ISPA
INSTITUTO UNIVERSITÁRIO
CIÊNCIAS PSICOLÓGICAS, SOCIAIS E DA VIDA

"THE TRUTH IS NEVER PURE AND RARELY SIMPLE": UNDERSTANDING THE ROLE OF REPETITION AND PROCESSING FLUENCY ON THE ILLUSION OF TRUTH EFFECT.

Rita Rocha da Silva

Tese orientada por

Professora Doutora Teresa Garcia-Marques

ISPA – Instituto Universitário

Tese submetida como requisito parcial para obtenção do grau de

Doutoramento em Psicologia

Área de especialidade..... Psicologia Cognitiva

2014

Tese apresentada para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Psicologia na área de especialização de Psicologia Cognitiva realizada sob a orientação de Teresa Garcia-Marques, apresentada no ISPA - Instituto Universitário no ano de 2014.

O presente trabalho foi financiado pelo Programa Operacional Ciência e Inovação (POCI 2010) da Fundação para a Ciência e Tecnologia (SFRH/BD/ 39153/ 2007).

Acknowledgments

My “thank you” notes go especially to my supervisor, Tammy, for all the hard work and friendship throughout this process. And besides thanking her for the supervision of this work in particular and of my doctoral studies in general, I want to acknowledge all the opportunities that were put in my way, which are a reflex of the investment made in the development of my qualities and abilities as a researcher. This is something that I am really thankful for.

I also want to thank the big research family that I am very proud of belonging to. This includes all the friends and colleagues at ISPA, but also all the friends and colleagues at Faculdade de Psicologia da UL and at ISCTE-UL. Some of these people are now really dear friends of mine, and all the companionship that we find in each other throughout the years pays for all the harshness of a $p > .05$. There are a handful (plus one finger) of people that I want to mention particularly: Sofia, Ricardo, Sara, Alexandre, Mariana and João.

Finally, I have to thank all the “not-nerdy friends”, those that have been there since I was in high school and had braces on my teeth. And also those that I met after the braces were gone, and when I was already “almost finished” with the PhD. I want to thank even those guys that in the end started to ask me “When are you finished? You’re writing that thing ever since I met you!” Together with the research family, you kept me sane and happy!

And of course, thank you Killa, mom and dad, Tobias, Sushi and Cinza. Just because family!

Palavras-chave:
Ilusão de verdade; repetição; familiaridade; fluência de processamento.

Key words:
Illusion of truth; repetition; familiarity; processing fluency.

Categorias de Classificação da tese

PsycINFO Classification Categories and Codes:

2300 Human Experimental Psychology
    2340 Cognitive Processes

3000 Social Psychology
    3040 Social Perception and Cognition

ABSTRACT

Repetition seems to increase the truth-value of information, generating the illusion that repeated statements are more valid than things we never heard or read before – the *illusion of truth effect*. The present thesis aims at providing further and clearer understanding of "why" and "how" we base the important decision of something we hear being true rather than false on repetition. We review the literature evidencing repetition's impact on judgments of truth and the major cognitive mechanisms that have been proposed to explain it. The first studies investigating the mechanisms underlying the effect show that subjective familiarity is more important than actual frequency of exposure. These approaches further suggested that the automatic memory component of Familiarity has a rather involuntary impact in truth judgments, and is the one supporting illusions of truth when the controlled Recollection process is impaired. A next approach showed that processing fluency experiences promoted by factors unrelated to previous exposure and memory are sufficient to generate illusions of truth. The first accounts suggesting processing fluency to be the process underlying the truth effect maintained the idea that the feelings of familiarity mediate fluency effects on judged truth. However, a more recent approach argues that fluency is an ecologically valid cue for truth, and thus fluency *per se* directly influences truth judgments, with no need for memory attributions. Drawing from this previous body of knowledge, we pose the question of whether there is something special in the relation repetition has with truth. Some evidence in the literature may suggest so, for example, the fact that illusions of truth have a higher magnitude when they are induced by repetition than when other fluency sources are used. Additionally, repetition has the unique characteristic of aggregating both perceptual and conceptual fluency, which may add an "extra" layer to the association with truth. Exploring these questions, we present three independent papers exploring the differences that may exist between repetition and other factors also able to impact truth judgments, and the relevance that repetition's unique characteristics may have in the shaping of the truth effect. In the first paper we demonstrate that the association of repetition with truth is more difficult to reverse than when pure perceptual fluency (e.g., color contrast) is manipulated, and that the confounds between the processing experiences and resulting effects on truth judgments the two variables promote can be dissociated. In the second and third papers, we isolate the conceptual and perceptual components involved in repetition, showing that conceptual overlap (a match in the content and meaning) takes precedence over the sharing of perceptual features in the generation of illusions of truth. Only when individuals no longer can access the specific meaning of what was previously presented do perceptual fluency effects emerge. We discuss how our findings integrate and expand what was previously known about judgments of truth, addressing the contributions and clarifications they bring to the main cognitive mechanisms that have been proposed to explain the effect.

Keywords: Illusion of truth; repetition; familiarity; processing fluency.

Index

Index of Figures

Index of Tables

Section I
Literature Review

"It's no wonder that truth is stranger than fiction.
Fiction has to make sense."
Mark Twain (1835-1910)

"The Truth is Never Pure and Rarely Simple"

Deciding about the validity of the information we come across is at the core of many of our daily activities – choosing a software for the statistical analyses we need to do for work, voting for or against the implementation of a new public policy that has been under discussion, start buying that dieting product everyone is talking about, or forcing our kids to eat liver because everybody says it's highly nutritive. And because this is such a ubiquitous decision in our life, understanding the process by which we come to it is integral to understanding of why we hold the attitudes we hold, why we make the choices we make, and even why we behave the way we do. But, as Oscar Wilde so elegantly put it on *The Importance of Being Earnest* (1895/2000), "The truth is never pure and rarely simple". There is not only one road for truth, nor are the paths to it so straightforward as we may think.

So, how do we decide that a given statement about reality is true or false? What leads us to believe the tour guide in a local Insect's Museum, when he tells us "It takes 20 days for a housefly to become a great-grandmother"? Well, for one thing, it could actually be that we know a thing or two about houseflies' sexual life habits, and then use that knowledge to infer that maybe less than a month is really enough for them to have a big family already (an inferential process such as syllogistic reasoning, Klauer, Musch, & Naumer, 2000). Or maybe we are specialists on insects' biology and can thus directly ascribe the truthfulness of the information the guide is giving us.

But what about the occasions when we lack knowledge about the topics that we hear about? Can we still decide whether a statement is true or false in those situations? Of course we can! But instead of knowledge, we use other types of information to help us make that decision. For example, when we hear the tour guide we may think, "well, if he is giving the tour he should know what he is talking about" (we use the person's expertise as a cue to infer he is giving correct information about reality, e.g., Chaiken & Maheswaran, 1994; Hovland & Weiss, 1951; Petty & Cacioppo, 1986). Even without making that inference, we might believe this person also because all the other people in the group are nodding to what the guide says, or because we hear all the other guides we pass by in the museum saying the same (we often use social consensus to help us come to a judgment, and we tend to comply with the behavior and/or opinions expressed by a majority; e.g., Asch, 1951; Festinger, 1954; Goldstein, Cialdini, & Griskevicius, 2008).

But besides using relevant knowledge and/or the clues available in the social environment, it seems also that we tend to simply believe a statement as we hear or read it, pretty much as we accept that an object exists in the moment we see or touch it. That is, *understanding* an assertion about reality seems to implicate *accepting it* as true (Spinoza, 1677/1982). And while this acceptance is rather effortless, following automatically from understanding the claim, categorizing information as false entails an extra step, which consumes our time and (cognitive) energy (e.g., Gilbert, 1991; Gilbert, Krull, & Malone, 1990). So why not just believe that trivial fact about the domestic houseflies? But surprisingly, we may also believe a statement just because it is something we heard before, because it is a story that we have encountered repeatedly in our lives (e.g., Bacon, 1979; Hasher, Goldstein, & Toppino, 1977).

Repetition seems to increase the truth-value of information, generating the illusion that repeated statements are more valid than things we never heard or read before. Hasher and colleagues (1977) were the first to empirically demonstrate this *illusion of truth effect,* and since then a considerable body of evidence about this effect has been growing in the literature (see the meta-analytic review by Dechêne, Stahl, Hansen, & Wänke, 2010). Because "repetition is an illogical basis for truth" (Begg, Anas, & Farinacci, 1992, p. 446), as simply repeating a claim does not bring further or less factual support for it, many authors became interested in understanding why repetition informs us about the validity of information; what processes lye behind this effect?

The present thesis aims at providing further and clearer understanding of "why" and "how" we base the important decision of something we hear being true rather than false on repetition. For that, we review the literature evidencing repetition's impact on judgments of truth and the major cognitive mechanisms that have been proposed to explain it. Drawing from this previous body of knowledge, we present three independent papers exploring the differences that may exist between repetition and other factors also able to impact truth judgments, and the relevance that repetition's unique characteristics may have in the shaping of the truth effect. Finally, we will discuss how our findings integrate and expand what was previously known about judgments of truth, addressing the contributions and clarifications they bring to the main cognitive mechanisms that have been proposed to explain the effect.

Chapter I: The Illusion of Truth Effect

Repetition affects many of our judgments and decisions about reality. The most obvious and direct ones are memory judgments. Ebbinghaus' (1885/1913) seminal experiments about the rate of learning and forgetting of information already clearly showed that the more times we practice a list of items (in his experiments he used nonsense syllables) in one day, the less repetitions we need to perfectly recall it on the following day. This was the first demonstration of a memory retention curve, and since then the effects of repetition on memory have been studied and extended to memory judgments beyond recall or recognition, which directly probe memory for the previous presentation of a target stimulus. For example, repetition positive impact on memory performance has also been evidenced in indirect, implicit memory tests such as word fragment completion (e.g., Tulving, Schacter, & Stark, 1982; these tests are called indirect because instead of asking participants to complete the fragment with a word that was presented in a list they studied before, they they ask them to complete it with the first word that pops in their minds). Thus, even in situations when the effects of repetition cannot be traced in direct memory queries, they may manifest in indirect measures.

Previous presentation also impacts "non-related to memory[1]" judgments. For example, simply being exposed to a set of neutral and ambiguous stimuli, like Chinese ideographs that we have no idea regarding what they mean, will make us prefer them over equivalent stimuli that we have not seen before (the mere exposure effect, e.g., Bornstein, 1989; Zajonc, 1968). Repetition of persuasive arguments also leads us to agree more with the attitudinal position they stand for, specially when the persuasive messages are not processed profoundly (e.g., Garcia-Marques & Mackie, 2001; Moons, Mackie, & Garcia-Marques, 2009).

And repetition impacts our judgments regarding the truth-value of a statement about reality (e.g., Bacon, 1979; Begg, et al., 1992; Hasher, et al., 1977). The impact of repetition on the perceived truth of a statement became known as the *illusion of truth effect*, or simply truth effect. The truth effect shows **repeated statements are considered more valid and believed more than new ones and independently of their original truth status** (e.g., Bacon, 1979; Begg, et al., 1992; Hasher, et al., 1977).

[1] For some authors, these judgments are indirect measures of memory. See for example Seamon et al. (1995) for evidence of explicit vs. implicit memory dissociations in the mere exposure effect.

Illusions of truth were originally identified by Hasher, Goldstein and Toppino (1977), and their empirical approach set the basis of the experimental paradigm that is still used nowadays to understand the underlying processes. Their interpretation of the effect, based on frequency of occurrence serving as a criterion for truth, also set the tone for the following theoretical accounts of the mechanisms involved in judgments of truth. Because of the relevance of that first study for the forthcoming approaches, we begin this chapter by carefully examining Hasher and colleagues' original experiment. We then attest the reliability of the truth effect by showing the many replications that have been accomplished in different laboratories while trying to explain the processes involved.

The Pioneer Study and the Establishment of the Basic Experimental Paradigm

Hasher, Goldstein and Toppino (1977) were the first to empirically demonstrate the truth effect. With this pioneer experiment, the authors wanted to understand how individuals judge the truth-value of statements when they have no actual knowledge about the facts being claimed. They proposed that frequency of occurrence could be the criterion people use in such situations, as there was wide evidence in the literature that repetition influenced memory measures such as recall and recognition (e.g., Underwood, Zimmerman, & Freund, 1971), and also that people are relatively good at judging the frequency of occurrence of events in an experiment (e.g., Hintzman, 1969), as well as of events in the real world (e.g., pairs of letters, Underwood, 1971).

In order to test this hypothesis, they presented college students with a set of 60 statements at three different occasions, each separated by an interval of two weeks. Half of the statements in the list were true and half were false, and they were about a variety of topics (e.g., sports, politics, arts). The statements were all plausible, but it was rather improbable that most college students had knowledge regarding their truth status. Participants' task was to hear each of the statements and rate how sure they were that it was true or false in a 7-point rating scale (1 – Definitely False; 2 – Probably False; 3 – Possibly False; 4 – Unsure; 5 – Possibly True; 6 – Probably True; 7 – Definitely True). Twenty of the statements were randomly selected to appear in all of the three experimental sessions (i.e., they were presented in the first session, and then repeated in the second and in the third sessions), together with other 40, always new, statements. The results of this experiment showed evidence of an increase in perceived validity with repetition in two ways: (1) repeated statements tended to

be evaluated as more probably true after each repetition, and (2) repeated affirmations were systematically considered truer than the new ones. These findings, which were obtained both for factually true as for factually false items, led the authors to conclude that indeed frequency of occurrence "served as a criterion of certitude" (p.112) that a statement was true.

Besides presenting the first empirical demonstration of the effect of repetition on judged truth and the first theoretical account for it, this experiment laid the fundamental characteristics of the experimental paradigm that is used to study illusions of truth. The basic routine of a truth effect experiment encompasses two different, subsequent phases: the *exposure phase* and the *truth evaluation phase*. The goal of the exposure phase is to familiarize participants with part of the statements that they will subsequently judge for truth, that is, the statements that will be repeated later in the evaluation phase of the experiment. In this first phase, participants are presented with a set of statements that are ambiguous regarding their truth status, that is, statements that have an equal probability of being considered true as of being considered false. It is necessary to use such type of material so to isolate repetition effects from other variables know to affect truth judgments, and also to guarantee that the stimuli are vulnerable to repetition effects (e.g., if individuals have factual knowledge about the claims, then they will answer on the basis of that knowledge and their responses become immune to the impact of repetition, Dechêne, et al., 2010; Unkelbach, 2007). Another reason to use ambiguous, trivial statements lays in the fact that personally relevant stimulus might also not be susceptible to the effects of repetition (Bacon, 1979). In order to reduce guessing in participants' responses (which is highly probable due to the ambiguity of statements), the instructions that are given in this phase usually stress that half of the statements are true and half are false (e.g., Bacon, 1975; Hasher, et al., 1977; Unkelbach, 2007), although this is less relevant if a high number of statements are presented (e.g., Hawkins & Hoch, 1992). To justify this first exposure to the statements, it is common to ask participants to perform a simple and unrelated to truth task, such as rating how interesting are the topics covered by the statements (e.g., Begg, et al., 1992), or how comprehensible are the sentences (Hawkins, Hoch, & Meyers-Levy, 2001). But, just like in the seminal experiment (Hasher et al., 1977), authors may ask for truth ratings immediately in the exposure phase (e.g., Dechêne, Stahl, Hansen, & Wänke, 2009).

The *truth evaluation phase* is the moment when the perceived validity of the statements is measured, in order to assess the effects of repetition. To do this, participants are asked to evaluate statements that were presented in the exposure phase (i.e., repeated

statements) mixed with totally new ones. These evaluations can be done either in rating scales similar to the one used in Hasher's (1977) study (e.g., Bacon, 1979, used the same scale but inverted its direction, while Brown & Nix, 1996, and Parks & Toth, 2006, used a 6-point rating scale), or using simple dichotomic measures in which participants have to decide whether each statement is either true or false (e.g., Unkelbach, 2007). In this phase of the experiment, evaluation of the statements can occur in one of two different contexts: a heterogeneous context and a homogenous context. In the heterogeneous context, the more commonly used, participants evaluate a mixed list of repeated and new statements (e.g., Arkes, Hackett, & Boehm, 1989; Hasher et al., 1977; Bacon, 1979; Begg, et al., 1992; Unkelbach, Bayer, Alves, Koch, & Stahl, 2011), and thus the truth effect is analyzed in a comparison between the truth ratings given to repeated items and to new items – a between-items criterion (Dechêne et al., 2010). In the homogeneous context, participants decide about the truth-value of the same set of statements; they evaluate only repeated items (e.g., Dechêne et al., 2009; Hawkins & Hoch, 1992; Schwartz, 1982). Here, the truth effect is analyzed in the comparisons of the first truth ratings given to the statements with the subsequent ones – a within-items criterion (Dechêne et al., 2010).

Reliability and Validity of the Illusion of Truth Effect

In their recent meta-analysis, Dechêne and her colleagues (2010) reviewed the many different conditions under which illusions of truth have been observed, showing it to be a medium-sized effect both when it is measured by between-items (d = .49, 95% *CI*: [.45 – .55]) or within-items comparisons (d = .39, 95% *CI*: [.32 – .47]).

Attesting to its reliability, the truth effect truth is observed not only with trivial facts about reality but also with marketing messages (e.g., Hawkins et al., 2001), claims about products (e.g., Skurnik, Yoon, Park, & Schwarz, 2005), or messages representing an individual's opinion (e.g., Arkes et al., 1989), and both in and outside controlled laboratory contexts (e.g., Gigerenzer, 1984). The effect is robust enough to emerge even when the time participants have to read the statements for the first time is constrained to as little as 1 s (e.g., Unkelbach, 2007), and also when the delay that exists between the exposure and the truth evaluation phases is as long as 1 or 2 weeks (e.g., Bacon, 1979; Gigerenzer, 1984; Hasher et al., 1977; Henkel & Mattson, 2011), or even 1 to 3 months (e.g., Brown & Nix, 1996). The reliability of repetition's effect is further ascertained by the lack of specificity of illusions of

truth to a modality of presentation – that is, repetition increases perceived validity both when items are presented auditorily (e.g., Gigerenzer, 1984; Hasher et al., 1977) or visually (e.g., Arkes et al., 1989; Begg et al., 1992; Hawkins & Hoch, 1992), and when there's a mixture between the two (i.e., the exposure phase is auditory and the evaluation phase is visual; e.g., Bacon, 1979; Begg & Armour, 1991; Unkelbach & Stahl, 2009).

In summary, the illusion of truth effect seems to be quite reliable and robust to the variations that are introduced in the basic experimental paradigm. The fact that it has been shown under such a diversity of conditions evidences how pervasive this effect of repetition is.

However, the relevance of the different conditions under which the effect was tested goes much beyond simply stating its reliability and pervasiveness. The changes that were progressively introduced in the experimental paradigm were created to test different explanations for the phenomenon. Since the first demonstrations of the effect that researchers have tried to understand *why and how* a statement that is repeated shines as more valid and true than something we hear or read for the first time. Being an effect that arises with repetition, memory processes were soon proposed as the mechanisms responsible for it. In the next chapter we review the most important points of such accounts.

Chapter II: Illusions of Truth as Memory Phenomena

Since the initial study documenting the truth effect (Hasher et al., 1977) that memory processes have been advanced as the mechanisms underlying illusions of truth. Remember that Hasher and colleagues (1977) suggested that memory for frequency of occurrence was the mechanism that led participants to consider repeated statements more valid than new ones. However, except for the effect of repetition itself, the authors did not present evidence that could directly and without doubts support such claim. But the challenge was made, and not long after the group of researchers self-presented as Bacon (1979, which was led by Ian Begg) carried out a study that would definitely establish the relation of the truth effect with memory, focusing on attributions to memory and the subjective feeling of familiarity.

The Memory Account and Subjective Familiarity

Just as Hasher and colleagues (1977) proposed, Bacon (1979) also believed that a memory attribution was the cause behind repeated statements' ring of truth. However, they disagreed from the previous approach, in that they proposed that the simple recognition of a statement from a previous occasion would be sufficient for the effect to emerge. That is, they hypothesized that the criterion of certitude that Hasher and colleagues talked about came directly from the "subject's memory judgment concerning the test statement being rated, without the mediated and redundant process of estimating the frequency with which the statement has occurred" (p. 242). Simply acknowledging that a statement was repeated served as an assurance that it was true.

To test this hypothesis, Bacon (1979) asked participants to give truth ratings of repeated and new statements in two different occasions separated by 3 weeks. They added to the original design a condition in which participants made recognition judgments about the statements (i.e., decide if they were repeated from the previous session or if they were new) before rating them for truth. This condition was added to set apart Bacon's recognition-based account from Hasher's frequency of occurrence explanation. If Bacon was right and truth is inferred from recognition decisions, then statements judged as old should be considered more valid than statements judged as new, independently of their actual frequency of occurrence in the experiment. And that was exactly what happened: statements that were recognized as being repeated were rated as truer than statements that were judged as new, and this occurred

independently of the statements' real repetition status. That is, **ratings of truth were more sensitive to subjective familiarity than to objective repetition** (or frequency of occurrence). This means that even new statements were considered more probably true if they were wrongly recognized as being repeated from the previous session.

These results suggested that individuals believe the things they remember (even if it's only falsely remembered), the things that they believe to match the content they have in the memory trace. It means that individuals have what Bacon (1979) described as "a bias toward believing the information that they possess" (p. 248), or simply deem to possess. Being so, if individuals are presented with statements that contradict previous ones, they should judge them as false. This hypothesis was tested in a second experiment (Bacon, 1979, Experiment 2), in which participants rated for truth a list containing new statements, repeated statements, and statements that were contradictions of previously presented ones. Importantly, in this experiment, before giving their truth ratings participants had to classify the items either as new, repeated or changed statements. Supporting the thesis that individuals believe what they remember, **repeated statements were given higher truth-value than new statements, while contradictory statements were given less truth-value than new ones.** But even more, truth ratings depended more on the classification that participants made of the statements than on their real status as new, repeated or changed. So, again, **participants believed what they remembered (even if incorrectly), and considered false what contradicted the information they had (or thought they had) in memory**. In summary, this first evidence regarding memory role on illusions of truth suggests that besides the matching between the information that is presented and the information that is activated in memory ("real" memory), also **only *believing* that the information is in our memory trace increases the truth-value of statements**.

Begg, Armour and Kerr (1985) gathered further support for the memory account, suggesting that the perceived validity of a statement depends on any relationship between the information it presents and the information that it activates in memory. For their first experiment, Begg and colleagues (1985) found inspiration in evidence showing that we tend to remember the general meaning or topic of a message more than its details (e.g., Bartlett, 1932; Begg & Wickelgren, 1974; Sachs, 1967). This led the authors to question whether memory of only the topic of a statement would be enough to promote illusions of truth. Their specific hypothesis was that if the truth-value of a target statement depends on the extent to which the content of that statement matches with information we have in memory (e.g.,

Glucksberg & McCloskey, 1981), then statements with familiar topics should be considered truer than statements with unfamiliar topics. They tested this idea by asking participants to study a list of topics (e.g., "A hen's body temperature", or "The Statue of Liberty") in the exposure phase. Afterwards, participants rated for truth a list of statements, half of which were facts about the familiar topics (e.g., "The temperature of a hen's body is about 104 degrees Fahrenheit", or "The extended right arm of the Statue of Liberty is 42 feet long"), and half were facts about unstudied topics. And as expected, **statements regarding familiar topics were indeed evaluated as more probably true than statements about new topics.** However, this effect was smaller than the one obtained in a condition where the entire statements were repeated instead of only their topics. The authors attributed this result to the fact that a literal repetition of a statement renders it more familiar, because besides repetition of the topic there's also repetition of the factual details that were provided in the first encounter with the statement. That is, there is a larger *overlap* between the information that is presented at test and the information that is activated and accessed in memory.

To test that prediction, Begg and colleagues (1985) designed a second experiment in which participants first had to answer (with yes or no) a list of questions that where either relevant or irrelevant questions about the facts they would later judge for truth. For example, for the statement "The extended right arm of the Statue of Liberty is 42 feet long", the relevant question would be "Do you have any idea how long the extended right arm of the Statue of Liberty is?" and the irrelevant question would be "Do you have any idea how long the Statue of Liberty has been in New York?". The rational for this manipulation was that relevant questions provided almost all the same information as test statements. Thus, statements with relevant questions should be considered truer than test statements about which irrelevant questions had been asked, because there was more overlapping with memory content. By the same token, new statements (i.e., about which no questions had been asked) would have the lowest truth-value of all. Results were perfectly aligned with the authors' hypothesis – **statements associated with a question providing almost all the information they contained were considered truer than statements associated with questions that did not provide such overlap of information.** These, in turn, were considered truer than totally new statements, providing more support that the truth-value of information depends on how much it agrees with what we have stored in memory.

The impact of the overlap between a statement's content and the information that is activated in memory on judgments of truth was tested in a different way in two other

experiments (Begg's et al., 1985, experiments 3 and 4). Bacon (1969) showed that the information we have in memory (or believe we have in memory) is held as true – remember that in his experiment statements that were considered as contradictions of previously presented ones were judged as less true than even new statements. So Begg and collaborators (1985) hypothesized that information that is presented with a tag casting doubt about its veracity should be encoded to a lesser degree than information with a tag that inspires confidence in its truthfulness. This should result in "doubtful" statements being considered less true than "trusting" statements when encountered a second time, supposedly because there is less information being accessed in memory, and hence less information matching the target statements' details. However, statements that had been presented with the doubtful tag should still be considered more valid than totally new statements. This is because these items create some level of familiarity (at least with the topic), while there was no overlap whatsoever between the information presented by a new statement and what is activated in memory. To test this hypothesis, in the exposure phase of the experiments, statements were preceded either by a positive (e.g., "It is frequently said that"; "It is commonly believed that") or a negative (e.g., "It is rarely said that"; "Few people believe that") biasing comment. Then, participants evaluated the truth of new and repeated statements (without the biasing introductions), and also indicated if they recognized each statement from the previous phase (yes/no decision, made for each statement immediately after its truth evaluation). The key results showed that, although participants were able to discriminate old from new statements equally well for positively and negatively biased statements, **they considered positively biased statements truer than negatively biased ones, which in turn were considered truer than new items**. With this, the authors concluded that even though the familiarity with the topic was enough to set apart repeated statements from new ones, a positive vs. negative bias affected the extent to which the details of the information were encoded. Thus, according to the authors, the truth ratings were based on memory for the facts and not on the biasing comment that accompanied repeated statements, otherwise the negative biased statements would be considered the falsest of all (and not the new statements). These results were interpreted as strengthening the thesis that the more information we remember about a statement, the more we will consider it valid and true. It is worth to notice, however, that the premises on which this conclusion was built – that the details of information pre-tagged as untrustworthy are not deeply encoded, cannot be directly tested or assessed in the data of this experiment, and so there is no support for them.

Begg and Armour (1991) looked for further evidence concerning the effect of biasing comments in determining how much is learned about a particular statement, and its consequence for truth judgments. They focused on the refutation of an alternative interpretation for their previous results – that the biasing comments were themselves remembered by participants, thus leading positively biased statements ring as truer. The results of their three experiments disconfirmed that alternative interpretation, showing that indeed participants did not remember the biases introduced in the statements, particularly the negative ones. However, **although the nature of the positive vs. negative biasing comments associated with a statement was not remembered, negatively biased statements were considered less valid than positively biased ones**. For this, the authors concluded that the previous interpretation of their results was valid, and the reason why negatively biased statements were considered less true than positively biased ones had to be the smaller degree of matching between the tested statements and how much of them had been encoded. However, there was also evidence of the strong association between recognition and the inference of truth that Bacon's (1979) work had already suggested. **Statements that participants judged to be repetitions were the ones judged as more probably true; statements judged to be contradictions of previous ones were the statements considered as more probably false; and the statements judged to be new were in between the other two**. And like Bacon (1979) had found, this association between recognition and judged truth was independent of the statements real repetition status. So, although the existence of an objective match between judged statements and memory content generates illusions of truth, it does not seem to be a necessary condition for the effect. These results stress again the importance of subjective familiarity with the statements in detriment of objective prior exposure to them. The agreement between the information presented in the tested statements and the information that is remembered does not need to be real, but only perceived.

The relevance of subjective familiarity for illusions of truth was also shown by Arkes, Hackett and Boehm (1989). In the first experiment of this paper, statements believed to be repetitions were rated truer than those believed to be new. This happened independently of statements' actual repetition status, and even for statements that were initially endorsed as false in a previous pre-test of the material. In this experiment, the authors also demonstrated that perceived repetition increased evaluations of truth of statements representing opinions about topics in which individuals are usually interested and have strong feelings about (e.g.,

death penalty, abortion). This means that the effect of repetition and perceived familiarity in truth judgments is so general and broad that it affects not only neutral and ambiguous statements, but also claims that we don't consider true accounts of reality, and even opinions about matters that we feel strongly about.

In a second experiment more support was gathered for the role memory plays in the truth effect, by testing yet another implication of the memory account. The logic followed from studies showing that people who are highly knowledgeable about a topic remember much more from a text passage about that topic than do less knowledgeable individuals (e.g., Chiesi, Spilich, & Voss, 1979). These findings are very much in line with the mechanism proposed by Begg and his collaborators (Begg et al., 1985; Begg & Armour, 1991) just outlined above. So, in this experiment, Arkes and collaborators (1989, Experiment 2) asked participants to rank the knowledge they had regarding the topics covered by sentences they would later rate for truth. They predicted that topics about which participants had less knowledge would be less well remembered, and therefore repetition would be less able to increase the truth-value of those statements. Accordingly, results showed that **the effect of repetition did not emerge for topics about which participants declared to have less knowledge**. Only for statements that participants considered themselves to be highly or moderately familiar with (i.e., topics they had high or moderate knowledge about) did repetition increase ratings of perceived truth. These results were backed-up by Boehm (1994, Experiment 3), who used a more objective measure of participants' knowledge level. Instead of using individuals' self-reports, Boehm (1994) used participants' expertise area (i.e., participants were university students, so their study field was used to operationalize expertise). Despite this change, results replicated what had been found before: **repetition impacted positively ratings of truth only for those participants who were experts in the topics of the statements**. Both authors interpreted these effects as evidence that knowledge increases detailed memory for a topic. As there is a high overlap between the information we have stored and the content of a statement pertaining to a topic we know a lot about, its truth-value increases. However the authors never tested if the overlap really occurred or if it was only a subjective belief that it did, which would fit the previous results offering an alternative explanation based on perceived familiarity instead of real memory activation.

The empirical evidence reviewed here shows in a clear way that memory plays a role in illusions of truth, either when its content is truly activated or when memories are false. In

this second case, a subjective feeling of familiarity (rather than objective pre-exposure to the statements) seems to support truth evaluations.

Memory as a heuristic. In the view of both Arkes and colleagues (1989) and Begg and Armour (1991), the use of memory as basis for the decision about a statement's validity works as a heuristic. That is, a mental shortcut, or rule-of-thumb that allows individuals to make quick judgments and decisions about the stimuli they face under uncertainty (Newell, Shaw, & Simon, 1959; Tversky & Kahneman, 1974). For example, when judging the probability of events, individuals rely on the ease with which examples of those events come to mind – if we can easily remember many examples, the probability of those events occurring must be high (availability heuristic, Tversky & Kahneman, 1973). Thus, when judging the truth-value of ambiguous statements we rely on how familiar they are to us to make that decision, because apparently we believe that the information we hold in memory is true (Bacon, 1979).

The hypothesis that memory is used as a heuristic assumes even "imperfect memory" can affect truth judgments. Why do we rely so much in our "imperfect memory". This inspired a branch of research focusing on the role that different memory mechanisms may play in the truth effect.

