporting surface for writing ($n = 41$)	.05	.25	.45	.35

Note. ID = Identifiability.
[a] Lists translated freely from Portuguese.

Correlations by participant. When the data for the identifiability condition is organized by participant, a significant correlation is observed between false recognitions and exact identifiability, $r(18) = .54$, $p = .013$, but not for comprehensive identifiability, $r(18) = .20$, $p = .382$.

3.3.3. Discussion

Results suggest that it is possible to obtain false memories with lists of ad hoc categories, as evidenced by the significant difference between false recognitions of critical lures and unrelated lures for ad hoc lists, both with and without themes. Moreover, there is a significant difference in the false recognition of the critical lures of ad hoc lists when compared with the exact same words when embedded in the recognition task for common categories lists in which they worked as unrelated lures, $t(37) = 4.58$, $p = .001$, $d = 1.50$ for ad hoc lists with theme, and $t(34) = 2.64$, $p = .012$, $d = 0.90$ for ad hoc lists without theme. This effect was somewhat smaller for ad hoc categories than for common categories. Taking into account the higher frequency of remember responses both in absolute terms and relative to know responses for common categories the phenomenological memory experience accompanying false memories seems to be less episodic in nature for ad hoc categories when compared to common categories.

Based on Dewhurst and Farrand's (2004) account of the false recognitions obtained with common categories, we expected the false recognition rates (both remember and know) for ad hoc categories to depend on the associations made between and from studied words. Given that there are no preexisting associations between the words in ad hoc lists, this would more likely happen as consequence of an organizing theme promoting ad hoc "instance-to-concept" associations. Interestingly, however, these associations seemed to have occurred even when the organizing themes (the ad hoc categories' titles) were not explicitly presented. Perhaps instance-to-concept associations are not as weak in the ad hoc categories that were used as past research (e.g., Barsalou, 1983) suggested. Correlations between theme identifiability and false recognition of critical lures computed by list and by participant further assessed such possibility.

These correlations did not reach statistical significance when organized by lists, although the correlation coefficients are relatively large, both in the identification and the memorization condition. These correlations by list are supposed to tap onto intrinsic characteristics of the lists that could be involved in the occurrence of false memories. However, the small number of lists used (11) is likely to have compromised the statistical power of this analysis. So, at this point we postpone any conclusions concerning the role of lists' instance-to-concept associations in the production of false recognitions until more data is collected (see Experiment 2). Correlations by participants, however, were significant. This could mean that, regardless of the lists' intrinsic characteristics, individual differences condition the relations between theme identification and false recognitions. Because exemplars of ad hoc lists are organized around specific goals, we could consider that differences in individual variables such as experience and creativity may be relevant in establishing significant associations between exemplars increasing theme identification and false memories.[10]

One issue concerning opposing effects in the identification task suggests caution when interpreting the correlations between identifiability and false recognitions. On one hand, considering the identification task as a deep processing manipulation, we would

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[10] The presence of two outlier lists in terms of high identifiability could generate a spurious correlation between identifiability and false recognition (we thank Henry Roediger for making this point). However, removing the two most identifiable lists did not substantially changed the correlations pattern for data organized by participant, $r(18) = .51$, $p = .019$, for exact identifiability and $r(18) = .20$, $p = .389$ for comprehensive identifiability.

expect an increase in the frequency of false recognition in the identification condition, (McCabe, Presmanes, Robertson, & Smith, 2004; Thapar & McDermott, 2001). On the other hand, there was a significant increase in target recognition when comparing identifiability and memorization conditions (in particular for remember responses)[11] implying an increase in the use of verbatim cues and a reduction in false memories (Brainerd, Gomes, & Moran, 2014). Thus, the theme identifiability data observed in this experiment may have been influenced by these two opposing effects and this could interfere with the relation between identifiability and false recognitions.

Although we will address the implications of the present experiment for the main theories of false memories in the General Discussion, it is important to note that, at first sight, the data does not seem to support any of them. The results showing similar levels of false recognition for ad hoc lists presented with and without theme would not be expected by the FTT. On the other hand, the finding that ad hoc categories, defined as lacking strong preexistence associations, produced considerable levels of false recognitions seems inconsistent with AMF predictions.

However, an alternative explanation for the ad hoc false memories reported in Experiment 1 is the existence of preexisting associations within the lists that may be strong enough to drive the false recognition for the critical lures. Such possibility could not be sufficiently controlled in Experiment 1 because of there is not a normative pool of associative relations for all the Portuguese words used in this experiment. Experiment 2 addresses this issue.

[11] Target recognition in the identification condition was significantly more frequent than in the memorization conditions both with theme, $t(38) = 3.33$, $p = .002$, $d = 1.08$, and without theme, $t(35) = 3.78$, $p = .001$, $d = 1.27$. The increase in remember responses for target recognitions in the identification condition was marginally significant compared with the memorization conditions both with theme, $t(38) = 1.85$, $p = .071$, $d = 0.60$, and without theme $t(35) = 1.88$, $p = .068$, $d = 0.63$.

3.4. Experiment 2

The ad hoc lists used in Experiment 1 were assumed to have no preexisting associations between lists' words. However, it was not possible to fully check for this due to a lack of published free-association norms for Portuguese words. Preexisting associations are interpreted here as a measure of backward associative strength, which is the strength of association from the studied items of the list to a critical nonpresented lure. This measure was found to be related to the production of false memories (Roediger, Watson, McDermott, & Gallo, 2001), which is a strong argument in favor of false memories deriving from preexisting associations. Therefore, we ran the next experiment in English using free-association norms for English words (Nelson, McEvoy, & Schreiber, 2004), which allowed us to control for preexisting words associations.

3.4.1. Method

Participants. One-hundred and 10 undergraduates (48 female) from Indiana University (M_{age} = 19.49, *SD* = 1.85), participated in this experiment in exchange for course credit. The distribution of participants between conditions is presented in Table 5. The experiment was approved by the Indiana University Institutional Review Board.

Material. Fifteen ad hoc lists were selected from three different sources ("Things to do for weekend entertainment," "Camping equipment," "Picnic activities," "Foods not to eat on a diet," and "Outfit to wear in the snow" from Barsalou, 1985; "Things that dogs chase," "Things people keep in their pockets," "Things people put on walls," "Things people take to a wedding," and "Things sold on the black market in Russia" from Vallée-Tourangeau et al., 1998; "A thing made of wood," "A thing a woman wears," "A thing that flies," "A thing that makes noise," and "A thing that is green" from Van Overschelde, Rawson, & Dunlosky, 2004), and 15 common categories lists were selected from Van Overschelde et al. (2004). Both types of lists were composed of 10 words with high output dominance. Each group of lists was checked so that no word appeared in more than one list.

A total of 75 words were removed from ad hoc lists, 37.5% of all the words (M_{word} = 5, SD 2). Words that were found to have any degree of backward associative strength as indexed by free association norms (Nelson et al., 2004) were removed[12] (24 words, 12% of all words) as well as words that repeated across lists (36 words, 18%). Similarly, words that can carry some emotional charge (the word “sex” appearing twice) and exemplars composed of multiple words representing complex concepts (13 exemplars, 6.5%) were removed. The removed words were substituted with the next suitable word in the output dominance scale.

Procedure and design. The procedure and design was the same as in the first experiment except that the remember/know task was used without including a guess option.

3.4.2. Results

Table 5 displays the mean frequencies of remember and know responses, and of total recognition for targets, critical and unrelated lures as a function of the different presentation variables: common categories, ad hoc categories with theme, ad hoc categories without theme, and ad hoc categories under identifiability instructions.

False recognition of related lures was significantly higher than recognition of unrelated lures for ad hoc lists presented with theme, $t(26) = 7.29$, $p = .001$, for ad hoc

[12] The only exception was the word “bench” in the list “things made of wood” that slipped by our sorting and had a backward associative strength of .036.

lists presented without theme, $t(28) = 5.59$, $p = .001$, and for taxonomic lists, $t(26) = 11.3$, $p = .001$.

Table 5

Mean proportions of phenomenological responses (remember, know) for Critical Lures, Targets and Unrelated Lures as a function of list type, theme presentation and study condition

	Experiment 2			
	Common categories presented without theme[a] (*n* = 26)	Ad hoc categories presented with theme[a] (*n* = 29)	Ad hoc categories presented without theme[a] (*n* = 27)	Ad hoc categories presented without theme[b] (*n* = 21)
	M (SE)	*M (SE)*	*M (SE)*	*M (SE)*
Targets				
Remember	.57 (.04)	.49 (.04)	.44 (.04)	.77 (.04)
Know	.25 (.04)	.22 (.04)	.23 (.02)	.10 (.02)
Total	.82 (.03)	.78 (.03)	.67 (.04)	.86 (.03)
Critical Lures				
Remember	.32 (.03)	.15 (.03)	.15 (.02)	.17 (.03)
Know	.29 (.03)	.21 (.03)	.21 (.03)	.16 (.03)
Total	.61 (.04)	.37 (.04)	.37 (.03)	.33 (.04)
Unrelated Lures				
Remember	.08 (.02)	.07 (.02)	.05 (.01)	.04 (.01)
Know	.06 (.02)	.06 (.02)	.15 (.03)	.06 (.01)
Total	.15 (.03)	.13 (.03)	.20 (.03)	.10 (.02)

[a] Lists presented under memorization instructions. [b] Lists presented under theme identification instructions.

Corrected recognition frequencies of targets and related lures were included in a 2 X 3 ANOVA with word (recognition for target and critical lure) as a within-participants variable and list (ad hoc with theme, ad hoc without theme and common categories) as a between-participants variable and yielded a main effect for list, $F(2, 79) = 13.13$, $p = .001$, $\eta_p^2 = .25$, with common categories having more recognitions overall, and a word main effect, $F(1, 79) = 170.16$, $p = .001$, $\eta_p^2 = .68$, with targets being recognized more frequently than critical lures. An interaction between the two factors, $F(2, 79) = 3.44$, $p = .036$, $\eta_p^2 = .08$, seems to come from a significantly smaller difference between recognitions of targets and critical lures in common categories than in both ad hoc categories with and without themes, $F(1, 79) = 6.18$, $p = .014$, $\eta_p^2 = .07$. As in Experiment 1, there was no significant difference for false recognition of related lures between ad hoc lists presented with and without a theme, $F(1, 79) = 1.91$, $p = .170$, $\eta_p^2 = .02$.

Regarding remember and know responses, a 2 X 3 ANOVA for related lures with response (remember or know) as the within-participants variable and list (ad hoc categories with and without theme, and common categories) as the between-participants variable yielded only a main effect of list, $F(2, 79) = 14.26$, $p = .001$, $\eta_p^2 = .26$, indicating a higher frequency of recognitions for common categories. For ad hoc lists with and without theme, know responses were consistently higher than remember responses, although this difference was marginally significant, $F(1, 79) = 3.49$, $p = .065$, $\eta_p^2 = .04$.

Themes' Identifiability. There was a significant difference between false recognition of critical and unrelated lures, $t(21) = 6.55$, $p = .001$, $d = 2.85$, for ad hoc lists presented under identification instructions, revealing a false memory effect.

Correlations by list. As in Experiment 1, exact and comprehensive identifiability were estimated. For data organized by list there was no significant correlation between false recognition of related lures for ad hoc categories under identifiability instructions and exact identifiability, $r(13) = -.20$, $p = .461$, or comprehensive identifiability, $r(13) = .02$, $p = .920$. There was also no significant correlation between false recognition of critical lures for ad hoc lists without theme and exact identifiability, $r(13) = .08$, $p = .764$, or comprehensive identifiability, $r(13) = .17$, $p = .528$.

Correlations by participant. For data organized by participant the correlation was in the same direction as the one obtained in Experiment 1 but fell short of statistical significance for exact identifiability, $r(19) = .33$, $p = .133$, and it was very similar for comprehensive identifiability, $r(19) = .33$, $p = .132$.

3.4.3. Discussion

The same pattern of false recognition was obtained for ad hoc category lists when backward associative strength was controlled for. As in Experiment 1, there was a significant difference between false recognition of critical and unrelated lures for ad hoc lists with and without themes, and between ad hoc critical lures compared to the exact same words when presented as unrelated lures for common categories, $t(51) = 4.34$, $p = .001$, $d = 1.21$, for ad hoc lists with theme and $t(53) = 4.95$, $p = .001$, $d = 1.35$ without theme. Backward associative strength does not seem to play a substantial role in false recognitions for ad hoc lists because the effect remained roughly at the same levels of Experiment 1.

The relation between theme identification and false recognition had a different pattern than the one found in Experiment 1 when the data is organized by lists. The observed correlations are weak (negative for exact identifiability and close to zero for comprehensive identifiability) and nonsignificant. When organized by participants the data show a similar positive correlation to the one obtained in Experiment 1, albeit nonsignificant. This seems to reinforce the idea that, more than list characteristics, participant characteristics may have a considerable influence in how theme identification and false recognition relate to each other in ad hoc lists.

Although there were more know than remember responses overall, the pattern of remember and know responses was similar across conditions to Experiment 1, except for a marginally significant increase in know responses for ad hoc categories presented with and without theme.

Inspired by Fuzzy-Trace theory (Brainerd & Reyna, 2002) and activation-monitoring theory (Roediger, Watson, McDermott, & Gallo, 2001), the previous experiments looked at the identifiability of lists' themes and controlled for the indirect activation through backward associative strength in order to better understand the finding of false memories with ad hoc categorical lists. Both experiments focused on processes occurring during the encoding phase and neither seemed to have a big impact on the effect.

Our attention now turns to processes that could take place during the test phase. Although processes in the test phase were found not to impact the occurrence of false memories in associative lists (Marsh, McDermott, & Roediger, 2004), studies showed that they can have considerable impact in false memories for category lists (Smith, Gerkens, Pierce, & Choi, 2002).

Specifically, processes occurring at test could have played a role in the ad hoc false memories obtained thus far because in the previous two experiments the unrelated lures for ad hoc lists presented during the recognition test were the critical words of nonstudied common categories. One of the principles of graded structure in categories is that concepts that do not belong to a category vary in how far they are from the concept of the category in question (McCloskey & Glucksberg, 1978). It is thus possible that these highly typical exemplars of common categories were perceived at the recognition test for ad hoc lists as salient and semantically distinct from the remaining words because of how far they are from the ad hoc categories' concept (and how close they are to common categories' concepts). This in turn could have led to the adoption of more lenient response criteria at test where the salient unrelated lures tended to be rejected but most critical lures were, by contrast, often accepted. The false recognitions in the case of ad hoc lists' that we reported could thus stem, to an unknown degree, from a distinctiveness effect occurring during the recognition test.

To eliminate the influence of the salience of unrelated lures in our next experiment, we replaced the unrelated lures in the recognition task (critical words from common categories) with weakly related words from the ad hoc lists studied. This way, participants should not be able to readily dismiss items based on their relatedness to the lists studied because all items are either strongly or weakly related to the lists.

3.5. Experiment 3

The structure of ad hoc categories is not expected to be as strong as that of common categories, which is evidenced by the low instance-to-concept associations explored in Experiments 1–2 and the low backward associative strength explored in Experiment 2. However, we assume that there is some degree of conceptual learning taking place in the study of ad hoc categories, even without themes. In fact, when the items corresponding to the ad hoc critical words were used as unrelated lures in the recognition tests of common categories' lists, they were rarely falsely recognized. However, for participants studying ad hoc lists in the experiments reported so far, the unrelated lures presented during the recognition task were critical words of nonstudied common categories and in this sense quite distinctive from the remaining items presented at test. As aforementioned, this could have increased the chances of falsely recognizing ad hoc critical lures if only for the fact that they would be very distinguishable from unrelated lures.

To tackle this problem, in Experiment 3 we replaced the unrelated lures (critical words from common categories) with weakly related words from the studied ad hoc lists. Hence, participants could no longer dismiss items based on their salience or "unrelatedness" to the lists studied because all items were now ad hoc lists' items, varying only on their level of output dominance.

We hypothesized that participants who studied the lists with a theme should represent the ad hoc categories in a more conceptually structured manner, thus enhancing the perceived differences between strongly and weakly related lures. This in turn was expected to eventually lead to more false recognition of the (strongly related) critical lures.

3.5.1. Method

Participants. Forty-six psychology undergraduates (36 females) from the University of Lisbon (M_{age} = 21.30, *SD* = 5.50) participated in the experiment in exchange for course credit. The experiment was approved by the research ethics committee of the Faculty of Psychology.

Material. The 11 lists were the same ones used in Experiment 1. In the recognition task, the 11 unrelated lures were substituted by 11 words weakly related to the ad hoc lists, one from each list. The production frequency of the weakly related words was between .05 and .07 and had approximately the same mean frequency of occurrence in language as the critical lures.