Familiarity: The Automatic Memory Component Affecting Judged Truth

When we encounter a statement, two different routes from memory can be taken to inform us about its past occurrence and, consequently, its validity (e.g., Atkinson & Juola, 1973; Jacoby, 1991; Mandler, 1980). Those two routes are Recollection and Familiarity, which anchor in a dualistic approach to cognitive processing. According to this dual-process perspective, we can deal with information and come to our decisions about it via two distinct systems: System 1 and System 2.[2] Many theories have been put forward regarding the way these systems (or information processing modes) operate, and their descriptions of the two overlap in many characteristics. System 1 is described as a fast, automatic system, and which occurs pre-consciously (i.e., it needs only the individual to notice the stimulus in his context, and no deliberate goal or intention, Bargh, 1994). It's largely independent of the availability of cognitive resources and motivation to process, drawing on well-learned associations and an

[2] Different authors have used different names to refer to the two systems; here we use the terms introduced by Stanovich (1999).

implicit use of knowledge. System 2, on the other hand, is characterized as a slow, analytic process, being rule-based and conscious of the steps that are taken during the processing of the information. To be put in motion, this system requires that individuals have both cognitive capacity and motivation to analyze information (for comprehensive reviews, see Evans, 2003, 2008; Sloman, 1996, 2002; Smith & DeCoster, 2000).

In what respects to memory, these two systems are reflected in the recollection and familiarity components of recognition memory (e.g., Jacoby, 1991; Mandler, 1980). Recollection is the controlled memory component, based on system 2's type of operations. It is the mechanism involved in the explicitly recall of having heard a statement before, in the retrieval of the details of the information stored in memory, depending on participants' capacity and motivation to embark on that effort. On the other end, there's the experience associated with processing a stimulus that we have encountered in the past can originate a feeling of familiarity. This is a more automatic memory component, free from the need of cognitive resources and motivation, and the one present when we feel that we have read that statement before, although we can't exactly recall it (see Yonelinas, 2002, for a review on the two memory components).

Begg and colleagues (1992) tested how these two independent memory components contribute to our evaluations of truth. Applying the *Process Dissociation Procedure* (PDP) introduced earlier by Jacoby (1991; Jacoby, Toth, & Yonleinas, 1993) in the context of recognition memory, the authors separated the controlled influence of recollection of information about the reliability of a source from the automatic impact of familiarity rising from the previous exposure to a statement. The authors showed that illusions of truth anchor in the unintentional effect of familiarity, being independent of explicit memory processes. To be able to estimate the controlled and automatic components of processing, they created inclusion and exclusion testing conditions for the truth ratings task. To do this, statements in the exposure phase were paired either with a true or false source. An inclusion condition is the one in which recollection and familiarity have the same effect on the judgment, they lead to the same decision. So, when a statement is originated by a credible, truthful source, both recollection of that source information and the familiarity with the repeated statement will lead to the evaluation that the statement is true. By opposition, exclusion conditions pair statements with unreliable, distrustful sources, leading to different recollection and familiarity decisions. In these conditions, a statement will only be considered true if familiarity's bias for truth is not opposed by the recollection that the source is not credible. Said in another way,

old statements from true sources can be judged true based both on their higher familiarity level and on the correct recollection of the source. On the other hand, old statements from false sources can only be considered true if participants can't recollect the source that presented them and the judgment is solely based on familiarity. Thus, when controlled processing is not impaired and recollection can be used, statements of the true source should be judged truer than statements from the false source, with the difference between the two ratings reflecting source recollection. If controlled processing is impaired, that difference is expected to decrease because participants will base their evaluations on familiarity, and as both sources' statements are repeated they are equally familiar. Impairment of the control component should also lead to a greater difference between the ratings of old false statements and new ones, as source recollection is not available and judgments are made solely on the basis of familiarity, which is less for new items.

Begg and colleagues (1992) tested these predictions by impairing participants' controlled processing during the exposure phase of the experiments, and therefore reducing the probability that information about the credibility of the sources was properly encoded and stored in memory. In one of the experiments (Experiment 3), they did this by presenting the source credibility information (association of a male vs. female source with truth vs. falseness) only after the statements and respective sources had been studied in the exposure phase. As the authors expected, participants' ability to discriminate statements from true and false sources was greatly reduced in this condition as compared to a condition in which information about the source was given together with the statements. This was visible both in the lack of difference between the truth ratings to true and false statements (which were both considered truer than new statements), and in the memory-for-source test in which participants' performance was only at chance level. Furthermore, after computing the recollection and familiarity components of participants' judgments, they found that only recollection was affected by the manipulation – that is, only recollection was significantly decrease when the source credibility information was delayed, as compared to when it was presented immediately with the statements. This result regarding the estimation of the two memory components is clear evidence of the unintentional nature of familiarity's impact on rated truth, as it remained constant across different processing conditions. These general results were replicated in another experiment (Begg et al., 1992, Experiment 4). Here, the authors used a different procedure to strengthen memory for the sources, and controlled processing was impaired by asking participants perform an arithmetic task at the same time

they studied the statements (cognitive overload condition). As in the previous experiment, **old true and old false items were judged equally true in the overload condition, because participants were unable to recollect the source of the statements**. Plus, **the magnitude of the truth effect (i.e., the difference between the ratings given to old and new statements) even increased** compared to the condition where participants had full capacity, making clear familiarity's strong impact. The results regarding recollection and familiarity's estimates were also congruent with the previous experiment, as again only the controlled component of the judgments was affected by divided attention, while the automatic component suffered no impact.

The study by Begg and colleagues (1992) was paramount in showing that previous exposure has an unintentional impact in our truth assessments. Even more, it suggests that *the feeling of familiarity is the component supporting illusions of truth,* and that recollection is the component that can prevent them from arising (as when participants' processing was not impaired, false source statements were not considered as valid as true source items were).

Several other studies explored the relationship between the automatic component of memory and truth judgments by asking for evaluations of truth in experimental settings designed to affect controlled memory processes. One example is the study by Hawkins and Hoch (1992), investigating how participants' level of processing affects the magnitude of repetition's effect on perceived truth. In one experiment, they put participants either in a high-involvement condition (performing truth ratings) or a low-involvement condition (rating how difficult statements were to understand) during the exposure phase. The rational behind this manipulation was that individuals under low-involvement conditions are less susceptible to think deeply about the statements they are reading and less prone to generate their own thoughts about it. Thus, these participants should be more affected by the mere feelings of familiarity in the later truth evaluation task. In that phase, participants were also asked to provide recognition judgments for each statement in order to investigate memory's mediating role in the effect. The results showed that **participants in the low-involvement condition presented poorer recognition performance, but a greater truth effect, suggesting that the higher truth ratings found for these individuals were promoted by the automatic familiarity component** (otherwise, participants would have been able to correctly recollect the statements they had been exposed to). In fact, these results are close to what Begg and collaborators (1985) found in one of their experiments (Experiment 4) – meaningful processing of the items in the exposure phase led to better recognition performance, but it did

not change de size of repetition's effect as compared to lower processing levels.

Adopting a dual-process perspective similar to Begg's and colleagues (1992), Garcia-Marques and Silva (2014) have also tested the impact that conditions favoring a deeper vs. more superficial processing mode have on the truth effect, expecting superficial processing conditions to be more favorable for the occurrence of illusions of truth. They manipulated both capacity and motivation to process information accurately (conditions which, as we saw above, constrain the engagement in System 2's type of deeper processing operations). However, differently from previous studies (e.g., Begg et al., 1992), those manipulations were implemented only in the truth ratings phase, so to clarify that the effect anchors on a retrieval mechanism. Thus, no constrains to processing were made during the first encoding of the statements. Their results show that although repeated statements were perceived as truer than new ones in all experimental conditions, the magnitude of the effect was significantly reduced when participants had both high capacity and high motivation to process information carefully and could engage in system 2 type of analytic processing. This evidence again suggests that an unintentional influence of familiarity contributes greatly to the truth effect, and that deep, controlled processing conditions lead individuals to reduce its relative impact.

The increased reliance on feelings of familiarity as a result of the impairment of resources in the retrieval phase (i.e., the truth ratings phase) was also evidenced in Brown and Nix's (1996) experiments. The authors varied the interval between the exposure and the truth evaluation phases from one week to three months, to understand how the increased vs. reduced capacity for recollecting a statement's true-false status would interfere with familiarity automatic impact on judged truth. Contrary to Begg and colleagues (1985) who used ambiguous biasing comments (as they only said things like "the majority of people does not believe that", thus not stating clearly whether a claim was true or false), Brown and Nix (1996) provided clear and unmistakable feedback about the truth status of each statement that was presented to participants. The manipulation of the interval between exposure and truth evaluation was a crucial characteristic of the study, because the passage of time degrades the memory trait and reduces the probability that the details about the statements, such as their tags as true or false, are recollected (sentences' wording details seem to be forgotten at faster time rates than their general meaning; e.g., Kintsch, Welsch, Schmalhofer, & Zimny, 1990). Consequently, results showed that old false statements were considered less true than new false statements at short intervals (one week), but equally true (in Experiment 2) or even truer (in Experiment 1) than new false statements at longer delays (three and one months,

respectively). Thus, **when recollection of statements' status as true or false was impaired due to the passage of time, participants' judgments were made on the basis of the familiarity felt with the items, leading to the higher perceived validity ratings of old false items after the long delay**.

In a similar way, Skurnik and colleagues (2005) also investigated the impact of longer vs. shorter delays between the exposure and truth ratings phases on the recollection component, and its consequence for truth evaluations. The authors eliminated the illusion of truth elicited by repetition just by warning participants which of the product claims they were going to read in a study list were false and which were true. However, this was only possible to do when the truth evaluations were made after a short delay (30 minutes) of reading the statements. **When the delay between the exposure and the truth evaluation phases was increased to three days, impairing Recollection of the details about the statements, participants exhibited a bias towards truth and misremembered and wrongly categorized false repeated statements as true.** These authors furnished further evidence regarding the role of familiarity as the component underlying illusions of truth by investigating the impact of number of repetitions and age of individuals on truth ratings. Repeating the product claims three times (vs. only once) eliminated the illusion of truth that had been observed in the 3-days delay condition, supposedly because more repetitions helped participants to accurately recollect which statements were true and which were false. However, this was true only for the younger adults in the study. The older adults continued to show a bias towards truth in the long-delay condition, even if the product claims and their false/true tag were repeated three times. This later result is in accord with evidence showing that with age, deficits in recollection increase, while familiarity is left practically unaffected (e.g., Light, Prull, LaVoie, & Healy, 2000; Luo & Craik, 2009; Lyons, Ghetti, & Cornoldi, 2010).

In sum, a considerable amount of evidence supporting the hypothesis that truth judgments anchor in an automatic component of memory relying on feelings of familiarity. This impact of familiarity is evident in the situations when system 2 controlled processing is restricted, due to the lack of cognitive resources or/and motivation (e.g., Garcia-Marques & Silva, 2014), which prevents, for example, the recollection of detailed source information (e.g., Begg et al., 1992; Skurnik et al., 2005).

A memory-based misattribution process. The use of memory as a heuristic for decisions about the truth-value of propositions (e.g., Begg & Armour, 1991) seems to anchor

in an automatic component of memory, familiarity. Feelings of familiarity seem to originate in the processing experiences associated with stimuli (Jacoby, Kelley, & Dywan, 1989). Research in the memory field showed that repeated stimuli are easier to process: repetition leads to better performance in the perceptual identification of words presented for very brief periods of time (e.g., Jacoby & Dallas, 1981), and it facilitates the identification of masked words that become progressively more visible (e.g., Feustel, Shiffrin, & Salasoo, 1983). This processing fluency is at the root of feelings of familiarity (Jacoby et al.,, 1989), a relation that is evident in studies showing false recognition of new words just because they are preceded by a related concept that facilitates their understanding (e.g., Jacoby & Whitehouse, 1989), and that predictions regarding the memorability of information are influenced by how easily items are processed (e.g., Begg, Duft, Lalonde, Melnick, & Sanvito, 1989). Jacoby and colleagues (1989) proposed that the attribution that is made regarding the experience of ease associated with a repeated stimulus is highly influenced by the processing goals individuals set and by context cues. In their words: "If their goal is remembering, subjects will correctly attribute fluency to the past. If their goal is judging temporal duration, the difficulty of a problem, or the flow of a paper, fluency resulting from the past is likely to be misattributed to goal-relevant aspects of the situation" (Jacoby et al., 1989, p. 399).

This impact of the judgmental-context characteristics is very well illustrated in a study by Whittlesea, Jacoby and Girard (1990), in which fluency was induced by means of repetition and the perceptual clarity of the stimuli. In their experiments, participants that were aware of the repetition factor but did not know that stimulus-clarity was also being manipulated judged the perceptually clearer items as more familiar. By the same token, those participants that knew about the clarity manipulation but ignored that some items were repeated presented the opposite attribution, judging repeated items as physically clearer. Congruently, when an individual's goal is to evaluate the truth-value of a statement, then the feelings of familiarity are misattributed to truth.

Begg and collaborators (1989; Begg et al., 1992) also proposed that the fluency associated with processing a stimulus promotes illusions of memory when the real source of fluency experience is not acknowledged. Feelings of familiarity can be caused by a variety of factors, and although we usually can separate them, we sometimes fail to do so. Our impressions about a stimulus do not automatically identify their sources, and so we fail to discount their influence and misattribute it to memory. Begg et al (1992) thus integrate this view with the perspective of memory as an attribution (e.g., Jacoby et al., 1989), suggesting

truth judgments to be an implicit memory measure which can capture the misattribution of fluency to truth via familiarity.

Source Dissociation Hypothesis

The proposal that illusions of truth result of an attribution process suggests that if we understand the correct source of our feelings of familiarity we may prevent their misattribution to truth. A similar hypothesis is suggested by Arkes and his collaborators (Arkes et al., 1989; Arkes Boehm, & Xu, 1991; Boehm, 1994). These authors proposed that when participants recognize a statement they might dissociate its repetition from a previous phase of the experimental context, misattributing it to an external source (e.g., hearing it from a friend, in the media, etc.). For these authors, it is not familiarity by itself that affects truth judgments; it is the perception that the statement has multiple sources (i.e., the present experimental context and an external source) that awards it validity. That is, individuals may interpret the familiarity they feel with the statement as a sign of *convergent validity*, which increases its perceived truth. Arkes et al., (1989) provided support for this hypothesis by demonstrating that statements were rated as more probably true when participants (falsely) "recognized" them from a context outside of the experiment (a misattribution) than when they attributed the repetition to the experimental setting (the true source). Although they found that **source dissociation was not necessary for the truth effect to emerge** (consistent with Bacon's, 1979, findings that if participants recognized a statement as being repeated from the previous sessions its truth-value would increase), source dissociation made the truth effect a lot stronger. A second experiment developed by, Arkes et al., (1991) suggested that source dissociation may have both a direct and an indirect impact on rated truth, by strongly influencing familiarity perceptions that then impact truth ratings. However, a set of experiments by Boehm (1994) showed that although source dissociation occurred, it was not necessary for illusions of truth to appear, nor did it impact their magnitude. This author's results only showed that familiarity was the relevant mediator between repetition and the inference of truth.

Thus, in general these findings suggest that **source dissociation is not a necessary condition for the truth effect, and it also does not impact the magnitude of the effect in a consistent manner.**

Chapter Summary

In this chapter we presented the first evidence of the illusion of the truth effect, showing that **repeated statements are considered more valid and believed more than new ones** (e.g., Bacon, 1979; Begg, et al., 1992; Hasher, et al., 1977). We revisited the first theoretical explanations for the effect, which explored the role memory processes play in repetition-based illusions of truth. The experiment testing these explanations showed that:

- Only *believing* that the information is in our memory increases the truth-value of statements (e.g., Bacon, 1979);
- Participants believed what they remembered (even if incorrectly), and considered false what contradicted the information they had (or thought they had) in memory (e.g., Bacon, 1979; Begg & Armour, 1991);
- Statements regarding familiar topics were evaluated as more probably true than statements about new topics (e.g., Begg et al., 1985);
- Statements associated with a question that provide almost all the information truer than statements associated with questions that do not provide such overlap of information (e.g., Begg et al., 1985);
- Although the nature of the positive vs. negative biasing comments associated with a statement was not remembered, negatively biased statements were considered less valid than positively biased ones, even though participants could not remember which statements had positive and which had negative bias (Begg & Armour, 1991);
- The effect of repetition did not emerge for topics about which participants declared to have less knowledge (e.g., Arkes et al., 1989);
- In overload conditions, old true and old false items were judged equally true in the, because participants were unable to recollect the source of the statements (e.g., Begg, 1992);
- Participants in the low-involvement condition presented poorer recognition performance, but a greater truth effect, suggesting that the higher truth ratings found for these individuals were promoted by the automatic familiarity component (Hawkins & Hoch, 1992);

- After a long delay, old false items were considered truer than new false statements, because recollection of the statements' true vs. false status is hindered by the passage of time (e.g., Brown & Nix; Skurnik, et al., 2005);
- Source dissociation is not a necessary condition for the truth effect, and it also does not impact the magnitude of the effect in a consistent manner (e.g., Arkes et al., 1989; Boehm, 1994).

From this set of results it is clear that subjective familiarity is more important than actual frequency of exposure, (e.g., Arkes, et al., 1989; Bacon, 1979; Begg & Armour, 1991). The fact that there is no logical reason to believe more in something just because it is repeated led the authors to dig deeply into the question of why does it happen and what processes underlie the effect. That question was answered by Begg and colleagues (1992), who showed that the automatic memory component of Familiarity has a rather involuntary impact in truth judgments, and is the one supporting illusions of truth when the controlled Recollection process is impaired.

At this point, the use of familiarity as a base for validity assessments was seen as a misattribution process, in which there is an "attribution of truth to statements that feel familiar (Begg, et al., 1992; p. 457). This attribution process is analogous to the one leading individuals to judge words that are presented with more clarity as being repeated, and to judge words that are repeated as being presented with more clarity (Whittlesea et al., 1990). People use the experience elicited by the stimuli according to the goals they have, and often fail to discount the real cause (see Jacoby et al., 1989).

As previous research had shown, repeated information seems to be easier do process (e.g., Jacoby & Dallas, 1981), and the effect of familiarity on judged truth was therefore placed in the same class of effects caused by factors that turn stimuli easier to process – that is, in the class of processing fluency effects (Begg et al., 1992). In the next chapter, we discuss the fluency account of the illusion of truth effect, focusing on the concept of processing fluency and its relation with repetition and validity judgments.

Chapter III: Processing Fluency, a Challenge to the Memory Account?

Processing fluency can be defined as the subjective experience of ease that accompanies the processing of a stimulus. Fluency can be elicited by several factors or attributes of the stimulus, such as its conceptual or perceptual features (e.g., Jacoby & Dallas, 1981; Jacoby et al., 1989; Whittlesea, 1993). The experience of fluency generated at the conceptual level is related with how easy it is to activate and extract a stimulus' meaning, occurring at high-level stages of processing involved in the categorization and relation of that stimulus in the structures of semantic knowledge. Therefore, conceptual fluency is influenced by variables such as semantic priming (presenting the word doctor facilitates the identification of the word nurse; e.g., Lupker, 1984), semantic predictability (i.e., presenting the target word in a sentence that creates a general expectation for its appearance; e.g., Whittlesea, 1993) or context congruity (i.e., consistency between the target stimulus and the context where it is presented; e.g., Palmer, 1975). Differently, the experience of fluency elicited at the perceptual level is associated with how easy it is to capture the physical and structural attributes of the stimuli, occurring at low-level stages of processing involved in the identification of the stimulus' physical identity. Perceptual fluency is affected by factors such as a word's color contrast against the background (which can make the stimulus easier or more difficult to perceive) or the stimulus' exposure duration (the longer a stimulus remains in our visual field the more information we can extract from it; for a review on conceptual and perceptual fluency see Winkielman, Schwarz, Fazendeiro, & Reber, 2003).

Although there are different levels at which fluency can be experience, the great diversity of fluency manipulations that can be found in the literature seem to promote very similar effects on judgments (for a review, see Alter & Oppenheimer, 2009). For example, judgments of liking are increased by presenting the stimuli in high color-contrast or for longer durations (e.g., Reber, Winkielman, & Schwarz, 1998), as well as when stimuli are easily retrieved from memory (e.g., Bornstein & D'Agostino, 1992) or are preceded by a conceptually related prime (e.g., Lee & Labroo, 2004). Memory judgments are also affected by a variety of fluency manipulations – words seem more familiar when written in an easy-to-read font (e.g., Reber & Zupanek, 2002), when they are presented with more clarity (e.g., Wittlesea et al., 1990), and when they are primed by a related concept (e.g., Whittlesea, 1993). The case is the same with confidence judgments, with statements written in an easy-to-read font inspiring more confidence (e.g., Alter, Oppenheimer, Epley, & Eyre, 2007), or

answers to trivia questions seeming more correct when they are semantically primed or easily retrieved from memory (e.g., Kelley & Lindsay, 1993). Additionally, it seems that different manipulations of perceptual fluency result in very similar judgments regarding the subjective experience of fluency itself, even though they objectively affect different stages of the perceptual process (i.e., contrast with the background affects reaction times in detection tasks, while letter font affects reaction times in discrimination tasks; Reber, Wurtz, & Zimmermann, 2004; Wurtz, Reber, & Zimmermann, 2008). Thus, there is relative consensus around the idea that fluency is a unitary experience, with convergent effects on judgments independently of the how it is generated (Alter & Oppenheimer, 2009).

Repetition is in itself a source of processing fluency. Repeated information is simply easier to process. Evidence of this can be found, for example, in the fact that repetition leads facilitates the identification of words presented for very brief periods of time (e.g., Jacoby & Dallas, 1981), and the identification of masked words that become progressively more visible (e.g., Feustel et al., 1983). Repetition also speeds the "word – non word" lexical decision task (e.g., Scarborough, Cortese, & Scarborough, 1977), and the reading time of sentences (e.g., Kolers & Ostry, 1974). And it seems that processing a repeated stimulus is associated with a decrease of neural activity in the brain (see Grill-Spector, Henson, & Martin, 2006), which helps make the case that indeed repeated stimuli are easy to deal with. But repetition can be a special source of fluency, as in comparison to other fluency manipulations repetition has the unique characteristic of aggregating different levels of the fluency experience. In fact, when processing a repeated statement, for example, we not only re-access its physical form and features (i.e., its wording and grammatical structure), what increases perceptual fluency, but also its semantic content and meaning, increasing conceptual fluency.

In the previous chapter it became clear that the experience of fluency that supports the automatic memory component Familiarity is associated with the truth effect. In those conceptualizations of repetition effects on judged truth it was assumed that the effect was rooted in memory attributions, and that relation to memory made it informative of truth (e.g., Begg et al., 1985; Begg, et al., 1992). However, researchers started to question whether the relation to memory was indeed necessary. Soon, this hypothesis started to be explored, and the experience of processing fluency *per se*, independent of associations to memory, was presented as the process underlying illusions of truth (e.g., Reber & Schwarz, 1999; Unkelbach, 2007; Unkelbach & Greifeneder, 2013).

Processing Fluency and Truth

Reber and Schwarz (1999) were the first to directly test the hypothesis that the reason why familiar statements (vs. new ones) have a higher truth-value is because they are processed more fluently. In a single exposure paradigm, the authors manipulated processing fluency through color contrast of the stimuli against the background, and found that **statements presented in high visual contrast were judged true more frequently than statements presented in low color contrast.** This finding led the authors to argue that any variable that increases processing fluency will impact truth judgments positively. This happens supposedly because "statements that are easy to process are experienced as familiar (e.g., Whittlesea et al., 1990), thus leading participants to feel that they have heard or seen this before, suggesting that it is probably true" (p. 342).

Besides this direct evidence that the fluency induced only by a perceptual characteristic of the statements, such as color contrast, is sufficient to elicit illusions of truth, other fluency manipulations unrelated to repetition or familiarity have been shown to affect validity judgments. For example, it has been found that aphorisms that rhyme are considered more accurate than aphorisms that don't rhyme (e.g., "Birds of a feather flock together" vs. Birds of a feather flock conjointly"; McGlone & Tofighbakhsh, 2000); semantically primed words (i.e., words that are preceded by related concepts) are judged as better answers to trivia questions than words that are not primed (Kelley & Lindsay, 1993); and easy-to-read letter fonts also lead to increased evaluations of truth than less readable fonts (Parks & Toth, 2006). Adding to this evidence, the recent account of the "*Aha-experience*" (i.e., insights) proposed by Topolinski and Reber (2010) also states that suddenly occurring processing fluency results in the conviction that we have found the true solution for a problem. As all this evidence makes clear, **processing fluency impacts the perceived validity of statements, and this is the case for experiences of fluency anchored in repetition but also in color contrast, letter font, rhyming or semantic priming.**

Yet, it seems that it is not merely feeling fluency with a statement that enhances its truth-value. That is, the experience of fluency on an absolute level does not seem to be enlightening. Rather, it seems that for fluency to be informative there must exist a discrepancy between the expectations individuals have regarding the level of fluency they will feel and the fluency they actually experience.

The discrepancy-attribution hypothesis. The importance of the discrepancy between expected and actual fluency was first demonstrated in recognition memory judgments by Whittlesea (e.g., Whittlesea & Leboe, 2003; Whittlesea & Williams, 1998, 2000). In one of his studies (Whittlesea & Williams, 1998), participants studied a list of words, regular non-words (i.e. easy to read/pronounce) and irregular non-words (hard to read/pronounce). Then, they received a second list with new and repeated words, regular and irregular non-words and had to perform a recognition test. According to the fluency impact on recognition judgments, it was expected that words presented the higher false recognition rate (i.e. false alarm), followed by regular non-words and finally by irregular non-words, mirroring the correspondent fluency level of each word category from the highest to the lowest. However, what the authors found was that regular non-words were the stimuli with the highest false alarm rate, supposedly because these stimuli were surprisingly more fluent than participants expected (both the enhanced fluency experienced with words and the lack of fluency experienced with non-words could be expected by participants, and thus discounted). This finding shows that **feelings of familiarity were more dependent on the discrepancy felt with a comparison standard of fluency than on objective fluency** (see also Westerman, 2008).

In order to understand whether the discrepant-fluency plays a role on the truth effect, Hansen and colleagues (2008) varied the perceptual fluency of statements via color contrast in a single exposure paradigm similar to Reber and Schwarz's (1999). They also manipulated whether there was a change (vs. no change) in the fluency level of a given statement in relation to the previously seen ones, manipulating the discrepancy between expected and actual fluency elicited by the items. Consistent with Whittlesea's proposal, **high fluency statements were considered more probably true than low fluency ones only when there was a *change* in the fluency level from low to high fluency**. The discrepancy hypothesis was tested in yet another study, this time with a repetition manipulation to induce fluency (Dechêne et al., 2009). Differently from the previous work, the authors manipulated discrepancy by establishing the comparison standard of the fluency experience on the average processing ease of other statements in the judging context. That is, they asked participants to evaluate either a mixed set of repeated and new statements, or a set of only repeated statements. These conditions created a heterogeneous evaluation context, allowing between-items comparisons, and a homogeneous context, allowing only within-items comparisons, respectively (Dechêne et al., 2009, 2010). Results showed that **when individuals judged only**

repeated statements the truth effect disappeared, supposedly because there was no variation in the fluency level of the test stimuli that could lead to some ringing truer than the other.

Mechanisms Underlying Fluency Effects on Subjective Truth

At this point, it is clear that the experience of processing fluency does not need to be elicited by previous exposure in order to affect truth evaluations, and for fluency to be informative about truth (or other dimensions) it needs to deviate from an *a priori* expectation regarding how easy it should be to process a given statement. However, holding these two assumptions does not provide by itself an explanation for the truth effect. So, why does a fluently processed statement ring as more probably true? In the next section we outline the most important mechanisms that have been proposed to explain how and why fluency affects judgments, and highlight the main differences between them.

Fluency informs about truth via attributions to familiarity. As we saw in the previous chapter, one of the most relevant hypotheses that were raised to explain the repetition-based truth effect is based on a misattribution process, by which feelings of familiarity are attribute to the truthfulness of a statement (e.g., Begg et al., 1992). Now, although the fluency experience increases perceived truth even when it is promoted by variables not related with previous exposure or memory activation, such an effect may still be rooted in feelings of familiarity. As stated above, this was the idea originally proposed in Reber and Schwarz's (1999) paper, drawing on the evidence that fluently processed stimuli are evaluated as familiar, even when encountered for the first time (e.g., Whittlesea, 1993; Whittlesea et al., 1990). The prevalence of this hypothesis is such that even in the studies testing the discrepant-fluency hypothesis, Hansen and colleagues (2008) also suggested that one possible mechanism is that "deviant fluency influences subjective truth via feelings of familiarity" (p. 690). However, if originally this was the view, the hypothesis has not been empirically pursued, remaining an open question.

Some insights regarding this hypothesis may be found in the results of Parks & Toth's (2006) study. While not testing directly the causal relationships between familiarity and truth evaluations, the authors found substantial correlations between participants' ratings of familiarity with the general idea conveyed by statements and how true they considered them. The more familiar a claim was considered, the higher its perceived validity (replicating

previous findings, Bacon, 1979; Begg & Armour, 1991). Importantly, these correlations were found in experimental settings in which fluency was associated not with repetition. **In fact, in one of the experiments the correlation between familiarity and truth emerged when pure perceptual fluency was used** by manipulating the statements' graphic style, making them easy or difficult to read. According to Parks & Toth (2006), the presence of the correlation between familiarity and truth judgments in these conditions suggests "feelings of familiarity drive judgments of truth even in the absence of episodic memory manipulation" (p. 239).

The hedonic marking of fluency. One of the main characteristics of fluency is that it seems to be inherently positive, and that aura of positivity is what supposedly leads to more favorable evaluations/judgments of fluent stimuli (Reber, Schwarz, & Winkielman, 2004; Reber et al., 1998; Winkielman, et al., 2003). Support for the hypothesis that fluency is hedonically marked can be found in the evidence showing that the processing of perceptually fluent stimuli (due to longer presentation times) is accompanied by an increase of activity in the "smiling muscle" *zygomaticus major* (e.g., Winkielman & Cacioppo, 2001). Additionally, stimuli presented with a good figure-ground contrast or an easy-to-read letter font and size are liked more (e.g., Reber et al., 1998), inspire more confidence (e.g., Alter et al., 2007) and seem to have been written by more intelligent authors (Oppenheimer, 2006) than perceptually disfluent stimuli. Conceptual fluency manipulations lead to similar effects, with products being preferred when they are primed by related concepts (e.g., Lee & Labroo, 2004), and words being considered more familiar when primed by another word to which they are semantically related to (e.g., Whittlesea, 1993). The same positivity ring is found in the experience of fluency induced by repetition, which leads to higher ratings of individuals' positive affect (e.g., Garcia-Marques, 1999), and also to higher activity of the *zygomaticus major* (e.g., Harmon-Jones & Allen, 2001). The relation between familiarity and positive affect is further corroborated by studies showing they exert a bi-directional impact on latencies to judgments about the other (Garcia-Marques, T., Mackie, Claypool, & Garcia-Marques, L., 2010). Now, in what concerns truth judgments, this positivity that seems to be inherent to fluency drives truth judgments to the more "positive" pole, and thus fluently processed statements seem more probably true rather than false, as fluently processed words are perceived as more familiar rather than new.

Contrary to this "hedonic marking of fluency" hypothesis, there is evidence suggesting fluency to have a rather diffuse nature, which makes it prone to attain different valences and meanings depending on context the individual is. That is, although fluency most frequently

(and perhaps by default) leads to more favorable evaluations/judgments, there is also evidence of its malleability regarding the attribution of meaning – similarly to how the physiological arousal associated with emotions is open to different interpretations and confounds, depending on the characteristics of the context where individuals search for cues to label and justify the arousing experience (see Schachter and Singer, 1962). A classic study by Mandler, Nakamura, and Van Zandt (1987) showed that enhancing stimuli's processing ease through repetition led both to judgments of increased brightness and of increased darkness. These results were interpreted as suggesting that the meaning given to the fluency experience is not fixed, but moderated by the judgmental task (i.e., judgments of brightness vs. darkness). The idea is similar to the model presented by Jacoby and colleagues (1989) regarding memory attributions that we briefly presented in the previous chapter. However, this context-dependency (or task-dependency) characteristic of fluency effects seems to be true only for non-evaluative judgments (for reviews see Reisenzein, 1983; Winkielman et al., 2003), and not much support has been found for judgments related with the perceived valence or affective experience associated with a target stimulus. For example, already in Mandler and colleagues' study (1987; see also Seamon, McKenna, & Binder, 1998), high levels of processing fluency promoted higher judgments of liking, but not higher judgments of disliking. In the same fashion, Reber and colleagues (1998) showed that increasing the perceptual fluency of target pictures (by means of figure-ground contrast) led to higher rating of prettiness, but not to higher ratings of ugliness. Thus, it is likely that for truth evaluations the meaning of fluency is closer to the positive pole of truthfulness rather than the negative pole of falseness.

But is the positivity associated with the experience of fluency responsible for illusions of truth? This hypothesis has been partially supported in a study by Unkelbach and collaborators (2011), who found that in within-individual analyses participants judged as more probably true statements that were framed positively (e.g., ''The divorce rate in Grenada is *higher* than in the rest of Spain") rather than negatively (''The divorce rate in Grenada is *lower* than in the rest of Spain"), and also a correlation between the degree of positive feelings that each statement elicited and its rated truth. However, in another experiment in which participants judged repeated and new statements, and the positive vs. negative frame was again manipulated, only the typical pattern of the repetition-based truth effect emerged, and no effects involving positivity were observed. This led the authors to conclude that

processing fluency (in this case induced by repetition) drives illusions of truth over and above the positivity that may accompany it.

Naïve theories about our cognitive experiences. One other mechanism that may underlie individuals' judgments of whether a statement is true or false: the *naïve theories* that people hold about the fluency experiences that accompany the processing of a stimulus (Schwarz, 2004). Naïve theories can be defined as the assumptions or ideas that individuals have about what makes it difficult or easy to process or to think about certain information. That is, judgments are not the product of only the content or information that is available to individuals when forming them, and the metacognitive experiences associated with processing that content seem to be very relevant for the final decision. According to Schwarz (2004), naïve theories are "a necessary link between people's [processing] experiences and the inferences they draw from them" (p. 333).

One classic study by Schwartz and collaborators (1991) documenting the ease-of-retrieval effect (which has to do with the availability heuristic, that states that individuals derive judgments of frequency or likelihood from the ease with which they can retrieve relevant information; Tversky & Kahneman, 1973) exemplifies the influence of naïve theories very well. In a set of experiments, participants were asked list either 6 or 12 examples of assertive or of unassertive behaviors they had performed, and then to rate their own assertiveness. While, as expected, participants that recalled 6 assertive behaviors rated themselves as more assertive than participants that recalled 6 unassertive behaviors, the pattern of results for participants that recalled 12 behaviors was very different: increasing the number of examples of behaviors to be recalled reversed the pattern, with participants that that had to list assertive behaviors rating themselves less ass less assertive than participants that listed unassertive behaviors. The authors suggested that this happened because the difficulty experienced in listing so many assertive behaviors led participants to conclude they were not that assertive after all, or else it wouldn't be so difficult to come up with the examples. This hypothesis was supported when in another experiment participants were told that the music playing in the background might lead them to experience difficulty in executing the task. As a result, because participants believed that the difficulty they were experiencing had nothing to do with coming up with examples of assertive behaviors, the group that had to recall 12 behaviors now rated themselves as more assertive than all the other groups of participants.

More recently, other studies demonstrated how the beliefs people have about the

meaning of the processing experiences qualify the output of their judgments. One very good example is the study conducted by Pocheptsova, Labroo and Dhar (2010) showing that in some situations low processing fluency can actually raise the desire to buy a product (which goes against the thesis that fluency is hedonically, defended by Winkielman and colleagues, 2003). They tested this hypothesis in the context of "special-occasion products" and showed that if an ad to those products promoted low levels of fluency (induced by hard-to-read fonts and difficulty of thought generation), then there was an increase in the purchase likelihood. The authors pointed out that this happens because low fluency signals that the product is less frequent and not so widely available, which is in accord with individuals' beliefs about the desirable characteristics of "special-occasion products". In the persuasion field, Petty, Briñol and Tormala (2006) specifically addressed the possibility that the meaning of processing fluency can change via an intentional manipulation of participants' naïve theories. In their study, fluency was manipulated through the easiness (vs. difficulty) of generating a small (vs. large) number of arguments supporting a given policy. They manipulated the interpretation that was given to the experience of fluency by inducing in participants either the belief that feeling easiness in the generation of arguments is a good thing (because it's typical of more intelligent people), or the belief that easiness while thinking is a bad thing (because it's typical of less intelligent people). As the authors expected, the interpretation that was provided for the experience of fluency moderated the attitudes participants reported about the target policy: when fluency was characterized as a good thing, participants who had to generate only a small number of arguments were the ones who showed more favorable attitudes, while in the condition where fluency was described as a bad thing the opposite pattern was found.

As these studies make clear, the way in which fluency is interpreted is modulated by the naïve theories we have about our own processing experiences. The question is whether this also applies for the interpretation of processing fluency as a sign of truth or of falseness. The studies reported by Skurnik, Schwarz, and Winkielman (2000) in a book chapter suggest that to be the case. In a set of unpublished data reported by the authors, the feeling of familiarity associated with the fluency induced by repetition was interpreted as a sign of falseness. This was done by leading participants to believe that a majority of statements previously presented were false. According to the authors, this information changed the naïve belief people hold about familiar information being most probably true, which then led participants to rate repeated statements as more false than new ones. However, that change in

the naïve theory did not alter the interpretation of the processing experience as familiarity. Fluency was always attributed to familiarity, and what changed was the belief about what familiarity meant. However, these studies do not clarify whether the inversion of the naïve theory parallels the automatic nature associated with the impact of familiarity on truth judgments (e.g., Begg et al., 1992), or if it encompassed an additional monitoring (control) process.

Fluency as an ecologically valid cue for truth. Building on previous evidence showing the malleability of meaning and attributions that seem to characterize the experience of fluency (e.g., Jacoby et al., 1989; Mandler et al., 1987; Whittlesea et al., 1990), Unkelbach (e.g., Unkelbach, 2006, 2007; Unkelbach & Greifeneder, 2013) proposes that the reason why fluently processed statements are liked more, considered more familiar or more truthful (just to name a few evaluative dimensions) is the existence of an ecologically valid correlation between fluency and those evaluative dimensions. According to this approach, people *learn* that fluency is a valid cue to inform about a criterion/dimension of a stimulus via a feedback-learning process that establishes a positive correlation between the presence of the cue and the criterion. Regarding the fluency-truth link, it is proposed that it spurs from a lifetime of experiences in which fluently processed information is indeed true rather than false. According to this hypothesis, it is more probable that we are repeatedly exposed to true information than to false information (both because individuals tend to present mostly truthful information, Grice, 1975; and because for each true fact about reality there are numerous false facts, increasing the probability that true facts are encountered more often, Unkelbach, 2007). Additionally, accepting a statement as true is less cognitively demanding, while the categorization of information as false is a lot more effortful (Gilbert, 1991; Gilbert et al., 1990). Once the correlation is established, it assumes the features of an apparently automatic process, being applied very quickly. But according to the authors, it is only "apparently" automatic, as it is not assumed the interpretation of fluency as truth to be restricted by such automatic vs. control assumptions (Unkelbach & Greifeneder, 2013). Congruently with the assumption that truthful information is associated with increased fluency, Unkelbach and Stahl (2009) showed that **factually true statements were judged as more familiar than factually false ones, suggesting that the fluency experience that accompanied the processing of the factually true statements was misattributed to familiarity.**

The hypothesis that the fluency-truth correlation depends on the learning history established by a given context was tested in a set of experiments designed to show that it is

possible to reverse the truth effect. The assumption underlying the experiments was that if the environment promotes and reinforces the correlation fluency = falseness, then individuals will judge fluently processed statements as false rather than true, because now that is the ecologically valid correlation. In one of the experiments (Experiment 2) participants were asked to judge as true or false a group of unambiguous statements (i.e., clearly true and clearly false; "February is the first month of the year", or "One hour has 60 minutes"), and received veridical feedback about the correctness of their responses. In this training block, fluency was manipulated through color contrast and participants trained either the classic fluency = truth link or its reversal (fluency = falseness). To promote the classic association of fluency = truth, all true statements were presented in high contrast to the background and all false statements were presented in low contrast; to promote the reversed link of fluency-falseness, all false statements were now presented in high contrast and all the true statements in low contrast. After this training phase, participants continued with the task, but now the statements to be judged were ambiguous (i.e. unclear if true or false; "Methuselah was the grandfather of Noah") and no feedback was given. Also, perceptual fluency was now orthogonal to truth status, preventing any systematic correlation between fluency and truth. The crucial result of this experiment was that **participants that had learned the fluency = falseness correlation in the training phase applied it to the ambiguous statements. That is, they judged high contrast statements as more probably false than low contrast statements, showing a reversal of the classic truth effect.** By opposition, participants who had learned the classic fluency = truth link evidenced the standard truth effect.[3] To show that it was indeed the association of processing fluency with truth that had changed, and not merely the establishment of an association between a specific contrast level and truth or falseness, that was responsible for the results, in another experiment (Experiment 3) the reversal of the truth effect was generalized to fluency due to repetition. **After learning the association low color contrast = truth in the training phase, participants subsequently judged new statements more probably true and old statements more probably false, reversing the repetition-based illusion of truth.** Such a result was interpreted as supporting not only the relevant role of processing fluency in the truth effect, but also a functional equivalence between fluency due to color contrast and fluency due to repetition.

[3] Similar reversal effects have also been evidenced with recognition judgments, in a study in which high perceptual fluency was perfectly correlated with novelty and low perceptual fluency with familiarity. After training these associations, participants exhibited a bias to judge as "old" the disfluent stimuli and to judge as "new" the fluent stimuli, even when the two factors (fluency and familiarity) were no longer systematically correlated (Unkelbach, 2006; see also Olds & Westerman, 2012 for a replication).

How Do These Different Explanations Relate, and Differ, to Each Other?

The different theoretical approaches outlined above share some assumptions and differ in regard to others. We analyze these similarities and differences focusing on the conceptualization of fluency as a direct cue for truth, and the automatic vs. controlled nature of the process underlying the association of fluency with truth.

Fluency as a direct cue for truth. The "attribution to familiarity" approach presented by Begg and collaborators (e.g., Begg et al., 1992), and which was still evident in the views of Reber and Schwarz (1999) and Dechêne and colleagues (e.g., Dechêne et al., 2009; Hansen et al., 2008), argues that feelings of familiarity mediate processing fluency effects on subjective truth. Similarly, the "hedonic marking of fluency" hypothesis also suggests positive affect may mediate fluency effects on judgments (e.g., Winkielman, et al., 2003). Quite differently, the fluency as an ecologically valid cue" model advocates that the truth effect is the result of "a direct utilization of processing fluency as a cue" (Unkelbach, 2007, p. 220). That is, once the correlation between fluency and truth is established there is no need for memory mechanisms or attributions to familiarity for fluency to inform truth judgments. This idea is also quite different from the approach based on naïve theories, for which the positive relation between processing experiences and truth is not conceived as a direct effect of fluency. They assume the relationship exists but call for an additional top-down process (i.e., conceptually-driven by *a priori* lay theories) that modulates the meaning given to the fluency experience (e.g., Schwarz, 2004)[4].

The assumption of a direct effect of processing fluency on perceived truth questions the use of the term "illusion" to characterize the truth effect. Whereas authors like Begg and colleagues (1992) assume that "there is no logical reason for repetition to affect rated truth or for earlier information to be trusted more than later information" (p. 447), the ecological perspective sees it as based on the premise that there are a number of factors that actually make processing fluency a good predictor of truth. Therefore, for this approach "the truth effect is not illusory after all, but a byproduct of an adaptive learning mechanism" (Unkelbach & Stahl, 2009, p. 35).

[4] Unkelbach and Greifeneder (2013) integrate naïve theories in their general model of fluency effects. In the interpretation step of the model they thus consider that, besides the mechanism based on people learning that fluent processing and truth are positively correlated and interpret the experience as a truth experience (Unkelbach, 2007), the existence of lay theories that fluent processing indicates truth (e.g., Schwarz, 2004) may also be one path for fluency influences.

The controlled vs. automatic nature of the interpretation of fluency as truth. Another significant difference between the theoretical approaches reviewed before refers to the automatic vs. controlled natured of the process supporting the fluency-truth link. As presented in the previous chapter, for Begg and colleagues (1992) illusions of truth are rooted in the unintentional effects of the memory component Familiarity, which implies an automaticity assumption (e.g., Jacoby, 1991). However, for both the ecological validity and naïve theories approaches the interpretation of fluency experiences should not be restricted by automaticity.

Chapter Summary

In this chapter we presented the main evidence showing that fluency experiences promoted by factors unrelated to previous exposure and memory are sufficient to generate illusions of truth. The studies addressing this hypothesis showed:

- Statements presented in high visual contrast were judged true more frequently than statements presented in low color contrast (e.g., Reber & Schwarz, 1999);
- Processing fluency impacts the perceived validity of statements, and this is the case for experiences of fluency anchored in repetition but also in color contrast, letter font, rhyming or semantic priming (e.g., McGlone & Tofighbakhsh, 2000; Toths & Park, 2006);
- High fluency statements were considered more probably true than low fluency ones only when there was a *change* in the fluency level from low to high fluency (e.g., Hansen et al., 2008);
- The correlation between ratings of familiarity and ratings of truth emerged when pure perceptual fluency was used (Parks & Toth, 2006);
- One of the main characteristics of fluency is that it seems to be inherently positive and hedonically marked (e.g., Allen & Harmond-Jones, 2001; Garcia-Marques, 1999; Reber et al., 1998; Winkielman & Cacioppo, 2001);
- Processing fluency (in this case induced by repetition) drives illusions of truth over and above the positivity that may accompany it (Unkelbach et al., 2011);

- Factually true statements were judged as more familiar than factually false ones, suggesting that the fluency experience that accompanied the processing of the factually true statements was misattributed to familiarity (Unkelbach & Stahl, 2009);
- Participants that had learned the fluency = falseness correlation in the training phase applied it to the ambiguous statements. That is, they judged high contrast statements as more probably false than low contrast statements, showing a reversal of the classic truth effect (Unkelbach, 2007);
- After learning the association low color contrast = truth in the training phase, participants subsequently judged new statements more probably true and old statements more probably false, reversing the repetition-based illusion of truth (Unkelbach, 2007).

The first accounts for the effect of fluency on truth judgments maintained that those effects were mediated by feelings of familiarity associated with fluently processed stimuli, and which then lead individuals to judge statements as more probably true (e.g., Hansen et al., 2008; Parks & Toth, 2006; Reber & Schwartz, 1999). However, a more recent approach argues that fluency is an ecologically valid cue for truth, and thus fluency *per se* directly influences truth judgments, with no need for mediating processes such as attributions to familiarity or the existence of naïve theories about its meaning (e.g., Unkelbach, 2007; Unkelbach & Stahl, 2009), which directly informs our judgments with no need for mediating processes such as attributions to familiarity or the existence of naïve theories about its meaning (e.g., Unkelbach, 2006, 2007; Unkelbach & Greifeneder, 2013; Unkelbach & Stahl, 2009).

All these findings and alternative mechanisms proposed to explain the truth effect open the chance for a better understanding of the role that repetition-based processing fluency plays in the phenomenon. As we stated early in this chapter, repetition has the unique characteristic of aggregating both conceptual and perceptual fluency experiences. Does this fact have any relevance for illusions of truth? Does it say anything about the nature of the effect? In the next chapter we will address these questions, which are at the core of the three papers that compose the empirical section of this dissertation.

Chapter IV: Is There Something Special in the Relation of Repetition to Truth?

From the literature reviewed in the previous chapters, it is clear that repetition impacts the perceived validity of a statement (e.g., Bacon, 1979; Hasher et al., 1972). The truth effect has been interpreted as the result of feelings of familiarity associated with the fluency of processing repeated stimuli, which are attributed to truth (e.g., Begg et al., 1992). The relevance of familiarity for the occurrence of illusions of truth is evident in the fact that statements that are perceived as repetitions are judged as more probably true than statements perceived as new, independently of the actual repetition status of the statement (e.g., Arkes et al., 1991; Begg & Armour, 1991). However, the truth effect has been shown to occur associated with other fluency sources unrelated to previous exposure or memory, namely perceptual fluency factors such as the color contrast of the statements that are presented for judgment (e.g., Reber & Schwarz, 1999). This led to the proposal that fluency is the process underlying illusions of truth. While some authors still conceive fluency effects on perceived truth to be mediated by feelings of familiarity (e.g., Hansen et al., 2008; Reber & Schwarz, 1999), others argue that fluency is a direct cue for truth, with no need for attributions to memory (e.g., Unkelbach, 2007).

Despite other fluency sources being able to elicit the same illusions of truth as previous exposure, some evidence in the literature may suggest that the presence of a match between the information that is encountered and the information that is activated in memory is a relevant feature of the truth effect. This idea is suggested, for example, by the comparison of the magnitude of the truth effects induced by repetition and by perceptual fluency manipulations. A meta-analytic review of 70 studies comparing truth ratings to repeated vs. new statements (Dechêne et al., 2010) showed the truth effect to be medium-sized (d = .50). In comparison, the few experiments that manipulated the perceptual fluency of statements present effects of smaller magnitude. For example, in Reber and Schwarz's (1999) study, the mean difference between how many of the high vs. low fluency statements (16 of each) were endorsed as true was only .23 (d = .13). Similarly, Parks and Toth (2006) also reported small mean differences in the truth ratings given to easy vs. difficult to read statements – across the different experimental conditions, the difference was never greater than .09 in a 4 point scale. In this experiment, no main effects associated with perceptual fluency were found (only an interaction effect involved this variable, but also with a small effect size, d = .12). Now, considering Hansen and colleagues (2008) experiment, in which color contrast of the

statements was manipulated to test whether the experience of discrepant fluency was relevant for truth judgments, the magnitude of the fluency effect on rated truth was of d = .51 – comparable to the value presented in the meta-analysis of repetition-induced truth effects (Dechêne et al., 2010). However, in Dechêne and colleagues' (2009) study testing the same discrepant-fluency hypothesis but using repetition as the fluency source, the effect size rose to d = 1.13, suggesting again the higher magnitude of repetition-based effects. One exception to these overall smaller effect sizes obtained with perceptual fluency manipulations has to be acknowledged: in one of his experiments, Unkelbach (2007, Experiment 2) found a truth effect associated with perceptual fluency (via color contrast) with a magnitude of d = 1.18.

One possible explanation for why the repetition-based truth effect seems to be stronger than the effect anchored in perceptual fluency may be the fact that repetition aggregates different fluency experiences (Whittlesea, 1993). Previous exposure encompasses the encoding of semantic information, which can then be reactivated when the statement is re-encountered. Thus, the fluency involved in processing a repeated statement can come from the repetition of different types of its perceptual features (e.g., wording, phrase structure), and from the repetition of different types of its conceptual characteristics (e.g., specific content, meaning, general topic). That is, repetition aggregates perceptual and conceptual fluency experiences. In fact, judged truth of statements increases not only when they are repeated verbatim (literally), but also when they repeat only the topic of previous statements (Arkes et al., 1991) or when they pertain to topics individuals have some knowledge about (Boehm, 1994). Thus, even if the illusions of truth that anchor in the experience of perceptual fluency go through memory attributions or feelings of familiarity (what is still an open question), the fact is that mere manipulations of a statement's perceptual attributes lack the "extra" conceptual fluency component that is part of repetition.

Given this evidence, in this thesis we present three independent papers addressing the different status that repetition may have in the illusion of truth effect. The experiments presented in each paper address the association of repetition with truth, and try to understand the relevance that the conceptual fluency component that is involved in repetition may have for the truth effect, as compared to the experience of mere perceptual fluency.

Overview of the Empirical Articles

The first paper, entitled "The differential effects of fluency due to repetition and fluency due to color contrast on judgments of truth" (submitted to the journal *Psychological Research*, edited by Springer), approaches the differences between the fluency elicited by repetition and by color contrast. In this paper, the association of the two sources of fluency with truth is contrasted, in a context designed to reverse that association and turn fluency into a sign of falseness. In one of the experiments, we compare how easy it is to associate each of the fluency sources with falseness. In a second experiment, repetition and color contrast are manipulated orthogonally to each other, allowing the direct contrast of the distinctive features the two experiences may have. If the conceptual features associated with repetition are a relevant feature of the fluency experience it elicits, than we should expect differences between the two fluency manipulations.

The second paper, entitled "Hearing a statement now and believing the opposite later" (submitted to the *Journal of Experimental Social Psychology*, edited by Elsevier), revisits a manipulation first used by Bacon (1979), and which allows to separate the influence of the repetition of conceptual features of a statement from the influence of repeating only its perceptual characteristics. This is achieved by the use of contradictory statements, which maintain the perceptual structure (words, phrase structure) of the items that were previously encountered, while totally changing their meaning. We expect contradictory statements to promote an illusion of falseness, because individuals remember the original statements and will thus reject the version that does not match their memory content. However, by introducing a longer delay between exposure and truth ratings phase, we expect to reduce explicit memory mechanisms and the access to the conceptual aspects of the original statements, creating the opportunity for perceptual fluency effects to emerge.

The experiments in the third paper, entitled "The informative value of type of repetition: Perceptual and conceptual fluency influences on judgments of truth" (submitted to the *Journal of Experimental Psychology: Learning, Memory and Cognition*, edited by the American Psychological Association) follow-up the second paper, extending and detailing its effects. In this paper, we isolate the different components of fluency associated with the repetition of the conceptual and perceptual features of the statements. For that, participants are asked to judge statements that: (1) change the wording of the original statements while maintaining their specific meaning (paraphrases), (2) change the meaning of the original statements while maintaining their wording and phrase structure (contradictory statements),

(3) change both the wording and the specific meaning of the statements, but maintain their general topic and subject (contradictory paraphrases), and (4) totally new statements, not sharing any conceptual or perceptual characteristic with original items. As in the previous paper, a delayed judgment condition is included to separate the direct influence of explicit memory from pure fluency effects. The comparison between the truth ratings given to all these types of repetition and those given to original statements allows understanding the role of the different conceptual and perceptual components of repetition in illusions of truth.

Section II
Empirical Articles

"If you tell the truth, you don't have to remember anything."
Mark Twain (1835-1910)

Empirical Article 1

The Differential Effects of Fluency Due to Repetition and Fluency Due to Color Contrast on Judgments of Truth

Rita R. Silva and Teresa Garcia-Marques

ISPA – Instituto Universitário, Lisbon

Word count: 6190 (excluding abstract and tables). References: 26

Author Note

Correspondence regarding this paper should be addressed to: Rita R. Silva, ISPA-Instituto Universitário, Rua Jardim do Tabaco, 34, 1149-041 Lisboa, Portugal. E-mail: rsilva@ispa.pt. Telephone: + 351 218 811 70

The writing of this article was supported by the grant SFRH/BD/39153/2007 awarded to Rita R. Silva, and the grant PTDCPSI-PCO1219162010 awarded to Teresa Garcia-Marques, by the Portuguese National Science Foundation (FCT).

The authors would like to thank Pedro Figueira and Joana Mello for their help in data collection.

Abstract

Two experiments contrast the effects of fluency due to repetition and fluency due to color contrast on judgments of truth, after participants learn to associate high levels of fluency with falseness (i.e., a reversal of the fluency-truth link). Experiment 1 shows that the interpretation of fluency as a sign of truth is harder to reverse when fluency spurs from repetition than when it comes from color contrast. Experiment 2 shows that when color contrast and repetition are manipulated orthogonally, the reversal of the truth effect learned with color contrast does not generalize to repetition. These results suggest specificities in the processing experiences generated by the two different sources of fluency, and their influences on truth judgments are separated when the context allows the comparison of their distinctive features. We interpret and discuss these results in light of the research addressing the convergence vs. dissociation of the effects elicited by different fluency sources.

152 words

Keywords: illusions of truth, processing fluency, repetition, color contrast

The Differential Effects of Fluency Due to Repetition and Fluency Due to Color Contrast on Judgments of Truth

Is the statement "The ice cream cone was invented in the U.S. in 1924" true or false? Most of us would be uncertain about the correct answer. However, if we hear it repeatedly we will most probably consider it true. This phenomenon is known as the *illusion of truth effect*, which shows that repeated statements have a higher truth-value than new statements (Hasher, Goldstein, & Toppino, 1977). This effect has been observed under many different conditions, both in laboratorial and more ecological contexts, and also with different types of statements (trivia facts, personal opinions, product-related claims; see Dechêne, Stahl, Hansen, & Wänke, 2010, for a meta-analysis).

Illusions of truth have been explained as the product of the processing fluency that is associated with repeated stimuli (e.g., Jacoby & Dallas, 1981). Congruently, the effect was shown to occur in conditions where other sources of fluency are used. For example, statements are considered more probably true when presented in good contrast rather than in low contrast (e.g., Reber & Schwarz, 1999), in a rhyming rather than a non-rhyming form (McGlone & Tofighbakhsh, 2000), or when words are primed by semantically related concepts vs. not primed (Kelley & Lindsay, 1993).

Yet, although the impact of fluency on truth judgments is undisputable, the literature also shows that the repetition-based truth effect has a greater magnitude than the truth effect elicited by perceptual fluency manipulations, such as color contrast or graphic style (e.g., Hansen, Dechêne, & Wänke, 2008; Parks & Toth, 2006; Reber & Schwarz, 1999; but see Unkelbach, 2007 for an exception). And although some researchers recognize it (e.g., Parks & Toth, 2006; Unkelbach, 2007), this evidence is generally devaluated due to the belief that no differences are expected between the fluency elicited by different sources. Their effects are simply assumed to reflect a unitary construct (Alter & Oppenheimer, 2009) and result in the same general subjective experience of processing ease (e.g., Reber, Wurtz, & Zimmermann, 2004; Wurtz, Reber, & Zimmermann, 2008).

Our goal with the present experiments is to show that this may not always be the case. The effects of two different sources of fluency, in this case repetition and perceptual contrast, on subjective judgments of truth may differ and even be dissociated. If so, it would suggest the existence of specificities in the processing experiences that these different sources of fluency generate, and which can be disentangled by our cognitive system in some contexts.

Unkelbach's (2007) work on the reversal of fluency effects on truth judgments shows evidence of an equivalence between perceptual fluency and repetition. The author asked participants to categorize a set of easy statements (e.g., "February is the first month of the year", or "One hour has 60 minutes") as true or false, and gave feedback about their answers. To reverse the fluency-truth link, true statements were always presented in low-contrast colors and false statements always in high-contrast colors. The effectiveness of the reversal was visible in a subsequent phase, when participants judged ambiguous statements (i.e., difficult to know if true or false, such as "Methuselah was the grandfather of Noah") without feedback: participants continued to judge low-contrast statements more probably true than high-contrast ones, showing evidence of having learned the fluency = falseness association. Importantly, the learning that occurred with perceptual fluency was generalized to the fluency experience elicited by repetition. That is, after learning that low-contrast was a sign that the statement was true, participants applied the same logic to old vs. new statements, and took novelty as a sign of truth.

Besides focusing on the relevance of fluency for the truth effect and that the fluency experience is open to different interpretations (e.g., Mandler, Nakamura, & Van Zandt, 1987; Skurnik, Schwarz, & Winkielman, 2000; Whittlesea, Jacoby, & Girard, 1990), these findings suggest that there are no specificities regarding the processing experiences elicited by the two sources of fluency that could be detected and result in a dissociation of their effects on subjective truth judgments. That possibility matches Reber and collaborators' (Reber et al., 2004; Wurtz et al., 2008) data showing that although different sources of perceptual fluency may have different objective impacts (measured in response times) in different stages of the perceptual process, they produce similar effects on the subjective judgment of how easy a stimulus is perceived.

But if, on the one hand, this evidence suggests that "fluency exerts the same influence on judgments independently of how it is generated" (Alter & Oppenheimer, 2009, p. 220), on the other hand, other evidence suggests that the use of fluency may be a sophisticated process, and that there are occasions when the effects promoted by the different fluency sources can be dissociated. One good example is the study by Whittlesea (1993) showing that when the perceptual and conceptual features of words were manipulated to induce fluency, judgments of semantic relatedness were only affected by conceptual fluency manipulations. This clearly suggests some degree of domain-specificity in the use of the fluency experience as a cue for our judgments, and also that different fluency manipulations do not always lead to the same

effect. In addition, Olds and Westerman (2012) presented data suggesting that the reversal of fluency effects found by Unkelback (2006) in the context of memory judgments (i.e., fluency = novelty) were not so easy to generalize from one fluency manipulation to another (learning the reversal with fluency due to visual contrast was not generalized to fluency due to repetition priming). Furthermore, the reversal did not generalize across different judgments (learning with recognition judgments did not generalize to frequency judgments), suggesting some specificity regarding the task and context in which the new association is learned and then applied.

Given this evidence, we hypothesize that the effects elicited by two different sources of fluency can be separated and dissociated in contexts that allow their distinctive features to emerge. We tested this hypothesis in two experiments, in which the effects of fluency due to color contrast and fluency due to repetition were contrasted within a learning context designed to reverse the association of fluency with truth.

Experiment 1

This experiment tested how easy it is to reverse the fluency-truth link when fluency anchors in color-contrast vs. repetition, replicating the feedback-learning procedure used by Unkelbach (2007). Only if the processing experiences that result from the two fluency sources are different should we expect differences regarding the ease with which learning occurs.

Method

Participants and design. Ninety-four undergraduate students (84 women; M_{age} = 20.19 years, *SD* = 6.01) participated in the experiment in exchange for course credit. They were randomly assigned to the cells of a 2 (fluency manipulation: repetition vs. color-contrast) × 2 (learning condition: classic vs. reversed) between-participants factorial-design.

Material. A set of 40 ambiguous (e.g., "It takes 60 days for a house fly to become great-grandmother") and 80 easy (e.g., "A guitar is a string instrument") statements about various topics were used. Ambiguous statements consisted of items that in previous pre-tests showed an equal probability of being considered true or false. Half of the statements in each category were true and half were false. Statements were written in Arial (size 28) and in blue color. Color contrast was manipulated by varying the RGB values (e.g., Hansen et al., 2008; Reber & Schwarz, 1999; Unkelbach, 2007), creating a low-contrast and a high-contrast blue.

Procedure. Participants were invited to take part in a study composed of different tasks, some related with reading sentences in different colors and others with the evaluation of images. The experiment began with an exposure phase, in which participants read a list of 40 ambiguous and 40 easy statements, about which they were told that half were true and half were false. Statements were presented one at a time, in high-contrast blue in the center of the screen with a 500 ms blank screen between them (the order of the statements was randomly determined for each participant). A rapid presentation time of 3 s per statement was used, to minimize chances of profound encoding and processing operations (see Unkelbach, 2007, experiment 3). Then, a filler task lasting approximately 15 minutes asked participants to rate the pleasantness of 35 images (objects, food, people). After this, the learning phase of the experiment started. Forty easy statements were presented and participants had to decide whether they were true or false. Participants in the color-contrast conditions judged only new statements, while participants in the repetition condition judged 20 new and 20 repeated statements (from the exposure phase). Statements (randomly ordered) were presented individually and remained on the screen until participants pressed either the "S" or the "L" key to indicate whether the statement was "True" or "False", respectively. Each response received veridical feedback, with the words "correct" or "wrong" appearing above the statement for 2 s. A 1 s blank screen separated each trial. Depending on the learning condition, high-contrast/repeated statements were always true – classic learning, or always false – reversed learning (and the opposite for low-contrast/new statements). Participants were instructed to respond as quickly as possible. Materials and responses were presented and registered using *e-prime* software (Schneider, Eschman, & Zuccolotto, 2002).