Design and procedure. Half of the participants were presented with the 11 ad hoc lists without a theme and the other half with the same lists with its respective theme. The procedure of these conditions was the same as in the last experiment, with the only difference that the 5-min Sudoku distraction task was substituted with a 3-min Tetris task.

3.5.2. Results

Table 6 displays the mean recognition frequencies for targets, critical and weakly related lures, divided in frequencies of remember and know responses.

Table 6

Mean proportions of phenomenological responses (remember, know) for Critical Lures (strongly related lures), Targets and Weakly related lures as a function of theme presentation

	Experiment 3	
	Ad hoc categories presented with theme (*n* = 22)	Ad hoc categories presented without theme (*n* = 24)
	M (SE)	*M (SE)*
Targets		
Remember	.52 (.06)	.60 (.05)
Know	.22 (.04)	.19 (.04)
Total	.74 (.03)	.79 (.03)
Critical Lures		
Remember	.14 (.03)	.16 (.03)
Know	.22 (.03)	.19 (.03)
Total	.36 (.04)	.36 (.04)
Weakly Related Lures		
Remember	.07 (.02)	.09 (.02)
Know	.05 (.03)	.15 (.02)
Total	.12 (.03)	.24 (.03)

A 3 X 2 ANOVA with word (target, critical and weakly related lures) as the within-participants variable,[13] and theme (with or without) as the between-participants variable yielded only a main effect of word, $F(2, 88) = 179.77$, $p = .001$, $\eta_p^2 = .80$. Planned comparisons showed that targets were more frequently recognized than critical

[13] Because there are no unrelated words in the recognition task, it was not possible to correct recognition for bias in this experiment.

lures, $F(1, 44) = 117.00$, $p = .001$, $\eta_p^2 = .72$, and more importantly, critical lures were falsely recognized more frequently than weakly related lures, $F(1, 44) = 45.48$, $p = .001$, $\eta_p^2 = .50$. The frequency of false recognition for critical lures was close to identical between study conditions. Recognition of weakly related lures, however, was significantly different between conditions, being less frequent for lists studied with a theme than without one, $F(1, 44) = 7.12$, $p = .010$, $\eta_p^2 = .13$. Recognition was significantly higher for critical than for weakly related lures both in study condition with theme, $F(1, 44) = 39.66$, $p = .001$, $\eta_p^2 = .47$, and without theme, $F(1, 44) = 10.07$, $p = .002$, $\eta_p^2 = .18$. However, this difference was larger in the condition with theme than in the condition without theme, $F(1, 44) = 5.54$, $p = .023$, $\eta_p^2 = .11$.

Regarding illusory recollection, a 2 X 2 ANOVA with response (remember or know) as within-participants variable and theme (with or without) as the between-participants variable for critical lures yielded a marginally significant main effect for response, $F(1, 44) = 3.60$, $p = .064$, $\eta_p^2 = .07$ (know responses were more frequent). There was no significant interaction, indicating a similar pattern for lists presented with or without theme.

3.5.3. Discussion

As in the previous experiments, we found no significant difference in false recognition of critical lures between lists presented with and without theme. False recognition of weakly related lures in the absence of the category’s theme was more frequent then when the theme was presented, which may suggest that ad hoc categories presented without themes have a less clearly graded structure, or a more diffuse one. However, the difference in false recognition between the two types of lures remained statistically significant, even if somewhat smaller in the absence of a theme. Given these results, it seems that the salience of unrelated words is not a key factor underlying the false recognition effect in ad hoc categories.

3.6. General Discussion

In three experiments, we found that lists of items from ad hoc categories with no preexisting associations in long-term memory can induce false memories in a DRM paradigm. False memories for ad hoc categories are not as high as for common categories lists, and there seems to be a tendency for more know responses than remember ones, which would be indicative of weaker phenomenological experience in the recollection of these false memories. Nevertheless, ad hoc false memories seem to be robust. They were consistently obtained with native speakers of Romance and Germanic languages, across 26 ad hoc lists obtained from different sources (including 11 lists developed and pretested for Experiments 1 and 3) and regardless of the type of distractor items that were used (unrelated or weakly related lures).

False memories for common categories may arise due to preexisting associations between items on the list and the critical lure, or by a strong association between the critical lure and the lists' theme/gist (that is activated by the lists through instance-to-concept association). Based on previous research (Barsalou, 1983, 1985, 1987), we initially assumed that both characteristics should be mostly absent in ad hoc lists, unless a theme is provided to bring a more cohesive meaning to the list. However, the absence of a theme, even when combined with a strict control for possible preexisting associations between the ad hoc critical words and the corresponding lists (backward associative strength), did not significantly reduce false memories (Experiments 1 and 2).

In the recognition tests of Experiments 1 and 2, the critical lures of nonpresented common category lists were used as the unrelated lures for the studied ad hoc lists and vice versa. This enabled us to control for any possible effects of the features of words (e.g., frequency in language, familiarity, typicality), as we could compare the false recognition of the exact same words that worked as critical lures in the recognition test for ad hoc lists and as unrelated lures in the recognition test for common categories. A possible drawback of this strategy is an increase in the distinctiveness at test of the common category lures that could eventually trigger a more lenient decision criterion (leading to the rejection of these salient nonrelated lures but simultaneously increasing the acceptance of the remaining ad hoc list including the critical lures), thus producing the observed false memories effect for ad hoc categories. In fact, Smith, Gerkens, Pierce, and Choi (2002; but see also Dewhurst et al., 2009) suggested that false memories derived from the study of category lists occur because of semantic processes during the test phase and not during encoding. This was not observed in the results obtained in Experiment 3, which replicated and extended the results of the previous experiments by replacing the common categories items during the test phase by words weakly related to the ad hoc categories.

3.6.1. Conceptual Challenges for AMF and FTT Accounts of False Memories

The occurrence of false recognition for ad hoc categories challenges the AMF, especially considering the persistence of the effect when backward associative strength is controlled for. Even if we consider backward associative strength of second and third order (words that were the second or third ones produced as associates), only four of the whole set of 150 words had any kind of associative strength, which is hardly enough to account for false recognition across lists.[14]

[14] We made one additional analysis to check for possible effects of moderated priming (the presence of words that are produced from a list word and produce the critical item in its turn). We found several instances of moderation between list words and critical words that were aggregated for each list. These

Another way to explain false recognition in ad hoc categories through the AMF would be that the category name is indirectly activated by the spreading activation of its exemplars. From the category name the exemplars with higher chances of being generated are necessarily the ones with the most output dominance (which are the ones selected as critical lures in the DRM paradigm). That would presuppose the existence of instance-to-concept associations, which puts AMF in the same spot as FTT in terms of explaining false recognition for ad hoc categories.

In FTT the list gist extraction is a central aspect of the production of false memories in the DRM paradigm, and it is challenged by the similar frequencies of false memory in ad hoc lists presented with and without theme.

Correlations between theme identification and false recognition further tested the notion that themes are extracted from ad hoc lists and that this increases the chances of false recognition. We initially expected this correlation to occur for lists, such that a more identifiable list would generate more false recognitions, but the correlational results pattern by lists turned out to be quite weak and inconsistent across Experiments 1 and 2. A more consistent correlational pattern was found by participants, showing that their “ability” in theme identification is related to a tendency for producing more false recognitions.

This could mean that, regardless of the lists’ intrinsic characteristics, individual differences in identifiability condition the relations between theme identification and false recognitions. In fact, even common taxonomic categories show variance in graded structure both between and within participants (Barsalou, 1987). This variance, we

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values were then standardized for comparison with false recognition in lists without theme. The correlation was negative and nonsignificant, $r(15) = -.27$, $p = .325$.

argue, should be even higher for ad hoc categories. Assuming that exemplars of ad hoc categories are more "difficult" to organize under the same concept, individual differences in terms of experience and creative thinking could have a substantial impact on how items are organized upon the lists' presentation, with some participants readily establishing more significant associations between exemplars, identifying more lists and incurring in more false recognitions even in the absence of an organizing theme.

In sum, conceptual learning of ad hoc categories seems to occur and to be strong enough to produce false memories. This learning occurs even in the absence of an organizing explicit gist as suggested by the significant levels of false memories for lists presented either with or without themes. However, somewhat weak evidence supporting the notion that learning of ad hoc categories may lead to the development of a less clear graded structure in the absence of an organizing gist comes from the higher frequency of false memories for weakly related lures when the same lists were presented without versus with a theme (Experiment 3). These results together with the positive correlations by participants between theme identification and false recognition suggest that the lists' themes (whether explicitly presented or generated by participants) contribute to the development of structured representations of ad hoc categories.

3.6.2. Other Sources of Ad Hoc False Memories

Semantic associations, such as the ones elicited by feature or meaning overlap between exemplars, are not characteristic of ad hoc categories since these categories do not necessarily have correlational structure, but they may sometimes occur between one or more exemplars (studied items) and related lures (e.g., cat-rat, rain-snow, table-chair, to give examples from the lists used here). The fact that false memories were found for even as few as one associate in lists of words (Anisfeld & Knapp, 1968; Underwood,

1965) suggests that these individual associations could be contributing to at least some of the false recognitions found for ad hoc lists.

Although typical DRM lists are composed of the highest associates of the critical word and are thus all similarly bound to have semantic associations and some degree of meaning overlap, they show considerable variability in the production of false recognitions, even when their total backward associative strength is controlled for and kept at low levels (Gallo & Roediger, 2002; Roediger, Watson, McDermott, & Gallo, 2001). Together with the false recognitions in ad hoc lists here reported, these results raise the question of what other types of association that are not captured by free association norms might be involved in the production of false memories.

Another possible source of associations between exemplars in ad hoc categories are functional affordances, which can be preexisting if the use related to the affordance is frequent or can be established online if the focus is on unusual affordances of the exemplar. Such possibility is suggested by theories of thematic relations (Estes, Golonka, & Jones, 2011), which do not depend on preexisting associations and/or semantic overlap. Instead they aggregate exemplars according to their participation in specific situations (akin to scripts). The idea of functional affordance is described as a source of association in some thematic relations, as for instance between “hammer” and “nail” (one affords hitting and the other afford being hit). The difference from ad hoc categories would be that in thematic relations the exemplars are necessarily complementary, that is, they fulfill different roles in the situation in question, while in ad hoc categories their roles would be focused in achieving a given goal. However, this is a tentative explanation that would need to be further developed. A first step would be to identify which affordances become more salient in one’s representation of the exemplar when one is exposed to a list of stimuli of an ad hoc category and if they converge to the relevant ad hoc goal or not.

In research on categorization, the assumption of a highly functional and flexible mental representation is in accordance with the view that all working concepts of categories are created in the instant they are needed (Barsalou, 1993, 1999), which has been the focus of more recent theorization (Casasanto & Lupyan, 2015; Thomas, Purser, & Mareschal, 2012). Whenever people deal with a category, regardless of its familiarity, they create a working concept for that category for the specific situation they are in, so that the category concept would vary at different situations. The information used to create a working concept would come from long-term memory, but its accessibility would be different in each moment and each context.

From this perspective, ad hoc categories are goal-derived categories, which have been constructed to achieve novel goals (Barsalou, 1983), and ad hoc false memories may be seen as the storage side effects of such goal-driven processes. However, instead of starting with goals (e.g., diet) and then deriving the corresponding goal-derived categories (e.g., "things not to eat on a diet"), participants in our experiments were passively presented with exemplars of ad hoc categories. Even so, some conceptual organization started to occur as suggested by the pattern of false memories found in our experiments. According to Barsalou (1995; see also Barsalou, Yeh, Luka, Olseth, Mix, & Wu, 1993), such process could also be viewed as goal-driven in the sense that any intelligent system has a general goal of constantly orienting itself with respect to what it is experiencing at a given moment and what it already knows about the world. Such default orientation is independent of strategic goals that people may be pursuing, and it facilitates adaptation to unanticipated circumstances that may arise later (Barsalou, 1991, 1995). We may thus speculate that even when presented with lists of exemplars that have no clear correlational structure, some of the initial steps of categorization begin to occur. Information about them is retrieved, rearranged and updated by our cognitive system based on the potential relations they establish with each other. Such a process does not necessarily lead to the development of a full-fledged new ad hoc category but may produce somewhat tentative and certainly vague ad hoc configurations of stimuli, which nevertheless enable later inferences that support the memory illusions reported here. In this view, such memory illusions could simply reflect the cognitive costs of a flexible and adaptive system.

Although generally consistent with the reported results, the abovementioned possible sources of ad hoc false memories and conjectures about the adaptive nature of categorization certainly require more research to better understand the phenomenon. For instance, if the conceptual categorization underlying these false memories is characterized as fuzzy, tentative and provisional, then it should fade away relatively rapidly when it does not serve any adaptive purposes that could lead to the full development and memory consolidation of new ad hoc categories. Thus, compared with categorical and associative false memories, ad hoc false memories should show a steeper decrease in delayed recognition tests.

3.7. Conclusion

The demonstration of false memories in a DRM paradigm with ad hoc categories even in the absence of the categories' themes raises interesting new questions and challenges current accounts of categorical, semantic, and associative false memories to provide a better integration of the extant research on memory and categorization. Notwithstanding the exploratory nature of our approach in the present experiments, we believe to have provided a first step in that direction.

4. Chapter IV - Memory illusions and category malleability – False recognition for ad hoc reorganizations of common categories[15]

Research on memory illusions using categorical exemplars (Buchanan, Brown, Cabeza & Maitson, 1999; Dewhurst & Anderson, 1999; Dewhurst, 2001; DeSoto & Roediger, 2014; Smith, Ward, Tindell, Sifonis & Wilkenfeld, 2000) highlights the effect of representational structures in the production of false memories by showing that the study of lists of exemplars from common taxonomic categories leads to the false recall and false recognition of non-presented categories' exemplars (critical words) with the highest output dominance (i.e., the exemplar's frequency of production; Smith, et al., 2000). For instance, presentation of a list composed of exemplars from the category "furniture" (such as table, couch, bed, desk…) would produce false memories of the most frequently produced exemplar "chair" not presented in the list. DeSoto and Roediger (2014) found that the higher the output dominance, the more frequent are the false memories of the non-presented words, evidencing that the graded structure of the exemplars will determine the probability of producing false memories.

According to defining theories of knowledge representation (e.g., Collins & Loftus, 1975; Medin & Schaffer, 1978; Rosch & Mervis, 1975; Rumelhart, Hinton, & Williams, 1986), graded structures of categories are based in stable and preexistent semantic relations in long-term memory. Other, more constructive, views of conceptual cognitive processes (e.g., Barsalou, 1999; Casasanto & Lupyan, 2015), however, propose that categories' graded structure is formed on the spot every time a category is

[15] This chapter is based on the paper: Soro, J. C., Ferreira, M. B., & Carneiro, P. (invited to resubmission). Memory illusions and category malleability – False recognition for ad hoc reorganizations of common categories.

to be processed. This categorization flexibility is particularly evident in *ad hoc categories*, which are goal-derived categories constructed to achieve a new goal and that therefore are not well established in memory (Barsalou, 1983; 1985; 1991).

Common categories tend to reflect the correlational structure of the environment as they are acquired mostly via exemplar learning (Collins & Loftus, 1975; Medin & Schaffer, 1978) in a bottom-up way (e.g., when learning about members of the category "birds" attributes such as "feathers", "wings" and "beak" typically co-occur). Ad hoc categories are constructed via conceptual combination of existing knowledge (Barsalou, 1991) and therefore tend to violate the correlational structure of the environment. Two kinds of ad hoc categories have been proposed regarding how the correlational structure of the environment is disrupted (Barsalou, 1985). In the first kind, members of the ad hoc categories cut across different common categories. For example, the category "things to take on a camping trip" might include exemplars such as "water", "tent", "matches", which come from different common categories and share few (if any) attributes. These *inter-taxonomic ad hoc categories* correspond to what has become the common definition of ad hoc categories (e.g., Barsalou, 2010). In the second kind, members of the ad hoc categories are a subset of common categories (e.g., "Sports practiced by rich people"). These *intra-taxonomic ad hoc categories* (henceforth referred to as subcategories), although composed of exemplars from the same common category, do not maximize the correlational structure of the environment because many members considered atypical in the graded structure of the subcategory (e.g., soccer) share many attributes with more typical members (e.g., polo).

Initial work using ad hoc categories (i.e., with exemplars from different common categories), showed false memories for these ad hoc categorical concepts that did not possess strong preexistent semantic relations between its exemplars (Soro, Ferreira, Semin, Mata & Carneiro, 2017; see also Chapter III of the present thesis). Across three experiments, participants were presented with lists of words from ad hoc categories, with and without the categories' names. The expected false recognition effect for non-presented critical words was found under both conditions, that is, whether the names of the categories were explicitly identified or not. However, a clearer graded structure seemed to emerge in the presence of the categories' names, which likely worked as organizing context (Experiment 3 in Soro et al., 2017; see also Experiment 3 in Chapter III of the present thesis).

Because the ad hoc categories used in the previous research were composed of words that came from different common categories, any semantic relations created on the spot via conceptual combination for this *new* set of words faced no preexisting semantic relations between these words in long-term memory. In contrast, the subcategories studied here include members that are part of preexisting common categories. What we explore in the present experiments is whether these subcategories can be represented consistently enough as to lead to different false memories than the ones typically produced by the well-established taxonomic structures in which they are embedded. In other words, can words that share preexisting semantic relations in taxonomic structures compose ad hoc representations capable of generating different false memories? To answer this question, we presented participants with lists of common categories, or subcategories derived from the former, in an experimental paradigm used to study false memories in lists of category exemplars (e.g., Smith, et al., 2000; Dewhurst, Bould, Knott & Thorley, 2009).

4.1. Categorical false memories and conceptual representation

Categorical false memories have been shown to increase with the number of exemplars presented (Dewhurst & Anderson, 1999; Dewhurst, 2001) and with the degree of strength of association from the list to the critical word (the backward associative strength - BAS; Knott, Dewhurst & Howe, 2012). This result suggests cumulative indirect activation of critical words from each word on the lists via preexistent associative connections (Dewhurst & Anderson, 1999; Dewhurst, 2001). However, there are important semantic aspects influencing memory illusions with category lists besides BAS. For instance, category lists will rarely produce false memories when the critical word is a superordinate to the lists' words (e.g., "orange, banana, lemon…" as list words related to the critical word "fruit"), even if they present a high BAS (Park, Shobe & Kihlstrom, 2005). The fact that false memories are observed in category lists even when BAS is low (Dewhurst, et al., 2009) also shows evidence that there are other (semantic) aspects that contribute to this effect.

A plausible alternative explanation for the effect is that the list gist (derived from the converging semantic meaning from each presented item) is closely related to the critical lure's gist (if not the same), leading to false memories when the list gist is cued in memory retrieval (Brainerd & Reyna, 2001, 2002). This gist extraction would, theoretically, converge to the category's name and not to the critical words (i.e., exemplars with high output dominance). Therefore, its impact on false memories is likely to occur indirectly via the implicit or explicit activation of the category itself and subsequently of their most accessible exemplars.

According to the notion of flexible conceptual representations of categorical knowledge (Barsalou, 1999; Casasanto & Lupyan, 2015), it follows from the above that it might be possible to influence the development of new category representations by simply providing names of subcategories for lists of exemplars from common categories, leading to different patterns of false memories, even if the subcategory is produced ad hoc and does not have stable representations in long-term memory. In fact, subcategories created ad hoc have been shown to have distinct graded structures characterized by different output dominance of the exemplars (Soro & Ferreira, 2017). This would allow the production of different patterns of false memories according to how the category was represented upon its presentation.

Summing up, the experiments here reported manipulated context by presenting categorical lists with common category or subcategory names. This manipulation was expected to guide the semantic relations established during study of the categorical lists leading to differences in the representational structures consistent enough to produce different patterns of false memories. Experiment 1 used lists of exemplars composed of high output dominance exemplars of common categories and high output dominance exemplars of the respective subcategories, allowing us to explore the impact of the category's naming manipulation on the exact same lists. However, by mixing high output dominance exemplars of both subcategories and common categories, these lists had a hybrid graded structure that did not correspond to the graded structure of either the common categories or the subcategories in which they were based. To address this issue Experiment 2 manipulated not only the categories names but also the lists of exemplars presented, which were either from common categories or from subcategories. Experiment 3 replicated the results for lists of subcategories in Experiment 2 and tested whether the difference found between false recognitions of subcategories lures and common lures in an ad hoc context (with presentation of subcategory lists and names), observed in Experiment 2, was due to retrieval monitoring processes (i.e., identifying common lures as too distinctive to be recognized).

By pitting false memories produced by subcategories against false memories produced by the common taxonomic representations on which the subcategories are embedded, we aim to explore the vulnerability of new semantic representations to false memories and the malleability of categorical knowledge. If the pattern of false memories differs significantly as the result of the manipulation (i.e., the presentation of either a common category name or a subcategory name) this would indicate that false memories may occur not only as the result of semantic structures established ad hoc in the absence of preexistent taxonomic categories (Soro et al., 2017), but also when these ad hoc structures compete with preexistent taxonomic ones.

4.2. Experiment 1

The aim of this experiment was to test if providing different names (common categories vs subcategories names) for the same lists of category exemplars would elicit the development of different graded structures and consequently influence the pattern of false recognition. Specifically, participants were presented with the same lists of exemplars from taxonomic categories under either a common category name (e.g., “sports”) or a context-specific subcategory name (e.g., “sports that are good for backache”) followed by a recognition task that included lures more related to the common category structure and lures more related to the subcategory structure. A contextual representation of subcategories created online as a result of the category’s name manipulation is expected to produce higher levels of false recognition of subcategories lures in comparison to common categories lures. A “no-context” condition where no name was presented before list presentation was also included. In this case it is assumed that common categories are likely to work as the default representations of category organization as they are closer to a basic level of classification than the subcategories (Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976). Thus, the no-name condition is expected to produce a pattern of false recognition similar to the one produced when the common categories names are presented.

4.2.1. Method

Participants. Seventy-five undergraduate students from the University of Lisbon (M_{age} = 19.73, *SD* = 3.05; 67 females) participated in the experiment in exchange for course credit.

Material. Ten mixed category lists were created. Each list included five frequently produced exemplars from a common category graded structure (e.g., “sports”) and five frequently produced exemplars from a subcategory graded structure (e.g., “sports that are good for backache”). It was made sure that the five exemplars from one structure were also produced in the other structure and that the output dominance for the 10 exemplars was similar between structures (Table 7). The exemplars were obtained from Portuguese norms for common categories, ad hoc categories and ad hoc subcategories (Soro & Ferreira, 2017). Exemplars were ordered by including in first place the most frequently produced exemplar from the subcategory followed by the most frequently produced exemplar from the common category, followed by the second most frequently produced exemplar from the subcategory, and so forth.

Table 7

Example of list used in Experiment 1, with critical lures and selected exemplars along with their corresponding frequency of production (output dominance) in both subcategory and common categories.

	OD of the exemplars in the subcategory "Sports that are good for backache"	OD of the exemplars in the common category "Sports"
Subcategory critical lure		
Yoga	0,59	0,02
Common critical lure		
Basketball	0,03	0,57
Exemplars in the list		
Swimming	0,83	0,55
Volleyball	0,06	0,39
Pilates	0,41	0,02
Gymnastics	0,17	0,2
Horse-riding	0,06	0,11
Athletics	0,06	0,29
Walking	0,08	0,01
Judo	0,05	0,09
Running	0,08	0,02
Cycling	0,06	0,07
Mean OD	0,18	0,18

Note. OD = Output Dominance

In the recognition task participants were presented with 60 exemplars comprising 30 targets (from the first, sixth and tenth positions of each presented list), 20 critical lures (10 from subcategories and 10 from common categories), and 10 unrelated lures from non-presented category lists (according to Pinto, 1992's output dominance norms). The critical lures from subcategory and common category structures were selected in such a way that a critical lure from one structure had low to no frequency of production in the alternate structure; at the same time, their output dominance in their respective structures (i.e., subcategory critical lure in subcategories and common critical lure in common categories) were as high and as similar as possible. For instance, in the case of the common category "sports" and the subcategory "sports that are good for backache”, the common critical related lure “basketball” had an output dominance of .57 in the common category list and .03 in the subcategory list, while the subcategory critical related lure “yoga” had an output dominance of .59 in the subcategory list and .02 in common category list (see Appendix A, Table A2, for the full lists of exemplars and their output dominance across both structures). Unrelated lures were selected from non-presented category lists so that their average frequency of production would be similar to that of the subcategory and common lures in their respective structures.

Design. The presentation of the lists’ names was manipulated between subjects, so that one group of participants studied the lists under common category names (N = 21), other studied the lists under subcategory names (N = 27) and another group studied the lists without any list names (N = 27). The dependent variables were recognition proportions for targets, subcategory and common critical lures and unrelated lures, as well as remember and know responses.

Procedure. Participants were instructed to memorize the words presented on the computer screen for a subsequent memory task. A screen preceding each list announced the beginning of a new list for 5s. In the conditions where the lists were preceded by a name (either subcategory or common category), the screen also contained the list’s name. Each word was presented individually in the center of the screen for 1.5s, with a 1s blank screen between words. The presentation order of the lists was randomized. After presentation of the lists, participants played the game Tetris as a distractor task for 3 minutes, which was followed by the instructions for the recognition task.

In the recognition task, the words were presented individually in a random order and, for each word, participants had to answer if it was *old* (presented in the studied lists) or *new* (not presented in the studied lists). When answering *old*, participants were presented with the choices to respond *remember* or *know*. Before the beginning of the task, instructions on the screen informed participants about the remember/know task and what each response meant. A sheet of paper containing detailed instructions for each phenomenological response (see Appendix B) was available to the participants during the task.

4.2.2. Results

Table 8 presents the mean recognition frequencies for targets and lures in the 3 name conditions, along with their decomposition into remember and know responses. The overall mean for hit rates are higher than for false alarms rates and false recognitions were higher for common categories than for subcategories. This difference is observed in lists presented with common category names and with no names, however it is inverted when lists are presented with subcategory names.

Table 8
Mean proportions of hit rates and false alarms (and standard error) under each name presentation condition and their decomposition into remember and know responses, from Experiment 1

	Lists presented with:			
	Subcategory name (*n*=27)	Common category name (*n*=21)	No name (*n*=27)	Overall (*n*=75)
	M (SE)	*M (SE)*	*M (SE)*	*M (SE)*
Targets	.79 (.02)	.76 (.03)	.73 (.02)	.76 (.01)
Remember	.69 (.04)	.53 (.04)	.45 (.04)	.56 (.02)
Know	.10 (.03)	.23 (.04)	.28 (.03)	.20 (.02)
Common Lures	.16 (.04)	.27 (.05)	.37 (.04)	.27 (.02)
Remember	.08 (.02)	.11 (.03)	.14 (.02)	.11 (.01)
Know	.08 (.03)	.16 (.03)	.23 (.03)	.16 (.02)
Subcategory Lures	.20 (.03)	.20 (.04)	.23 (.03)	.21 (.02)
Remember	.07 (.02)	.09 (.02)	.07 (.02)	.08 (.01)
Know	.13 (.03)	.11 (.03)	.16 (.03)	.13 (.02)
Unrelated Lures	.03 (.01)	.04 (.02)	.04 (.01)	.04 (.01)
Remember	.01 (.01)	.02 (.01)	.02 (.01)	.02 (.01)
Know	.02 (.01)	.02 (.01)	.02 (.01)	.02 (.01)

Hit rates. Mean recognition for targets were included in a one-way ANOVA with Name (subcategory name, common category name and no-name) as a between-subjects factor showed no significant differences in the mean proportions of target recognitions, $F < 1$.

False alarm rates. Mean proportions of false recognitions of critical and unrelated lures were analyzed by a 3 X 3 ANOVA with Lure (common critical lures, subcategory critical lures, unrelated lures) as a within-subjects factor, and Name (subcategory name, common category name and no-name) as a between-subjects factor (Figure 1). A main effect of Lure was observed, $F(2, 144) = 64.50$, $p < .001$, $\eta_p^2 = .47$, with critical lures showing higher levels of false recognition than unrelated lures. There was a marginally significant main effect of Name, $F(2, 72) = 2.65$, $p = .077$, $\eta_p^2 = .07$. False alarm rates tended to be higher under no name ($M = .21$, $SD = .12$) followed by common category name ($M = .17$, $SD = .12$) and subcategory name conditions ($M = .13$, $SD = .12$). The interaction between Lure and Name was significant, $F(4, 144) = 5.05$, $p < .001$, $\eta_p^2 = .12$. Common lures were more falsely recognized than subcategory lures under common category name, $F(1, 72) = 4.17$, $p = .044$, $\eta_p^2 = .05$, and under no-name condition, $F(1,72) = 19.74$, $p < .001$, $\eta_p^2 = .21$.Under subcategory name, there was no significant difference between false recognition of common lures and subcategory lures, $F(1,72) = 1.44$, $p = .233$, $\eta_p^2 = .01$.[16]

[16] No differences were observed between false recognition of unrelated lures under subcategory name; common category name or no name condition, all *F*s < 1, indicating that no correction of the recognition scores was needed.

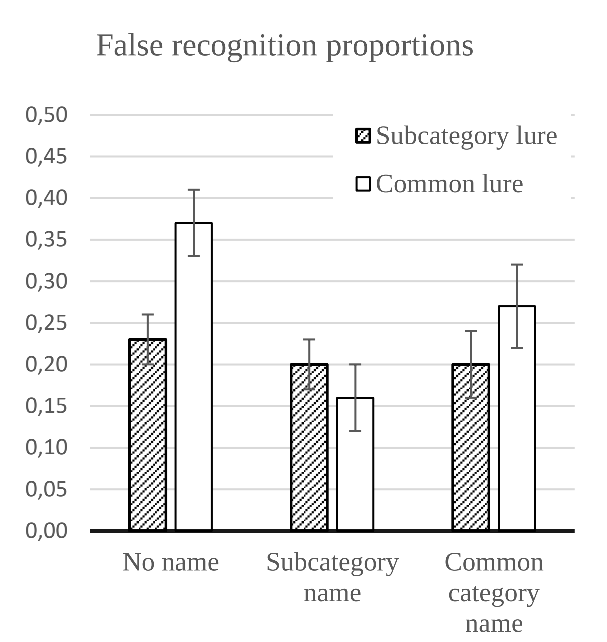

Figure 1. Proportions of false recognition for subcategory and common lures under different names from Experiment 1

Remember/Know responses. Remember and know responses for subcategory and common lures (Table 8) were analyzed by a 2 X 2 X 3 ANOVA with Response (remember, know) and Critical lure (common critical lure, subcategory critical lure) as within-subjects factors and Name (subcategory name, common category name and no-name) as a between-subjects factor. There was a main effect of Response, $F(1,72)$ = 10.47, p = .001, η_p^2 = .12, showing a higher level of know (M = .15, SD = .13) than remember responses (M = .09, SD = .10), suggesting that false recognition was mostly based on familiarity with the exemplar for both types of critical lures across all name presentation conditions. The effects that did not include the Response factor repeated the pattern of the previously reported ANOVA with critical lures.[17]

[17] The other significant effects are not relevant for the purposes of the current Experiment because they are based on the means between remember and know responses. They include a main effect of Critical lure, $F(1,72)$ = 9.40, p = .003, η_p^2 = .11, and a significant interaction between Critical lure and Name, $F(2,72)$ = 8.10, p < .001, η_p^2 = .18.

4.2.3. Discussion

The same false recognition pattern for lists presented with a common category name and with no name suggests that participants perceived the mixed lists as common categories. The presentation of subcategory names seems to have provided a context strong enough to disrupt the use of common organizations, or to make the common category lures distinctive and thus more promptly discarded by retrieval monitoring processes. However, it did not create a new subcategory representation cohesive enough to increase false recognition of subcategory critical lures.

By mixing exemplars of both subcategories created ad hoc and common categories, the lists used did not adhere to the graded structure of either common categories or subcategories. This might have contributed to the development of new subcategory representations (when under subcategory names) too weak to generate specific false memories. The study of lists of highly dominant exemplars of subcategories along with the subcategories' names (the contextual cue) may be necessary for the expected changes in the categorical representations and, consequently, in the pattern of false memories. Experiment 2 tested for this possibility.

4.3. Experiment 2

In the current experiment the mixed lists were replaced by lists of exemplars based entirely in the graded structures of subcategories or taxonomic categories.

Specifically, we used lists composed of high output dominance exemplars produced for subcategories and lists composed of high output dominance exemplars produced for common categories. These lists were presented either with or without the category's name. Our goal was to test if the summed influence of context elicited by both the category name and the exemplars list would lead to a new and different category representation that produces different false memories. We also wanted to examine if simply presenting the most representative exemplars of a subcategory (without name) could be enough to trigger a new subcategory representation strong enough to overcome the dominance of common taxonomic structure.

In two more conditions, the lists and category cues were crossed so that participants were presented with lists of frequently produced exemplars from subcategories under common category names and vice-versa. This crossover is expected to produce a disruption of representational structure activation as in the first experiment when subcategory names were used.

Regarding the remember/know task, know responses can be overestimated because participants may respond “know” to recognitions that were based on guessing (Gardiner, Java, & Richardson-Klavehn, 1996). To avoid this issue, we included a “guess” response option. Guess responses, however, were not included in the proportion of recognitions for the lures, because they are assumed not to be based in memory traces (Gardiner, Ramponi & Richardson-Klavehn, 2002).