Dependent measures. Using the proportions of "True" responses to true statements – Hit rate, and to false statements – false alarms (FA) rate, we derived signal detection theory (SDT) estimates of *d'* (discrimination ability; higher values represent better discrimination between true and false statements) and *C* (criteria for answering "True"; $C = 0$ represents a unbiased respondent; negative values indicate a bias to answer "True", and positive values indicate a bias to answer "False"). Participants' response times (RTs) to high fluency (repeated or high-contrast items) and low fluency (new or low-contrast items) statements were also analyzed.

Results and Discussion

Mean Hit rates, FA rates, and SDT *d'* and *C* estimates are provided in Table 1. For parsimony, we report only the analyses of the SDT measures.

Discrimination estimates (*d'*) were analyzed with an ANOVA, with fluency manipulation (repetition vs. color-contrast) and learning condition (classic vs. reversed) as independent factors. Corroborating that the statements used were very clear concerning their factual true or false status, *d'* estimates were high in all conditions (all *d'*s > 2.00). However, discrimination was significantly better in the classic learning condition ($M = 3.27$, $SD = .52$) than in the reversed condition ($M = 2.80$, $SD = .64$), $F(1, 90) = 20.82$, $p < .001$, $\eta^2_{partial} = .19$, suggesting that either the congruency of the cues in the classic condition facilitated the task, or that the contrast of the information received in the reversed condition inhibited it. Relevant to our goal, discrimination was better in the color-contrast condition than in the repetition condition, $F(1, 90) = 10.67$, $p = .002$, $\eta^2_{partial} = .11$, suggesting that the two sources of fluency provide different learning contexts. Congruently with this hypothesis, fluency source moderated the effect of learning condition, $F(1, 90) = 4.00$, $p = .049$, $\eta^2_{partial} = .04$: the lower discrimination observed in the reversed learning (vs. classic learning) was clearly more pronounced when the fluency source was repetition ($M_{difference} = .76$), $t(90) = 4.21$, $p < .001$, $d = 1.35$, than when it was color-contrast ($M_{difference} = .29$), $t(90) = 2.04$, $p = .044$, $d = .54$. This suggests that repetition offered more resistance to a change of meaning than color contrast did.

Results of the ANOVA with the same factors analyzing *C* estimates suggest that the lower accuracy observed in the reversed learning condition with repetition was in fact due to a resistance in associating repeated statements with the response "False" (and not in associating new statements with the response "True"). This is evidenced by the significant interaction between fluency source and learning condition, $F(1, 90) = 7.11$, $p = .009$, $\eta^2_{partial} = .07$: participants in the repetition condition adopted a more liberal criterion in the reversed learning than in the classic learning, $t(90) = 2.89$, $p = .004$, $d = .93$; a difference that does not exist in the color-contrast condition, $t(90) = .66$, $p = .513$. In fact, the bias to answer "True" was only visible in the specific reversed learning condition with repetition as the fluency source (note also the high FA rate in that condition, Table 1), whereas in all other conditions participants performance is practically unbiased (i.e., $C = 0$). So, it seems that participants were not able to totally counteract the default association between repetition and truth, something that is apparently easier to do when fluency stems from color contrast. Because the

criterion to judge statements "True" was more liberal in the reversed learning condition with repetition than in all other conditions, a main effect of fluency source also emerged, $F(1, 90) = 4.21$, $p = .043$, $\eta^2_{partial} = .05$, and the effect of learning condition was marginally significant, $F(1, 90) = 3.40$, $p = .069$, $\eta^2_{partial} = .04$, ($M_{reversed} = -.08$, $SD = .24$ and $M_{classic} = -.02$, $SD = .20$).

Participants' RTs (Table 2) were analyzed with an ANOVA with fluency level (high vs. low) as a within-participants factor and fluency manipulation (repetition vs. color contrast) and learning condition (classic vs. reversed) as between-participants factors.[5] A main effect associated with fluency level emerged, showing the expected response facilitation when statements were easier to process: RTs were faster to high fluency than to low fluency statements, $F(1, 90) = 57.88$, $p < .001$, $\eta^2_{partial} = .39$. The main effect of learning condition supports the idea that the learning procedure was more difficult in the reversed condition (as suggested by the lower discrimination ability in that condition), with slower RTs in that condition ($M = 2835$, $SD = 722$) than in the classic learning ($M = 2279$, $SD = 717$), $F(1, 90) = 15.08$, $p < .001$, $\eta^2_{partial} = .14$.

Contrasts on the data associated with the interaction involving all three factors ($F(1, 90) = 2.74$, $p = .101$, $\eta^2_{partial} = .03$) support the increased difficulty associated with learning the reversal of the repetition-truth link. While in the color-contrast reversed learning condition there were no differences in RTs to high-contrast vs. low-contrast statements ($t < 1$), in the repetition reversed learning condition RTs were faster to repeated than to new items, $t(90) = 3.62$, $p < .001$, $d = .37$. This pattern is consistent with the hypothesis that participants have a greater tendency to base their responses on the automatic repetition-truth association (which is not correct in the reversed learning condition), what does not happen with perceptual contrast. This hypothesis fits the lower discrimination ability and the higher bias for truth observed in the repetition conditions.

The general pattern of results is associated with other effects. The main effect of fluency source shows faster RTs in the repetition conditions than the color-contrast ones ($M_{repetion} = 2365$, $SD = 717$ and $M_{color\text{-}contrast} = 2737$, $SD = 760$), $F(1, 90) = 6.58$, $p = .012$, $\eta^2_{partial} = .07$. A significant interaction between fluency level and learning condition also emerged, $F(1, 90) = 17.86$, $p < .001$, $\eta^2_{partial} = .17$. This interaction corroborates the idea that reversed learning demands participants to inhibit the responses that are more readily available (to avoid errors), what is evident in smaller difference in the RTs to low vs. high fluency

[5] We also analyzed RTs after trimming the values at 1000 ms and 5000 ms (following Unkelbach, 2007), and results were unchanged.

items in the reversed learning ($M_{difference}$ = 109) than in the classic learning ($M_{difference}$ = 381). Finally, the interaction involving fluency level and fluency source, $F(1, 90) = 40.31$, $p < .001$, $\eta^2_{partial} = .31$, shows that in the repetition conditions RTs were faster for high fluency (old) than for low fluency (new) items, $t(90) = 8.96$, $p < .001$, $d = .62$, whereas in the color-contrast condition that difference was not significant, $t(90) = 1.00$, $p = .318$.

Table 1

Mean (SD) Hits, False Alarm Rates, and SDT Estimates in Experiment 1, by Fluency Source (Repetition vs. Color-contrast) and Learning Condition (Classic vs. Reversed)

	Hits	FA	*d'*	*C*
Repetition *n* = 37	.93 (.05)	.12 (.08)	2.81 (.68)	-.10 (.23)
Classic learning *n* = 19	.94 (.05)	.06 (.05)	3.18 (.56)	-.00 (.16)
Reversed learning *n* = 18	.91 (.05)	.18 (.10)	2.42 (.57)	-.20 (.26)
Color contrast *n* = 57	.95 (.06)	.06 (.06)	3.18 (.55)	-.01 (.21)
Classic learning *n* = 29	.96 (.05)	.05 (.06)	3.32 (.49)	-.03 (.23)
Reversed learning *n* = 28	.93 (.07)	.07 (.05)	3.03 (.57)	.00 (.19)

Table 2

Mean (SD) Response Times in ms to High and Low Fluency Statements in Experiment 1, by Fluency Source (Repetition vs. Color-contrast) and Learning Condition (Classic vs. Reversed)

	High Fluency Statements (Repeated / High Contrast)	Low Fluency Statements (New / Low Contrast)
Repetition *n* = 37	2149 (769)	2598 (664)
Classic learning *n* = 19	1735 (543)	2373 (636)
Reversed learning *n* = 18	2562 (755)	2822 (628)
Color contrast *n* = 57	2721 (774)	2761 (745)
Classic learning *n* = 29	2442 (726)	2565 (730)
Reversed learning *n* = 28	3000 (729)	2957 (720)
Total *n* = 94	2488 (819)	2692 (715)
Classic learning *n* = 48	2088 (741)	2469 (694)
Reversed learning *n* = 46	2781 (762)	2890 (682)

The results observed in this experiment clearly suggest that the fluency experience elicited by repetition and by color contrast is not equivalent, and seems to be differently connected with the inference of truth. Congruently with the fact that the truth effect is stronger with repetition than when perceptual fluency sources are used (e.g., color contrast or letter font), the association between fluency and truth was harder to reverse in the repetition condition than in the color-contrast condition. The fact that these effects emerged with statements that were unambiguous in their true/false status is quite remarkable, as it is expected that with such stimuli individuals answer on the basis of the factual knowledge they possess (Dechêne et al., 2010; Unkelbach, 2007).

Experiment 2

By showing that the reversal of the truth effect learned with fluency due to color contrast can be generalized to a repetition manipulation, Unkelbach (2007) presented relevant evidence that the two sources of fluency generate a processing experience with convergent effects on subjective judgments of truth. However, because the generalization occurred in a context where only repetition was manipulated, a confounding between the fluency experiences promoted by repetition and color contrast may have happened. That is, it is possible that the experiences resulting from the two fluency sources are not exactly the same, but just similar enough for one to be mistaken for the other. To understand which of these hypotheses is more likely to be true, participants should experience the fluency induced by repetition and color contrast simultaneously. Such context allows assessing whether both sources of fluency still exert convergent effects, or if their impact is dissociated due to their opposite associations with truth (the reversal of the truth effect is trained only with color contrast). This is what we did in Experiment 2, replicating Unkelbach's (2007) previous experiment while introducing that small but relevant factor (i.e., the manipulation of color contrast orthogonal to repetition) in the test phase. In addition, we added a recognition test in the end of the experiment to understand how memory mechanisms might contribute to the expected reversal effects.

Method

Participants and design. Fifty-three undergraduate students (42 women; M_{age} = 20.58 years, SD = 4.61) participated in the experiment in exchange for course credit. They were randomly assigned to the conditions of a 2 (learning condition: classic vs. reversed) × 2

(familiarity: repeated vs. new statements) × 2 (color contrast: high vs. low) factorial-design, with the last two factors manipulated within-participants.

Material. A set of 96 ambiguous and 60 easy statements were used.[6] Half of the statements in each category were true and half were false. Color contrast was manipulated as in Experiment 1, but different colors were used: blue and red in the learning phase, and green and orange in the test phase (to avoid the association of a particular color with a particular answer, Unkelbach, 2007). For each color, two levels of contrast (high vs. low) were created.

Procedure. Procedure was similar to Experiment 1, with the following adaptations: a) the exposure phase presented 48 ambiguous statements (24 true and 24 false); b) the learning procedure was done solely with color contrast, and 60 statements were used (30 true and 30 false); c) a test phase was presented as a continuation of the learning task; and d) a final recognition test was introduced. In the test phase, participants were again told that half of the statements were true and half were false, but that different colors would be used and feedback would no longer be provided. They were also instructed to answer as fast as possible. Ninety-six ambiguous statements were presented (all 48 from the exposure phase plus 48 new items), half in high-contrast colors and half in low-contrast. Truth status of the statements was orthogonal to both repetition and color contrast. In the recognition test, 44 statements were presented (16 old items from the exposure phase, 16 of the items presented as new on the test phase, and 16 totally new statements, all randomly selected),[7] written in black and with the question "Was this statement presented in the first exposure phase of the experiment?" on top. Participants used the "S" key to signal that a statement had been presented in the exposure phase ("Old" responses), and the "L" key to signal that it had not ("New" responses). A 1 s blank screen separated the trials. After the recognition test, participants were thanked and debriefed.

Dependent Measures. For the learning and test phases, *d'* and *C* estimates were again calculated from the Hit and FA rates in the different experimental conditions, and participant's RTs were also analyzed. However, for the recognition test we considered only

[6] Statements were selected from the same pre-test described in Experiment 1.
[7] Due to an error in programming, order of presentation of the items in the recognition test was not random: first, all the exposure phase statements were presented, then all the items that served as new in the test phase, and then all the new items.

the proportions of "Old" responses to the three types of statements – old (Hits), "new" items from the test phase (FA-test phase), and new statements (FA).[8]

Results and Discussion

Only the data of 47 participants were analyzed, as 6 participants could not be considered due to (a) having participated in a similar experiment in the previous semester (n = 2), (b) not finishing the experiment (n = 2), and (c) interrupting the viewing of the exposure phase to complain about the rate at which stimuli were presented (n = 2).

Learning phase. Table 3 presents mean Hits and FA rates and *d'* and *C* estimates in all conditions. Regarding *C* estimates, a *t*-test with learning condition (classic vs. reversed) as the independent factor revealed no differences between the two groups ($t < 1$), with mean values of *C* reflecting unbiased decisions in both conditions (both *C*s ≈ 0). The analysis of *d'* estimates showed equally high accuracy levels in the two conditions, $t(45) = 1.37$, $p = .177$, indicating that participants in each learning group clearly understood which statements were true and which were false (all *d'*s > 3.00).

Participants' RTs (Table 4) were analyzed with an ANOVA with color contrast (high vs. low) as a within-participants factor, and learning condition as a between-participants factor. No main effects where found (color contrast: $F(1, 45) = 1.22$, $p = .276$; learning condition: $F(1, 45) = 1.28$, $p = .263$).[9] However a significant interaction emerged between the two factors, $F(1, 45) = 18.03$, $p < .001$, $\eta^2_{partial} = .29$, showing that while in the classic learning condition participants were faster responding to high-contrast statements than to low-contrast ones, the opposite occurred in the reversed learning condition. As fluency and truth were perfectly confounded in this phase of the experiment, this result reflects participants' overall faster responses to true statements than to false statements, replicating Unkelbach's (2007) findings.

[8] SDT estimates were not computed for this task because two different *d'* and *C* estimates would have to be calculated, as there were two different types of FA rates and a single Hit rate. In this analysis, this would not bring any advantage to comparing the differences between the three proportions themselves.

[9] RTs were analyzed after trimming the values at 1000 ms and 5000 ms in the learning phase, and at 1000 ms and 7000 ms in the test phase (Unkelbach, 2007), and as before results were unchanged.

Table 3

Mean (SD) Hits, False Alarm Rates, and SDT Estimates in the Learning Phase of Experiment 2, by Learning Condition (Classic vs. Reversed)

Learning Condition	Hits	FA	*d'*	*C*
Classic learning *n* = 26	.93 (.06)	.09 (.07)	3.06 (.73)	-.04 (.24)
Reversed learning *n* = 21	.95 (.03)	.08 (.07)	3.32 (.54)	-.07 (.29)
Total (*n* = 47)	.94 (.05)	.08 (.07)	3.18 (.66)	-.05 (.26)

Table 4

Mean (SD) Response Times in ms to High and Low-Contrast Statements in the Learning Phase of Experiment 2, by Learning Condition (Classic vs. Reversed)

Learning Condition	High-Contrast	Low-Contrast
Classic learning *n* = 26	2967 (584)	3336 (706)
Reversed learning *n* = 21	3065 (652)	2848 (563)
Total *n* = 47	3016 (611)	3092 (684)

Test phase. To understand whether the learning phase was successful in reversing the truth effect elicited by perceptual fluency, *C* estimates (Table 5) were analyzed in an ANOVA with learning condition (classic vs. reversed) as between-participants factor and familiarity (repeated vs. new) and color contrast (high vs. low) as within-participants factors. A successful reversal of the perceptual fluency experience should result in the use of a more liberal criterion for low-contrast statements than high-contrast ones in the reversed learning condition, by opposition to what is expected in the classic learning. And this is exactly what was found, as shown by the significant interaction between color-contrast and learning condition, $F(1, 45) = 10.16$, $p = .003$, $\eta^2_{partial} = .18$. In the classic learning condition, the typical illusion of truth emerged and participants showed a higher bias for truth for high-contrast statements ($M = -.27$, $SD = .55$) than low-contrast ones ($M = -.07$, $SD = .51$), $t(45) = 2.46$, $p = .018$, $d = .38$. But this pattern inverted in the reversed learning condition, and the higher bias for truth emerged for low contrast statements ($M = -.39$, $SD = .49$) rather than high-contrast ones ($M = -.57$, $SD = .45$), $t(45) = 2.08$, $p = .044$, $d = .38$. This result demonstrates that the learning procedure was effective in promoting the reversal of the truth effect associated with color contrast.

The key question is now if such reversal was extended to repetition. This would suggest it to be experienced similarly to perceptual fluency and that their effects could not be

dissociated. However, contrary to that hypothesis, there was a main effect of repetition reflecting the typical truth effect pattern: the criteria to judge a statement "True" was a lot more liberal for repeated statements (M = -.49, SD = .61) than for new ones (M = -.13, SD = .46), $F(1, 45) = 37.78$, $p < .001$, $\eta^2_{partial} = .46$. Additionally, although the interaction between repetition and learning condition was also statistically significant, $F(1, 45) = 5.61$, $p = .022$, $\eta^2_{partial} = .11$, its pattern does not mimic what happened with color contrast; in fact it shows the opposite. This interaction shows the truth effect was larger in the reversed learning condition (difference between repeated and new items = .52) than in the classic one (difference between repeated and new items = .29). The ANOVA also revealed a main effect of learning condition, with participants in the reversed learning condition showing a higher bias to judge statements "True" than participants in the classic condition, $F(1, 45) = 7.59$, $p = .008$, $\eta^2_{partial} = .14$. All other effects were not significant ($F < 1$).

The analysis of participants' discrimination ability supports the ambiguity of the material regarding truth status. Mean *d'* estimates were very low across all conditions (Table 5), suggesting that it was highly difficult to distinguish true from false facts. Congruently, an ANOVA with the same factors as the previous one yielded no significant main effects or interactions on *d'* estimates (all Fs < 1, except the three-way interaction, $F(1, 45) = 1.70$, $p = .199$). Only the interaction between repetition and color contrast was marginally significant, $F(1, 45) = 3.51$, $p = .069$, $\eta^2_{partial} = .07$, showing a tendency for new statements to be discriminated better when presented in high than in low-contrast ($M_{high\text{-}contrast} = .08$, $SD = .62$; and $M_{low\text{-}contrast} = -.11$, $SD = .48$), while the opposite happened for repeated statements ($M_{low\text{-}contrast} = .09$, $SD = .48$; and $M_{high\text{-}contrast} = .01$, $SD = .57$).

Participants' RTs (Table 6) corroborate that both repetition and high-contrast increase statements' processing fluency. Results of the ANOVA associated with the design showed the expected processing advantage of repetition – participants were faster to answer to repeated than to new statements ($M_{repeated} = 3699$, $SD = 1042$, and $M_{new} = 4396$, $SD = 1081$), $F(1, 45) = 87.08$, $p < .001$, $\eta^2_{partial} = .66$. Similarly, participants were also faster responding to high-contrast than to low-contrast statements ($M_{high\text{-}contrast} = 3909$, $SD = 1070$ and $M_{low\text{-}contrast} = 4186$, $SD = 1053$), $F(1, 45) = 15.45$, $p < .001$, $\eta^2_{partial} = .26$. No other effects were significant (all Fs < 1, except the three-way interaction, $F(1, 45) = 1.31$, $p = .26$).

Table 5

Mean (SD) Hits, FA Rates, and SDT Estimates in the Test Phase of Experiment 2, by Learning Condition (Classic vs. Reversed), Repetition (Repeated vs. New) and Color Contrast (high vs. Low) Level

Learning Condition	Hits	FA	*d'*	*C*
Classic learning *n* = 26	.56 (.20)	.55 (.20)	.02 (.57)	-.17 (.53)
Repeated - High contrast	.64 (.23)	.61 (.21)	.10 (.57)	-.40 (.61)
Repeated - Low contrast	.57 (.23)	.55 (.18)	.06 (.46)	-.18 (.55)
New - High contrast	.55 (.18)	.53 (.21)	.03 (.68)	-.14 (.48)
New - Low contrast	.47 (.17)	.51 (.21)	-.11 (.55)	.03 (.48)
Reversed learning *n* = 21	.65 (.18)	.66 (.16)	.01 (.50)	-.48 (.47)
Repeated - High contrast	.67 (.20)	.73 (.19)	-.13 (.57)	-.63 (.59)
Repeated - Low contrast	.79 (.16)	.76 (.13)	.13 (51)	-.86 (.46)
New - High contrast	.56 (.19)	.53 (.15)	.14 (.54)	-.15 (.38)
New - Low contrast	.58 (.17)	.62 (.16)	-.12 (.37)	-.29 (.44)

Table 6

Mean (SD) Response Times in ms in the Test Phase of Experiment 2, by Learning Condition (Classic vs. Reversed), Repetition (Repeated vs. New) and Color-Contrast (high vs. Low) Level

Learning condition	High contrast	Low contrast
Classic learning *n* = 26	3998 (1146)	4232 (1096)
Repeated	3584 (1143)	3950 (1112)
New	4412 (1148)	4513 (1080)
Reversed learning *n* = 21	3803 (984)	4130 (1018)
Repeated	3457 (942)	3774 (952)
New	4149 (1025)	4486 (1083)
Total *n* = 47	3909 (1070)	4186 (1053)

Recognition test. Proportions of "Old" responses in the recognition test (Table 7) were analyzed with an ANOVA, having learning condition (classic vs. reversed) and type of statement (old vs. "new" items of the test phase vs. new items; repeated measures) as independent factors. As Table 7 shows, participants had good memory for the information that had been presented in the exposure phase. This is evidenced by the main effect of type of statement, $F(2, 90) = 97.68$, $p < .001$, $\eta^2_{partial} = .69$, showing a high mean proportion of Hits

and a very low proportion of FA (associated with totally new items). This means that even though statements in the exposure phase were presented rapidly, participants were still able to register the information they were exposed to and later recognize it. However, the proportion of FA associated with "new" items of the test phase was at chance level (*t*-test comparing this FA rate with chance level of .50, $t(46) = -1.17$, $p = .250$), evidencing some confusion regarding the origin of this type of statements.

Table 7

Mean (SD) Hits, FA and FA-Test Rates in the Recognition Test of Experiment 2, by Learning Condition (Classic vs. Reversed)

Learning condition	Hits	FA	FA-test phase
Classic learning $n = 26$	.80 (.21)	.07 (.08)	.48 (.39)
Reversed learning $n = 21$	.85 (.21)	.11 (.18)	.38 (.38)
Total $n = 47$	.82 (.21)	.09 (.13)	.43 (.38)

Conditional analysis. Repetition elicits not only an increased experience of fluency but also familiarity with the items, which also supports illusions of truth (e.g., Begg et al., 1992). The absence of a reversal of the truth effect associated with repetition suggests that the experience of familiarity may have been more relevant than the increased experience of fluency for participants' truth judgments. We tested this hypothesis by comparing the proportion of "True" responses to the statements that participants perceived as familiar ("old") and those they considered "new", independently of their real repetition status. The ANOVA with learning condition (classic vs. reversed) as between-participants factor and recognition (old vs. new) status of the statements as repeated measures revealed only a main effect of the items' recognition status, $F(1, 45) = 16.94$, $p < .001$, $\eta^2_{partial} = .27$. Congruently with previous studies (e.g., Bacon, 1979; Begg & Armour, 1991), the proportion of "True" responses was higher for statements that participants considered old ($M = .65$, $SD = .17$) than for those they considered new ($M = .46$, $SD = .26$). This result, allied with the fact that participants were quite accurate in recognizing repeated statements, suggests that indeed the experience of familiarity was relevant for the decision. Neither the effect of learning condition, $F(1, 45) = 1.76$, $p = .19$, nor the interaction between the two factors, $F(1, 45) = 1.63$, $p = .21$, were significant.

Together, the results of this experiment suggest that although there are occasions when the effects associated with a specific source of fluency are generalized to another one, it

seems that such generalization is more prone to happen in a context where there is not the possibility to contrast the distinctive features between the two fluency instances. When such possibility for differentiation is allowed (by putting the two fluency sources side by side with opposing signs regarding the inference of truth) the confounding previously found is eliminated and effects are dissociated.

General Discussion

Our goal in this study was to contrast perceptual fluency and repetition effects on subjective judgments of truth, as a way to understand if there are specificities in the processing experiences they promote that can be disentangled by our cognitive system. Experiment 1 showed that although the interpretation of fluency due to repetition is susceptible to a reversal, it is not as easy to train it as when fluency spurs from color contrast. Experiment 2 corroborates this by showing that even though there are occasions when the experience elicited by one source of fluency can be confounded with another one and be interpreted in the same way (Unkelbach, 2006, 2007), it seems that such confound is more prone to happen in a context where it is not possible to contrast the distinctive features between them. When repetition and color contrast were manipulated orthogonally and had opposing signs regarding the association with truth, they were differentiated and their effects dissociated.

Results of Experiment 1 fit well with the fact that in the literature the truth effect associated with repetition is usually of a higher magnitude than when perceptual fluency manipulations are used (e.g., Hansen et al., 2008; Parks & Toth, 2006; Reber & Schwarz, 1999; but see Unkelbach, 2007, for an exception). Given the difficulty that our participants demonstrated in associating repeated statements with the response “False”, even though they were clearly false (only easy statements were used in this experiment), it seems that repetition has a stronger connection to truth, which is also less malleable than in the case of perceptual fluency. One reason for why this might happen is that repetition aggregates different levels of fluency – besides the perceptual fluency that comes from reprocessing the wording and phrase structure of the statements, repetition also increases conceptual fluency due to the reprocessing of the semantic content and meaning of the stimuli.

Our results add elements to the learning process that Unkelbach (2007; Reber & Unkelbach, 2010) suggested to underlie the interpretation of fluency as truth. According to the author’s learning approach, throughout their lives individuals learn that fluency correlates

positively with truth, and thus if the opposite correlation is promoted then individuals will learn to interpret fluency as falseness. What our data suggests is that fluency due to repetition and perceptual fluency may have a different learning history regarding the association with truth, what calls for an explanation based on differences that may exist between them.

In this regard, the examination of response-reversal paradigms that Coutanche and Thompson-Schill (2012) presented recently suggests that the response reversal observed after a block of training does not necessarily mean that the primary association (e.g., fluency-truth) itself has changed. To illustrate this, the authors explain the context-specificity characteristic of a newly formed association after a new contingency between stimulus and response is established. In summary, a training block aiming at reversing the typical response to stimulus turns it ambiguous, with two possible interpretations – the original and the reversed one. And just like for any ambiguous stimulus, the choice between the two available responses can be cued/supported by the context an individual is in. Additionally, a crucial consequence of ambiguity is that it drives attention to the context, in search of cues to help in the decision. Therefore, the new response is most likely to be the one selected in the specific context where it was developed. However, the exhibition of this apparent response reversal cannot be taken as a clear sign that the original association has been changed. Rather, it probably remained unaltered and is just not being activated in that specific context because individuals learned that it is not the appropriate one.

Our results challenge the idea that fluency will always have the same effect on subjective judgments, independently of how it is promoted (e.g., Alter & Oppenheimer, 2009). Congruently with Whittlesea's (1993) work demonstrating that conceptual judgments (e.g., semantic relatedness) are influenced only by conceptual fluency (e.g., semantic priming manipulations) and not perceptual fluency, Experiment 2 also suggests that there is some degree of specificity in the fluency experiences that repetition and color contrast generate and how they are used. This is visible in the fact that the truth effect was reversed only for color contrast, while repetition continued to increase subjective truth independently of the learning condition participants were in. Since the learning procedure was directed only to color contrast, this result evidences that the new fluency-falseness association was limited to the fluency instance with which it was learned.

Reber and colleagues (2004; Wurtz et al., 2008) showed that different instances of perceptual fluency (e.g., figure-ground contrast and letter font) have different impacts in objective measures of the perceptual process (e.g., RTs in detection and discrimination tasks).

They also showed that those different objective impacts condensed in one and the same subjective feeling of processing ease. We extend these conclusions by showing that the impact of different fluency experiences can also be dissociated in subjective judgments, such as truth judgments, and not only in objective measures of cognitive processing.

But even though different fluency manipulations may result in different (objective and subjective) effects, the fact is that certain evaluative contexts lead to confounds between them, suggesting that the experiences they elicit share important characteristics. For example, it seems that the processing experience promoted by diverse fluency sources is positive and hedonically marked (e.g., Winkielman, Schwarz, Fazendeiro, & Reber, 2003). This, or other shared features of different fluency sources, can lead to one being taken by another when the context does not allow the comparison of their distinctive attributes. A reason that contributes for the confound is the diffuse nature of fluency (e.g., Mandler et al., 1987), which results in no clear borders between the experiences elicited by different manipulations, or between them and the judgments they affect.

To conclude, by showing a dissociation of perceptual fluency and repetition effects on truth judgments, our results present the first direct evidence that the fluency elicited by the two different sources is not equivalent. Additionally, these results highlight the relevance of the contexts in which individuals make their judgments. When the evaluative context allows the simultaneous experience of the fluency generated by different factors, their influences on subjective judgments can be separated. However, in this work we only contrasted repetition and color contrast as sources of fluency. It is high relevant that future research explores whether the dissociations found are a specific case of repetition, or if they would also emerge with other stimuli's features that impact processing ease. Another question to be addressed is whether these dissociations are also found for other types of judgments, especially those addressing directly the subjective experience of ease.

References

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. *Personality and Social Psychology Review, 13,* 219-235.

Bacon, F. T. (1979). Credibility of repeated statements: Memory for trivia. *Journal of Experimental Psychology: Human Learning and Memory, 5,* 241-252.

Begg, I. M., Anas, A., & Farinacci, S. (1992). Dissociation of processes in belief: Source recollection, statement familiarity, and the illusion of truth. *Journal of Experimental Psychology: General, 121,* 446–458.

Begg, I., & Armour, V. (1991). Repetition and the ring of truth: Biasing comments. *Canadian Journal of Behavioural Science, 23,* 195-213.

Coutanche, M. N., & Thompson-Schill, S. L. (2012). Reversal without remapping what we can (and cannot) conclude about learned associations from training-induced behavior changes. *Perspectives on Psychological Science, 7,* 118-134.

Dechêne, A., Stahl, C., Hansen, J., & Wänke, M. (2010). The truth about the truth: A meta-analytic review of the truth effect. *Personality and Social Psychology Review, 14,* 238-257.

Garcia-Marques, T., Silva, R., Reber, R., & Unkelbach, C. (2014). *Hearing a statement now and believing the opposite later*. Manuscript submitted for publication.

Hansen, J., Dechêne, A., & Wänke, M. (2008). Discrepant fluency increases subjective truth. *Journal of Experimental Social Psychology, 44,* 687-691.

Hasher, L., Goldstein, D., & Toppino, T. (1977). Frequency and the conference of referential validity. *Journal of Verbal Learning and Verbal Behavior, 16,* 107-112.

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 110,* 306-340.

Kelley, C. M., & Lindsay, D. S. (1993). Remembering mistaken for knowing: Ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language, 32,* 1-24.

Mandler, G., Nakamura, Y., & Van Zandt, B. J. (1987). Nonspecific effects of exposure on stimuli that cannot be recognized. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13,* 646-648.

McGlone, M. S., & Tofighbakhsh, J. (2000). Birds of a feather flock conjointly (?): Rhyme as reason in aphorisms. *Psychological Science, 11,* 424-428.

Olds, J. M., & Westerman, D. L. (2012). Can fluency be interpreted as novelty? Retraining the interpretation of fluency in recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38,* 653-664.

Parks, C. M., & Toth, J. P. (2006). Fluency, familiarity, aging, and the illusion of truth. *Aging, Neuropsychology, and Cognition, 13,* 225-253.

Reber, R., & Schwarz, N. (1999). Effects of perceptual fluency on judgments of truth. *Consciousness & Cognition, 8,* 338-342.

Reber, R., & Unkelbach, C. (2010). The epistemic status of fluency as source for judgments of truth. *Review of Philosophy and Psychology, 1,* 563-581.

Reber, R., Wurtz, P., & Zimmermann, T. D. (2004). Exploring "fringe" consciousness: The subjective experience of perceptual fluency and its objective bases. *Consciousness and Cognition, 13,* 47-60.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). E-Prime user's guide. Pittsburgh: Psychology Software Tools, Inc.