4.3.1. Method

Participants. One hundred and forty-eight undergraduate students from the University of Lisbon (M_{age} = 21.37, *SD* = 6.87; 107 females) participated in the experiment in exchange for course credit.

Material. Fourteen lists were used in total. Half were composed of high production frequency exemplars from common categories (e.g., “sports”) while the other half were composed of high production frequency exemplars from ad hoc subcategories based in the same common categories (e.g., “sports usually played by rich people”). The subcategory lists were selected from the same Portuguese production frequency norms (Soro & Ferreira, 2017) used in Experiment 1. Both types of lists were composed of the 10 most frequently produced exemplars, presented in decreasing order, except for the first most produced one which was selected as the critical related lure. Critical lures were not presented in the list from which they came, or in the alternative structure's list (e.g., "soccer", which is the critical lure for the category "sports", did not appear in the common category list "sports", or in the subcategory list "sports usually played by rich people"). Lists of exemplars and their output dominance are presented in Appendix A, Table A3.

The recognition task had a total of 49 items, composed of 14 targets (study words taken from the first and fifth position of the presented lists), 7 subcategory critical lures (the most produced exemplar for the ad hoc list composition), 7 common critical lures (the most produced exemplar for the common list composition), and 21 unrelated lures from 7 non-presented common category lists - the first, second and fifth most produced exemplars according to Pinto (1992)'s output dominance norms.

Design. List type and presentation of category name was manipulated between participants, creating 6 conditions. Half of the participants studied common category lists under common category names (*N* = 25), subcategory names (*N* = 25) or no names (*N* = 24) and the other half studied subcategory lists under common category names (*N* = 25), subcategory names (*N* = 24) or no names (*N* = 25). The dependent variables were the proportion of recognition for targets, common critical lures, subcategory critical lures and unrelated lures as well as remember, know and guess responses.

Procedure. Participants were randomly assigned to one of the six conditions. The procedure was the same as in Experiment 1, except for the distractor task (5 minutes of sudoku) and the inclusion of instructions for guess responses in the recognition task (see Appendix B).

4.3.2. Results

Table 9 displays the mean recognition frequencies for targets and lures in the 6 conditions, along with their decomposition into remember, know and guess responses. Means aggregating across subcategory and common category lists are displayed in Table 10. These means show that overall hit rates were higher than false alarm rates for critical lures, which were higher than unrelated lures rates. Levels of false recognition of common lures were generally higher than subcategory lures across conditions, especially when the presented lists had a common category structure. The pattern was inverted only when subcategory lists were presented with subcategory names.

Table 9

Mean proportions of hit rates and false alarms (and standard error) under the different conditions of name and list presentation and their decomposition into remember, know and guess responses, from Experiment 2.

	Subcategory lists presented with:				Common category lists presented with:				
	Subcategory name (*n*=24)	Common category name (*n*=25)	No name (*n*=25)	Overall (*n*=74)	Subcategory name (*n*=25)	Common category name (*n*=25)	No name (*n*=24)	Overall (*n*=74)	Total (n = 148)
	M (SE)	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*
Targets (without guess)	.86 (.03)	.81 (.03)	.79 (.03)	.82 (.02)	.84 (.03)	.83 (.03)	.71 (.03)	.79 (.02)	.81 (01)
Remember	.75 (.05)	.67 (.05)	.68 (.05)	.70 (.03)	.67 (.05)	.71 (.05)	.55 (.05)	.64 (.03)	.67 (,02)
Know	.11 (.04)	.14 (.04)	.11 (.04)	.12 (.02)	.17 (.04)	.12 (.04)	.16 (.04)	.15 (.02)	.13 (.01)
Guess	*.04 (.01)*	*.05 (.01)*	*.06 (.01)*	*.05 (.01)*	*.06 (.01)*	*.09 (.01)*	*.09 (.01)*	*.08 (.01)*	*.06 (.019*
Common Lures (without guess)	.12 (.04)	.22 (.04)	.15 (.04)	.17 (.02)	.20 (.04)	.26 (.04)	.28 (.04)	.24 (.02)	.20 (.02)
Remember	.07 (.03)	.12 (.03)	.05 (.03)	.08 (.02)	.11 (.03)	.13 (.03)	.14 (.03)	.12 (.02)	.10 (.01)
Know	.05 (.03)	.10 (.03)	.10 (.03)	.09 (.02)	.09 (.03)	.13 (.03)	.14 (.03)	.12 (.02)	.10 (.01)
Guess	*.10 (.03)*	*.09 (.03)*	*.15 (.03)*	*.11 (.02)*	*.13 (.03)*	*.19 (.03)*	*.22 (.03)*	*.18 (02)*	*.14 (.01)*
Subcategory Lures (without guess)	.23 (.03)	.18 (.03)	.13 (.03)	.18 (.02)	.17 (.03)	.14 (.03)	.11 (.03)	.14 (.02)	.16 (.01)
Remember	.14 (.03)	.10 (.03)	.08 (.03)	.11 (.01)	.07 (.03)	.08 (.03)	.06 (.03)	.07 (.01)	.09 (.01)
Know	.09 (.02)	.08 (.02)	.05 (.02)	.07 (.11)	.10 (.02)	.06 (.02)	.05 (.02)	.07 (.01)	.07 (01)
Guess	*.18 (.03)*	*.07 (.03)*	*.18 (.03)*	*.14 (.02)*	*.10 (.03)*	*.06 (.03)*	*.11 (.03)*	*.09 (.02)*	*.12 (.01)*
Unrelated Lures (without guess)	.01 (.01)	.07 (.01)	.04 (.01)	.04 (.01)	.02 (.01)	.01 (.01)	.02 (.01)	.02 (.01)	.03 (<.01)
Remember	< .01 (.01)	.03 (.01)	.01 (.01)	.02 (<.01)	.01 (.01)	<.01 (.01)	.01 (.01)	.01 (<.01)	.01 (<.01)
Know	< .01 (.01)	.04 (.01)	.03 (.01)	.02 (<.01)	.01 (.01)	.01 (.01)	.01 (.01)	.01 (<.01)	.02 (<.01)
Guess	*.02 (.01)*	*.05 (.01)*	*.06 (.01)*	*.05 (.01)*	*.02 (.01)*	*.03 (.01)*	*.05 (.01)*	*.03 (.01)*	*.04 (<.01)*

Table 10
Overall (i.e., aggregated across subcategory and common category lists) mean proportions of hit rates and false alarms (and standard errors) under the different conditions of name presentation and their decomposition into remember, know and guess responses, from Experiment 2.

	Subcategory name (*n*=49)	Common category name (*n*=50)	No name (*n*=49)
	M (SE)	*M (SE)*	*M (SE)*
Targets (without guess)	.85 (.02)	.82 (.02)	.75 (.02)
Remember	.71 (.03)	.69 (.03)	.62 (.03)
Know	.14 (.02)	.13 (.02)	.13 (.03)
Guess	*.05 (.01)*	*.06 (.01)*	*.08 (,01)*
Common Lures (without guess)	.16 (.03)	.24 (.03)	.22 (.03)
Remember	.09 (.02)	.13 (.02)	.10 (,02)
Know	.07 (.02)	.11 (.02)	.12 (.02)
Guess	*.11 (.02)*	*.14 (.02)*	*.19 (,02)*
Subcategory Lures (without guess)	.20 (.02)	.16 (.02)	.12 (.02)
Remember	.10 (.02)	.09 (.02)	.07 (.02)
Know	.10 (.01)	.07 (.01)	.05 (.01)
Guess	*.14 (.02)*	*.06 (.02)*	*.14 (.02)*
Unrelated Lures (without guess)	.01 (.01)	.04 (.01)	.03 (.01)
Remember	<.01 (<.01)	.02 (<.01)	.01 (<.01)
Know	.01 (<.01)	.02 (<.01)	.02 (<.01)
Guess	*.02 (.01)*	*.04 (.01)*	*.05 (.01)*

Hit rates. Mean proportions of target recognition were analyzed by a 3 X 2 ANOVA with Name (subcategory name, common category name and no-name) and List (subcategory list, common category list) as between-subjects factors. There was only a main effect of Name, $F(2, 142) = 5.51$, $p = .004$, $\eta_p^2 = .07$ (Table 10). A post hoc Tukey test revealed that target recognition levels were lower under no name compared to subcategory name, $p = .003$, and compared to common category name condition, $p =$

.060. This suggests that subcategory and common category names provided an organizational advantage at encoding, which later helped recognition of targets.

False alarm rates. Mean proportions of false recognition of critical and unrelated lures were analyzed by a 3 X 2 X 3 ANOVA with Lure (subcategory lure, common lure, unrelated lure) as within-subjects factor and both List (subcategory list, common category list) and Name (subcategory name, common category name, no-name) as between-subjects factors (see Figure 2). There was a main effect of Lure, $F(1, 284) = 73.42$, $p < .001$, $\eta_p^2 = .34$, where subcategory and common lures, showed higher levels of false recognition than unrelated lures. There was an interaction between Lure and List, $F(2, 284) = 8.41$, $p < .001$, $\eta_p^2 = .05$. While, in subcategory lists, false recognition did not differ between common lures and subcategory lures, $F < 1$; in common category lists, false recognitions were higher for common lures than subcategory lures, $F(1, 142) = 19.02$, $p < .001$, $\eta_p^2 = .11$. There was also an interaction between Lure and Name, $F(4, 284) = 4.24$, $p = .002$, $\eta_p^2 = .05$. False recognition was higher for common lures than for subcategory lures under common category name, $F(1, 142) = 7.17$, $p = .008$, $\eta_p^2 = .04$, and under no-name conditions, $F(1, 142) = 11.95$, $p < .001$, $\eta_p^2 = .07$. However, under subcategory name, there was no difference between common lures and subcategory lures, $F(1, 142) = 1.82$, $p = .179$, $\eta_p^2 = .01$ (Table 10).

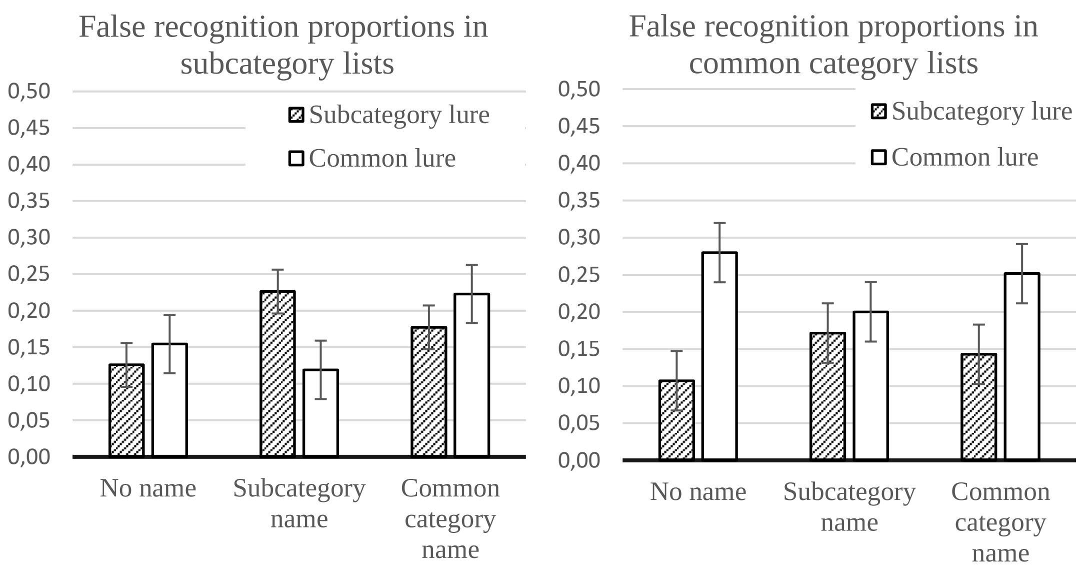

Figure 2. Proportions of false recognition for subcategory and common lures for different structures under different names from Experiment 2

As expected, planned comparisons showed that common lures were more falsely recognized than subcategory lures for common category lists with common category names, $F(1, 142) = 7.10$, $p = .008$, $\eta_p^2 = .04$, and for common category lists with no-names, $F(1, 142) = 17.25$, $p < .001$, $\eta_p^2 = .10$. However, there was no difference in false recognition between critical lures when there was a mismatch between list structure and list name, that is, when subcategory lists were presented with common category names, $F(1, 142) = 1.26$, $p = .263$, $\eta_p^2 < .01$, or when common category lists were presented with subcategory names, $F < 1$. Subcategory lists presented with no name also did not show differences in false recognition between common and subcategory lures, $F < 1$. Regarding false recognition of unrelated lures, for common category lists there was no significant differences between presentation of subcategory names and either common category names or no names conditions, all *F*s < 1. For subcategory lists, unrelated lures had fewer false recognitions under subcategory names than under either common category names, $F(1, 142) = 21.84$, $p < .001$, $\eta_p^2 = .13$, or no names conditions, $F(1, 142) = 7.65$, $p = .006$, $\eta_p^2 = .05$.[18]

While subcategory name or subcategory list did not produce substantially different patterns of false recognition by themselves, the combination of both did. When subcategory lists were presented with subcategory names, subcategory lures had a significantly higher level of false recognition than common category lures, $F(1, 142) = 6.64$, $p = .010$, $\eta_p^2 = .04$. This suggests that a cohesive ad hoc gist (from a novel subcategory representation) was only consistently evoked by the presence of both subcategory structure and name.

Remember/Know responses. Proportions of remember, know and guess responses are displayed in Table 9. A 2 X 2 X 2 X 3 ANOVA with Response (remember, know) and Critical lure (subcategory lure, common lure) as within-subjects factors and List (subcategory list, common category list) and Name (subcategory name,

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[18] Notwithstanding these differences in false recognition, the pattern of results is the same with and without recognition correction. For full disclosure we present the same analysis with corrected recognition for critical lures. There was a main effect of Lure, $F(1, 142) = 7.60$, $p < .006$, $\eta_p^2 = .05$, where common lures ($M = .18$, $SD = .15$) showed more false recognitions than subcategory lures ($M = .13$, $SD = .15$). There was an interaction between Lure and List, $F(1, 142) = 11.63$, $p < .001$, $\eta_p^2 = .07$. While the levels of false recognition between common lures ($M = .13$, $SD = .18$) and subcategory lures ($M = .14$, $SD = .18$) did not differ for subcategory lists, $F < 1$; false recognitions were higher for common lures ($M = .23$, $SD = .23$) than subcategory lures ($M = .12$, $SD = .12$) in common category lists, $F(1, 142) = 19.02$, $p < .001$, $\eta_p^2 = .11$. There was also an interaction between Lure and Name, $F(2, 142) = 6.64$, $p = .001$, $\eta_p^2 = .08$, showing that false recognition was higher for common lures than for subcategory lures under common category name ($M_{Common\ Lures} = .20$, $SD_{Common\ Lures} = .20$ and $M_{Subcategory\ Lures} = .12$, $SD_{Subcategory\ Lures} = .13$), $F(1, 142) = 7.17$, $p = .008$, $\eta_p^2 = .04$; and under no-name condition ($M_{Common\ Lures} = .19$, $SD_{Common\ Lures} = .24$ and $M_{Subcategory\ Lures} = .09$, $SD_{Subcategory\ Lures} = .13$), $F(1, 142) = 11.95$, $p < .001$, $\eta_p^2 = .07$; but not under subcategory name ($M_{Common\ Lures} = .15$, $SD_{Common\ Lures} = .17$ and $M_{Subcategory\ Lures} = .18$, $SD_{Subcategory\ Lures} = .17$), $F(1, 142) = 1.82$, $p = .179$, $\eta_p^2 = .01$.

common category name and no-name) as between-subjects factors showed no main effect of Response or interactions involving Response.[19]

4.3.3. Discussion

The same pattern of false recognitions for lists presented with common names and no-names indicates a tendency for all lists to be encoded as common categories. However, the subcategory structure alone caused some disruption in the use of common taxonomic representations, as evidenced by the similar levels of false recognitions for subcategory and common lures when the list names were not presented (which is not observed for common lists presented with no name). This disruption is maintained even when a common name is presented, which could mean that the subcategory structure breached the graded structure induced by the common name. In the same vein, the subcategory name alone also produced some disruption of the encoding and representation of common lists, leading to similar levels of false recognition between subcategory and common lures possibly due to common lures being perceived as more distinctive. The relative superiority of subcategory false memories when compared to common false memories emerged only when the subcategory lists were accompanied by their corresponding names. Apparently, the expected online establishment of new subcategory representations depends on the presence of both an appropriate contextual cue (i.e., the subcategory name) and a list composition that reinforces this context by presenting high output dominance exemplars of the subcategory. It is worth noticing that in this condition the level of false recognition of subcategory lures is close to the level of false recognition of common lures for common category lists with common

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[19] The other significant effects (based on the means between remember and know responses) include one main effect of Critical lure, $F(1, 142) = 7.60$, $p = .006$, $\eta_p^2 = .05$; an interaction between Critical lure and List, $F(1, 142) = 11.63$, $p < .001$, $\eta_p^2 = .07$, $F(1, 142) = 19.02$, $p < .001$, $\eta_p^2 = .11$; and an interaction between Critical lure and Name, $F(2, 142) = 6.64$, $p = .001$, $\eta_p^2 = .08$.

category names. This indicates that new subcategory structures were consistent enough to elicit false recognitions as intrusive as the ones produced for common structures.

However, the decrease in false recognition of common lures compared to subcategory lures in an ad hoc context (i.e., subcategory lists under subcategory names) could be interpreted as deriving from strategic processing during recognition, such as retrieval monitoring (Gallo, 2006, 2010), especially when considering that false recognition of unrelated lures was significantly lower when subcategory names were presented with subcategory lists. Common lures may become highly distinctive when presented at the recognition test after studying subcategory lists with subcategory names. Such distinctiveness could then be used to identify these lures as *new* items, not presented in the study lists. The decrease in false recognition for unrelated lures in subcategory lists with subcategory names is congruent with such a possibility. Experiment 3 was aimed at clarifying this issue.

Regarding the phenomenological experiences of false recognition, they seem to be equally divided between illusory recollection and familiarity. The addition of guess responses suggested that know responses in Experiment 1 may have been inflated by guessing.

4.4. Experiment 3

The main goal of Experiment 3 was to test whether the false recognition pattern observed in Experiment 2 could be the result of strategic retrieval monitoring and distinctiveness effects rather than the result of establishment of an ad hoc subcategory concept more consistent than the preexistent taxonomic representation in which it is embedded. The same subcategory lists of Experiment 2 were presented in the study phase and followed, in one condition, by a speeded recognition task. Time pressure at test has been shown to hamper strategic memory-editing processes at retrieval, reducing distinctiveness effects (Dodson & Hege, 2005) and increasing the use of familiarity as a criterion for recognition (Benjamin, 2001). In the other condition participants responded to the standard (self-paced) recognition task used in experiments 1 and 2.

4.4.1. Method

Participants. One hundred and eighty-three participants, undergraduates from the University of Lisbon (M_{age} = 24.75, *SD* = 5.07; 128 females) participated in the experiment in exchange for gift vouchers.

Material. The present experiment used part of the material already employed in Experiment 2 - the same 7 subcategory lists and the same words that were used in the recognition task of the subcategory list structure condition.

Design. Type of name associated to the presented lists (subcategory name, common category name, no-name) and type of recognition (self-paced, speeded) were both manipulated between-participants, so that half of the participants answered to a self-paced recognition condition for subcategory lists presented with subcategory names (*N* = 32), common category names (*N* = 31) or no names (*N* = 32), and the other half answered to a speeded recognition condition for lists presented with subcategory names (*N* = 32), common category names (*N* = 31), or no names (*N* = 31). The dependent variables were recognition proportion for targets, subcategory critical lures, common critical lures and unrelated lures, as well as remember, know and guess responses under normal recognition (as in Experiment 2, guess responses were not included in the statistical analyses).

Procedure. In the self-paced recognition condition, the procedure was the same as in Experiment 2. In the speeded condition, participants were instructed to respond as fast as possible. Participants began by performing a short practice task where the words YES or NO were presented in the screen and they were asked to respond by pressing the keys “s” and “n” respectively, to familiarize themselves with the response time frame and visual aspects of the task. Following the practice task, participants were introduced to the recognition task being instructed to respond in a very short time. The words were presented for 250ms after which participants had 500ms to respond. If the answer was given after 500ms a message was presented asking them to respond faster. If no response was given until 1500ms after the response window, a message instructing participants to respond faster in the next trials was displayed and the trial ended.

4.4.2. Results

In the speeded condition, the responses given until 1000ms (which includes the first 250ms of word presentation, the 500ms window of response and up until 250ms after the response window) were included in the analyses. In total, 1.59% of the responses were removed from the analyses for being slower than 1000ms (1.35%) or for not being responded at all (0.24%).

Table 11 displays mean proportions of recognition for targets and lures in the 6 conditions, along with the decomposition of the proportions for remember, know and guess responses for the self-paced condition. Means aggregating across self-paced and speeded conditions are displayed in Table 12. Repeating the pattern found in Experiment 2, false alarm rates for common lures were higher than for subcategory lures, except when the subcategory lists were presented with subcategory names, case in which the pattern is inverted.

Table 11

Mean proportions of hit rates and false alarms (and standard errors) under different conditions of name presentation and recognition task, and their decomposition into remember, know and guess responses (Experiment 3).

	Self-paced recognition				Speeded recognition				
	Subcategory name (*n*=31)	Common category name (*n*=30)	No name (*n*=31)	Overall (*n*=92)	Subcategory name (*n*=30)	Common category name (*n*=31)	No name (*n*=30)	Overall (*n*=91)	Total (n = 183)
	M (SE)	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*
Targets (without guess)	.88 (.03)	.79 (.03)	.81 (.03)	.83 (.02)	.77 (.03)	.77 (.03)	.68 (.03)	.74 (.02)	.78 (.01)
Remember	.78 (.04)	.61 (.04)	.62 (.04)	.67 (.02)					
Know	.10 (.04)	.18 (.04)	.19 (.04)	.16 (.02)					
Guess	*.03 (.01)*	*.06 (.01)*	*.05 (.01)*	*.05 (01)*					
Common Lures (without guess)	.10 (.04)	.20 (.04)	.24 (.04)	.18 (.02)	.36 (.04)	.50 (.04)	.46 (.04)	.44 (.02)	.31 (.02)
Remember	.03 (.03)	.11 (.03)	.08 (.03)	.07 (.01)					
Know	.07 (.03)	.10 (.03)	.16 (.03)	.11 (.01)					
Guess	*.08 (.02)*	*.11 (.02)*	*.11 (.02)*	*.10 (.01)*					
Subcategory Lures (without guess)	.29 (.04)	.15 (.04)	.16 (.04)	.20 (.02)	.45 (.04)	.35 (.04)	.30 (.04)	.36 (.02)	.28 (.01)
Remember	.12 (.02)	.08 (.02)	.05 (.02)	.08 (.01)					
Know	.17 (.03)	.07 (.03)	.11 (.03)	.12 (.01)					
Guess	*.14 (.03)*	*.08 (.03)*	*.12 (.03)*	*.11 (.02)*					
Unrelated Lures (without guess)	.02 (.02)	.04 (.02)	.04 (.02)	.03 (.01)	.15 (.02)	.18 (.02)	.17 (.03)	.17 (.01)	.10 (.01)
Remember	.00 (.01)	.02 (.01)	.02 (.01)	.01 (<.01)					
Know	.01 (.01)	.02 (.01)	.02 (.01)	.02 (.01)					
Guess	*.01 (.01)*	*.03 (.01)*	*.03 (.01)*	*.02 (.01)*					

Table 12

Overall (i.e., aggregated across self-paced and speeded recognition) mean proportions of hit rates and false alarms (and standard errors) of common category and subcategory critical lures and unrelated lures, under different conditions of name presentation (Experiment 3).

	Subcategory name (*n*=61)	Common category name (*n*=61)	No name (*n*=61)	Total (n = 183)
	M (SE)	*M (SE)*	*M (SE)*	*M (SE)*
Targets (without guess)	.82 (.02)	.78 (.02)	.75 (.02)	.78 (.01)
Common Lures (without guess)	.23 (.03)	.35 (.03)	.35 (.03)	.31 (.02)
Subcategory Lures (without guess)	.37 (.02)	.25 (.02)	.23 (.02)	.28 (.01)
Unrelated Lures (without guess)	.08 (.02)	.11 (.01)	.11 (.02)	.10 (.01)

Hit rates. Mean proportions of target recognition were analyzed by a 3 X 2 ANOVA with Name (subcategory name, common category name, no-name) and Recognition (self-paced, speeded) as between-subjects factors. A main effect of Recognition showed more target recognition in self-paced than in speeded recognition, $F(1, 177) = 15.51$, $p < .001$, $\eta_p^2 = .08$, replicating previous results (e.g., Benjamin, 2001; Dodson & Hege, 2005; Carneiro, Fernandez, Diez, Garcia-Marques, Ramos & Ferreira, 2012). A main effect of Name was also significant, $F(2, 177) = 4.29$, $p = .015$, $\eta_p^2 = .04$ (Table 12). A post hoc Tukey test showed that target recognition was more frequent under subcategory name than under no-name, $p = .010$. This suggests an organizational advantage of name presentation for subcategory structures (as in Experiment 2).

False alarm rates. Proportions of false recognition of critical and unrelated lures were analyzed by a 3 X 3 X 2 ANOVA with Lures (subcategory lures, common lures, unrelated lures) as within-participants factor and Name (subcategory name, common category name, no-name) and Recognition (self-paced, speeded) as between-participants factors (see Figure 3). There was a main effect of Lure, $F(2, 354) = 112.45$, $p < .001$, $\eta_p^2 = .38$, where unrelated lures had a lower level of false recognition than subcategory and common lures. There was a main effect of Recognition, $F(1, 177) = 75.22$, $p < .001$, $\eta_p^2 = .29$, where false alarm rates were more frequent in speeded ($M = .32$, $SD = .15$) than in self-paced recognition ($M = .14$, $SD = .15$). An interaction between Lure and Recognition, $F(2, 354) = 8.79$, $p < .001$, $\eta_p^2 = .04$, showed that while there was no significant difference between false recognition of subcategory and common lures in self-paced recognition, $F < 1$; in speeded recognition common lures were more falsely recognized than subcategory lures, $F(1, 177) = 10.80$, $p = .001$, $\eta_p^2 = .05$. Moreover, an interaction between Name and Lure, $F(4, 354) = 15.65$, $p < .001$, η_p^2

= .15 showed that under subcategory name, subcategory lures were more falsely recognized than common lures, $F(1, 177) = 23.85$, $p < .001$, $\eta_p^2 = .11$, while this pattern was inverted under common category name, $F(1, 177) = 14.14$, $p < .001$, $\eta_p^2 = .07$, and no-name condition , $F(1, 177) = 17.82$, $p < .001$, $\eta_p^2 = .09$ (see Table 12).[20]

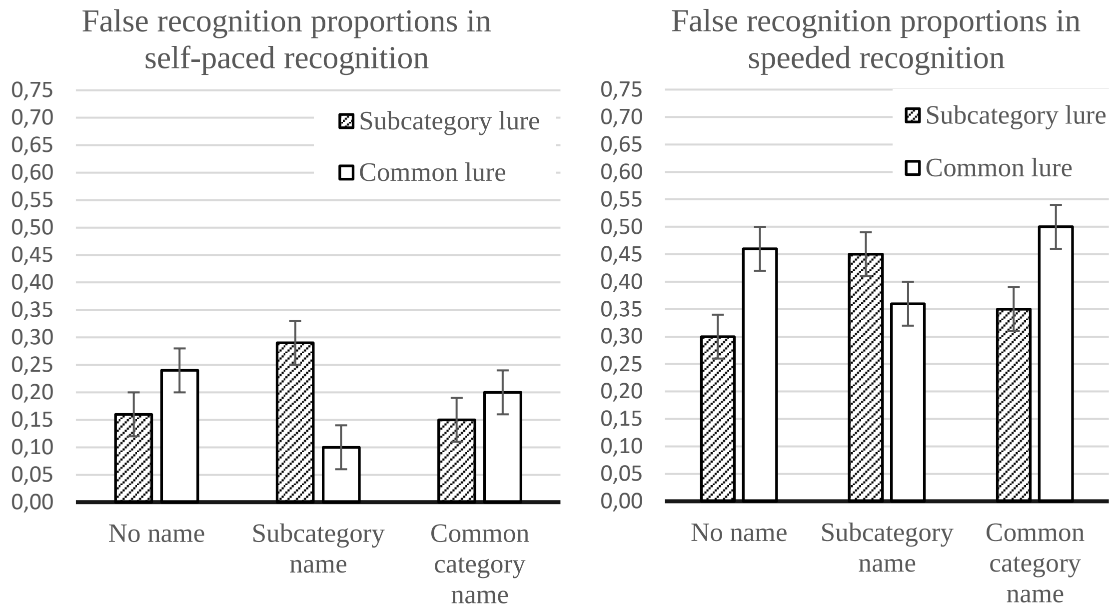

Figure 3. Proportions of false recognition for subcategory and common lures for different recognition tasks under different names from Experiment 3

Remember/Know. Proportions of remember and know responses for subcategory and common lures in the self-paced condition (Table 11) were analyzed in a 2 X 2 X 3 ANOVA with Response (remember, know) and Critical Lure (subcategory lure, common lure) as within-subject factor and Name (subcategory name, common category name, no-name) as between-subject factor. There was a main effect of Response which approached significance, $F(1, 89) = 3.73$, $p = .056$, $\eta_p^2 = .04$, with a

[20] No differences were observed for unrelated lures in self-paced or speeded false recognition under the different name conditions (all *F*s < 1) indicating that no correction of the recognition scores was needed (Table 11).

tendency for more know (*M* = .11, *SD* = .13) than remember (*M* = .08, *SD* = .11) responses.[21]

4.4.3. Discussion

While in the self-paced condition common lures and subcategory lures produced similar levels of false recognition in general, in the speeded condition participants produced more false recognitions for common lures than for subcategory lures. Although both lures had an expected increase in false recognition in the speeded condition, this increase was higher for common lures. In other words, retrieval monitoring processes in self-paced recognition had a greater effect in common lures, potentially decreasing the false recognition of common lures in an ad hoc context (perhaps by their distinctiveness in this context). However, even when controlling for the effect of retrieval monitoring processes, subcategory lures showed higher levels of false recognition than common lures when a subcategory list structure was accompanied by a subcategory name, which suggests that subcategories can produce substantial false memories as long as they are properly contextualized.

4.5. General discussion

In three experiments, we found that ad hoc subcategories from broader common categories (Barsalou, 1985) generated new semantic relations consistent enough to interfere with the false memories induced by preexistent relations from these common categories (Experiment 1); and to reverse the pattern such that false memories produced by subcategories became more frequent than false memories produced by common categories when they were presented with their names (Experiment 2 and 3).

[21] The other significant effect (based on the means between remember and know responses) was an interaction between Critical lure and Name, $F(2, 89) = 16.03$, $p < .001$, $\eta_p^2 = .26$.

In Experiment 1, each list of exemplars was half composed of high output dominance exemplars from one common category whereas the other half corresponded to high output dominance exemplars from a subcategory. Participants studied these lists under common category names, subcategory names, or with no name introducing each list. Results showed substantially more false recognitions for common critical lures than subcategory critical lures, unless they were presented with subcategories names, in which case there was no significant difference in false recognition between the two types of lures.

Experiment 2 followed the procedure of Experiment 1 except that the lists presented were exclusively composed of exemplars with high frequency of production of common categories or of subcategories. A clear pattern of context-specific representation emerged for subcategories lists when subcategories names were presented, such that false recognition of subcategory lures occurred with significantly higher level than common lures.

Experiment 3 replicated the effect for subcategories lists presented with different names (common, subcategory, and no-name) found in Experiment 2. Subcategory lures had significantly higher rates of false recognition than common lures when subcategories were presented with their names. Furthermore, in Experiment 3 the comparison between the self-paced and the speeded conditions revealed that retrieval monitoring processes might have affected results by decreasing the rate of false recognition of common lures. This probably occurred because the common lures had a greater distinctiveness in the ad hoc context, which resulted in the use of monitoring strategies to reject them in the final recognition of self-paced condition. Nonetheless, even when processes of retrieval monitoring were hindered by speeded recognition, subcategory lures were more falsely recognized than common lures in a fully subcategory context. This pattern of false recognitions suggests that, in specific conditions, novel (subcategory) semantic relations between concepts that already share other preexistent and stable (common taxonomic) semantic relations can produce specific memory intrusions.

The decrease in common false memories found in subcategories lists (Experiment 2), is likely to also result from a corresponding decrease in output dominance of these lists' exemplars in the graded structure of the broader common categories (in which the subcategories lists were embedded). In accordance with this interpretation, studies of category learning show that when more diverse sampling of the category is presented right from the beginning (compared to when the most typical exemplars of a category are presented together in the beginning of the task) subjects identify new exemplars of the category less accurately and make less extreme typicality ratings (Elio & Anderson, 1984).[22] Importantly, this decrease in false recognitions also implies category malleability, in the sense that false memories for common categories are not the product of a default representation activated by the presented gist (the category's name), but stem from malleable categorical representations that change according to the structure of the encoded stimuli.