Skurnik, I., Schwarz, N., & Winkielman, P. (2000). Drawing inferences from feelings: The role of naive beliefs. In H. Bless & J. Forgas (Eds.), *The message within: The role of subjective experience in social cognition and behavior* (pp. 162-175). Philadelphia, PA: Psychology Press.

Unkelbach, C. (2006). The learned interpretation of cognitive fluency. *Psychological Science, 12,* 339-345.

Unkelbach, C. (2007). Reversing the truth effect: Learning the interpretation of processing fluency in judgments of truth. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, *33,* 219-230.

Whittlesea, B. W. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19,* 1235-1253.

Whittlesea, B. W., Jacoby, L. L., & Girard, K. (1990). Illusions of immediate memory: Evidence of an attributional basis for feelings of familiarity and perceptual quality. *Journal of Memory and Language*, *29,* 716-732.

Winkielman, P., Schwarz, N., Fazendeiro, T., & Reber, R. (2003). The hedonic marking of processing fluency: Implications for evaluative judgment. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion* (pp. 189-217). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Wurtz, P., Reber, R., & Zimmermann, T. D. (2008). The feeling of fluent perception: A single experience from multiple asynchronous sources. *Consciousness and Cognition, 17,* 171-184.

Empirical Article 2

Hearing a statement now and believing the opposite later

Teresa Garcia-Marques and Rita R. Silva

ISPA – Instituto Universitário, Lisbon

Rolf Reber

University of Oslo

Christian Unkelbach

University of Cologne

Word count: 2498 (excluding figure and references) References: 23

Author note

Correspondence concerning this article should be addressed to Teresa Garcia-Marques (gmarques@ispa.pt), ISPA- Instituto Universitário, Rua do Jardim do Tabaco, 34, 1149-041 Lisboa, Portugal. Telephone: + 351 218 811 700.

The writing of this article was supported by the grant SFRH/BD/39153/2007 awarded to Rita R. Silva, and the grant PTDCPSI-PCO1219162010 awarded to Teresa Garcia-Marques, by the Portuguese National Science Foundation (FCT).

Abstract

Existing findings on the truth effect could be explained by recollection of the statements presented in the exposure phase. In order to examine a pure fluency account of this effect, we tested a unique prediction that could not be derived from recollection of a statement. In one experiment, participants judged the truth of a statement that had the same surface appearance as a statement presented earlier but contradicted it, for example "crocodiles sleep with their eyes open" one week after having heard "crocodiles sleep with their eyes closed". We predicted and found that participants judged contradictory statements as being more false than new statements after a delay of only a few minutes, but judged them as more likely to be true after one week. In contrast to earlier findings, this result cannot be explained by accounts relying on recollection of the previously presented statements.

144 w.

Key words: Illusion of truth effect; verbatim repetition; contradictory statements

Hearing a statement now and believing the opposite later

The truth effect is the phenomenon that people believe a statement due to repeated exposure. For example, hearing the statement "The first animated film was shot in France" makes people believe this statement when they hear it again a week later. This repetition-induced illusion of truth effect is highly robust and frequently replicated (e.g., Bacon, 1979; Hasher, Goldstein, & Toppino, 1977; see the meta-analytic review by Dechêne, Stahl, Hansen, & Wänke, 2010). However, does hearing the statement "The first animated film was shot in France" make people also believe a week later that "The first animated film was shot in England"? That is, does the repetition-induced truth spread to verbally similar, but semantically contradictory statements?

This question has important theoretical implications. The repetition-induced truth effect is often explained as a processing fluency effect; processing fluency influences truth judgments independent of repetition (e.g., Reber & Schwarz, 1999; McGlone & Tofighbakhsh, 2000) and it is therefore a prime candidate to explain illusions of truth based on repetition. Several experiments tried to separate recollection and fluency effects by "tagging" statements as true or false during presentation, for example, via honest and dishonest statement sources (e.g. Begg, Anas, & Farinacci, 1992; Brown & Nix, 1996; Skurnik, Yoon, Park, & Schwarz, 2005). For example, participants would see statements from an honest and a dishonest source. If participants consciously recollect that a statement came from a dishonest source, they should not call it "true". If they nevertheless judge repeated statements from a dishonest source as true, their judgments cannot rely on conscious recollection; they apparently must have relied on something else. For example, Begg and colleagues (1992) used such a setup to dissociate conscious recollection from unintentional memory processes and suggested that people rely on an automatic familiarity component in their judgments of truth. However, as these studies used identical statements at presentation and test, these findings could still be explained without invoking fluency as the underlying mechanism. In line with explanations for the sleeper effect (Hovland & Weiss, 1951), people may simply recollect a given statement, but lose the "tag" or mix-up the source, and judge the statement as true.

Here, we present stronger support for the fluency account of the repetition-induced truth effect: the phenomenon that people believe statements that contradict previously heard

statements. Such finding strongly supports a fluency account because fluency and recollection predict opposite effects of repeated exposure on the believability of statements that contradict previously encountered ones. On the one side, recollection should decrease believability, because, as Gilbert (1991) proposed, people accept statements as true upon understanding them, akin to the process by which people accept the existence of physical objects upon seeing them. Thus, people who recollect having heard the statement should have accepted its previous version as true, and therefore should reject a new statement that contradicts the original one. In our example, people should believe the statement about England less, because they already accepted that the first animated film was shot in France. This recollection-based explanation is supported by findings that the repetition-induced illusion of truth is contingent on perceived repetition, with the subjective experience of having seen or heard a statement being more important than the actual repetition status of an item (e.g., Arkes, Boehm, & Xu, 1991; Begg, Armour, & Kerr, 1985). Further, Bacon (1979) showed that a statement that contradicts the one presented in the exposure phase has a lower truth-value than both new statements and the original statement itself. The effect occurs supposedly because people are able to recognize changes in the meaning of the original statement.

On the other side, processing fluency should increase the believability of statements that contradict previously encountered statements. For most authors, processing fluency is a meta-cognitive experience of ease associated with perceptual, conceptual, and other cognitive processes (Unkelbach & Greifeneder, 2013; Alter & Oppenheimer, 2009). Unkelbach and Greifeneder summarized two ways in which the experience of processing fluency should influence truth judgments: people might have lay theories that fluent processing indicates truth (Schwarz, 2007), and/or people might learn that fluent processing and truth are positively correlated and interpret the experience as a truth experience (Unkelbach, 2006, 2007). In the present case, typographic information and the re-exposure to the general topic of the repeated statement generate experiences of fluency (Reber & Schwarz, 1999; Unkelbach & Stahl, 2009), which are independent of whether or not people retrieve specific statement contents from memory. Indeed, judged truth of statements increases not only when they are repeated verbatim, but also when they pertain to related topics (Arkes et al., 1991; Begg et al., 1985).

Consequently, we expect people to believe more in the statement that the first animated film was shot in England than in new and semantically unrelated statements, if they cannot consciously recollect that it was shot in France. Yet, if people remember the statement,

we expect them to discard the contradictory version as they have accepted the original statement upon comprehending it (Gilbert, 1991). Without recollection of the original statements, the experience of processing fluency should create illusions of truth (see Begg, et al., 1992, for a similar dual-process view).

This dual-process view is supported by earlier research (e.g., Brown & Nix, 1996; Skurnik et al., 2005) showing that statements labeled as "false" in the exposure phase were judged as true after a long delay. However, in these experiments, statements in the exposure and the judgment phase were identical. Because long delays increase the probability that a tag is lost or that a dishonest source is confused with an honest source, participants may have judged statements as being true because they recollected them but forgot the qualifying label or forgot the source. Therefore, the present experiment provides a stronger test of recollection and fluency accounts, as instead of presenting the same judgment at exposure and test, participants are given two statements that contradict each other. To achieve this effect, we changed either the predicate or one of the arguments of the original statement, so that if one of the statements is true, the other is necessarily false. With this manipulation recollection and fluency counteract each other when participants encounter contradicting statements.

In sum, in this experiment participants judge the truth of either verbatim (exact repetitions) or contradictory statements, either after a short delay (few minutes) or after a long delay (one week). The comparison standard is a participants' judgment about new statements that have not appeared before; that is, we compare old-verbatim and old-contradictory to new statements. Participants should be more likely to recollect the original statement after a short delay (Kintsch, Welsch, Schmalhofer, & Zimny, 1990), judging the contradictory statements as being more probably false than new statements. After a long delay, participants should be less likely to consciously recollect the specific meaning of the original statement, while gains in processing fluency due to repetition should remain stable over time. In sum, the relative effect of processing fluency, compared to recollection, increases over time (e.g., Arkes et al., 1991; see meta-analysis by Dechêne et al., 2010). Consequently, participants should judge the contradictory statements as being more probably true than new statements.

Method

Fifty-eight university students (47 women; age: $M = 20.69$, $SD = 1.81$) were randomly assigned to a 2 (old-verbatim vs. old-contradictory statements) x 2 (same-session vs. 1-week)

x 2 (old- vs. new-statements) design, with the last factor as a within-participants manipulation. Given the average effect size of d = 0.49 [95% *CI*: 0.45 – 0.55] reported by Dechêne and colleagues (2010), the present design has sufficient power to detect the predicted interaction (with α = .05, $1\text{-}\beta$ = .80, and correlation between repeated measures = .20; Faul, Erdfelder, Lang, & Buchner, 2007).

We created two lists with 20 neutral statements each (following Bacon, 1979). The two lists of statements contradicted each other, but were otherwise identical ("crocodiles sleep with their eyes closed" vs "crocodiles sleep with their eyes open"; or the animated movie example mentioned earlier). A pre-test showed that both versions of all statements were rated as equally likely to be true. Twenty new statements served as baseline for all groups. The verbatim-old condition presented participants (n = 30) with the same statements in both the initial exposure and the truth rating phase; the opposite-old condition presented participants (n = 28) with statements that contradicted the old statements in the test phase, but were otherwise identical. Statement lists were counterbalanced across exposure and test phases.

Experimental sessions included 10-15 participants. In the exposure phase, participants listened to tape recorded statements, including four practice statements at the beginning (not included in the statistical analysis). Their task was to rate the interestingness of the statements and they were told that half of the statements were true and half were false. In the test phase, participants received a booklet with 40 statements. Depending on condition, statements were 20 old-verbatim or 20 old-contradictory statements, mixed with 20 new-statements. Participants rated all statements for truth (1 = "certainly-false" to 7 = "certainly-true"). Half of the participants made their ratings in the same session, the other half one week later. Each participant only judges one version of a repeated statement (verbatim vs. contradictory) and delay was a between-participants variable. Thereby, the design allows separating the effects of recollection and fluency of the statement.

Results

We computed participants' mean rated truth score. Figure 1 depicts these means as a function of delay (same session vs. one week) and repetition status (old verbatim/old contradictory vs. new). Figure 1 shows that participants gave higher truth scores to old-verbatim statements (M = 4.99, SD = .82) than new statements (M = 4.59, SD = .51) across both delay conditions, $t(28) = 2.21$, p = .035, d = .86, replicating the standard truth effect. For

contradictory statements, we expected and found that within the same session, participants gave lower truth scores to old-contradictory statements, $t(26) = 5.19$, $p < .001$, $d = 2.04$, than to new statements. Yet, after a delay of one week, participants gave old-contradictory statements higher truth scores than to new-statements, $t(26) = 2.11$, $p = .044$, $d = .83$. This differential pattern results in a significant three-way interaction in the respective ANOVA ($F(1, 54) = 13.37$; $p < .001$, $\eta^2_{partial} = .20$).

In sum, we first replicate the standard truth effect across the delay conditions. Second, contradictory statements are believed less than new statements when judged within the same session. However, after one week, participants believe contradictory statements *more* than new statements.

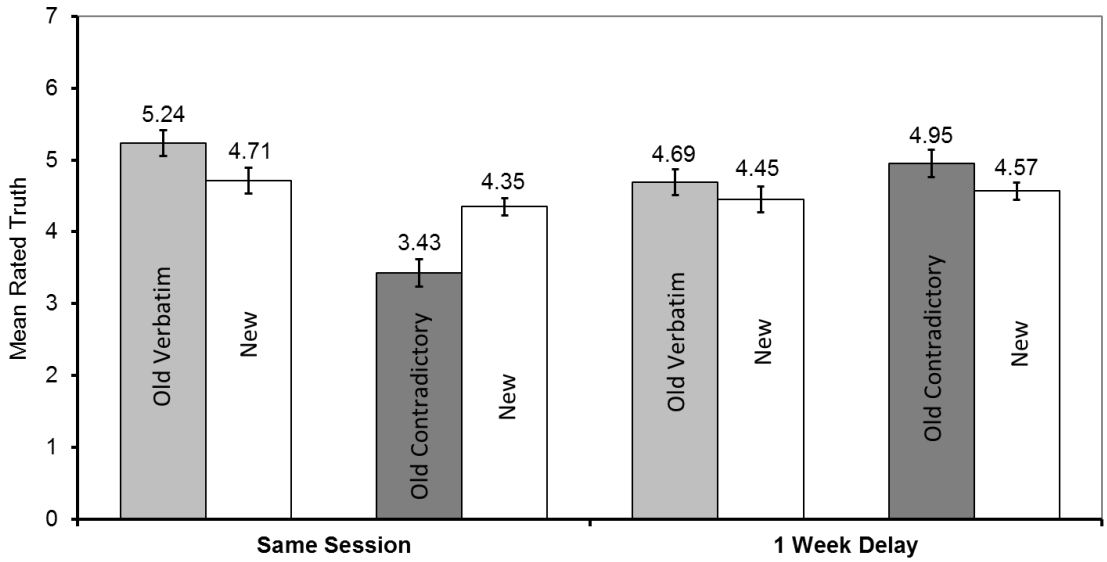

Figure 1. Mean ratings of truth by delay condition (Same Session vs. 1 Week) and statement type (old verbatim vs. old contradictory vs. new). Error bars represent standard errors of the means.

In addition to the predicted effect, the ANOVA showed a main effect of type of old items ($F(1, 54) = 14.72$; $p < .001$; $\eta^2_{partial} = .21$) and a two-way interaction involving repetition and type of old statement ($F(1, 54) = 9.20$; $p = .004$; $\eta^2_{partial} = .15$) that can be derived from the pattern of results reported above: a) participants in the verbatim statement conditions gave higher ratings than participants in the contradictory statement conditions; b)

the interaction qualifies this main effect; repeated ”same vs. contradicting” differed whereas new items did not differ.

Discussion

The design of this experiment allows us to oppose the repetition-based influences of processing fluency and recollection memory on truth judgments. In the short delay condition, participants judge a contradictory statement as less probably true compared to new statements. After one week, however, participants were more likely, compared to new statements, to believe a statement that contradicted the original statement they heard before. The results obtained in the short delay condition follow from Gilbert's (1991) notion that people believe statements upon comprehending them. In a similar vein, it could be argued that when participants made their judgments in the same session, contradictory statements are considered false by the same *recall-to-reject* mechanism that allows individuals to reject lures that are similar to original items in memory tests (e.g., Jones, 2005; Rotello & Heit, 1999, 2000). This process involves recollecting the original item and comparing it to the similar lure. When participants are tested immediately after learning the stimuli they are likely to recollect the original statement, leading to rejections of the contradictory statements. When they are probed after a longer delay, recollection of the original statement is less likely, but repetition-induced fluency experiences remain intact to guide the truth judgment.

In contrast to earlier studies that presented identical statements at training and test but tagged some statements at test as false or present statements from honest and dishonest sources (Brown & Nix, 1996; Skurnik et al., 2005; Unkelbach & Stahl, 2009), we changed the meaning of test statements, making their truth value mutual exclusive with statements presented in the exposure session. Thus, the effect cannot be attributed to a weaker association of the statement with its tagged truth status or lost and/or confused sources. It has to be attributed to a property of the processing of repeated stimuli that is not sensible to their semantic features, and that seems to be the fluency with which the items are processed. This finding reveals that processing fluency influences truth judgments independently of semantic memory mechanisms; and thus experienced truth is much more malleable than previous research has shown.

Conclusion

Does hearing the statement “The first animated film was shot in France” make people also believe a week later that “The first animated film was shot in England”? In light of our results, this seems to be the case. When memory fails, people have to rely on their experience of processing fluency to provide truth judgments. Our study shows that after a delay of one week, this lack of recollecting of the original statement results in the endorsement of claims that contradicted it.

This effect requires a modification of a Bayesian analysis of the truth effect provided by Reber and Unkelbach (2010). According to this analysis, people may trust their feeling of fluency for judging the truth of a proposition under most ecologically valid circumstances. A modified analysis would have to consider the fact that fluency does not only stem from the same statement.

The illusion of truth found in this study has important implications for teaching, marketing, health prevention, or politics. Imagine a teacher telling students that the first animated movie was shot in France. Some days later, the teacher notes that this was wrong. The first animated movie was made in England. Our findings suggest that simply stating the true statement increases its validity for those who heard the wrong statement, compared to those who never heard any statement about this topic. At least in some situations, it may be more effective to just tell the truth without mentioning what was wrong. Finally, the finding reveals the power of opposite statements as innuendos. For example, the statement “the supervisor harassed the employee” is straightforward and would be seen as an offense that damages the reputation of the supervisor. Our research shows, however, that the statement “The boss did *not* harass the employee” may in the long run be as dangerous to the superior’s reputation as the affirmative statement.

References

Arkes, H., Boehm, L., & Xu, G. (1991). Determinants of judged validity. *Journal of Experimental Social Psychology*, *27*, 576–605.

Bacon, F. (1979). Credibility of repeated statements: Memory for trivia. *Journal of Experimental Psychology: Human Learning and Memory, 5*, 241-252.

Begg, I., Anas, A., & Farinacci, S. (1992). Dissociation of processes in belief: Source recollection, statement familiarity, and the illusion of truth. *Journal of Experimental Psychology: General, 121*, 446-458.

Begg, I., Armour, V., & Kerr, T. (1985). On believing what we remember. *Canadian Journal of Behavioral Science, 17*, 199-214.

Brown, A., & Nix, L. (1996). Turning lies into truths: referential validation of falsehoods. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22*, 1088-1100.

Dechêne, A., Stahl, C., Hansen, J., & Wänke, M. (2010). The truth about the truth: A meta-analytic review of the truth effect. *Personality and Social Psychology Review, 14*, 238-257.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191.

Gilbert, D. T. (1991). How mental systems believe. *American Psychologist*, *46*, 107-119.

Hasher, L., Goldstein, D., & Toppino, T. (1977). Frequency and the conference of referential validity. *Journal of Verbal Learning and Verbal Behavior, 16*, 107-112.

Hovland, C. I., & Weiss, W. (1951). The influence of source credibility on communication effectiveness. *Public Opinion Quarterly, 15,* 635-650

Jacoby, L. L., & Kelley, C. M. (1992). A process-dissociation framework for investigating unconscious influences: Freudian slips, projective tests, subliminal perception, and signal detection theory. *Current Directions in Psychological Science, 1*, 174-179.

Jones, T. C. (2005). Study repetition and the rejection of conjunction lures. *Memory*, *13*, 499–515.

Kintsch, W., Welsch, D., Schmalhofer, F., & Zimny, S. (1990). Sentence memory: A theoretical analysis. *Journal of Memory and Language, 29*, 133–159.

McGlone, M. S., & Tofighbakhsh, J. (2000). Birds of a feather flock conjointly (?): Rhyme as reason in aphorisms. *Psychological Science, 11*, 424-428.

Reber, R., & Schwarz, N. (1999). Effects of perceptual fluency on judgments of truth. *Consciousness & Cognition, 8*, 338-342.

Reber, R., & Unkelbach, C. (2010). The epistemic status of processing fluency as source for judgments of truth. *Review of Philosophy and Psychology*, *1*, 563-581.

Rotello, C. M., & Heit, E. (1999). Two-process models of recognition memory: Evidence for Recall-to-reject? *Journal of Memory and Language, 40,* 432-453.

Rotello, C. M., & Heit, E. (2000). Associative recognition: A case of recall-to-reject processing. *Memory & Cognition, 28,* 907-922.

Skurnik, I., Yoon, C., Park, D., & Schwarz, N. (2005). How warnings about false claims become recommendations. *Journal of Consumer Research, 31*, 713-724.

Unkelbach, C. (2006). The learned interpretation of cognitive fluency. *Psychological Science, 17*, 339-345.

Unkelbach, C. (2007). Reversing the truth effect: Learning the interpretation of processing fluency in judgments of truth. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 33*, 219-230.

Unkelbach, C., & Greifeneder, R. (2013). A general model of fluency effects in judgment and decision making. In C. Unkelbach & R. Greifeneder (Eds.), *The experience of thinking: How the fluency of mental processes influences cognition and behaviour* (pp. 11–32). New York, NY: Psychology Press.

Unkelbach, C., & Stahl, C. (2009). A multinomial modeling approach to dissociate different components of the truth effect. *Consciousness & Cognition, 18*, 22-38.

Empirical Article 3

The Informative Value of Type of Repetition: Perceptual and Conceptual Fluency Influences on Judgments of Truth

Rita R. Silva and Teresa Garcia-Marques

ISPA – Instituto Universitário, Lisbon

Rolf Reber

University of Oslo

Word count: 8161 (excluding abstract, references and tables). References: 37

Author Note

Correspondence regarding this paper should be addressed to: Rita R. Silva, ISPA-Instituto Universitário, Rua Jardim do Tabaco, 34, 1149-041 Lisboa, Portugal. E-mail: rsilva@ispa.pt. Telephone: + 351 218 811 700.

The writing of this article was supported by the grant SFRH/BD/39153/2007 awarded to Rita R. Silva, and the grant PTDCPSI-PCO1219162010 awarded to Teresa Garcia-Marques, by the Portuguese National Science Foundation (FCT).

The authors would like to thank to Pedro Fonseca, Raquel Ceirão and Inês Dias for the assistance provided in the preparation of the materials used in the experiments.

Abstract

The similarity of a statement with a previously presented one enhances its ease of processing, promoting an illusion of truth. In two experiments, we address similarity with a statement's core meaning (conceptual fluency) in opposition to similarity with its verbatim quote (perceptual fluency). After being exposed to a set of statements, participants rated the truth of exact repetitions (verbatim) or/and paraphrased versions. A long-delay condition was added to hamper explicit memory mechanisms. In Experiment 1 with a between-participant design, paraphrases were evaluated exactly as verbatim repetitions, with delay moderating the magnitude of the illusions of truth elicited by both types of statements. In Experiment 2, participants judged both verbatim and paraphrased repetitions with the same vs. contradictory meaning regarding the original statements, in a within-participants setting. In this context an illusion of truth for same-meaning items, and an illusion of falseness for contradictory items emerged. A long delay reduced the magnitude of both those effects, and disrupted the illusion of falseness more if contradictory statements were verbatim repetitions. We discuss the role of memory and fluency mechanisms on the illusion of truth effect, as well as the nature of the evaluative context (homogeneous vs. heterogeneous) in which the truth evaluations are made.

203 words

Keywords: illusion of truth, repetition, perceptual fluency, conceptual fluency

The informative value of type of repetition in the illusion of truth effect

Statements that are repeated are considered more probably true and more valid than new statements, the so-called "Illusion of truth effect". Hasher, Goldstein and Toppino (1977) were the first to empirically demonstrate this effect, which has been repeatedly replicated in different settings and with different materials (see Dechêne, Stahl, Hansen, & Wänke, 2010, for a meta-analysis).

The majority of experiments that illustrate this effect have used "literal" (verbatim) repetition of the statements. That is, participants evaluate the truth of exactly the same items they were previously exposed to. However, to capture the processes that underlie evaluations of truth, some empirical approaches have made changes to the statements that are judged. Three changes are of particular relevance for that purpose: (1) changes to the wording of the statements while maintaining their core meaning (i.e., paraphrases), (2) changes to the meaning of the statements while maintaining most of their wording (i.e., contradictory statements), and (3) changes in both the wording and the specific meaning of the statements, but maintaining their general topic and subject (i.e., gist repetition). By comparing truth judgments of repeated statements with these kinds of changes, we are able to contrast the role of memory activation vs. perceptual fluency features have in illusions of truth.

This paper first provides an overview on the memory and fluency accounts to explain the impact of repetition on perceived truth, and the experiments that introduced changes to the repeated statements to find support for one or the other account. In addition, we present two experiments that contrast those manipulations' effects, showing the relevance of the type of repetition that is used for the emergence of illusions of truth, and thus bringing further understanding about the processes underlying truth judgments.

Processes underlying repetition's impact on truth judgments

Several processes can sustain the evaluation of truth of repeated statements. People might use their knowledge to infer the validity of a statement – we know at least some proportion of what is true and what is not. And our knowledge can generate either correct or incorrect conclusions regarding the truth status of propositions we are not sure about, based on inferential processes (e.g., syllogistic reasoning, Klauer et al., 2000).

Simply remembering that we have heard or read a statement before influences how we judge its validity. One reason for why this may occur is that when we recognize the statement we also recall information about its epistemic value (whether it was presented as true or false; see Brown & Nix, 1996, for evidence of *referential validity*). It may also happen because just the fact that we remember the statement signals it must be true (see Arkes, Hacket, & Boehm, 1989, and Arkes, Boehm, & Xu, 1991, for evidence of *convergent validity*; and Bacon, 1979 for the first demonstration).

The effects of memory on subjective truth are expected to be conscious and strategic (Bacon, 1979). This becomes visible when the judged status of statements as old or new determines their truth evaluations, regardless of their actual repetition status. For example, Bacon (1979) showed that truth evaluations are enhanced only for statements that participants correctly recognized as old (hits). Begg and Armour (1991) showed that statements judged as old were evaluated as true whether they were repetitions that subjects correctly remembered or new statements that subjects mistook for repetitions. Furthermore, old statements that were forgotten were evaluated just as true as new statements correctly identified as such. In addition, Ozubko and Fugelsang (2010) demonstrated that information that is retrieved from memory (in the absence of explicit repetition) has an increased subjective truth-value.

But repeated statements can affect truth ratings even when explicit memory plays no role. In this case, an individual will simply experience familiarity with a statement, which is anchored in its fluent processing (e.g., Jacoby & Dallas, 1981). Begg, Anas, and Farinacci (1992) offer evidence of this second route for judging truth, showing that memory and processing fluency have independent contributions in the enhancement of subjective truth. Repeated stimuli are easy to process, and fluency can support memory judgments (e.g., Jacoby & Whitehouse, 1989) as well as evaluations of truth. Although fluency is intrinsic to the processing of repeated stimuli, its role on illusions of truth is better observed when isolated from it. For example, individuals evaluate statements as more probably true simply because they are presented in high as compared to low visual contrast (Reber & Schwarz, 1999). Similarly, aphorisms are perceived as truer when presented in a rhyming (e.g., "Birds of a feather flock together") rather than a non-rhyming form (e.g., "Birds of a feather flock conjointly", McGlone & Tofighbakhsh, 2000). Also, semantically primed words (i.e., words that are preceded by related concepts) are judged as better answers to trivia questions than words that are not primed (Kelley & Lindsay, 1993).

The ubiquity of the repetition-based truth effect may come from the fact that repetition aggregates fluency experiences elicited by different sources/factors (Whittlesea, 1993). Repetition may even combine the several mechanisms proposed by the different theoretical approaches. The fluency involved in the processing of a repeated statement can come from the repetition of different types of its perceptual features – perceptual fluency, and/or the repetition of the different types of its conceptual characteristics – conceptual fluency.

Previous exposure induces perceptual fluency due to the creation of a feature-based representation of the stimulus (visual, auditory, pictorial), which supposedly facilitates the encoding and processing of the statement when faced again (Jacoby & Dallas, 1981; Shapiro, 1999). But through repetition individuals also learn about the structural properties of statements (e.g., grammars), which facilitate their subsequent processing (Reber, 1967). Thus, even if a statement is not the same but has a similar structure to a previous one, individuals may experience increased fluency (see Reber & Unkelbach, 2010, for a similar argument), which does not come from conceptual details. Conceptual fluency occurs because previous exposure creates a meaning-based representation that facilitates retrieval, encoding and processing in future encounters (Shapiro, 1999; Whittlesea, 1993). This type of fluency can come from the activation of the core meaning of the statement or of a more general knowledge structure (theme, topic category or schemata). The activation of these knowledge structures in memory facilitates subsequent processing (e.g., Bartlett, 1932). Knowing the convergence of effects that fluency exerts in a great diversity of judgments (see Alter & Oppenheimer, 2009), the power of repetition in consistently promoting illusions of truth is not surprising – repetition simply aggregates different sources of perceptual and conceptual fluency.

Previous experiments have contrasted conceptual and perceptual fluency effects, showing that the two can bias judgments about stimulus repetition, and liking (see Whittlesea, 1993). Whittlesea manipulated the fluency of a target word (e.g., *boat*) either by repeating it (referring it as "perceptual fluency") or by simply placing it in a predictable context (e.g., "the stormy seas tossed the *boat*"; conceptual fluency). He showed that both fluency manipulations impacted the subsequent judgments of the word.

However, using an experimental paradigm inspired in Whittlesea's (1993), Shapiro (1999) provided evidence that these effects can be moderated by the similarity of the context – that is, although perceptual and conceptual fluency may exert similar effects in similar

contexts, only conceptual fluency influences individuals' choices when the context of evaluation is modified.

The evidence of the distinctive roles of the two types of fluency is corroborated by data showing that conceptual fluency increases through elaboration and is affected by attentional processes, which is not the case for perceptual fluency (Eich, 1984; Hamann, 1990). Also, although perceptual changes have been found to influence implicit and explicit memory judgments, their impact seems not to be same in both memory measures and the literature suggests mixed results regarding the direction of the effects. While some evidence suggests that perceptual fluency increases "Know" responses but has little effect on "Remember" responses (e.g., Gregg & Gardiner, 1994; Rajaram, 1993), other data shows that physical overlap between studied and tested pictures boosts the experience of *remembering* but not the experience of *knowing*, while conceptual fluency affects both "Know" and "Remember" responses (Rajaram, 1996; Rajaram & Geraci, 2000).

Types of repetition

Although illusions of truth have mostly been associated with verbatim repetition, this is not a necessary feature of the effect. The effect is expected to occur if a target statement is sufficiently similar (perceptually or conceptually) to a previously presented one, facilitating its processing. Thus, different kinds or levels of repetition are expected to promote illusions of truth. However, this assumption is only weakly supported, as there is "a lack of findings on similarity and judged truth so that this issue awaits further research." (Reber & Unkelbach, 2010, p. 566).

Research has focused different types of repetition so to better understand the mechanism that underlies the truth effect. Thus, besides verbatim repetition, we also find data showing illusions of truth with "topic" (gist) repetition and part of the statement's verbatim repetition.

To activate the topic of statements that participants were going to evaluate for truth, Begg, Armour and Kerr (1985) exposed participants to parts of the target statements in a previous phase of the experiment (e.g., "A hen's body temperature" was presented as part of the statement "The temperature of a hen's body is about 104 degrees Fahrenheit"), leading to an increase in those items' perceived validity. These results were replicated in a second experiment in which the statements' topic was activated by posing a question that included

more ("Do you have any idea how long the extended right arm of the Statue of Liberty is?") or less ("Do you have any idea how long the Statue of Liberty has been in New York?") relevant details regarding a target statement that would be rated for truth (e.g., "The right arm of the Statue of Liberty is 42 feet long").

Arkes and colleagues (1991) wanted to test these effects in a context of simple topic repetition. They familiarized participants with statements either about China or other topics, and one week later presented either China-related text passages or unrelated ones. Another week later, participants had to evaluate for truth a group of statements pertaining to China, including those presented before. Results showed that reading the China text passages on week 2 led participants to consider the China-related statements more valid, independently of having been exposed to the statements previously.

Hawkins, Hoch, and Meyers (2001) offer further evidence of the impact of non-verbatim repetition on perceived truth. These authors tested how the perceived truth of a claim was influenced both by its exact repetition and by the repetition of associated claims (which shared some words with the original statement). They found little evidence of truth effects with the associated claims. However, both repetition conditions increased the perceived truth of a superordinate general claim to which all others were (conceptually) related. Mediation analyses suggested that the effect was mediated both by an increase in perceived familiarity and in perceived coherence of the claim (possibly related with the ease of processing its content).