The lack of evidence supporting the emergence of consistent new subcategory representations based only on a subcategory list structure or on subcategory list name suggests boundary conditions to how effectively a new representation for the category may set in and affect other processes.

The difficulties in creating new semantic structures in the presence of preexistent (taxonomic) ones, verified in the experiments here reported, bears similarities to results

[22] Unlike Elio and Anderson (1984) we used output dominance and not typicality to define the categories graded structures. Future research should address this point by comparing the two measures in the production of false memories.

concerning episodic priming effects in newly acquired associations between items (Dagenbach, Horst & Carr, 1990). These authors found evidence that episodic priming has less chances of occurring between words that integrate preexisting associative networks than between words that are previously unrelated. Similarly, in our experiments, a consistent representation of an (ad hoc) subcategory strong enough to create false memories would have to bypass or at least prevail over the preexistent default semantic relations entailed in their status as a member of a taxonomic category.

4.5.1. The role of gist on ad hoc categories false memories

In the present research, both the category name (gist) and the list structure had an important role in the production of false recognitions of subcategories lures. The presentation of the name of subcategories increased the production of false memories for subcategories lures in comparison to common lures only when the categorical lists had a subcategory structure (Experiment 2 and 3). This result contrasts with the ones reported by Soro et al. (2017) where (inter-taxonomic) ad hoc lists produced similar levels of false recognition when these lists were presented with or without their names. As aforementioned, the main difference between these ad hoc categories and the ad hoc subcategories used in the present experiments is that the first cut across different common categories and thus their exemplars share few (if any) previous semantic relations, while in the latter case all exemplars share meaningful taxonomic semantic relations for belonging to the same common category.

Ad hoc categories are found to have weak instance-to-concept associations (Barsalou, 1983), that is, solely presenting exemplars do not elicit activation of the category concept. In the case of ad hoc subcategories this weak association may be further impaired by the prior existence of other plausible (and more stable) representations, stemming from the common categories in which subcategories are embedded. In (inter-taxonomic) ad hoc categories (Soro et al., 2017) participants had to make sense of lists of “unrelated” items, and in this effort, they seem to get close enough to the category’s gist (as indicated by the false recognitions) even when the lists were not named. In the subcategories used in the current experiments, the simplest path for making sense of the lists with no name is to represent them as their default common category (even if with occasional unconventional exemplars).[23] Hence, the context enabled by the explicit naming of these subcategories played an important role in the organization of new semantic networks strong enough to be more salient than the easily accessible taxonomic categories.

While representations of common categories are stable enough to be sustained in lists with some unconventional exemplars, representations of new subcategories seem to be more affected by the presence of less typical exemplars, even if the context is made explicit by the subcategory name (Experiment 1). This suggests that list’s composition also affects significantly the strength of the context in which the subcategory is represented, which may come from the fact that subcategories are necessarily more restricted than their common categories counterparts (e.g., some sports could be considered by some participants as actually bad for a backache). The atypical exemplars of subcategories included in the hybrid lists used in Experiment 1 may have been perceived as “more atypical” than atypical exemplars of common categories, which in turn made the subcategory representations less consistent.

4.5.2. Limitations and future research

One limitation of the present work concerns the “ad hoc” status (Barsalou, 1985) of the subcategories here used. Although these subcategories were conceived to be

[23] As evidenced by the similar levels of false recognition for common lures presented with their common category names and with no names.

rarely thought of by participants, it can be argued that at least some of them could have been used enough times to become well-defined subcategories of common categories. But even if we cannot be sure that we always used “pure” ad hoc subcategories in the sense that they are not part of long-term semantic knowledge, there are key qualitative differences between these subcategories and the common categories in which they are embedded. The main difference is in terms of the goal-derived nature of the subcategories, which qualities are mostly absent in common categories. Further research could explore this issue by comparing the prevalence of memory illusions in subcategories that vary in how well established they are (i.e., how frequently they were previously used) in participants’ minds.

The way in which subcategory representations are identified in the present experiments is quite strict, as it hinges on the proportion of false memories of a single word (selected to be the critical lure) from each list. Future research would benefit from using other measures to capture the emergence of new subcategory structures. For instance, new experiments could use a larger variety of critical lures in the recognition tasks, including free recall tests, and assessing the subcategories graded structure through other measures (e.g., typicality, ideals) besides output dominance. These measures could help to understand if other processes, besides gist meaning, associations or semantic relationships, may be involved in the production of false memories for subcategories, as well as to capture consistent variations in the representation of common categories according to variation in the exemplars presented during encoding.

Another aspect worth exploring is the context manipulation. The manipulation of name presentation for the lists was a quite simple and straightforward manipulation. More engaging and goal-oriented context could lead to the development of clearer conceptual structures and, as a result, increase the frequency of memory illusions. For example, requesting participants to actively imagine planning a picnic before list presentation could activate schematic knowledge such as “where to go”, “what to take”, “how to get there” potentially increasing the number of specific false memories about subcategories like “places to have a picnic”, “food usually taken for a picnic” and “tools useful in a picnic”. More generally, priming a goal-derived scenario that activates the representation of the subcategories presented in the encoding phase should increase memory illusions. In fact, one way in which common taxonomic and goal-derived ad hoc categories differ (besides reflecting or not the correlational structure of the environment) refers to the categories function. According to Barsalou (1985) goal-derived categories are mostly used for instantiating schema variables while achieving goals, whereas common categories are more often used for classification. Hence, categorization is likely to make available context dependent properties of the exemplars (Barsalou, 1982) that otherwise remain inactive due to lack of contextual activation.

In sum, besides promoting a clearer conceptual ad hoc representation, successful and more complex manipulation of context could bring the results found in experimental memory illusions closer to practical implications of memory processes.

4.6. Conclusion

Semantic relations established during study of lists have the capacity to affect memory illusions despite the preexistent semantic relations among the same stimuli. This suggests that the constructive nature of memory builds on dynamic categorical relations that are instantiated in flexible and adaptive ways to serve new goals. By exploring such psychological processes of meaning-making our goal was to pave the way for future research that may further close the gap between fundamental research on categorization and the practical use people make of categories.

5. Chapter V - General discussion

In the previous Chapters, it was presented a series of experiments in which representations of ad hoc categories were explored regarding their patterns of graded structure and the resulting patterns of false memories, either in the absence or presence of preexistent semantic relations of other taxonomic representations.

Chapter II presented the process of obtaining norms for lists of exemplars from inter and intra-taxonomic ad hoc categories as well as common taxonomic categories. They were developed to provide material for the experiments presented in Chapters III and IV, using lists with minimal (if any) overlap between presented exemplars and critical lures and with measures to compare exemplar accessibility through production frequency between ad hoc and common taxonomic categories. Production potency (Table 1 in Chapter II), for instance, provided a measure of how many exemplars are produced in average, considering the number of participants producing exemplars. Comparisons between types of categories showed that common taxonomic categories had a significantly higher production potency than ad hoc categories, while inter-taxonomic ad hoc categories had a higher production potency than intra-taxonomic ad hoc categories. Comparisons of average production frequency for the 5 more frequently produced exemplars in each type of category shows that in all 5 levels production frequency is higher in common taxonomic categories than in ad hoc categories and higher in inter-taxonomic than in intra-taxonomic ad hoc categories (both comparisons are significant at the 4^{th} and 5^{th} levels).

These results suggest that exemplar production is more consistent in common taxonomic categories than in ad hoc categories. Exemplars of common categories are more accessible (more exemplars are produced) and there is more agreement between participants about which are these exemplars (production frequencies are higher for the most produced exemplars). Similar results were found in Barsalou (1983), which argues in favor of the idea that common taxonomic categories have more stable representations than ad hoc categories.

It is worth noticing that production frequency in inter-taxonomic ad hoc categories have a tendency of being more consistent than in intra-taxonomic ad hoc categories, and the reason for this does not appear to be obvious. Perhaps the underlying presence of preexistent taxonomic semantic relations in the intra-taxonomic ad hoc categories could have interfered in the ad hoc representations, as it was indicated by the experimental results presented in Chapter IV. However, one could have predicted that this interference would have the opposite effect, that is, the preexistent semantic relations could have lent the ad hoc representation its consistency, leading to more agreement between participants and higher production frequencies. Another possible explanation for this somewhat diminished consistency in intra-taxonomic exemplar production is the fact that these ad hoc categories would tend to be more restrictive than inter-taxonomic ones. That is, while in inter-taxonomic ad hoc categories the criterion of membership is the presence of some characteristic(s) that enables the achievement of a goal, in intra-taxonomic ones there is also the criterion of belonging to a common taxonomic category. This could mean that there are extra steps in determining a suitable exemplar for intra-taxonomic ad hoc categories, making them harder to identify and leading to a low power of production (i.e., less exemplars produced by participant).

Nevertheless, this restrictive aspect of intra-taxonomic ad hoc categories does not explain why the frequency of production of exemplars tends to be smaller. This difference (compared to intra-taxonomic ad hoc categories) is not significant in the first two levels of output dominance but it becomes so in the consecutive ones. One possibility is that the categories are so restrictive in their criteria of exemplar membership that, while few exemplars appear to match the category very well, there are no clear further exemplars suitable for it. In this scenario, after producing the clear matches to the category, participants could have engaged in guessing, and this could have led to more divergence between them.

In Chapter III, a paradigm of categorical false memories was used to observe semantic memory intrusions from inter-taxonomic ad hoc categories. These experiments manipulated a contextual cue (i.e., presence vs. absence of a category's name), established a tighter control for the presence of preexistent associations and controlled for the use of familiarity as a cue in the recognition task. The main goal was to obtain evidence that novel category representations can produce false memories in a simple experimental paradigm of list presentation.

In the first experiment, levels of false recognition for inter-taxonomic ad hoc categories were significantly higher than false recognition for unrelated items (albeit being lower than false recognition for common taxonomic categories). This suggests that the false recognitions were errors based in conceptual knowledge, and not haphazard guessing. Because ad hoc categories are not expected to have stable representations in long-term memory or to have strong instance-to-concept associations, the presence of a contextual cue (the name of the ad hoc category) was expected to facilitate the conceptual representation of the lists and thus lead to more false recognitions. However, there was no significant difference in false recognition frequency between ad hoc lists presented either with or without their contextual cues. One possible account for this result is that participants were able to extract a gist for the lists that was close enough to the concept involved in the lists' contextual cues, which increased the chances of critical lures being falsely recognized. Frequencies of category name identification were obtained in a procedure in which participants were asked to identify a potential theme for each list and afterwards performed a recognition task. Correlations between identifiability of lists and their frequency of false recognitions was in the expected direction but did not reach conventional levels of statistical significance. However, correlations between participants' identification of lists and their production of false recognitions was significant. This suggests that name identification as a participants' feature or "ability" but not as an intrinsic characteristic of the lists, can, at least partially, explain the results found for ad hoc lists presented without contextual cues.

The second experiment referred in Chapter III provides a replication of the results in the first experiment with additional material and a better control for preexistent associations between list words and critical lures. The same procedure was applied with lists from different inter-taxonomic ad hoc categories from which were removed words that had preexistent associations with the critical lure (as measured by free association norms). The pattern of results was the same. However, the correlation between false memories and list identification between participants was weaker and non-significant.

In the third experiment of Chapter III, lures in the recognition phase were altered, so that unrelated lures from non-presented common categories were replaced by weakly related lures from the presented ad hoc categories. This was done to circumvent the possibility that unrelated lures were perceived as distinctive (for not being related to the presented lists), hence “artificially” increasing false recognitions of ad hoc categories. This change did not affect false recognition in lists presented with or without categories’ names. However, presence of names led to a decrease of false recognition of the weakly related lures, indicating a clearer structuring in the representation of the categories.

Chapter IV presented false memory experiments relying on the same experimental paradigm used in Chapter III, but with lists of intra-taxonomic ad hoc categories, or ad hoc subcategories. These categories differ from inter-taxonomic ad hoc categories in the sense that they are composed of exemplars from the same common taxonomic category. This means that besides the new relations established by the subcategory representation, the exemplars share preexistent semantic relations converging in the common taxonomic representation. False memories for the critical lure from the ad hoc subcategory representation would, in this case, be the result of considerable category malleability establishing a new subcategory representation consistent enough to produce specific false memories despite the preexistent semantic associations. In the first experiment, participants studied lists of words composed of frequently produced exemplars from both the common category and its ad hoc subcategory and were presented with either the subcategory contextual cue (the subcategory name), the common contextual cue (the common category name) or no contextual cues. Common false memories, related to the common categories’ “default” representation, occurred less when lists were presented with a subcategory contextual cue. False memories from subcategories, however, did not become more frequent as function of the contextual cue manipulation.

In the second experiment, the hybrid lists were replaced by lists composed of frequently produced exemplars from either a common or an ad hoc subcategory representation of taxonomic categories. Mismatches in category name and structure (common lists with subcategory names and vice-versa) produced similar levels of false memory for subcategories and common categories. When both subcategory list structure and name coincide, false memories for subcategories were significantly more frequent than common false memories.

In the third experiment of Chapter IV, it was explored the possibility that the higher level of false memories for subcategories lures when compared to common categories lures was due to a distinctiveness effect. Specifically, common lures could have become particularly salient and easily dismissed at recognition through retrieval monitoring in fully ad hoc contexts (subcategory lists with subcategory contextual cues). In this third experiment, the same procedure was applied with only the subcategory lists from the previous experiment and the addition of a speeded recognition condition to decrease the chances of retrieval monitoring. A distinctiveness effect was found, in which common category lures resulted in a significant increase in false recognition, compared to subcategory lures. However, in fully ad hoc contexts, false memories for subcategories continued to be significantly more frequent than false memories for common categories, suggesting that, in such context, the representation of the ad hoc subcategory is consistent enough to produce specific false memories despite the preexistent common representation of the taxonomic category.

Taken together, the results from the experiments presented here provide evidence for the occurrence of false memories from new (as in recently produced) goal-derived conceptual representations. This effect was replicated a) across the different experiments, using different sets of ad hoc categories, which indicate its robustness; and b) using ad hoc subcategories, suggesting the persistence of the effect even in presence of “competing” preexistent relations converging in different concepts. Theories proposed to explain the phenomena found in list word presentation generally focus on the effects found with material that have convergent preexistent associative and/or semantic relations. Such associations were, at best, scarce in ad hoc categorical lists here used. Next, I discuss what are the consequences of the present findings to two of the most frequently referred theories: activation-monitoring framework (AMF) and the fuzzy-trace theory (FTT).

5.1. Consequences for theories of false memories

Two theories of false memories have had considerable impact in the field, for offering compelling accounts of memory illusions: activation-monitoring framework (AMF) and the fuzzy-trace theory (FTT). Both will be described separately as well as considered in terms of how false memories from ad hoc representations can be explained by each of them.

5.1.1. Activation-Monitoring Framework

The AMF explanation for the false memory phenomenon focuses on associations and their automatic mechanisms. Underwood (1965) refers to associative activation to explain false memories found in recognition tasks, proposing that presentation of a word during a recognition task produces implicit associative responses, which lead to the automatic activation of a highly associated word, even if not presented. This implicit activation would make participants confound presented and implicitly activated words, producing false recognitions. The concept of associative activation was further developed by connectionist theories of cognitive association that introduced the notion of spreading activation mechanism (Anderson, 1983; Collins & Loftus, 1975; McClelland & Rumelhart, 1981). In these theories, concepts are assumed to be stored in the form of nodes in a network of other conceptual nodes connected through associative links of varying strengths. The activation of one conceptual node would spread to the neighboring nodes with decreasing strength. However, multiple small activations could accrue eventually leading to a stronger activation.

In the DRM paradigm these aspects of associative theories are evoked to explain the activation of the critical lure. According to the AMF, the fact that all items in a list are associated to the critical lure means that activation of each concept of a DRM list spreads to the critical lure, causing accumulation of indirect activation that may translate into a conscious activation of the critical lure (though this activation need not always be conscious - McDermott & Watson, 2001; Seamon, Lee, Toner, Wheeler, Goodkind, & Birch, 2002; Seamon, Luo, & Gallo, 1998). One evidence that suggests automatic activation of the critical lure during the encoding phase comes from the fact that measures of mean backward associative strength from lists (MBAS) are the best predictors of frequency of false memory from DRM lists (Roediger, Watson, McDermott & Gallo, 2001). This means that the higher the tendency for words on a list to produce the critical lure in free-association norms, the higher will be the tendency for this list to produce false memories for this critical lure.