By manipulating these different types of repetition, these studies could yield information regarding the role that perceptual and conceptual fluency mechanisms exert in the truth effect. Unfortunately neither of the studies that repeated the gist of the statements isolated conceptual fluency from perceptual fluency. For example, in the Arkes et al. (1991) study, repetition of the topic made use of several words that had been heard in the first exposure to the statements. So individuals may have experienced some level of perceptual fluency just by processing those overlapping words (e.g., China). This possibility is even stronger in the experiments by Begg et al. (1985), in which a considerable part of the statements is literally repeated.

However, Hawkins and collaborators' (2001) study provides some insight, since their data suggests that the relevant feature of the gist manipulations was the conceptual component. They got a null result when they used as repetitions statements that shared only

some words with the original claim (e.g., the name of the product), but a significant impact of topic repetition in a general statement that was conceptually represented in all the original claims. Thus, simply repeating some words in the absence of an overlap with the meaning of the original statement may not provide a significant level of perceptual fluency to increase truth evaluations.

Other studies have used repetitions in which all the perceptual characteristics (words, phrase structure) of the original statements are kept, except for one small detail that produces a contradiction to its original meaning. Using this kind of stimuli, Bacon (1979) found that when contradictions are presented together with original statements participants rated them as falser than new statements, creating an illusion of falseness. The falseness effect has been replicated even in the absence of original statements, but it seems to occur only when evaluations occur in the same session as the exposure phase and not after longer 1-week delays (Garcia-Marques, Silva, Reber, & Unkelbach, 2014), suggesting explicit memory mechanisms to moderate how perceptual fluency informs judgments of truth. Findings by Begg and colleagues' (1992) provide further support for the role of explicit memory mechanisms in the illusion of falseness. In an experiment the authors asked individuals to evaluate both original and contradictory statements, showing that when statements contradicted items that had been presented as false, they were evaluated with about the same truth-value as new statements. In contrast, if the original statements had been presented as being true, participants rated contradictory items as falser than new ones.

Thus, it seems that memory for the statements that were presented before may modulate the effect of perceptual fluency arising from the similarities between the original and contradictory statements (e.g., wording and sentence structure; Garcia-Marques et al., 2014). This is also shown by Johar and Roggeveen's (2007) experiments, which investigated the effectiveness of refutations of an original statement depending on whether they shared perceptive similarity with it or not. Their study showed that refutations that were direct contradictions of the original claim and therefore perceptually similar were less believed than indirect refutations (i.e., statements not seen before but that could be inferred from old statements). Mediation analysis suggested that more similar refutations were stronger recall cues for the original claims, and this recall decreased belief in the contradiction itself. Thus, in agreement with other studies, explicit memory for the original statement was shown to decrease contradictions' truth-value.

The Present Experiments

One type of repetition that has not been clearly and fully explored is the repetition of the core meaning of a statement independent of its perceptual features. This kind of paraphrase reduces perceptual fluency mechanisms (visual and sound features), isolating conceptual fluency effects. Besides having the same theme of the original statements, paraphrases overlap in all their semantic features while differing in the perceptual features. Reading time measures show that these statements tend to be reprocessed as unchanged repetitions (Levy, Barnes & Martin, 1993), suggesting that although perceptual features may be sufficient causes for illusions of truth to emerge, they might not be necessary causes.

The present experiments tested the impact of paraphrases of previously presented statements on truth judgments, to understand the role that conceptual and perceptual fluency play in illusions of truth. By doing so, these experiments extend prior research, introducing a manipulation that maintains the exact core meaning of the original statement (and not only its topic), and at the same time reduces the perceptual fluency usually associated with repetition. In addition to paraphrases, participants in Experiment 2 judged statements that contradict the core meaning but maintain the perceptual features of the items first presented. Such contradictory statements maintain both the topic/gist and the perceptual features of the original ones, while differing in their core meaning (which is the only overlap paraphrases have with original items). Furthermore, by making paraphrases of the contradictory statements, we isolate the fluency due to having the same topic from the fluency of both the core meaning and the perceptual features, which are changed. The comparison between the truth ratings promoted by these manipulations allows us understanding the relevance that each of these components has in the promotion of illusions of truth.

In their meta-analysis, Dechêne and colleagues (2010) contrasted the results of the experiments that manipulated the repetition of topic and related issues with those that focused on the repetition of literal (verbatim) statements. Their analyses suggest that gist repetition produces small truth effects in heterogeneous contexts (which allow between-item comparisons) and null effects in homogeneous contexts (in which the comparisons are within-item). The authors interpreted this difference as indicating that homogeneous contexts are more likely to activate explicit memory processes, and are thus less prone to the influence of low-level perceptual processes, which are typical of implicit memory (Roediger, 1990). This assumption is supported by the fact that homogeneous contexts are more sensible to

manipulations that disturb explicit memory mechanisms, such as the delay of measurement (Dechêne et al., 2010).

Therefore, we introduced a delayed judgment condition in our experiments. Experiment 1 presents a homogeneous evaluation context in which participants rate only one type of repeated statements, and Experiment 2 a heterogeneous context in which participants evaluate all types of statements. With these manipulations we expect to understand how pure perceptual and conceptual fluency modulate perceptions of truth when isolated from explicit memory processes.

Experiment 1

Experiment 1 goal was to contrast paraphrases and verbatim repetition effects on perceived truth, either when judgments are made within a few minutes after exposure or after a long delay. We expected a truth effect associated with repeated statements to emerge in the two delay conditions. We also expected the contribution of explicit memory mechanisms to illusions of truth to be reduced when evaluation occurs after a long delay. If the truth ratings given to paraphrases are similar to those given to verbatim-repetitions, this suggests that processing fluency rising only from conceptual overlap can induce illusions of truth.

Method

Participants and Design. A total of 105 undergraduate students (95 women; M_{age} = 22.00, SD = 7.03) participated in the experiment for course credit. Participants were randomly distributed by the cells of two between-participants manipulations: statement repetition type (verbatim vs. paraphrase) x truth evaluation session (same-session vs. 1-week delay). All participants evaluated repeated and new items.

Stimulus Development. We developed paraphrases of 52 statements that had been previously pre-tested as neutral (equal probability of being considered true or false),[10] ensuring that they: (a) had approximately the same length (number of words) as the original statements, (b) repeated as few words as possible from the original statements, (c) had a different phrase structure, and (d) shared exactly the same meaning of the original statements.

[10] See Garcia-Marques et al. (2014), for details about this pre-test.

For example, the paraphrase of the statement "Crocodiles sleep with the eyes open" is "When sleeping, crocodiles don't close their eyelids".[11]

From the original-paraphrases pairs, we selected the 42 (21 factually true and 21 factually false) that scored higher in a pre-test regarding meaning similarity (all the pairs that had $M_{\text{similarity}} \geq 5$ in a rating scale from 1 to 7; overall mean was $M_{\text{similarity}} = 6.21$, $SD = 1.37$). From those, 10 true and 10 false pairs were randomly selected to compose the list of target (i.e., repeated) stimuli of the experiment. Twenty further statements (half true, and half paraphrases) were randomly selected from the remaining highly similar pairs to serve as the new statements in the truth evaluation task. This selection balanced the number of statements by their characteristics, that is, True/False status and Set A/Set B (one is the paraphrase of the other). New statements were the same for both sets.

Procedure. Participants arrived in the lab and were seated on individual workstations. In the exposure phase, participants were asked to evaluate a set of 24 statements on their level of interest (1 - Not Interesting at all; 7 - Very Interesting). Statements were presented one at a time through headphones, with an interval of 3 seconds between each. The first four statements were used as practice trials. Half of the participants listened to Set A and the remaining to Set B.

After the exposure phase, participants in the 1-week delay group were invited to participate in another, unrelated experiment. Participants in the same-session group were presented with an "unrelated" task, in which they had to evaluate how true they considered a new group of 40 statements, half true and half false, using a 7-point scale (1 - Certainly False; 4 - Uncertain; 7 - Certainly True). Half of the statements were new and half were old. Depending on the experimental condition, participants evaluated either verbatim-repetitions or paraphrases of the original statements.

The two tasks lasted between 15-20 minutes, and upon completion participants were thanked and debriefed. All participants were instructed to come back to the lab one week later, and whereas those in the 1-week delay group completed the truth evaluations at that time, the same-session group participated in a different study.

[11] All the statements were presented in Portuguese, and thus the overlap of words between the two versions of the statements is less than what the translation to English suggests (e.g., "A infeção com maior prevalência no mundo é a Malária" vs. " A Malária é a doença infecciosa mais predominante no planeta").

Results

We expected participants to indicate higher truth-values to repeated items than to new ones, showing evidence of an illusion of truth effect. In addition, session of the truth evaluation (same-session vs. 1-week delay) was expected to moderate the effect, depending on how explicit memory drives truth judgments in the same session group. If, as expected, it contributes positively to illusions of truth, the effect should be less visible in the delayed condition. Finally, if paraphrases are dealt with as unchanged repetitions, we expected them to ring as true as verbatim repetitions.

Mean ratings of truth (Table 1) were analyzed in a 2 (same-session vs. 1-week delay) x 2 (verbatim vs. paraphrased repetition) x 2 (Old vs. New items) ANOVA, with the last factor as repeated measures. The only significant effects that emerged from the analysis were the expected main effect of repetition, $F(1, 101) = 105.54$, $p < .001$, $\eta_p^2 = 0.51$, evidencing a truth effect associated with old items ($M_{Old} = 5.01$, $SD = .82$; $M_{New} = 4.26$, $SD = .46$), and its moderation by time of the evaluation session, $F(1, 101) = 13.81$ $p < .001$; $\eta_p^2 = 0.12$, showing the predicted decrease of the difference between the ratings given to repeated and new statements in the 1-week delay condition. No effects associated with type of repetition were found (all Fs < 1), suggesting verbatim and paraphrased repetitions to induce the same effects on truth judgments.

Table 1

Mean (SD) Ratings of Truth to Old and New Statements in Experiment 1, by Type of Repetition and Truth Evaluation Session

	Same-Session			1-Week Delay		
	Verbatim	Paraphrases	Total	Verbatim	Paraphrases	Total
Old	5.14 (1.01)	5.37 (.90)	5.24 (.96)	4.92 (.67)	4.71 (.60)	4.82 (.64)
New	4.10 (.43)	4.28 (.36)	4.18 (.41)	4.33 (.56)	4.29 (.42)	4.32 (.49)
n	26	22	48	29	28	57

Direct tests of our hypothesis were performed with planned comparisons testing the presence of the truth effect (repeated statements: 1; new statements: -1) in all experimental

conditions. For the verbatim-repetition condition, a truth effect emerged in both the same-session, $t(101) = 6.84$, $p < .001$, $d = 1.34$, and the 1-week delay condition, $t(101) = 4.08$, $p < .001$, $d = .96$. The same pattern was found for paraphrases: same-session, $t(101) = 6.59$, $p < .001$, $d = 1.59$; 1-week delay, $t(101) = 2.80$, $p < .006$, $d = .81$.

Discussion

Experiment 1 showed that paraphrases are evaluated exactly as true as verbatim repetitions, both when evaluations are made immediately after exposure or after a 1-week delay. This suggests that processing fluency promoted exclusively at the conceptual level mimics processing fluency associated with verbatim-repetition. The perceptual overlap incorporated in verbatim repetition does not seem to add any additional effect.

Yet although perceptual overlap is not a necessary condition for the truth effect to occur, we already know from previous research (see above) that it seems to be a sufficient cause. Thus, perceptual fluency may still support verbatim repetition effects, but our experimental context did not allow detecting it because it created a homogeneous context in which paraphrases were never contrasted with pure repetitions.

To enable such comparisons, Experiment 2 collected data in a heterogeneous context, by adding to the verbatim vs. paraphrases conditions a factor manipulating whether repeated statements maintained or contradicted the core meaning of the statements originally presented, and asking participants to give truth ratings of all these types of statements.

Experiment 2

The goal of Experiment 2 was to further investigate the role that conceptual and perceptual fluency exert in truth evaluations of repeated statements, by allowing participants to contrast statements that share either perceptual (same words and sentence structure, but not the meaning) or conceptual features (same topic and core meaning, but not the wording or sentence structure) with the original ones. Thus, four types of statements were presented: (1) verbatim repetitions (original statements), (2) paraphrases, (3) contradictory statements, and (4) paraphrases of the contradictory statements (contradictory paraphrases). Participants evaluated all types of statements in a heterogeneous context (Dechêne, et al., 2010), either in a same-session or in a 1-week delay condition. The contrasts between all these types of items

allow us isolating the effects of the different sources of fluency, and consequently address their specific contributions to illusions of truth. Compared to original statements, paraphrases isolate the core meaning and topic of the original items from their perceptual features, which are altered. Contradictory statements isolate the fluency due to topic similarity and perceptual features from the fluency due to repetition of the core meaning of the original statement (because that core meaning is changed). Contradictory paraphrases isolate the fluency due to sharing the topic with original statements from both the fluency due to repeating its core meaning and perceptual details.

By analyzing truth ratings that take recognition classifications of the statements into account (i.e., conditional analysis), we can test differences between statements thought to be repeated and those thought to be new relative to actual repetitions and new statements. Therefore, a recognition test was added to the experiment. Although we expect memory and truth judgments to share variability (as both judgments are influenced by the ease with which a statement is processed), we expect this not to completely overlap. Additionally, any effects associated with the different types of statements in the conditional analysis will inform about the role that conceptual and perceptual features play in the relation memory and truth judgments seem to have.

Method

Participants and Design. Forty-five undergraduate students (36 women; M_{age} = 20.20, SD = 3.00) participated in the experiment for course credit. They were randomly assigned to one of the between-participants condition: truth evaluation session (same-session vs. 1-week delay). All participants evaluated five types of statements: original statements (verbatim-repetitions), paraphrases, contradictory statements, contradictory paraphrases, and new statements.

Stimulus Development. From the 52 pairs of neutral statements and paraphrases pre-tested in Experiment 1, we selected the 40 pairs (20 true and 20 false) that scored the highest on meaning similarity to use as target stimuli. For each statement and its paraphrase, we developed a contradictory version by changing a small detail in the statements (usually a word

or two) that alters and contradicts its original meaning.[12] For example, for the statement "Crocodiles sleep with the eyes open": the paraphrase is "When sleeping, crocodiles don't close their eyelids"; the contradictory version is "Crocodiles sleep with the eyes closed"; and the contradictory paraphrase version is "When sleeping, crocodiles do close their eyelids". As new statements, we used 20 other items (half true and half false), 12 of which were the original version of the remaining pairs of the similarity pre-test, and added eight more statements that had also been pre-tested regarding their neutral/ambiguous truth status.

Procedure. The procedure was the same of Experiment 1, except that in the truth evaluation task participants rated all the four types of repeated statements (n = 10 of each type; statements in each of the repetition conditions were counterbalanced, so that each statement was evaluated equally often in all four versions), mixed with the 20 new ones (statements were randomly ordered for each participant).

After providing truth ratings, participants were presented with exactly the same set of statements (again in random order) and were asked to indicate if each item had been presented in the first interest ratings task. Responses in this memory test were given in a dichotomic scale, by means of the "S" and "L" keys (Yes vs. No, respectively).

The three tasks (interest ratings, truth evaluation, and memory test) lasted between 20 and 30 minutes, depending on individual speed. When participants completed their recognition judgments they were thanked and debriefed.

Results

We expected a replication of the truth effect, evidenced by higher truth evaluations to repeated items than to new ones. In line with Experiment 1, we expected delay of the evaluation to moderate the truth effect, reducing its magnitude. Although we expected no differences between original and paraphrased statements in the 1-week delay condition, the heterogeneous context may promote some differences when judgments are made in the same-session, since participants may rely more on explicit memory in making their judgments. By opposing the core meaning of original items, contradictory statements were expected to promote an *illusion of falseness* (illusion, because there is no reason to consider the changed

[12] Contradictory statements were also pre-tested as neutral regarding truth status, and this pre-test showed that both versions of all statements were rated as equally likely to be true. (see Garcia-Marques et al., 2014, for details).

statements to be the false ones), being evaluated as less true than new items. However, we expected this effect to be reduced in the delayed evaluation because of the perceptual similarity of contradictory statements to the original items (Garcia-Marques et al., 2014). Contradictory paraphrases were also expected to promote an illusion of falseness in the same-session condition, as they also oppose the core meaning of original statements. But if perceptual fluency drives the reversion of the falseness effect in the delayed judgment condition, we did not expect the two types of contradictory items to promote the same effects in that condition.

Truth Judgments. Truth evaluations (Table 2) were analyzed with an ANOVA[13] defined by 5 (type of statement) x 2 (truth evaluation session). No direct effect of the time factor was observed ($F < 1$). A main effect of type of statement suggests differences in the evaluation of the 5 types of items, $F(4, 156) = 31.48$, $p < .001$, $\eta_p^2 = .45$. As expected, the effect of type of statement was moderated by the time of the evaluation session, $F(4, 156) = 9.33$, $p < .001$; $\eta_p^2 = .19$.

As in Experiment 1, we tested our direct hypotheses with planned comparisons addressing the presence of truth effects (repeated statements: 1; new statements: -1) with each type of repeated statement in both evaluation session conditions.

Replicating Experiment 1, we found clear evidence of a truth effect associated with original statements both in the same-session, $t(39) = 6{,}26$, $p < .001$, $d = 1.97$, and in the delayed-session condition, $t(39) = 2{,}51$, $p < .016$, $d = 0{,}84$. The same pattern was found for paraphrases: same-session condition, $t(39) = 6{,}23$, $p < .001$, $d = 1.91$, and delayed-session condition, $t(39) = 2.88$, $p < .007$; $d = 1.10$. As in Experiment 1, paraphrases were rated just as true as original statements ($t < 1$), suggesting that even when the context favors activation of other types of fluency, repetition of the statements' core meaning is sufficient to promote the effect.

Contradictory statements produced an illusion of falseness effect in the same-session condition, being considered less true than new items, $t(39) = -2.01$, $p = .052$; $d = .36$, and therefore also less true than original statements. However, this effect disappeared in the 1-week delay condition, in which they were evaluated to be just as true as original items, $t(39) = 1.11$, $p = .275$, and presented a marginal tendency to be evaluated as more probably true than

[13] Four participants were excluded from our analysis given their extreme values in their response times. The main findings reported here did not change when these participants were included in the analysis.

new statements (a unilateral hypothesis, marginally significant, $p = .07$, in line with Garcia-Marques et al.'s, 2014 results in a homogeneous context). This suggests that in the absence of an overlap in conceptual features, perceptual fluency promoted effects similar to pure repetitions when explicit memory mechanisms were prevented from intervening (i.e., 1-week delay condition).

Contradictory paraphrases were also perceived as less true than new statements in the same-session condition, $t(39) = -2.75$; $p = .009$; $d = .58$ (and thus also less true than original items), reinforcing the idea that changing the statements' core meaning leads to an illusion of falseness. However, in the delayed session these statements were evaluated just as true as new ones ($t < 1$) and falser than original statements, $t(39) = 2.72$, $p = .010$, $d = .82$. The simultaneous change of meaning and of perceptual features hampered the process by which illusions of truth are elicited, and independently of statements sharing the theme with original ones. Thus, it seems that in a heterogeneous context, sharing the same topic or theme with original statements does not increase subjective truth.

The comparison of contradictory statements and contradictory paraphrases in the 1-week delay condition allows us to assess perceptual fluency effects in the absence of conceptual fluency: contradictory statements were considered more probably true than their paraphrases, $t(39) = 2.00$, $p = .052$, $d = .45$, and this can only be attributed to the fact that they share perceptual features with the original statements. The lack of differences between the two types of statements in the same-session condition ($t < 1$) suggests that the observed illusion of falseness was not caused by perceptual fluency.

By comparing paraphrases with contradictory paraphrases in the 1-week delay condition we assess conceptual fluency effects in the absence of perceptual fluency. In this condition, paraphrases were rated more probably true than contradictory paraphrases ($t(39) = 3.14$, $p = .003$, $d = 1.02$), emphasizing the relevance of conceptual fluency for the emergence of the truth effect in the absence of perceptual fluency.

Table 2

Mean (SD) Ratings of Truth in Experiment 2, by Type of Item and Truth Evaluation Session

	Original	Contradictory	Paraphrases	Contradictory Paraphrases	New
Same-Session, *n* = 20	5.17 (.69)	3.66 (1.02)	5.12 (.68)	3.61 (.62)	3.95 (.54)
1-Week Delay, *n* = 21	4.58 (.67)	4.33 (.61)	4.64 (.52)	4.05 (.63)	4.10 (.46)
Total, *n* = 41	4.87 (.74)	4.00 (.90)	4.88 (.64)	3.83 (.65)	4.03 (.50)

Memory Judgments. Proportions of hits (saying yes to the original items) and false alarms (FA, saying yes to new, contradictory statements, paraphrases, and contradictory paraphrases) for old/new discrimination of statements are depicted in Table 3. While mean proportions of FA to the different types of repetition were in between $M = .50$ and $M = .72$ (with 98% of participants making at least one FA to each type of item), FA related to new statements were $M = .16$ (and less da 70% of participants committed this kind of FA).

To understand the independent influence of each type of statement similarity in level of discrimination, we computed signal detection theory *d'* scores for each type of statement, using the proportions of hits and the proportions of the four different types of FA. These scores (Table 3) inform us about how much participants could distinguish between pure repetitions and all other set of "new" items. Discrimination scores were analyzed with a repeated measures ANOVA, with delay condition as a between-participants factor.

A set of hypotheses can be deducted from our previous claims. First, the idea that paraphrases are perceived as unchanged repetitions suggests that paraphrases would be more falsely recognized than any other type of item. The *d'* scores computed with FA to paraphrases is thus expected to be the lowest one and to be associated with a main effect of type of statement. Second, as delay of the judgments reduces recognition performance, we also expected it to lower all *d'* values due to the increase in FA and the decrease in Hits (main effect of evaluation session). Third, as delay is expected to decrease explicit memory but not implicit memory mechanisms (which are based on processing fluency), we also expected that type of statement should qualify the effects of the evaluation session due to variation in fluency.

Results of the ANOVA support all these predictions, showing the presence of significant main effects of type of statement, $F(3, 117) = 76.16$, $p < .001$, $\eta_p^2 = .66$, and

evaluation session, $F(1, 39) = 15.13$, $p < .001$, $\eta_p^2 = .28$, as well as a significant interaction between the two, $F(3, 117) = 6.67$, $p < .001$, $\eta_p^2 = .15$. In order to understand how these effects inform recognition memory, we performed the same specific planned comparisons as we did for the truth judgments. Thus, main contrasts compared the discrimination indices of each type of statement (1) with those of new statements (-1), in the two evaluation session conditions.

In line with our hypotheses, discrimination of paraphrases was worse than discrimination of new items in both the same-session, $t(39) = -11.01$, $p < .001$, $d = 3.06$, and the delayed-session conditions, $t(39) = -6.13$, $p < .001$, $d = 1.87$. In fact, the relevance of conceptual fluency is such that the level of discrimination of paraphrased statements did not differ from a pure chance level ($d' = 0$), either in the same ($t < 1$) or the delayed-session ($t(20) = 1.61$, $p = .123$). Once again, the repetition of statements' meaning led participants to accept paraphrases as unchanged repetitions.

Contradictory statements were also worse discriminated than new statements in the two evaluation session conditions (same-session, $t(39) = -6.74$, $p < .001$, $d = 1.71$, and delayed-session, $t(39) = -4.91$, $p < .001$, $d = 1.40$). The overlap of perceptual features thus seems to harm individuals' ability to discriminate between original items and statements that contradict their meaning.

Sharing the original statements' topic also led to poorer discrimination than totally new statements. This is clearly shown in the contrast between the discrimination scores of contradictory paraphrases and new items, in both evaluation sessions (same-session, $t(39) = -7.86$, $p < .001$, $d = 1.80$, and delayed-session, $t(39) = -6.14$, $p < .001$, $d = 1.60$). Thus, independently of sharing the core meaning and the perceptual features of original statements, sharing the same topic induces false memories.

Table 3.

Mean (SD) Proportions Of Hits And False Alarms (FA), and SDT Discrimination Estimates (d') in Experiment 2, by Type of Item and Truth Evaluation Session

	Hits and False Alarms Discrimination ability (*d'*)				
	Hits Original	FA Contradictory	FA Paraphrases	FA Contradictory Paraphrases	FA New
Same-session	.93 (.11)	.56 (.25)	.89 (.13)	.59 (.22)	.16 (.26)
$n = 20$	---	$d' = 1.17$ (.68)	$d' = .12$ (.61)	$d' = 1.11$ (.65)	$d' = 2.60$ (.97)
1-week delay	.63 (.23)	.45 (.22)	.57 (.22)	.49 (.19)	.16 (.15)
$n = 21$	---	$d' = .53$ (.60)	$d' = .20$ (.58)	$d' = .42$ (.54)	$d' = 1.55$ (.84)
Total	.78 (.23)	.50 (.24)	.72 (.24)	.53 (.24)	.16 (.21)
$n = 41$	---	$d' = .84$ (.71)	$d' = .26$ (.59)	$d' = .76$ (.69)	$d' = 2.06$ (1.04)

Conditional Analysis of Truth Ratings. The preceding analyses revealed differences in both the rated truth and the recognition of the different types of statements. To understand whether perceived familiarity supported the evaluations, we calculated the mean ratings of truth of only those items that were considered old in the recognition test, for each type of statement; new statements were excluded. This was necessary because although all types of items promoted FA, mean truth estimates of the perceived to be "old" items have a different reliability than those of the items perceived as "new", for two main reasons. First, as results of the recognition test revealed (Table 3), not all participants committed FA with new statements and only a few set of new statements were falsely recognized ($M = .16$). This makes mean truth ratings of the new statements falsely recognized as "old" less reliable than the estimates of the other types of items. Second, exactly the opposite happens with the estimation of means of all the other statements when perceived to be "new", as most participants (98%) evidenced false recognitions for at least 50% of items belonging to each type of repetition.

Truth ratings of the perceived to be "old" items (Table 4) were analyzed with an ANOVA with the 4 types of repeated statements as a within-participants factor and evaluation session as a between-participants factor. Results revealed a main effect of type of statement, $F(3, 114) = 7.21$, $p < .001$, $\eta_p^2 = .159$, showing that contradictory paraphrases were considered as less probably true than all the other types of statements ($M_{\text{Contradictory-paraphrases}} =$

4.23, SD = 1.16 vs. $M_{Contradictory}$ = 4.68, $M_{Original}$ = 4.97, SD = 0.93, $M_{Paraphrases}$ = 5.17, SD = 0.86; contrast, $t(38) = 3.34$; $p = .002$; $d = 1.08$). Thus, statements that lack both conceptual and perceptual fluency were not perceived as true as any of the statements whose conceptual and/or perceptual features elicit processing fluency, even if they are falsely recognized. Time of the evaluation session did not affect truth ratings of the perceived to be Old items ($F < 1$), and it also did not interact significantly with the type of statement factor, $F(3, 114) = 1.21$, $p = .310$.

Table 4.

Mean (SD) Ratings of Truth of the Perceived to Be "Old" and Perceived to Be "New" Statements in Experiment 2, by Type of Item and Truth Evaluation Session

		Type of Statement				
	Perceived	Original	Contradictory	Paraphrases	ContradictoryParaphrases	New[14]
Same Session	"Old"	5.13	4.60	5.26	4.08	4.13
	n = 20	(.93)	(1.04)	(.90)	(1.27)	(.83)
	"New"	3.38	2.16	3.08	2.90	3.93
	n = 6	(1.20)	(.98)	(1.96)	(.78)	(.51)
1-week delay	"Old"	4.81	4.76	4.95	4.38	4.32
	n = 20	(.92)	(.83)	(.82)	(1.04)	(1.08)
	"New"	4.05	3.78	4.22	3.90	4.08
	n = 21	(1.16)	(1.32)	(.97)	(.84)	(.52)
Total	"Old"	4.97	4.68	5.11	4.23	4.23
	n = 40	(.93)	(.93)	(.86)	(1.16)	(.96)
	"New"	3.90	3.42	3.97	3.68	4.00
	n = 27	(1.18)	(1.41)	(1.30)	(.92)	(.51)

Discussion

Experiment 2 replicated and extended the results of Experiment 1 in several ways. First, the effects observed in Experiment 1 were replicated in a heterogeneous context in which participants evaluated all different types of statements. This context rendered the

[14] The values presented for new statements reflect the truth evaluations of a different number of participants than that of the other types of statements (as new statements were not included in the ANOVA). Thus, in the same-session condition, new items perceived as "old", n = 13; and perceived as new, n = 20. In the delayed condition, items perceived as "old", n = 15; and perceived as new, n = 21.

differences between items clearer, being therefore more likely to prevent biases. Individuals reacted to paraphrases as if they were pure repetitions, showing that the simultaneous presentation of verbatim repetitions and paraphrases does not promote a differentiation between these two types of items in either truth or memory judgments, in both evaluation session conditions.

Second, Experiment 2 replicates previous results (Garcia-Marques et al., 2014) obtained in a homogeneous context, by showing a falseness effect for statements sharing perceptual features but not the core meaning of the original statements (i.e., contradictory statements) in the same session, which disappeared in the delayed condition. The heterogeneous nature of the context seems however to reduce the magnitude of the impact of delay on the truth effect. Thus, although contradictory statements were perceived as true as verbatim repetitions in the delayed evaluation, the contrast with new items did not reach statistical significance. Nevertheless, these results make clear that perceptual fluency elicited by sharing the visual form of original statements is a sufficient condition to promote illusions of truth. In the heterogeneous context provided by this experiment, sharing the theme or topic of an original statement was not enough to induce a change in processing that influenced truth judgments (however, one should not interpret this as evidence that topic similarity never impacts perceived truth).

The conditional analyses showed that memory and truth judgments share the influence of the statements' characteristics to a great extent. Replicating previous results (e.g., Bacon, 1979; Begg & Armour, 1991), statements that were perceived to be old were also perceived to be more probably true, independently of their actual old/new status. However, the different patterns of results obtained for the two measures suggest that not all features that produce false memories produce illusions of truth or vice versa. For example, statements that share only the topic of the previously presented ones (contradictory paraphrases) and statements that share also their perceptual features (contradictory statements) seem to affect truth ratings independently from having been judged as repeated or not. Presumably, the contradictory status of these items prevents their impact on memory judgments (reducing false memories), but not the influence that the remaining similarities with the original statements (i.e., perceptual features and topic) has on perceived truth.

General Discussion

The goal of the two reported experiments was to understand how the repetition of different conceptual and perceptual features of statements influences their subjective truth-value. Experiment 1 showed that paraphrases were evaluated exactly as true as verbatim repetitions of the original statements, both in immediate evaluations and after a 1-week delay. This result suggests that perceptual overlap is not necessary for the emergence of illusions of truth. However, perceptual fluency effects were found in Experiment 2, which replicated and extended Garcia-Marques and collaborators' (2014) results. A falseness effect was found for statements that contradicted the core meaning of the original items when evaluations immediately followed the exposure phase. This was true independently of whether repetitions maintained the perceptual characteristics of the previous items (contradictory statements) or not (contradictory paraphrases). However, when truth evaluations were delayed, the fluency associated with repeating the perceptual features of original statements (wording and phrase structure) led to a reversal of the falseness effect, and contradictory statements were perceived to be as true as verbatim repetitions. In contrast, contradictory paraphrases lacked the perceptual overlap with original statements and thus continued to be perceived as less true than original items.

These results yield further understanding of the effects of explicit memory mechanisms on perceived truth. Explicit memory mechanisms seem to support both illusions of truth for items that match what was seen before, and illusions of falseness for items that do not. While memory prevented the effects of perceptual fluency when truth evaluations were made in the same session as the first exposure to statements, such effects manifested themselves when the evaluations were delayed for one week. In fact, results of the delayed evaluation conditions indicate that processing fluency elicited by repeated items, either in their conceptual (paraphrases) or perceptual (contradictory statements) components, drives judgments of truth. These findings are akin to those of Johar and Roggeveen (2007). These authors investigated whether there was a difference in the effectiveness of refutations (i.e., contradictory statements) to an original claim based on the degree of perceptual similarity between them. They found that refutations with high similarity to the original claim were believed less than the less similar ones, because they contained stronger recall cues for the original statement, and this recall decreased belief in the contradiction itself. However, when the authors tried to interfere with the explicit memory mechanism, by raising perceptual similarity between the original claim and the refutations to a degree that participants no longer

recognized refutations as such, then highly similar contradictions were believed more. This is exactly what we observed in Experiment 2. In immediate truth evaluations, there were no differences in the truth-value attributed to contradictory statements and contradictory paraphrases, which were both believed less than original items. However, when explicit memory mechanisms were hindered by delaying the truth evaluation by one week, contradictory statements were considered more probably true than contradictory paraphrases and just as true as original statements. This happened supposedly because they share the original perceptual features to a great extent (while contradictory paraphrases do not) and thus participants no longer recognized them as contradictions.

The context in which individuals make their truth evaluations has a considerable degree of influence on the effects that fluency can promote (Dechêne et al., 2010), and the present experiments are also informative about this subject. Conceptual fluency effects were found in both a homogenous (Experiment 1, in which participants evaluated only one type of repeated statements) and a heterogeneous (Experiment 2, in which participants evaluated all types of repeated statements) context. However, the falseness effect found in Experiment 2 for contradictory statements in the same-session condition was not completely reversed into an illusion of truth in the delayed-session condition, as it was in the study by Garcia-Marques and collaborators (2014) in which presented items in a homogeneous evaluation context. This might have happened because homogeneous contexts are more sensible to manipulations that disturb explicit memory mechanisms, such as the delay of measurement (see Dechêne et al., 2010), or because heterogeneous contexts allow more comparisons between the fluency experiences generated by the different types of repetition.

Interestingly, contradictory paraphrases were considered less probably true than all other types of repetitions even if they were falsely recognized as statements presented before. Since items that are perceived as familiar are considered more valid than items perceived as new (e.g., Bacon, 1979; Begg & Armour, 1991), this result suggests that the objective dissimilarities regarding the core meaning and perceptual features of original statements reduced the influence of subjective familiarity on truth evaluations. Thus, the impact of subjective familiarity on judgments of truth seems to take into account the level at which that feeling is originated, with the fluency that comes from simple topic repetition not being able to increase the truth-value of a statement (at least in a heterogeneous evaluation context). This dissociation between recognition and truth judgments opens a door for a better understanding of the mechanism underlying the truth effect. In this sense, some relevant information may be

found in Rajaram's (1996, 1998) distinctiveness–fluency hypothesis. This framework assumes that processing the salience and distinctiveness of conceptual and/or perceptual features of a stimulus gives rise to the experience of *remembering*, while leaving *"know" responses* unaffected.

Our experiments show the flexible use of fluency as information for judgments of truth. Reber, Wurtz, and Zimmermann (2004) and Wurtz, Reber, and Zimmermann (2008) presented evidence that different manipulations of perceptual fluency have different objective impacts (measured by response times) at different stages of the perceptive process but they all seem to feed into one and the same subjective experience of ease. Our data shows that if conceptual fluency is not present and explicit memory mechanisms are reduced, perceptual fluency can take over as the relevant source of information for our judgments, producing convergent effects in subjective judgments of truth.

There is no doubt that judgments of truth are determined by a multitude of processes, and that both memory and fluency mechanisms contribute to it. The present work supports this argument by showing how these diverse mechanisms play their role in different evaluative moments and contexts. All in all, as Oscar Wilde wrote, "The truth is never pure and rarely simple", and we will always find the necessary information to decide whether it is true that "Crocodiles sleep with their eyes open".

References

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. *Personality and Social Psychology Review, 13,* 219-235.

Arkes, H., Boehm, L., & Xu, G. (1991). Determinants of judged validity. *Journal of Experimental Social Psychology, 27,* 576–605.

Arkes, H., Hacket, C., & Boehm, L. (1989). The generality of the relation between familiarity and judged validity. *Journal of Behavioral Decision Making, 2, 81-94.*

Bacon, F. (1979). Credibility of repeated statements: Memory for trivia. *Journal of Experimental Psychology: Human Learning and Memory, 5,* 241-252.

Bartlett, F. C. (1932). *Remembering.* London: Cambridge University Press.

Begg, I., Anas, A., & Farinacci, S. (1992). Dissociation of processes in belief: Source recollection, statement familiarity, and the illusion of truth. *Journal of Experimental Psychology: General, 121,* 446-458.

Begg, I., & Armour, V. (1991). Repetition and the ring of truth: Biasing comments. *Canadian Journal of Behavioural Science, 23,* 195-213.

Begg, I., Armour, V., & Kerr, T. (1985). On believing what we remember. *Canadian Journal of Behavioral Science, 17,* 199-214.

Brown, A. S., & Nix, L. A. (1996). Turning lies into truths: Referential validation of falsehoods. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22,* 1088-1100.

Dechêne, A., Stahl, C., Hansen, J., & Wänke, M. (2010). The truth about the truth: A meta-analytic review of the truth effect. *Personality and Social Psychology Review, 14,* 238-257.

Eich, E. (1984). Memory for unattended events: Remembering with and without awareness. *Memory & Cognition*, *12,* 105-111.

Garcia-Marques, T., Silva, R., Reber R., & Unkelbach, C. (2014). *Hearing a statement now and believing the opposite later*. Manuscript submitted for publication.

Gregg, V. H., & Gardiner, J. M. (1994). Recognition memory and awareness: A large effect of study-test modalities on "know" responses following a highly perceptual orienting task. *European Journal of Cognitive Psychology*, *6,* 131-147.

Hamann, S. B. (1990). Level-of-processing effects in conceptually driven implicit tasks. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *16,* 970-977.

Hasher, L., Goldstein, D., & Toppino, T. (1977). Frequency and the conference of referential validity. *Journal of Verbal Learning and Verbal Behavior, 16,* 107-112.

Hawkins, S. A., Hoch, S. J., & Meyers-Levy, J. (2001). Low-involvement learning: Repetition and coherence in familiarity and belief. *Journal of Consumer Psychology*, *11,* 1-11.

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 110,* 306-340.

Jacoby, L. L., & Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. *Journal of Experimental Psychology: General*, *118,* 126-135.

Johar, G.V., & Roggeveen, A. L. (2007). Changing false beliefs from repeated advertising: The role of claim-refutation alignment. *Journal of Consumer Psychology, 17,* 118-127.

Kelley, C. M., & Lindsay, D. S. (1993). Remembering mistaken for knowing: Ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language, 32,* 1-24.

Klauer, K. C., Musch, J., & Naumer, B. (2000). On belief bias in syllogistic reasoning. *Psychological review*, *107,* 852-884.

Levy, B. A., Barnes, L., & Martin, L. (1993). Transfer of fluency across repetitions and across texts. *Canadian Journal of Experimental Psychology, 47,* 401-427.

Lindsay, D. S., & Kelley, C. M. (1996). Creating illusions of familiarity in a cued recall remember/know paradigm. *Journal of Memory and Language*, *35,* 197-211.

McGlone, M. S., & Tofighbakhsh, J. (2000). Birds of a feather flock conjointly (?): Rhyme as reason in aphorisms. *Psychological Science, 11,* 424-428.

Ozubko, J. D., & Fugelsang, J. (2011). Remembering makes evidence compelling: Retrieval from memory can give rise to the illusion of truth. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37,* 270-276.

Rajaram, S. (1993). Remembering and knowing: Two means of access to the personal past. *Memory & Cognition*, *21,* 89-102.

Rajaram, S. (1996). Perceptual effects on remembering: Recollective processes in picture recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22,* 365-377.

Rajaram, S. (1998). The effects of conceptual salience and perceptual distinctiveness on conscious recollection. *Psychonomic Bulletin & Review*, *5,* 71-78.

Rajaram, S., & Geraci, L. (2000). Conceptual fluency selectively influences knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26,* 1070-1074.

Reber, A. S. (1967). Implicit learning of artificial grammars. *Journal of Verbal Learning and Verbal Behavior, 6,* 855-863.

Reber, R., & Schwarz, N. (1999). Effects of perceptual fluency on judgments of truth. *Consciousness & Cognition, 8,* 338-342.

Reber, R., & Unkelbach, C. (2010). The epistemic status of processing fluency as source for judgments of truth. *Review of Philosophy and Psychology, 1,* 563-581.

Reber, R., Wurtz, P., & Zimmermann, T. D. (2004). Exploring "fringe" consciousness: The subjective experience of perceptual fluency and its objective bases. *Consciousness and Cognition, 13,* 47-60.

Roediger, H. L. (1990). Implicit memory: Retention without remembering. *American Psychologist, 45,* 1043.

Shapiro, S. (1999). When an ad's influence is beyond our conscious control: Perceptual and conceptual fluency effects caused by incidental ad exposure. *Journal of Consumer Research, 26,* 16-36.

Whittlesea, B. W. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19,* 1235-1253.

Wurtz, P., Reber, R., & Zimmermann, T. D. (2008). The feeling of fluent perception: A single experience from multiple asynchronous sources. *Consciousness and Cognition, 17,* 171-184.

Section III
General Discussion

"I have a theory that the theory is never told during the nine-to-five hours"

Hunter S. Thompson (1937-2005)

General Discussion

The three papers that were presented in the empirical section addressed the specificities of the repetition-truth link, exploring the role that the experience of conceptual vs. perceptual fluency may have in that relation.

The experiments reported in the first empirical article contrasted perceptual fluency and repetition effects on judgments of truth. Our goal was to understand whether there are specificities in the processing experiences they promote that can be disentangled by our cognitive system and be translated in a dissociation of effects on a subjective judgment. Making use of the feedback-learning procedure that Unkelbach (2006, 2007) introduced in his studies, Experiment 1 showed that although the interpretation of fluency due to repetition is susceptible to a reversal, it is not as easy to train it as when fluency spurs from color contrast. Experiment 2 showed that even though there are occasions when the experience elicited by one source of fluency can be confounded with another one and be interpreted in the same way (Unkelbach, 2006, 2007), that confound does not happen in a context where there is the possibility to contrast the distinctive features between them. When repetition and color contrast were manipulated orthogonally and had opposing signs regarding the association with truth, they were differentiated and their effects on perceptions of truth were dissociated. These experiments suggest that there are differences in the relation that fluency due to repetition and fluency due to perceptual features have with inferences of truth. Also, they suggest that the fluency elicited by the two different manipulations is not equivalent.

The main purpose of the second paper was to contrast the role of processing fluency and explicit memory in supporting truth judgments. As the results of that experiment showed, within a short interval between the exposure and truth ratings phase participants judged a statement as less probably true than new statements when it contradicted the original statement, an illusion of falseness. After one week, however, participants were more likely to believe a statement that contradicted the one they heard before than new statements. This happened supposedly because recollection of the original statement failed, and the fluency elicited by the match in perceptual features influenced truth judgments. These results suggest that the processing fluency elicited by the match of perceptual features influences truth judgments when the mismatch regarding conceptual features is not identified because recollection of the statements is impaired.

These results were replicated and extended in the third paper, in two experiments aiming to understand how repetition of conceptual and perceptual features influences subjective truth. Experiment 1 showed that paraphrased versions of previously heard statements were evaluated just as true as their verbatim (literal) repetitions, both in immediate evaluations and after a one-week delay. As paraphrases share the conceptual features of original statements (i.e., their meaning) but not their perceptual features, this result suggests that fluency resulting from perceptual overlap is not a necessary condition for illusions of truth to occur when there is already a match with the conceptual characteristics (semantic content) of original statements. Replicating the results of the second paper, in Experiment 2 perceptual fluency was sufficient to promote illusions of truth, but only when the conceptual details about the original statements were lost. When truth evaluations immediately followed the exposure phase and thus the specific content of original statements was still available in memory, an illusion of falseness emerged for contradictory statements. This illusion of falseness occurred both for contradictory statements that maintained the perceptual characteristics of the previous items and for those that did not (i.e., contradictory paraphrases), suggesting again the relevance of conceptual fluency. Yet, when truth evaluations were delayed, the fluency associated with the re-exposure to the perceptual features of original statements led to a reversal of the falseness effect, and contradictory statements were perceived to be as true as verbatim repetitions. In contrast, contradictory statements lacking the perceptual overlap continued to be perceived as less true than original items as there was neither a match in conceptual or perceptual features. These experiments suggest that the fluency promoted by conceptual overlap takes precedence over the fluency that may be elicited by at a pure perceptual level – perceptual fluency-based illusions of truth emerged only when individuals cannot access the semantic content of the statements they were exposed to.

Taken together, the three papers suggest that the relation between repetition and inferences of truth may be substantially different than that of sources of fluency based merely on the perceptual features of the stimuli. By nature, repetition encompasses not only the reactivation of perceptual information, but also of semantic information concerning the content and meaning of the stimuli. This characteristic makes repetition a unique case among the many fluency sources, as it aggregates two different types of fluency experience – perceptual and conceptual fluency. Additionally, our experiments suggest conceptual fluency

to be a relevant, if not the most relevant, part of the mechanism underlying illusions of truth, with effects that do not seem to gain much from increases in perceptual fluency. But it is also clear that our judgments can be biased by perceptual fluency alone.

We will address some theoretical proposals that may help to understand why conceptual fluency is such a relevant factor for the truth effect. We will discuss the relevance of the congruency between the type of fluency that is experienced and the type of judgment that is asked, and clarify the conditions under which reversal effects have been found and how they are related with the presence vs. absence of a conceptual component in the fluency experience. Subsequently, we will focus the illusion of falseness effect that was found in our studies (replicating Bacon, 1979; Begg & Armour, 1991), discussing how it relates with the access to conceptual content of the original statements, and also "re-open" the discussion regarding the role that memory attributions have in the truth effect.

The Relevance of Conceptual Fluency

Congruency between fluency manipulation and type of judgment. Whittlesea (1993) showed that conceptual judgments pertaining to semantic relatedness of words (or *"familiarity of meanings"* as the author called them) are susceptible to the influence of conceptual fluency manipulations, while perceptual fluency does not seem to affect them strongly unless it is (mis)interpreted as resulting from conceptually driven processing. According to the author, the use of processing fluency as a heuristic for familiarity judgments "requires that the fluency of performance feel as though it is due to a source that normatively would be appropriate for the decision to be made" (Whittlesea, 1993, p. 1244).

Truth judgments are conceptual in nature, as the assessment of whether a proposition is valid or not implicates an evaluation of its semantic content, of its meaning. Therefore, according to Whittlesea's (1993) proposal, truth judgments should be more affected by fluency resulting from conceptually, rather than perceptually driven processing. One set of experiments by Parks and Toth (2006) suggests this to be the case. In two different experiments, the authors presented participants with product claims varying in fluency levels. In the first experiment, perceptual fluency was induced via the manipulation of statements' graphic style, making them easy vs. difficult to read. In this setting, barely any effects of perceptual fluency on rated truth were found. However, when a conceptual fluency manipulation was used, which consisted of placing a statement in the end of a paragraph that was either semantically related vs. not related to it, fluency significantly impacted truth

ratings (with an effect size of d = .52). Interpreting these findings with Whittlesea's (1993) theoretical proposal, it seems likely that conceptual fluency is felt as the appropriate experience to base truth judgments, contrary to what happens with perceptually induce fluency.

The experiments of the second and third empirical articles of this dissertation further clarify the relevance of the experience of conceptual fluency associated with repetition. Maintaining the conceptual meaning of the statements between exposure and truth evaluations was more determining for illusions of truth than was the existence of a match in perceptual characteristics. Perceptual fluency was relevant for the evaluation of truth-value only when conceptual fluency was significantly diminished by a longer interval that hindered memory for the meaning of original statements. The relevance of the congruence between the type of judgment and fluency experience (conceptual or perceptual) is also visible in the results of the first empirical article. As reported in Experiment 1, participants demonstrated higher difficulty in associating repetition with falseness than was the case with high color contrast. One of the reasons why this happened may be the conceptual fluency component involved in repetition. This characteristic may add "extra strength" to the relation repetition has with truth, making its reversal more difficult.

One way in which this hypothesis can gain stronger support is by creating an experimental setting akin to the one Whittlesea (1993, Experiment 4) implemented to examine whether perceptual fluency would influence judgments of semantic relatedness if it were interpreted as resulting from conceptual factors. The same can be done in the context of truth judgments, by objectively manipulating the perceptual fluency of statements (e.g., color contrast, letter font, exposure duration) and leading participants to believe that the resulting processing experience is caused by conceptual aspects of the stimuli or the context in which they are presented (e.g., presenting a statements after a text passage that supposedly is related vs. unrelated to it).

Repetition and reversal effects. The theoretical approach that conceptualizes fluency as an ecologically valid cue for truth (e.g., Reber & Unkelbach, 2010; Unkelbach, 2007; Unkelbach & Greifeneder, 2013) does not presume differences regarding the effects of perceptual and conceptual fluency. Congruently, it also does not assume truth judgments to be anchored in conceptual fluency (being it objectively manipulated, or individuals believing the fluency they are experiencing results from the conceptual processing; Whittlesea, 1993).

However, our first paper shows that the attempt to reverse repetition's use as a cue for truth is prone to more errors than it is the case with color contrast. One hypothesis for this fact may be that the conceptual fluency component in repetition brings an "extra layer" to its association with truth, making it harder to reverse. This possibility finds some support in the other two studies we presented, by showing that conceptual overlap with original statements is more relevant for illusions of truth than is fluency based on perceptual similarities.

Yet, Unkelbach (2007) did find a reversal of the truth effect associated with repetition. In light of the theories that we have been discussing here, one possible explanation for the reversal effect is that it was actually based on the fluency elicited merely by the perceptual match/mismatch with original statements. Two findings in that experiment may support this alternative explanation. First, participants' memory regarding what statements had been presented before was at chance level, and second, there was also no evidence of truth judgments being affected by the recognition status of the statements (i.e., whether they were perceived as "old" or "new"), as revealed by conditional analysis. Assuming that comprehending a statement implies that individuals accept it as true (Gilbert, 1991), these results suggests that participants in that experiment probably could not remember the content of the repeated statements, and thus their judgments were guided by perceptual fluency. In this sense, it is conceivable that participants simply generalized the reversal they had learned from one perceptual fluency source (color contrast) to another (wording and syntax of the statements).

In Experiment 2 of our first paper a dissociation of the effects promoted by pure perceptual fluency and by repetition was found. The orthogonal manipulation of these two sources of fluency resulted in the reversal of the truth effect to be associated only with color contrast (the source of fluency with which it was trained), while repetition was always associated with the typical illusions of truth. We interpret these findings as the result of a direct contrast of the distinctive features between the two fluency manipulations, which allowed the elimination of the confound that had been found previously (Unkelbach, 2007). If the experience of conceptual fluency associated with repetition is the relevant attribute driving illusions of truth, future research should replicate this experiment with other conceptual fluency manipulations. Specifically, it should be addressed whether conceptual fluency has to be related with the reactivation of the specific meaning of the statement (vs. conceptual fluency not anchored on previous exposure or memory) in order to promote the dissociation of effects that was found in our experiments.

Illusions of Falseness

In our papers we replicated an effect already detected by Bacon (1979), which shows that statements contradicting what has been seen or heard before are judged as more probably false than original items, and also than totally new statements. Illusions of falseness are also conceptual fluency effects, as they result of the assessment of the truth-value of repeated statements – when we believe (vs. not believe) a proposition, we accept (vs. discard) its semantics and meaning, not its words and syntax. This is very evident also in the results we obtained with the paraphrased versions of the original statements. Because this type of statements maintain the conceptual meaning and content of the original items, they are always judged as true as the original statements.

Why do individuals judge contradicting claims as less valid than statements they never saw before, instead of simply evaluating them equal to new statements? In this sense, our data needs to be read also in light of Gilbert's (1991; Gilbert et al., 1990) theory of "how mental systems believe". In accord with Spynoza's proposal, Gilbert and colleagues (1990) found that individuals seem to accept a proposition as valid merely by comprehending it, this being a rather automatic operation. Categorizing a fact as false entails an extra step, which consumes time and (cognitive) energy. Thus, our general results can be explained as a consequence of a "if you understand it, you believe it" kind of mechanism. As reported, in short delay conditions participants judged a statement as less probably true when it contradicts the original statement, because they have accepted it as "true" upon comprehending it, and still remember clearly what it was that they accepted as a true proposition. However, after one week participants were more likely to believe contradictory statements than new ones, probably because they could no longer remember original statements' exact meaning, and thus perceptual fluency took over. Some results of our first paper also reflect this mechanism, as for example the errors that emerged for participants learning the reversal of the "repeated = true" association. It is possible that when individuals were exposed to a set of facts they automatically accepted them as true, and this made it more difficult to categorize (all of) repeated statements as false in a subsequent moment.

Thus, the falseness effect seems to suggest as well the relevance that the conceptual features of a repeated statement have in the direction that truth judgments may take. Repetition of the conceptual features of the statements takes precedence over repetition of perceptual features. When the conceptual attributes are no longer accessible, perceptual fluency effects arise.

Do Attributions to Familiarity Mediate Fluency Effects on Subjective Truth?

In the literature review, it became clear that there is a strong positive relation between feelings of familiarity (a belief that the information was previously encountered) and illusions of truth created by repetition (e.g., Arkes et al., 1989, 1991; Bacon, 1979; Boehm, 1994). This relation is evident in the studies showing that statements recognized as repetitions are evaluated as truer than statements perceived to be new, independently of their actual repetition status. This evidence suggests that there is an "attribution of truth to statements that feel familiar" (Begg, et al., 1992; p. 457), and those feelings of familiarity may rise both from the activation of "real" and of "false" memories. But what happens with other sources of fluency? Do feelings of familiarity also play a role when the source of the fluency experience is not related to memory?

Although some of the authors that have found evidence of illusions of truth associated with pure perceptual fluency manipulations (e.g., color contrast of the statements with the background) suggested feelings of familiarity could mediate the effects (e.g., Hansen et al., 2008; Reber & Schwarz, 1999), this hypothesis was not thoroughly investigated. But some clues for answering this question can be extracted from the results of Parks and Toth's (2006) study. While not testing directly the causal relationships between familiarity and truth evaluations, the authors found substantial correlations between participants' ratings of familiarity with the general idea conveyed by statements and how true they considered them. The more familiar a claim was considered, the higher its perceived validity. Importantly, these correlations were found in experimental settings in which there was no statement repetition. In fact, in one of the experiments the correlation between familiarity and truth emerged when pure perceptual fluency was used (easy vs. difficult-to-read graphic style). According to Parks and Toth (2006), such a result was "evidence that feelings of familiarity drive judgments of truth even in the absence of episodic memory manipulation" (p. 239).

The studies presented in the Empirical Section did also not address this issue directly. However, they may provide some useful insights and directions for future research. Considering specifically our third paper, in Experiment 2 we found that when individuals made truth ratings immediately after the exposure phase, contradictory statements were less true than original items, and congruently they were also the statements that were better discriminated from the original ones in the recognition test. We argue this to be a reflex of contradictory statements not matching in conceptual content with original statements. When looking at the data from participants making truth ratings only one week after exposure, the

story changes a little. In this condition, contradictory statements are now evaluated just as true as original ones and their discrimination from original items drops markedly in comparison to the immediate evaluation condition. But, this drop in the discrimination index seems to rise not from the fact that contradictory statements are considered "old" more often, but from a higher failure in the recognition of original statements (see Tables 2 and 3 of the third paper). In fact, in the delayed condition all attributions to memory are simply lower, what may be due to a decrease in the confidence participants have in their memory judgments. Given our interpretation that the illusion of truth found for contradictory statements is driven by perceptual fluency (as they match the wording and structure of original items), these results may suggest that the reported perceptual fluency effects on truth may not have gone through an attribution to familiarity. However, the analysis of the truth ratings conditional to the recognition status of the items suggests the opposite regarding the relation between memory and truth judgments. These data show that all types of statements have higher ratings of truth when they are perceived as "old" than when they are perceived as "new", also when judgments were delayed, which is when perceptual fluency increased perceived validity of the statements (see Table 4). This suggests that also in our experiment the relation between memory and truth evaluations is a positive one, even in the condition where perceptual fluency is driving the illusions of truth.

Thus, although some theoretical approaches assume that fluency effects on rated truth are direct and memory attributions are not necessary for the truth effect (e.g., Unkelabch, 2007; Unkelbach & Stahl, 2009), many studies show a positive relation between subjective familiarity and truth – statements perceived as familiar are considered truer than statements perceived to be new (e.g., Arkes et al., 1989; Bacon, 1979; Begg & Armour, 1991; Parks & Toth, 2006). And given Parks and Toth's (2006) results (and our own), this may well be the case even when the fluency experience is merely perceptual and not related with previous exposure.

Conclusion

Although many questions remain open and in need for future research, we believe that the studies presented in this thesis contribute to a better understanding of the mechanism underlying the truth effect. They give clear indications of repetition "special" status regarding its influence on the perceived truth-value of the information we (re)encounter. These studies

also present clear evidence of the relevant role that conceptual fluency seems to have in judgments of truth in comparison to pure perceptual fluency manipulations.

References

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. *Personality and Social Psychology Review, 13,* 219-235.

Alter, A. L., Oppenheimer, D. M., Epley, N., & Eyre, R. N. (2007). Overcoming intuition: Metacognitive difficulty activates analytic reasoning. *Journal of Experimental Psychology: General*, *136*, 569-576.

Arkes, H., Boehm, L., & Xu, G. (1991). Determinants of judged validity. *Journal of Experimental Social Psychology, 27,* 576–605.

Arkes, H., Hacket, C., & Boehm, L. (1989). The generality of the relation between familiarity and judged validity. *Journal of Behavioral Decision Making, 2, 81-94.*

Asch, S. E. (1951). Effects of group pressure upon the modification and distortion of judgments. In Harold Guetzkow (ed.), *Groups, leadership, and men* (pp. 222-236). New York, NY: Russell and Russell.

Atkinson, R. C., & Juola, J. F. (1973). Factors influencing speed and accuracy of word recognition. *Attention and Performance, 4*, 583-612.

Bacon, F. (1979). Credibility of repeated statements: Memory for trivia. *Journal of Experimental Psychology: Human Learning and Memory, 5,* 241-252.

Bargh, J. A. (1994). The Four Horsemen of automaticity: Awareness, efficiency, intention, and control in social cognition. In R. S. Wyer, Jr., & T. K. Srull (Eds.), *Handbook of social cognition* (2nd ed., pp. 1-40). Hillsdale, NJ: Erlbaum.

Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology.* Cambridge, England: Cambridge University Press.

Begg, I., Anas, A., & Farinacci, S. (1992). Dissociation of processes in belief: Source recollection, statement familiarity, and the illusion of truth. *Journal of Experimental Psychology: General, 121,* 446-458.

Begg, I., & Armour, V. (1991). Repetition and the ring of truth: Biasing comments. *Canadian Journal of Behavioural Science, 23,* 195-213.

Begg, I., Armour, V., & Kerr, T. (1985). On believing what we remember. *Canadian Journal of Behavioral Science, 17,* 199-214.

Begg, I., Duft, S., Lalonde, P., Melnick, R., & Sanvito, J. (1989). Memory predictions are based on ease of processing. *Journal of Memory and Language*, *28*, 610-632.

Begg, I., & Wickelgren, W. A. (1974). Retention functions for syntactic and lexical vs semantic information in sentence recognition memory. *Memory & Cognition*, *2*, 353-359.

Boehm, L. E. (1994). The validity effect: A search for mediating variables. *Personality and Social Psychology Bulletin, 20,* 285-293.

Bornstein, R. F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968–1987. *Psychological Bulletin*, *106*, 265-289.

Bornstein, R. F., & D'Agostino, P. R. (1992). Stimulus recognition and the mere exposure effect. *Journal of Personality and Social Psychology*, *63*, 545-552.

Brown, A. S., & Nix, L. A. (1996). Turning lies into truths: Referential validation of falsehoods. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22,* 1088-1100.

Chaiken, S., & Maheswaran, D. (1994). Heuristic processing can bias systematic processing: effects of source credibility, argument ambiguity, and task importance on attitude judgment. *Journal of Personality and Social Psychology*, *66*, 460-473.

Chiesi, H. L., Spilich, G. J., & Voss, J. F. (1979). Acquisition of domain-related information in relation to high and low domain knowledge. *Journal of Verbal Learning and Verbal Behavior*, *18*, 257-273.

Dechêne, A., Stahl, C., Hansen, J., & Wänke, M. (2009). Mix me a list: Context moderates the truth effect and the mere-exposure effect. *Journal of Experimental Social Psychology*, *45*, 1117-1122.

Dechêne, A., Stahl, C., Hansen, J., & Wänke, M. (2010). The truth about the truth: A meta-analytic review of the truth effect. *Personality and Social Psychology Review, 14,* 238-257.

Ebbinghaus, H. (1913). *Memory: A contribution to experimental psychology*. New York, NY: Teachers College, Columbia University. (Original work published 1885)

Evans J. S. B. (2003). In two minds: dual process accounts of reasoning. *Trends in Cognitive Science, 7,* 454–459.

Evans, J. S. B. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology*, *59*, 255-278.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, *7*, 117-140.

Feustel, T. C., Shiffrin, R. M., & Salasoo, A. (1983). Episodic and lexical contributions to the repetition effect in word identification. *Journal of Experimental Psychology: General*, *112*, 309-346.

Garcia-Marques, T. (1999). *The mind needs the heart. The mood-as-regulation-mechanism hypothesis* (Unpublished doctoral dissertation). Universidade de Lisboa, Lisboa.

Garcia-Marques, T., & Mackie, D. M. (2001). The feeling of familiarity as a regulator of persuasive processing. *Social Cognition, 19,* 9-34.

Garcia-Marques, T., Mackie, D. M., Claypool, H. M., & Garcia-Marques, L. (2010). Is it familiar or positive? Mutual facilitation of response latencies. *Social Cognition*, *28*, 205-218.

Garcia-Marques, T., & Silva, R. R. (May, 2014). *Individuals' processing conditions (capacity and motivation) moderate the illusion of truth effect.* Poster presented at the 26th Convention of the Association for Psychological Science, San Francisco, CA.

Garcia-Marques, T., Silva, R. R., Reber R., & Unkelbach, C. (2014). *Hearing a statement now and believing the opposite later*. Manuscript submitted for publication.

Gigerenzer, G. (1984). External validity of laboratory experiments: The frequency-validity relationship. *The American journal of psychology, 97,*185-195.

Gilbert, D. T. (1991). How mental systems believe. *American Psychologist*, *46*, 107-119.

Gilbert, D. T., Krull, D. S., & Malone, P. S. (1990). Unbelieving the unbelievable: Some problems in the rejection of false information. *Journal of Personality and Social Psychology*, *59*, 601-613.

Glucksberg, S., & McCloskey, M. (1981). Decisions about ignorance: Knowing that you don't know. *Journal of Experimental Psychology: Human Learning and Memory*, *7*, 311-325.

Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research*, *35*, 472-482.

Grice, H. P. (1975). Logic and conversation. In P. Cole & J. L. Morgan (Eds.). Syntax and semantics: Vol. 3. Speech acts (pp. 41–58). New York, NY: Academic Press.

Grill-Spector, K., Henson, R., & Martin, A. (2006). Repetition and the brain: neural models of stimulus-specific effects. *Trends in Cognitive Sciences*, *10*, 14-23.

Hansen, J., Dechêne, A., & Wänke, M. (2008). Discrepant fluency increases subjective truth. *Journal of Experimental Social Psychology, 44,* 687-691.

Harmon-Jones, E., & Allen, J. J. (2001). The role of affect in the mere exposure effect: Evidence from psychophysiological and individual differences approaches. *Personality and Social Psychology Bulletin*, *27*, 889-898.