According to the AMF, this activation of critical lures during encoding phase generate memory illusions through failure in monitoring during the retrieval phase. When retrieving information from memory, both internally and externally produced information can be accessed. That is, one can recollect about what was seen in a specific episode and what was thought of in the same specific episode. The set of processes involved in differentiating both types of information has been called *source monitoring* (Johnson, Hashtroudi & Lindsay, 1993)

In the DRM paradigm, the indirect activation that accrues in the critical words makes them less discernible from the presented words, even if they were only produced internally, causing failures in the source monitoring processes during memory tasks, which may lead to the false recognition or recall of the critical words.

The assumption of a direct association between list word and critical word is the most salient limitation of AMF for explaining the phenomena in inter-taxonomic ad hoc categories (Chapter III), considering that these categories do not have stable representations in long-term memory. The same limitation applies for ad hoc subcategories, even if they share taxonomic relations among their exemplars. As evidenced in the experiments in Chapter IV, the taxonomic organization is the most prevalent one, and it takes a considerable amount of contextualization to make the subcategory lures falsely recognizable, meaning that any relation that may preexist among the exemplars will tend to converge on the most frequently produced exemplar of the common taxonomic representation, and not the ad hoc one.

Considering BAS as the most compelling argument in favor of AMF, even false memories for some common categories cannot be fully explained by the theory. As mentioned in Chapter I, some common categories have very low or non-existent measures of BAS, and yet they produce significant levels of false memories (Dewhurst et al, 2009). One possible way of explaining these effects with AMF is to consider a spread activation in two levels. Although exemplars of some categories are not associated directly to the critical word, they tend to have a direct association to the superordinate concept, the name of the category (Park et al., 2005). The indirect activation of this category's name would then spread to the more closely related concepts, which would include the more frequently produced exemplar of the category. This, second level, indirect activation would then accrue in the exemplar in the same way as theorized by AMF, increasing its chances of being falsely recognized later. In ad hoc categories one would not expect the exemplars to activate the ad hoc category name automatically, because of the weak instance-to-concept associations found for this type of categories, but once the ad hoc category concept is identified (explicitly, with category name presentation, or implicitly, with subjective identification of the category theme), each presented exemplar will reactivate it (or confirm it, if it is being identified by the participant), potentially producing activation of its most frequently produced exemplar. However, resorting to an activation of the category concept brings the AMF explanation closer to the one proposed by the Fuzzy-trace theory (FTT), in terms of how it focuses on gist traces to enable false memories.

5.1.2. Fuzzy-Trace Theory

The FTT is proposed as a general theory of the relation between memory and reasoning processes (Reyna & Brainerd, 1995), from which the false memory phenomenon can be derived. The theory proposes a dual-process approach for encoding of information and its retrieval. Information about surface and concrete form (verbatim) and information about meaning and content (gist) are obtained from the experienced event and stored in parallel and independently, creating separate types of memory traces. In associative lists of the DRM paradigm, all items converge semantically to the critical word. In the process of extracting the gist of the items of a list, this convergence in meaning produces a consistent gist overlapping among the items, a “list gist”, which is assumed to have great meaning commonality with the list’s critical item. In free recall tasks, after retrieving words via verbatim traces, this strong and consistent gist information is used as a guide to generate items potentially seen previously, which more often than not includes the critical item (Brainerd, Payne, Wright & Reyna, 2003). In recognition tasks, the presentation of critical lures strongly cues memory traces for the list gist, inducing its false recognition.

The FTT seems to provide a good fit in explaining the occurrence of false memories with lists of inter and intra-taxonomic ad hoc categories. This is so mainly because the theory does not determine explicitly that memory errors necessarily arise from preexistent associative or semantic relations (although it is implicitly acknowledged in the meaning overlap that the theory attributes to the words involved in false memories from associative and categorical lists).

Regarding gist extraction, for false memories from inter-taxonomic ad hoc categories (Chapter III) presented with names, there is not so much gist extraction as there is gist establishment, because the gist is provided by the presentation of the category's name. This established gist is then reinforced and made consistent by the presentation of frequently produced exemplars. When the ad hoc categories names are not presented, though, actual gist extraction must take place. FTT proposes that many gists can be extracted from the same information, in multiple hierarchical levels, to be used according to their relevance to the task to be performed (Brainerd & Reyna, 1990; Brainerd & Reyna, 2001; Reyna & Brainerd, 1991). That is, upon presentation of the word "python" the gist extracted may be as general as "animal" or more specific like "reptile" or "snake". The theory does not specify that these hierarchical levels must follow "taxonomic" levels. Thus, one may assume that they can include specific levels such as "things that can kill you in the jungle" or "venomous animals". When the category name is not presented participants may try to make sense of the items presented in a list by finding a common ground between them. This common ground may be (as evidenced by the theme identification results in Chapter III) a specific gist level that is somewhat related to the category's original name, thus creating the conditions for false recognition at test (such account is consistent with the correlation found between false recognition and theme identification of the lists).

In the case of intra-taxonomic ad hoc categories presented without names (Chapter IV), one could argue that a potential gist extraction is disrupted by a strong competing gist: the classification of the items as exemplars of a common taxonomic category. A consistent ad hoc gist leading to false memories is only present if it is exogenously established (via presentation of the ad hoc category's name) and made "consistent" with presentation of the respective relevant and frequently produced exemplars.

Regarding gist retrieval in recognition tasks, the FTT proposes that false memories for the DRM lists occur because the gist accessed from the critical items presented in the task cues the gist extracted from the presented lists due to their similarity (Reyna & Lloyd, 1997). In DRM lists and category lists, this similarity between gists of critical items and gists of lists is self-evident (because the lists converge associatively to the critical item), suggesting that the cueing of gist memory traces by the critical item arises somewhat effortlessly (akin to the automaticity of activation proposed by the AMF). In ad hoc categories, one would not expect a gist that is effortlessly evoked by the critical items alone to be elaborate and specific enough as to be similar to some of the names of ad hoc categories in the experiments presented here, especially considering the aforementioned weak instance-to-concept associations of ad hoc categories. Going back to the considerations on gist extraction, it was argued that gist extraction might happen at many levels concurrently. So that, besides the explicit name of the category (or any composite theme that participants may generate in the no-name condition of inter-taxonomic ad hoc categories), simpler gists may also be extracted (perhaps even at an unconscious level). These gists may correspond to features evoked by (and common to) the exemplars of a list, such as a context or one or more attributes and affordances that are related to the relevant action to be performed in pursuing the goal implied by the ad hoc category.

Such possibility of exemplars evoking a common context is suggested by a recent theory of conceptualizations through simulations (Barsalou, 1999; 2003), which argues that representations are not retrieved as amodal concepts in memory but are instead recreated in simulations. These simulations are based on previous encounters with the element to be represented (or similar ones) and they use sensory-motor information from these previous encounters in its production. This means that representations of elements (or the category exemplars, in the present case) come necessarily accompanied by some degree of experienced information with the exemplar that can range from perception of its physical characteristics, its common uses and functions, to the context in which it is commonly encountered. Furthermore, the representation of exemplars is assumed to always occur in some background context and not in isolation. In other words, they are always situated simulations (Barsalou, 2003; 2009).

To give an example, take the ad hoc category "things that people put on walls" (Chapter III, Experiment 2). The representation of all presented exemplars (wallpaper, poster, shelf, mirror…) would probably occur in a context in which they are affixed to a wall (some more frequently than others). Because of this convergence it could be possible that the contextual feature "affixed to a wall" would be salient enough to be extracted as one level of list gist.

The same rationale could be applied to affordances from exemplars. Affordances (Gibson, 1977) have been defined as those characteristics of the environment that provide the organism (human or animal) with a specific form of interaction relative to its capabilities. Although initially associated to a theory of visual perception and dependent on the direct interaction between the person and the environment, the concept of affordances was borrowed and adapted to fit theories of cognitive processing and conceptualization (Proctor & Miles, 2014). In this vein, some theories consider that affordances are included in the mental representations of elements (Ellis & Tucker, 2000; Borghi & Riggio, 2015) and can affect cognitive processes even when these representations are activated via word presentation (without any visual input of the element in question; Tucker & Ellis, 2004). In this sense, affordances may be integrated in the simulated representations of Barsalou's conceptualization theory. For instance, take the category "things that can be used as support surface for writing" (Chapter III, Experiments 1 and 3). The representation of the list exemplars (book, notepad, wall, chair, floor…) can potentially include (and converge in) the affordance of "having a somewhat stable and flat surface with which to interact", making this feature a salient gist from the list.

Lastly, these contexts and affordances may, in turn, contribute to the general gist of the critical items presented at recognition (e.g., the critical item "Picture" can have a salient "fixed to a wall" context extracted in its gist; and the critical item "Table" a salient affordance of "interaction with a stable flat surface") contributing to the likelihood of false memories.

5.2. Limitations and future studies

5.2.1. On the assumption that ad hoc categories are devoid of preexistent semantic relations

Most studies using false memory paradigms of lists presentation use words that share preexistent (semantic) associations, turning memory illusions into one of the hallmarks of stable memory representations. By exploring to what extent semantic memory illusions could occur in a set of stimuli that did not have stable representations in long-term memory (i.e., stimuli that did not share preexistent semantic associations), the goal was to not only test this assumption but also extend the boundary conditions of memory illusions putting forward new challenges to current accounts of false memories. However, the assumption that the ad hoc categories used in previous research (e.g., Barsalou, 1983, Valleé-Tourangeau et al, 1998; Van Overschelde et al, 2003) and in the experiments described here, are devoid of preexistent semantic relations is not always easily verifiable. In the experiments reported here, the more direct attempt at doing so was performed in Experiment 2 of Chapter III where exemplars presented on lists were controlled for the presence of BAS identified through free association norms. BAS is not only one straightforward way of tapping into preexistent associations, but also refers directly to one of the main predictors of false memories of associative lists (Roediger, Watson, McDermott & Gallo, 2001) and stands out as one of the strongest evidences for the AMF. In the remaining experiments this control was not applied, because extensive free association norms for words in Portuguese were not found. Although Experiment 2 of Chapter III provides compelling evidence for the significant production of false memory in ad hoc lists with no BAS, the reliability of the reported results would be improved if appropriate BAS control had been applied to all stimuli used in the experiments. Producing free association norms for the words used in Portuguese could better characterize potential associations involved not only between list words and critical words, but also among list words.

The same applies for semantic variables that were found to have significant role in the production of false memories. Brainerd, Yang, Reyna, Howe and Mills (2008) identified semantic variables that are related to false memories production and to BAS in DRM lists, more specifically measures of familiarity and meaningfulness of critical items, obtained from semantic word norms (Toglia & Battig, 1978). In the English material used in Experiment 2 of Chapter III, the comparison between false recognition of critical items and their measures of familiarity and meaningfulness showed only a significant negative correlation between meaningfulness and false recognition in the no-name condition, $r(11) = -.70$, $p = .016$. This unexpected result may suggest that these semantic characteristics only predict false memory production positively in as much as they are predictive of BAS. In lists where BAS is low or not present (like in the lists used in Experiment 2 of Chapter III) meaningfulness may have an inverted predictive effect on false memories, as suggested by the negative correlation found, and other semantic characteristics may have a more significant role in false memory production than previously observed. The semantic variables explored in Brainerd et al. (2008) would be a good starting point for further research on potential semantic characteristics of words that could influence the false memory effect in ad hoc categories.

5.2.2. Limitations stemming from the small number of lists used

The relatively small set of lists and words used in the experiments reported in this thesis is also an issue to be addressed in future studies. As indicated in Chapters III and IV, subjecting the material to minimal controls of co-occurrences between lists limited greatly the number of lists and exemplars used in the experiments. For the experiments with inter-taxonomic ad hoc categories (Chapter III), even though the lists were composed of exemplars from different categories, there was a considerable number of co-occurrences between them; that is, exemplars that were frequently produced in more than one category. In hindsight, this may have been a result of the process of obtaining norms for ad hoc categories. If ad hoc categories must be created on-the-spot, it means that the task of amassing exemplars for some of the categories can be challenging, so it would not be surprising to find out that participants “re-used” exemplars produced for other ad hoc categories in the same questionnaire when they were minimally adequate, increasing the co-occurrence of exemplars among lists. This led to the necessity of considerable editing and selection of lists, in which many had to be removed and the remaining ones had to be shortened to 10 items. In intra-taxonomic ad hoc categories (Chapter IV), the necessary control was not between ad hoc categories, but between the ad hoc and the common version of categories, specifically concerning co-occurrence of critical items. Future research using more ad hoc category lists, may allow to develop a finer notion of the pattern of false memories production, specifically regarding the correlation between false memories and list identifiability.

Running false memory studies with more lists would further allow a better control over individual semantic characteristics of ad hoc critical exemplars by having more than one set of lists, presenting one set in the study phase and using exemplars of the non-presented set as unrelated distractors in the recognition phase. Certainly, some measure of control was obtained using one set of ad hoc categories and another of common categories. However, the difference between both types of categories (i.e., presence of stable representations in long-term memory and correlational structure - especially in studies with inter-taxonomic ad hoc categories) may have affected their tendency to produce false memories. Using the same rationale that lead to Experiment 3 of Chapter III, an ad hoc critical exemplar from a non-studied list could have been less salient than a critical exemplar from a non-presented common category in a recognition task, perhaps leading to more errors (false recognition of unrelated lures) in comparison to semantic false memories.

5.2.3. On the importance of using alternative measures of categories' graded structure

Frequency of production was used in the present experiments as the sole measure to select critical items from lists. Some evidence from the presented experiments suggest that this measure is a good predictor of false memories in ad hoc categories, specifically those with manipulations that included other related lures of the lists in the recognition task, such as in Experiment 3 of Chapter III and all experiments in Chapter IV. Alternative measures of representation structure should be explored, though, considering the differences between common and ad hoc categories. Measures of typicality are usually found to be highly correlated with frequency of production in common categories (Mervis, Caitlin & Rosch, 1976) and ad hoc categories (Barsalou, 1983). Although Smith et al. (2000) found evidence that frequency of production is a better predictor of false memories than typicality; the latter has been used recurrently in the literature as an indicator of how probable an item is to be activated in a category semantic context. Future studies could, thus, access typicality in the context of ad hoc categories and false memory production.

Perhaps even more relevant as measures of graded structure of ad hoc categories would be *ideals*. Ideals were proposed by Barsalou (1985) as a potential determinant of graded structure, along with central tendency and frequency of instantiation, and it is defined as those attributes or features that exemplars should have to help achieve a goal associated to the category. Considering that ad hoc categories tend to be created as tools to achieve goals, it seems reasonable to assume that ideals would be a core aspect in their graded structure. In fact, along with frequency of instantiation, ideals are highly correlated with measures of typicality in goal-derived categories, suggesting that they are, indeed, central in defining graded structure (Barsalou, 1985). Identifying ideals associated to each ad hoc category, as well as their measures for each exemplar, would allow exploration of an alternative representation of graded structure that could have a determinant effect in the production of false memories. Measures of ideals could also allow for more specific testing of the FTT account of ad hoc false memories described here, in which the extracted gist leading to false memories is based on context features and affordances of the critical item. In other words, the contexts and affordances that are salient in critical exemplars from ad hoc categories can be identified as a relevant ideal that organizes the category's graded structure. If these attributes are found to be a relevant variable in the production of false memories (as is production frequency) this could be interpreted as evidence in favor of the proposed FTT account.

Category lists are not as convergent as DRM associative lists, in the sense that their exemplars do not seem to have a direct link to the critical item. This is, in fact, one of the arguments for why they usually produce less false memories than DRM-like associative lists. This characteristic, however, gives the material some flexibility, in the sense that some common categories have several exemplars with high frequency of production allowing for several critical exemplars to be obtained from the same list and explored consecutively or even simultaneously in memory tasks (Roediger & DeSoto, 2014; Smith, et al., 2000; Meade & Roediger, 2006). Having a small number of ad hoc categories suitable to use in studies of false memories (compared to common ones) means that only a few would pass this criterion, especially considering that they have a tendency of showing larger drops in production frequency as one goes downwards on their lists of exemplars. In this sense, new graded structure based on measures of ideals or typicality could provide more critical exemplars from lists, enabling the access to a more detailed variability in the production of false memories for ad hoc lists.

In sum, the use of other measures of graded structure could provide a new pool of critical items for the ad hoc categories. This would circumvent an experimental limitation that ad hoc categories have compared to common categories (especially if they are not positively correlated with frequency of production).

5.2.4. Recollection, recognition and remember/know responses in ad hoc false memories

The results of the phenomenological experience of false recognition of ad hoc critical, obtained through remember/know tasks, suggest that both recollection and familiarity guide the false recognitions, with a tendency towards use of familiarity. In inter-taxonomic ad hoc categories there was a marginal tendency for more know responses that disappeared once a guess option of response was made available. In intra-taxonomic ad hoc categories, this tendency was stronger, being significant without a guess option of response and marginally significant with the guess option. Considering that mean recognition (including both recollection and familiarity) was considerably low across experiments (compared to associative DRM lists and taxonomic lists in general) ad hoc false memories obtained from free recall tasks would be expected to be even lower, assuming that they derived solely from recollection. Thus, free recall studies with ad hoc categories could characterize a boundary conditions for the ad hoc false memory effect and further inform about the role of recollection in this phenomenon.

5.3. Conclusions

Investigation in false memories has long proven its relevance by showing consistent evidence of our memory’s fallibility and its implications in diverse fields ranging from Law to Medicine (e.g., Loftus, 1975; 1997). Straightforward methods of obtaining this effect in laboratory, like the DRM paradigm, or similar procedures applied with category lists, provides the possibility of increased control over the material and the cognitive processes involved. The use, in these methods, of conceptual material that share stable and preexistent relations in long-term memory favors the robust replicability of the effect, allowing more control in the manipulations and the results from it derived. However, this robustness may come at the expense of a lost in relatedness to real-world situations and the flexible categorizations we employ in every-day life scenarios.

The work presented here pursued the goal of presenting production of false memories derived from flexible categorization processes not dependent on preexistent associations and linked to contexts related to goals. The results show production of false memories for ad hoc categories (that entails the desired characteristics aforementioned), even if with a lower frequency when compared to what is commonly found for preexistent conceptual relations. These ad hoc false memories were also produced in conditions where preexistent relations would lead to a different pattern of semantic intrusions, given that the ad hoc context is explicitly presented. The strong influence of preexistent relations in the false memory effect is clear (they produce higher levels of false memories and “impose” themselves on situations where ad hoc categorization is also possible). Nonetheless these limitations, the false memories from flexible categorizations revealed to be a consistent phenomenon. They provide a potential path for exploring memory illusions closer to or even directly related to scenarios from real-world environment expanding the conditions under which the effect is found (besides the conditions commonly present in procedures like the DRM paradigm or category list presentation), and contributing, as a result, to the revision and improvement of current theories of false memories.

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Appendix A – Lists of exemplars used in the experiments

Table A1

Lists of exemplars from inter-taxonomic ad hoc categories used in the Experiments 1 and 3 of Chapter III and their respective levels of Frequency of Production (translated from Portuguese)

Things that can be walked upon (n = 36)	FP	Things that dogs chase (n = 36)	FP	Things that can fall on your head (n = 33)	FP	Things that float on water (n = 33)	FP
Grass	.50	***Cat***	.69	***Rain***	.70	***Buoy***	.52
Road	.33	*Ball*	.50	*Leaf*	.48	*Boat*	.36
Sand	.31	Bone	.36	Snow	.24	Plastic	.27
Sidewalk	.31	Dog	.28	Dust	.15	Feather	.15
Rock	.31	Person	.28	Vase	.15	Cork	.15
Dirt	.28	*Fly*	.22	*Fruit*	.12	*Algae*	.12
Wood	.25	Rat	.22	Dish	.12	Bottle	.09
Carpet	.25	Car	.19	Ceiling	.12	Surfboard	.09
Asphalt	.22	Toy	.17	Chandelier	.09	“Bragadeira” [a]	.06
Bridge	.22	Owner	.17	Hail	.09	(plastic) Bag [b]	.06
Crosswalk	.22	Stick	.14	Brick	.09	Styrofoam	.06
						Cup	.06

Things people carry in their pockets (n = 33)	FP	Things used to take a cat down from a tree (n = 23)	FP	Things that are flammable (n = 41)	FP	Things to take to a camping trip (n = 41)	FP
Cellphone	.91	***Step ladder***	.65	***Alcohol***	.73	***Tent***	.98
Wallet	.73	*Broom*	.30	*Gasoline*	.63	*Food*	.73
Key	.73	Ladder	.26	Gas	.29	Flashlight	.71
Handkerchief	.45	Rope	.13	Acetone	.24	Sleeping-bag	.63
Money	.36	*Fireman*	.04	Lye	.20	Water	.44
Coin	.30	Gloves [b]	.09	*Paper*	.20	*Bug spray*	.27
Card	.21	Stool	.06	Diesel	.15	Blanket	.24
Pen	.18	Hose	.04	Spray	.15	Mattress	.17
MP3 (player)	.18	Net	.04	Matches	.15	Backpack	.17
Document	.15	Trampoline [b]	.06	Petroleum	.12	Camping stove	.12
(transport) Pass	.09	Crane	.04	Detergent	.12	Pillow	.07
		Van [a]	.04				
		Fire extinguisher [a]	.04				

Things that can be bought on a flea market (n = 40)	FP	Things that serve as mementos (n = 41)	FP	Things that can be used as support surface for writing (n = 41)	FP
Clothes	.80	***Photo***	.80	***Table***	.93
CD	.40	*Postcard*	.63	*(person’s) Back*	.46
Clock	.35	Note	.32	Book	.46
Shoes	.30	Letter	.32	Notepad	.41
DVD	.28	Flower	.15	Wall	.39
Antique	.20	*Video*	.15	*Chair*	.37
Furniture	.20	Ring	.12	Floor	.27
Bijou	.13	Magnet	.12	Leg	.24
Necklace	.10	Bracelet	.12	Desk	.20
Painting	.10	Music	.10	Knee	.15
(fashion) Accessory	.08	Present	.10	Counter	.12

Note. Words in bold are critical lures not presented during the study phase, words in italic were presented in the recognition task. FP = Frequency of Production.
[a] Exemplar present on the list on Experiment 1. [b] Exemplar present in the list on Experiment 3.

Table A2

Exemplars presented in the lists, subcategory and common lures used in Experiment 1 in Chapter IV (translated from Portuguese) with their respective output dominance in subcategory and common category representations.

Exemplars	Subcategory names and OD for exemplars under subcategory names	Common names and OD for exemplars under common category names	Exemplars	Subcategory names and OD for exemplars under subcategory names	Common names and OD for exemplars under common category names
	Foods that one takes to winter holidays parties (Christmas and New Year's Eve)	Foods		Clothes one takes when mountain climbing	Clothes
	OD	OD		OD	OD
Critical lures			Critical lures		
Raisins	0,53	ND	Cap	0,44	0,05
Fish	0,05	0,65	Shirt	0,02	0,49
Exemplars			Exemplars		
Cake	0,50	0,30	Coat	0,76	0,65
Meat	0,13	0,67	Pants	0,56	0,84
Sweets	0,28	0,08	Boots	0,66	0,03
Chocolate	0,10	0,25	T-shirt	0,18	0,51
Snacks	0,21	0,08	Gloves	0,53	0,14
Potato (chips)	0,10	0,25	Shirt	0,39	0,48
Shrimp	0,18	0,02	Socks	0,39	0,42
Shellfish	0,12	0,02	Shorts	0,11	0,35
Starters	0,09	0,01	Scarf	0,23	0,18
Chicken	0,09	0,04	Underpants	0,05	0,23
	Sports that are good for backache	Sports		Musical instruments that can fit in a travel luggage	Musical instruments
	OD	OD		OD	OD
Critical lures			Critical lures		
Yoga	0,59	0,02	Triangle	0,32	0,14
Basketball	0,03	0,57	Cello	0,16	0,36
Exemplars			Exemplars		
Swimming	0,83	0,55	Flute	0,98	0,67
Volleyball	0,06	0,39	Guitar	0,25	0,73
Pilates	0,41	0,02	Violin	0,51	0,54
Gymnastics	0,17	0,20	Saxophone	0,25	0,40
Horse-riding	0,06	0,11	Clarinet	0,29	0,17
Athletics	0,06	0,29	Viola	0,24	0,39
Walking	0,08	0,01	Tambourine	0,22	0,13
Judo	0,05	0,09	Trumpet	0,21	0,28
Running	0,08	0,02	Harmonica	0,19	0,05
Cycling	0,06	0,07	Xylophone	0,16	0,21

Continued

	Beverages that are usually consumed mixed with other ingredients	Beverages
	OD	OD
Critical lures		
Milk	0,35	0,22
Beer	0,16	0,43
Exemplars		
Water	0,44	0,78
Juice	0,30	0,66
Vodka	0,40	0,31
Wine	0,37	0,52
Coke	0,26	0,31
Gin	0,19	0,04
Coffee	0,16	0,09
Syrup	0,12	0,04
Lemonade	0,14	0,03
Sugarcane liquor	0,09	0,01

	Professions for people who enjoy travelling	Professions
	OD	OD
Critical lures		
Pilot	0,57	0,05
Physician	0,04	0,59
Exemplars		
Businessman	0,25	0,11
Architect	0,03	0,17
Journalist	0,16	0,06
Manager	0,12	0,14
Salesman	0,15	0,11
Actor	0,06	0,14
Politician	0,13	0,03
Driver	0,03	0,11
Truck driver	0,10	0,02
Researcher	0,09	0,05

	Kitchen objects that can be used to hunt a fly	Kitchen objects
	OD	OD
Critical lures		
Cloth	0,56	0,06
Fork	0,02	0,58
Exemplars		
Glass	0,34	0,30
Spoon	0,22	0,59
Frying pan	0,34	0,27
Pot	0,20	0,58
Spatula	0,20	0,09
Towel	0,15	0,08
Napkin	0,15	0,02
Cutting board	0,12	0,06
Dish tablecloth	0,15	0,02
Oven glove	0,12	0,02

	Vegetables that can be used to fan the face in a hot day	Vegetables
	OD	OD
Critical lures		
Leek	0,34	0,09
Broccoli	0,02	0,33
Exemplars		
Lettuce	0,78	0,66
Carrot	0,05	0,57
Cabbage	0,66	0,40
Spinach	0,15	0,23
Cress	0,07	0,17
Eggplant	0,02	0,09
Celery	0,05	0,03
Coriander	0,05	0,06
Zucchini	0,05	0,03
Turnip	0,05	0,06

	Animals that can be heard in a mountain area	Animals
	OD	OD
Critical lures		
Wolf	0,79	nd
Cat	0,02	0,73
Exemplars		
Bear	0,53	0,08
Dog	0,12	0,82
Eagle	0,47	0,05
Rat	0,05	0,20
Owl	0,37	0,02
Lion	0,07	0,36
Bird	0,33	0,15
Goat	0,23	0,05
Deer	0,09	0,02
Cow	0,05	0,14

	Fruits that can be played as marbles	Fruits
	OD	OD
Critical lures		
Cherry	0,58	0,25
Orange	0,26	0,59
Exemplars		
Grape	0,82	0,37
Apple	0,23	0,81
Plum	0,28	0,18
Blueberry	0,25	0,04
Tangerine	0,15	0,12
Strawberry	0,11	0,64
Blackberry	0,23	0,10
Medlar	0,11	0,07
Pomegranate	0,12	0,04
Litchi	0,11	0,01

Note. OD = Output dominance.

Table A3

Lists exemplars and critical lures for common and subcategory versions of taxonomic categories used in Experiment 2 in Chapter IV with their respective output dominance (translated from Portuguese).

	Common category name		Subcategory name
	Foods		Foods that is usually taken to winter holidays parties (Christmas and New Year's Eve)
Exemplars	OD	Exemplars	OD
Critical lure		Critical lure	
Fish	0,63	Raisin	0,56
Exemplars		Exemplars	
Meat	0,63	Cake	0,51
Fruit	0,57	Sweets	0,31
Bread	0,50	Shrimp	0,21
Pasta	0,35	Snack	0,21
Rice	0,34	Patty	0,14
Cake	0,30	Potato (chips)	0,11
Potato (chips)	0,26	Meat	0,11
Cookie	0,23	Shellfish	0,11
Vegetable	0,23	Chocolate	0,10
Chocolate	0,19	Croquette	0,10

	Common category name		Subcategory name
	Sports		Sports usually played by rich people
Exemplars	OD	Exemplars	OD
Critical lure		Critical lure	
Soccer	0,73	Golf	0,94
Exemplars		Exemplars	
Basketball	0,52	Tennis	0,67
Swimming	0,50	Horse-riding	0,32
Volleyball	0,33	Squash	0,14
Handball	0,31	Sailing	0,14
Tennis	0,26	Cricket	0,11
Athletics	0,23	Skiing	0,11
Gymnastics	0,17	Polo	0,08
Badminton	0,12	Surf	0,08
Dance	0,11	Diving	0,05
Horse-riding	0,09	Motocross	0,05

Continued

	Common category name		Subcategory name
	Clothes		Clothes to put on a basket for a pet to sleep on
Exemplars	OD	Exemplars	OD
Critical lure		Critical lure	
Pants	0,79	Wrap/blanket	0,58
Exemplars		Exemplars	
Coat	0,63	Sweater	0,56
T-shirt	0,46	Coat	0,26
Sweater	0,39	T-shirt	0,18
Shirt	0,34	Scarf	0,11
Skirt	0,34	Sock	0,08
Dress	0,34	Dress	0,05
Sock	0,30	Shawl	0,05
Shorts	0,23	Shirt	0,03
Top	0,17	Pajama	0,03
Scarf	0,12	Robe	0,03

	Common category name		Subcategory name
	Musical instruments		Musical instruments that can be used to contain dripping from the ceiling
Exemplars	OD	Exemplars	OD
Critical lure		Critical lure	
Piano	0,71	Saxophone	0,36
Exemplars		Exemplars	
Guitar	0,68	Guitar	0,35
Flute	0,58	Viola	0,31
Drums	0,57	Drum	0,24
Violin	0,41	Trumpet	0,19
Viola	0,34	Flute	0,17
Trumpet	0,30	Trombone	0,17
Cello	0,28	Cello	0,14
Harp	0,17	Drums	0,12
Clarinet	0,15	Tuba	0,12
Xylophone	0,15	Violin	0,12

	Common category name		Subcategory name
	Beverages		Beverages used in exotic cocktails
Exemplars	OD	Exemplars	OD
Critical lure		Critical lure	
Water	0,77	Vodka	0,75
Exemplars		Exemplars	
Juice	0,65	Rum	0,37
Wine	0,52	Juice	0,34
Beer	0,43	Martini	0,14
Coke	0,31	Whiskey	0,14
Milk	0,22	Malibu	0,13
Tea	0,13	Safari	0,13
Whiskey	0,11	Sugarcane liquor	0,11
Smoothie	0,10	Gin	0,11
Ice-tea	0,10	Liquor	0,11
Coffee	0,08	Tequila	0,09

Continued

	Common category name		Subcategory name
	Professions		Professions for people who enjoy travelling
Exemplars	OD	Exemplars	OD
Critical lure		Critical lure	
Teacher	0,60	Air-steward	0,58
Exemplars		Exemplars	
Physician	0,59	Pilot	0,56
Psychologist	0,45	Businessman	0,25
Lawyer	0,31	Journalist	0,16
Engineer	0,29	Salesman	0,14
Nurse	0,28	Politician	0,13
Architect	0,17	Manager	0,11
Manager	0,14	Truck-driver	0,10
Actor	0,14	Guide (tourist)	0,10
Sociologist	0,12	Researcher	0,08
Banker	0,10	Ambassador	0,07

	Common category name		Subcategory name
	Fruits		Fruits that can be played as marbles
Exemplars	OD	Exemplars	OD
Critical lure		Critical lure	
Apple	0,80	Grape	0,83
Exemplars		Exemplars	
Pear	0,69	Cherry	0,69
Strawberry	0,68	Orange	0,25
Banana	0,65	Plum	0,22
Orange	0,52	Blackberry	0,19
Pineapple	0,45	Tangerine	0,19
Mango	0,45	Walnut	0,13
Peach	0,31	Pomegranate	0,13
Kiwi	0,34	Blueberry	0,11
Melon	0,33	Strawberry	0,11
Cherry	0,30	Peach	0,11

Note: OD = Output dominance.

Appendix B – Remember / Know (/ Guess) instructions translated from Portuguese.

In Experiment 2 & 3 of Chapter III and Experiments 1 & 2 of Chapter IV:

For Remember responses: respond “Remember” if you recall having “physically seen the word as a clear event in your recent past. This recalling may be based in details of the moment you saw the word, such as specific associations that the word evoked (e.g., I remember seeing the word “cards” because it reminded me of my father that loves to play cards), sensory information (e.g., I remember the word “pizza” because it made me hungry) or even physical appearance of the word (e.g., I remember the word “sun” for being a very small word).

For “Know” responses: Respond “know” when you do not recall seeing the word clearly, but you feel a strong sense of familiarity with the word such that you consider that it was in fact in the lists.

In Experiment 1 of Chapter III and Experiment 2 of Chapter IV:

For “Guess” responses: Respond “guess” when the word does not give a strong familiarity feeling and you do not clearly recall seeing it on the lists, but you guess it might have been in the lists.