Hasher, L., Goldstein, D., & Toppino, T. (1977). Frequency and the conference of referential validity. *Journal of Verbal Learning and Verbal Behavior, 16,* 107-112.

Hawkins, S. A., & Hoch, S. J. (1992). Low-involvement learning: Memory without evaluation. *Journal of Consumer Research, 19*, 212-225.

Hawkins, S. A., Hoch, S. J., & Meyers-Levy, J. (2001). Low-involvement learning: Repetition and coherence in familiarity and belief. *Journal of Consumer Psychology*, *11,* 1-11.

Henkel, L.A., & Mattson, M. E. (2011). Reading is believing: The truth effect and source credibility. *Consciousnsess and Cognition, 11,* 1705-1721.

Hintzman, D. L. (1969). Apparent frequency as a function of frequency and the spacing of repetitions. *Journal of Experimental Psychology*, *80*, 139-145.

Hovland, C. I., & Weiss, W. (1951). The influence of source credibility on communication effectiveness. *Public Opinion Quarterly*, *15*, 635-650.

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language*, *30*, 513-541.

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 110,* 306-340.

Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory attributions. In H. L. Roediger, & F.I.M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 391-422). Hillsdale, NJ: Erlbaum.

Jacoby, L. L., Toth, J. P., & Yonelinas, A. P. (1993). Separating conscious and unconscious influences of memory: Measuring recollection. *Journal of Experimental Psychology: General*, *122*, 139-154

Jacoby, L. L., & Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. *Journal of Experimental Psychology: General*, *118,* 126-135.

Kelley, C. M., & Lindsay, D. S. (1993). Remembering mistaken for knowing: Ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language, 32,* 1-24.

Kintsch, W., Welsch, D., Schmalhofer, F., & Zimny, S. (1990). Sentence memory: A theoretical analysis. *Journal of Memory and language*, *29*, 133-159.

Klauer, K. C., Musch, J., & Naumer, B. (2000). On belief bias in syllogistic reasoning. *Psychological Review*, *107,* 852-884.

Kolers, P. A., & Ostry, D. J. (1974). Time course of loss of information regarding pattern analyzing operations. *Journal of Verbal Learning and Verbal Behavior*, *13*, 599-612.

Lee, A. Y., & Labroo, A. A. (2004). The effect of conceptual and perceptual fluency on brand evaluation. *Journal of Marketing Research*, *41*, 151-165.

Light, L. L., Prull, M. W., LaVoie, D. J., & Healy, M. R. (2000). Dual-process theories of memory in old age. In T. J. Perfect & E. A. Maylor (Eds.), *Models of cognitive aging* (pp. 238-300). Oxford, UK: Oxford University Press.

Luo, L., & Craik, F. I. (2009). Age differences in recollection: Specificity effects at retrieval. *Journal of Memory and Language*, *60*, 421-436.

Lupker, S. J. (1984). Semantic priming without association: A second look. *Journal of Verbal Learning and Verbal Behavior*, *23*, 709-733.

Lyons, K. E., Ghetti, S., & Cornoldi, C. (2010). Age differences in the contribution of recollection and familiarity to false-memory formation: a new paradigm to examine developmental reversals. *Developmental Science*, *13*, 355-362.

Mandler, G. (1980). Recognizing: The judgment of previous occurrence. *Psychological Review*, *87*, 252-271.

Mandler, G., Nakamura, Y., & Van Zandt, B. J. (1987). Nonspecific effects of exposure on stimuli that cannot be recognized. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13,* 646-648.

McGlone, M. S., & Tofighbakhsh, J. (2000). Birds of a feather flock conjointly (?): Rhyme as reason in aphorisms. *Psychological Science, 11,* 424-428.

Moons, W. G., Mackie, D. M., Garcia-Marques, T. (2009). The impact of repetition-induced familiarity on agreement with weak and strong arguments. *Journal of Personality and Social Psychology, 96*, 32-44.

Newell, A., Shaw, J. C., & Simon, H. A. (1959). *The processes of creative thinking*. Santa Monica, CA: Rand Corporation.

Olds, J. M., & Westerman, D. L. (2012). Can fluency be interpreted as novelty? Retraining the interpretation of fluency in recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38,* 653-664.

Oppenheimer, D. M. (2006). Consequences of erudite vernacular utilized irrespective of necessity: Problems with using long words needlessly. *Applied Cognitive Psychology*, *20*, 139-156.

Palmer, S.E. (1975). The effects of contextual scenes on the identification of objects. *Memory & Cognition, 3,* 519-26.

Parks, C. M., & Toth, J. P. (2006). Fluency, familiarity, aging, and the illusion of truth. *Aging, Neuropsychology, and Cognition, 13,* 225-253.

Petty, R. E., Briñol, P., & Tormala, Z. L. (2002). Thought confidence as a determinant of persuasion: the self-validation hypothesis. *Journal of Personality and Social Psychology*, *82*, 722.

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology*, *19*, 123-205.

Pocheptsova, A., Labroo, A. A., & Dhar, R. (2010). Making products feel special: When metacognitive difficulty enhances evaluation. *Journal of Marketing Research*, *47*, 1059-1069.

Reber, A. S. (1967). Implicit learning of artificial grammars. *Journal of Verbal Learning and Verbal Behavior, 6,* 855-863.

Reber, R., & Schwarz, N. (1999). Effects of perceptual fluency on judgments of truth. *Consciousness & Cognition, 8,* 338-342.

Reber, R., Schwarz, N., & Winkielman, P. (2004). Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review*, *8*, 364-382.

Reber, R., & Unkelbach, C. (2010). The epistemic status of processing fluency as source for judgments of truth. *Review of Philosophy and Psychology, 1,* 563-581.

Reber, R., Winkielman, P., & Schwarz, N. (1998). Effects of perceptual fluency on affective judgments. *Psychological Science*, *9*, 45-48.

Reber, R., Wurtz, P., & Zimmermann, T. D. (2004). Exploring "fringe" consciousness: The subjective experience of perceptual fluency and its objective bases. *Consciousness and Cognition, 13,* 47-60.

Reber, R., & Zupanek, N. (2002). Effects of processing fluency on estimates of probability and frequency. In P. Sedlmeier, & T. Betsch (Eds.), *Frequency processing and cognition* (pp. 175–188). Oxford, UK: Oxford University Press.

Reisenzein, R. (1983). The Schachter theory of emotion: two decades later. *Psychological Bulletin*, *94*, 239-264.

Sachs, J. S. (1967). Recognition memory for syntactic and semantic aspects of connected discourse. *Perception & Psychophysics*, *2*, 437-442.

Scarborough, D. L., Cortese, C., & Scarborough, H. S. (1977). Frequency and repetition effects in lexical memory. *Journal of Experimental Psychology: Human Perception and Performance*, *3*, 1-17.

Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review*, *69*, 379-399.

Schwarz, N. (2004). Metacognitive experiences in consumer judgment and decision making. *Journal of Consumer Psychology*, *14*, 332-348.

Schwarz, N., Bless, H., Strack, F., Klumpp, G., Rittenauer-Schatka, H., & Simons, A. (1991). Ease of retrieval as information: Another look at the availability heuristic. *Journal of Personality and Social Psychology, 61,* 195-202.

Seamon, J. G., McKenna, P. A., & Binder, N. (1998). The mere exposure effect is differentially sensitive to different judgment tasks. *Consciousness and Cognition*, *7*, 85-102.

Seamon, J. G., Williams, P. C., Crowley, M. J., Kim, I. J., Langer, S. A., Orne, P. J., & Wishengrad, D. L. (1995). The mere exposure effect is based on implicit memory: Effects of stimulus type, encoding conditions, and number of exposures on recognition and affect judgments. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*, 711-721.

Skurnik, I., Schwarz, N., & Winkielman, P. (2000). Drawing inferences from feelings: The role of naive beliefs. In H. Bless & J. Forgas (Eds.), *The message within: The role of subjective experience in social cognition and behavior* (pp. 162-175). Philadelphia, PA: Psychology Press.

Skurnik, I., Yoon, C., Park, D. C., & Schwarz, N. (2005). How warnings about false claims become recommendations. *Journal of Consumer Research*, *31*, 713-724.

Smith, E. R., & DeCoster, J. (2000). Dual-process models in social and cognitive psychology: Conceptual integration and links to underlying memory systems. *Personality and social psychology review*, *4*, 108-131.

Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin*, *119*, 3-22.

Sloman, Steven A. (2002). Two systems of reasoning. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 379-396). New York, NY: Cambridge University Press.

Spinoza, B. (1982). *The ethics and selected letters.* (S. Feldman, Ed., and S. Shirley, Trans.). Indianapolis, IN: Hackett. (Original work published 1677)

Stanovich, K. E. (1999). *Who is rational? Studies of individual differences in reasoning*. Mahwah, NJ: Erlbaum.

Topolinski, S., & Reber, R. (2010). Gaining insight into the "Aha" experience. *Current Directions in Psychological Science*, *19*, 402-405.

Tulving, E., Schacter, D. L., & Stark, H. A. (1982). Priming effects in word-fragment completion are independent of recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *8*, 336-342.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*, 207-232.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*, 1124-1131.

Underwood, B. J. (1971). Recognition memory. In H. H. Kendler & J. T. Spence (Eds.), *Essays in neo-behaviorism*. New York, NY: Appleton-Century-Crofts.

Underwood, B. J., Zimmerman, J., & Freund, J. S. (1971). Retention of frequency information with observations on recognition and recall. *Journal of Experimental Psychology*, *87*, 149-162.

Unkelbach, C. (2006). The learned interpretation of cognitive fluency. *Psychological Science, 12,* 339-345.

Unkelbach, C. (2007). Reversing the truth effect: Learning the interpretation of processing fluency in judgments of truth. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, *33,* 219-230.

Unkelbach, C., Bayer, M., Alves, H., Koch, A., & Stahl, C. (2011). Fluency and positivity as possible causes of the truth effect. *Consciousness and Cognition*, *20*, 594-602.

Unkelbach, C., & Greifeneder, R. (2013). A general model of fluency effects in judgment and decision making. In C. Unkelbach & R. Greifeneder (Eds.), *The experience of thinking: How the fluency of mental processes influences cognition and behaviour* (pp. 11–32). New York, NY: Psychology Press.

Unkelbach, C., & Stahl, C. (2009). A multinomial modeling approach to dissociate different components of the truth effect. *Consciousness & Cognition, 18*, 22-38.

Westerman, D. L. (2008). Relative fluency and illusions of recognition memory. *Psychonomic Bulletin & Review*, *15*, 1196-1200.

Whittlesea, B. W. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19,* 1235-1253.

Whittlesea, B. W., Jacoby, L. L., & Girard, K. (1990). Illusions of immediate memory: Evidence of an attributional basis for feelings of familiarity and perceptual quality. *Journal of Memory and Language*, *29,* 716-732.

Whittlesea, B. W., & Leboe, J. P. (2003). Two fluency heuristics (and how to tell them apart). *Journal of Memory and Language*, *49*, 62-79.

Whittlesea, B. W. A., & Williams, L. D. (2000). The source of feelings of familiarity: The discrepancy-attribution hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 547-565.

Whittlesea, B. W., & Williams, L. D. (1998). Why do strangers feel familiar, but friends don't? A discrepancy-attribution account of feelings of familiarity. *Acta Psychologica*, *98*, 141-165.

Wilde, O. (2000). *The Importance of Being Earnest and Other Plays.* London, UK: Penguin Books (Original work published 1895).

Winkielman, P., & Cacioppo, J. T. (2001). Mind at ease puts a smile on the face: psychophysiological evidence that processing facilitation elicits positive affect. *Journal of Personality and Social Psychology*, *81*, 989-1000.

Winkielman, P., Schwarz, N., Fazendeiro, T., & Reber, R. (2003). The hedonic marking of processing fluency: Implications for evaluative judgment. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion* (pp. 189-217). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Wurtz, P., Reber, R., & Zimmermann, T. D. (2008). The feeling of fluent perception: A single experience from multiple asynchronous sources. *Consciousness and Cognition, 17,* 171-184.

Yonelinas, A. P. (2002). The nature of recollection and familiarity: A review of 30 years of research. *Journal of Memory and Language*, *46*, 441-517.

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology*, *9*, 1-27.

APPENDIXES

Appendix A: Statements Used in the Experiments of the Empirical Articles

The statements used in the experiments of the empirical articles were selected from two different sources. Part of the statements was selected from the material previously pre-tested and validated by Garcia-Marques (1999, see Table 1). The studies that have been conducted with this material since it was pre-tested show that the statements maintain their neutral truth status still in the present day (e.g., when presented as new, they are judged around the mean point of the rating scales used to measure truth-value).

Additionally, a pre-test was carried out to validate another set of statements, as more stimuli were required for some of the experiments presented earlier. This pre-test consisted in the presentation of 60 statements (30 true and 30 false), selected from encyclopedias and other sources of information. These statements were evaluated by 49 university students, who were asked to read each of them and indicate whether they consider it true or false (dichotomic decision). The proportion of "True" and "False" responses were calculated for each statement, and *t*-tests were performed to test if there were significant differences against a 50% chance.

Table 1.

Means associated with each pre-tested sentence and proportion of individuals that considered each sentence true (*n* for each sentence in between 16-20). In bold – statements validated as neutral. Source: Garcia-Marques (1999).

TRUE VERSION	True	False	FALSE VERSION
O ovo de uma avestruz leva cerca de uma hora a cozer	4.11 (56%)	2.42 (0%)	O ovo de uma avestruz leva cerca de seis horas a cozer
A maior cidade a sul do equador é Melbourne, na Austrália	4.86 (70%)	3.13 (33%)	A maior cidade a sul do equador é Buenos Aires, na Argentina
Até à cerca de 300 anos atrás comia-se apenas com os dedos*	4.22 (56%)	2.29 (15%)	Até à cerca de 200 atrás anos comia-se apenas com os dedos*
Os crocodilos dormem de olhos fechados	**4.00 (42%)**	**4.25 (56%)**	**Os crocodilos dormem de olhos abertos**
Um cubo de gelo aumenta o nível da água de um copo à medida que derrete	1.71 (0%)	5.50 (67%)	Um cubo de gelo não aumenta o nível da água de um copo à medida que derrete.
A harpa tem 47 cordas e sete pedais	2.88 (30%)	3.14 (30%)	A harpa tem 27 cordas e dois pedais
Henry Ford esqueceu-se de incluir a marcha-atraz no seu primeiro veículo.	3.33 (0%)	2.14 (0%)	Henry Ford esqueceu-se de incluir travões no seu primeiro veículo
A estátua do Cristo-Rei tem 28m de altura	**5.11 (58%)**	**4.71 (52%)**	
Um ano luz corresponde a 10 biliões de kms	3.85 (15%)	4.00 (56%)	**A estátua do Cristo-Rei tem 38m de altura**
Duas mãos direitas juntas eram o símbolo da amizade para os romanos	**4.78 (56%)**	**4.71 (58%)**	Um ano luz corresponde a 10 triliões de kms **Uma mão direita e esquerda juntas eram o símbolo da amizade para os romanos**
O coração da cobra localiza-se a cerca de metade da distancia entre a sua cabeça e a cauda	3.57 (15%)	3.75 (23%)	O coração da cobra localiza-se a cerca de um quinto da

"Mackintosh" em 1924 designava um tipo de tecido sedoso transparente	2.14 (15%)	2.87(10%)	distancia entre a sua cabeça e a cauda "Mackintosh" em 1924 designava um tipo de tecido
A altitude máxima média a que voa um avião, não vai além dos 15 km	3.33 (33%)	3.57 (30%)	impermeável vulcanizado
Apenas 50% do calor energético da gasolina é aproveitado para mover o automóvel.	3.85 (15%)	3.37 (23%)	A altitude máxima média a que voa um avião, não vai além 10 km
O recorde de salto de uma pulga é de 18 cm.	3.33 (33%)	3.71 (42%)	Apenas 20% do calor energético da gasolina é aproveitado para mover o automóvel
O gelado de cone surgiu nos EUA em 1904.	4.66 (56%)	5.71 (70%)	
Pela Bíblia não se pode provar que Jesus alguma vez chorou	2.57 (15%)	3.00 (10%)	O recorde de salto de uma pulga é de 11 cm
O primeiro filme de desenhos animados é francês	**4.44 (52%)**	**5.14 (56%)**	O gelado de cone surgiu nos EUA em 1924.
Os ovos de cobra são ou brancos ou creme	4.22 (33%)	5.86 (87%)	Pela Bíblia não se pode provar que Jesus alguma vez sorriu
São necessários 20 dias para que uma mosca doméstica seja bisavó	**3.86 (42%)**	**4.00 (42%)**	**O primeiro filme de desenhos animados é inglês**
O homem tem 20% mais glóbulos vermelhos no seu corpo do que a mulher	3.55 (33%)	3.28 (30%)	Os ovos de cobra são ou castanhos ou creme **São necessários 60 dias para que uma mosca doméstica seja bisavó**
Os dentes do siso não nascem em 60% dos seres humanos	4.86 (70%)	4.00 (35%)	A mulher tem 20% mais glóbulos vermelhos no seu corpo do que o homem
Na época medieval eram os vidreiros quem fabricava lentes de correcção para a vista	3.67 (56%)	2.71 (15%)	Os dentes do siso não nascem em 40% dos seres humanos
No ano de 205 A.C os romanos instituíram uma lei que proibia as mulheres de conduzir carros de gala	3.00 (22%)	2.86 (15%)	Na época medieval eram os curandeiros quem fabricava lentes de correcção para a vista
Nenhum lugar na terra está livre de tempestades eléctricas	**5.55 (58%)**	**4.71 (52%)**	No ano de 205 A.C os romanos instituíram uma lei que proibia as mulheres de possuir carros de gala
Para obter um kg de açafrão são necessárias 70 a 80 000 flores	4.66 (33%)	4.00 (30%)	**Nenhum lugar na terra está livre de actividade vulcânica**
As zonas polares não se encontram delineadas com precisão nos mapas	4.88 (67%)	2.83 (30%)	Para obter um kg de açafrão são necessárias 700 a 800 flores
O presidente John Taylor dos EUA, adoptou 14 crianças	**3.43 (42%)**	**3.00 (40%)**	As ilhas do Japão não se encontram delineadas com precisão nos mapas
A árvore-vaca da Venezuela designa-se deste modo por produzir folhas malhadas de branco e preto com aparência de pele de vaca	5.43 (86%)	4.56 (35%)	**O presidente John Taylor dos EUA, foi pai de 14 crianças**
As partículas atómicas sabem diferenciar entre direita e esquerda	3.77 (22%)	5.00 (42%)	A árvore-vaca da Venezuela designa-se deste modo por produzir um leite com aparência e gosto idêntico ao leite de vaca
As borboletas têm o paladar nas patas e não na boca	4.44 (56%)	3.33 (15%)	
Os tubarões antecedem temporalmente os dinaussaros	3.67 (33%)	3.50 (30%)	As partículas atómicas não sabem diferenciar entre direita e esquerda
Uma flor de papoila só dura 3-5 dias	3.43 (42%)	5.00 (67%)	
A temperatura dentro de um pepino é sempre mais quente do que do ar ambiente	3.88 (33%)	5.00 (56%)	As borboletas têm o paladar nas cavidades nasais e não na boca
Uma joaninha recém nascida é amarela e vermelha	**4.00 (42%)**	**4.77 (67%)**	Os tubarões são contemporâneos dos dinossauros Uma flor de papoila só dura um dia.
A infecção com maior prevalência no mundo é a malária	**3.89 (56%)**	**3.83 (42%)**	A temperatura dentro de um pepino é sempre mais fria do que do ar ambiente
As três cores com maior predominância nas flores são, por ordem, o branco, vermelho e azul.	4.44 (67%)	3.83 (30%)	**Uma joaninha recém nascida é cinzenta e amarela**
Um bébé elefante chucha com a sua tromba e não com a boca	5.00 (57%)	3.00 (10%)	**A infecção com maior prevalência no mundo é a cólera**
A profissão de arquitecto era reconhecido em Roma como a de um artista e intelectual	5.78 (90%)	3.67 (30%)	As três cores com maior predominância nas flores são, por ordem, o vermelho, azul e branco
Mozart escreveu uma sonata intitulada *Les Adieux*	3.43 (30%)	2.89 (10%)	Um bébé elefante chucha com a sua boca e não com a tromba
A maior distância a que uma bola de basebol foi lançada é de cerca de 230 metros	**4.86 (58%)**	**4.67 (55%)**	A profissão de arquitecto era tida em Roma por a de um técnico e não por a de um artista
A Igreja Metodista foi estabelecida em1698	4.00 (15%)	3.78 (10%)	Beethoven escreveu uma sonata intitulada *Les Adieux*
Andrew Jackson foi o primeiro presidente dos EUA a andar de balão	3.57 (15%)	3.44 (10%)	**A maior distância a que uma bola de basebol foi lançada é de cerca de 130 metros**
O primeiro cão-guia para cegos foi apresentado a um cego em 1938	**4.66 (61%)**	**3.50 (40%)**	A Igreja Metodista foi estabelecida em 1738
O preço da pituitária de porco ultrapassa os 6 contos o Kg	3.67 (33%)	3.50 (42%)	Andrew Jackson foi o primeiro presidente dos EUA a andar de comboio
Os chineses inventaram uma moeda de pagamento de favores e protecção aos mortos	3.44 (22%)	4.50 (30%)	**O primeiro cão-guia para cegos foi apresentado a um cego em 1948**
A porta giratória foi inventada no Norte de África	5.17 (58%)	3.56 (35%)	O preço da pituitária de porco ultrapassa os 16 contos o Kg
Apenas cerca de 3% da energia de uma lâmpada eléctrica resulta em luz	3.33 (10%)	4.16 (58%)	Os moris inventaram uma moeda de pagamento de favores e protecção aos mortos
As avestruzes não enterram a cabeça na areia	2.00 (10%)	6.00 (70%)	A porta giratória foi inventada nos Estados Unidos da América
A primeira bandeira da Confederação nos EUA designava-se "Estrelas e Linhas"	**5.11 (42%)**	**5.00 (55%)**	Apenas cerca de 40% da energia de uma lâmpada eléctrica resulta em luz
Cabelos e unhas crescem em cadáveres.	6.43 (86%)	4.44 (55%)	As avestruzes enterram a cabeça na areia
O lago Itasca em Michigan é a nascente do rio Mississipi	4.28 (15%)	4.22 (35%)	**A primeira bandeira da Confederação nos EUA designava-se "Antiga Glória"**
A distância de Cucujães a Lisboa é de 123 km.	3.57 (30%)	3.78 (35%)	Cabelos e unhas não crescem em cadáveres.
	4.28 (42%)	**4.44 (42%)**	O lago Itasca em Minnesota é a nascente do rio Mississipi
	4.00 (30%)	4.55 (67%)	A distância de Cucujães a Lisboa é de 283 km

A Etiópia tem apresentado nos últimos anos as taxas mundiais mais baixas de suicídio	4.12 (30%)	3.55 (35%)	**O Egipto tem apresentado nos últimos anos as taxas mundiais mais baixas de suicídio**
O carvalho através das suas folhas numa semana de verão, pode perder até 560 litros em humidade.	4.00 (22%)	4.00 (42%)	O carvalho através das suas folhas num único dia de verão, pode perder até 560 litros de humidade
A cortina de fogo, para camuflar o andamento de tropas, foi inventada em 1943	5.25 (89%)	4.85 (70%)	A cortina de fogo, para camuflar o andamento de tropas, foi inventada em 1923
Devido à iluminação artificial, caí na terra por hectare, em média, cerca de 2,5 kg de nitrogénio	5.14 (70%)	2.22 (0%)	Devido às chuvas intensas, caí na terra por hectare, em média, cerca de 2,5 kg de nitrogénio
A primeira mulher a receber uma medalha na Força Aérea mundial foi uma enfermeira americana	3.86 (42%)	3.77 (35%)	A primeira mulher a receber uma medalha na Força Aérea mundial foi uma enfermeira alemã
O maior estádio do mundo é a de Kharkov na Rússia	5.00 (70%)	3.67 (35%)	A maior prisão do mundo é o de Kharkov na Rússia
A raposa põe uma pata ao lado da outra deixando duas linhas de pegadas	**4.14 (58%)**	**4.33 (55%)**	A raposa põe uma pata à frente da outra deixando uma única linha de pegadas
O melhor modo de retirar um insecto do ouvido é enche-lo de vapor de água	3.71 (30%)	2.44 (10%)	O melhor modo de retirar um insecto do ouvido é enche-lo com água tépida
A máxima velocidade atingida por um réptil em terra é de 66km/hora.	4.12 (33%)	5.14 (70%)	**A máxima velocidade atingida por um réptil em terra é de 46km/hora**
Um dente partido necessita de ser lavado para poder ser recolocado no lugar	**4.38 (56%)**	**4.71 (58%)**	Um dente partido não poderá ser recolocado no lugar se for lavado
O jogo de voleibol foi inventado por William G.Morgan em 1895	**4.50 (42%)**	**4.57 (58%)**	O jogo de badminton foi inventado por William G.Morgan em 1895
Os selos de via aérea foram pela primeira vez emitidos em 13 de maio,1918	4.14 (30%)	3.89 (35%)	**Os selos de via aérea foram pela primeira vez emitidos em 13 de maio,1926**
O número de rotações de uma máquina de lavar roupa pode ir de 500 a 1100 por minuto	5.25 (67%)	6.28 (87%)	**O número de rotações de uma máquina de lavar roupa pode ir de 500 a 1100 por minuto**
O consumo de sódio aconselhado a um adulto, é de 800 mg por dia	4.30 (70%)	4.33 (55%)	O consumo de cálcio aconselhado a um adulto, é de 800 mg por dia
	3.42 (42%)	**4.11 (42%)**	
	5.42 (70%)	4.11 (35%)	Bioquimicamente o colesterol é um ácido gordo
Bioquimicamente o colesterol é um álcool ao qual se fixa um ácido gordo	4.00 (22%)	4.43 (42%)	O moinho de água é anterior ao moinho de vento
O moinho de vento é contemporâneo do moinho de água	3.75 (33%)	5.71 (70%)	**Uma ervilha não mastigada encontrar-se-á inteira nas fezes**
Uma ervilha não mastigada deixará vestígios nas fezes			Na Idade média designava-se o açúcar de "sal indiano"
Na Idade média designava-se o sal fino de "sal indiano"	6.00 (89%)	4.43 (70%)	A primeira mulher operadora de telefone foi Emma Ball, em 1878
A primeira mulher operadora de telefone foi Emma Nutt, em 1878	4.57 (70%)	3.11 (0%)	Uma embarcação de madeira é mais leve do que uma embarcação das mesmas dimensões sem aço.
Uma embarcação de aço é mais leve do que uma embarcação das mesmas dimensões em madeira.	**4.29 (58%)**	**4.00 (42%)**	Schik é o apelido do inventor da lâmina de barbear
Gillette é o apelido do inventor da lâmina de barbear.	3.89 (33%)	4.71 (87%)	A maior pepita de ouro encontrada até hoje pesava cerca de 67 kg
A maior pepita de ouro encontrada até hoje pesava cerca de 20 kg	3.44 (22%)	4.86 (70%)	**O preço mais elevado alguma vez pago por uma orquídea foi de 500 contos, em 1906 por Mrs Sanders de Londres**
O preço mais elevado alguma vez pago por uma orquídea foi de 50 contos, em 1906 por Mrs Sanders de Londres.	3.86 (0%)	4.11 (35%)	Desde o século sétimo depois de Cristo que se faziam dentaduras artificiais com dentes de cadáveres e de animais
Desde o século sétimo antes de Cristo que se faziam dentaduras artificiais com dentes de cadáveres e de animais.	4.29 (30%)	4.44 (35%)	O whisky de milho provém de uma massa de vários cereais, sendo dois quintos de milho
O whisky de milho provém de uma massa de vários cereais, sendo dois quintos de aveia	**4.29 (42%)**	**3.56 (42%)**	Em Portugal as emissões de dióxido de enxofre, por habitante e por ano, atinge os 33 kg
Em Portugal as emissões de dióxido de enxofre por habitante e por ano, atinge os 5 kg.	**4.14 (42%)**	**4.67 (53%)**	É necessário refinar cerca de 45 toneladas de minério para obter uma tonelada de urânio.
É necessário refinar cerca de 45 toneladas de minério para obter uma tonelada de níquel	**5.00 (61%)**	**5.11 (58%)**	**A fritura em óleo consiste na criação de uma película de proteínas coaguladas e caramelização dos glúcidos**
A fritura em óleo consiste na criação de uma película de glúcidos coagulados e colorados.	4.00 (42%)	3.56 (23%)	**A flor mais pequena do mundo encontra-se no Brasil e mede 1milimetro**
A flor mais pequena do mundo encontra-se no Japão e mede meio milímetro	3.29 (30%)	6.11 (89%)	**O primeiro piano foi construído em Itália em 1709**
O primeiro piano foi construído na Áustria em 1709	3.56 (22%)	3.71 (15%)	O México tem 28 estados mais um distrito capital, federal
O México tem 38 estados mais um distrito capital, federal	2.89 (0%)	2.86 (15%)	De todas as "Monas Lisas" existentes apenas duas têm autoria atribuída a Leonardo de La Vinci
De todas as "Monas Lisas" existentes apenas uma tem autoria atribuída a Leonardo de La Vinci	5.00 (58%)	2.44(0%)	A pata traseira de um texugo é maior do que a dianteira
A pata dianteira de um texugo é maior do que a traseira	**3.43 (42%)**	**4.11 (42%)**	Uma caixa de papelão vazia com tampa é recomendada como equipamento de sobrevivência no montanhismo
Uma lata média vazia com tampa é recomendada como equipamento de sobrevivência no montanhismo	4.44 (56%)	5.28 (87%)	As unhas dos dedos das mãos crescem mais rapidamente do que as dos pés
As unhas dos dedos dos pés crescem mais rapidamente do que as das mãos	**4.43 (58%)**	**3.89 (42%)**	**As balizas do pólo aquático têm 3 metros de largura**
	3.00 (0%)	4.71 (58%)	Uma ratazana pode ter cerca de 70 crias por ano
			O sangue do corpo humano completa um circuito de 23 em

As balizas do pólo aquático têm 2 metros de largura	2.00 (15%)	6.44 (89%)	**23 minutos**
Uma ratazana pode ter cerca de 50 crias por ano			O ser humano tem três vezes mais glóbulos vermelhos do que a ovelha
O sangue do corpo humano completa um circuito de 23 em 23 segundos	2.56 (10%)	3.29 (15%)	As cascavéis não põem os seus ovos. Elas dão à luz as suas crias.
As ovelhas têm três vezes mais glóbulos vermelhos do que o ser humano	5.56 (89%)	3.43 (30%)	
As cascavéis não dão à luz as suas crias. Elas põem ovos	**4.71 (42%)**	**4.67 (67%)**	Para que os soalhos parem de ranger deita-se leite entre as tábuas
	2.57 (15%)	4.78 (78%)	O soutien só surgiu no inicio do século XV
Para que os soalhos parem de ranger deita-se pó-de-talco entre as tábuas	3.71 (30%)	3.56 (10%)	**A graduação do vinho da Madeira situa-se entre os 18 e 20 graus**
O soutien só surgiu no inicio do século XX	6.00 (86%)	1.89 (0%)	Para limpar a maioria das nódoas deve-se utilizar água fria
A graduação do vinho da Madeira situa-se entre os 20 e 22 graus	5.89	4.86 (58%)	A foca macho recusa-se a comer na época de acasalamento que vai de Março a Agosto
Para limpar a maioria das nódoas deve-se utilizar água morna	(100%)	3.13 (35%)	O monóxido e dióxido de carbono encontram-se entre os sete principais poluentes da atmosfera
A foca fêmea recusa-se a comer na época de acasalamento que vai de Março a Agosto	3.25 (25%)	**3.50 (44%)**	A Casa Branca tem menos de 100 quartos
O monóxido de carbono não se encontra entre os sete principais poluentes da atmosfera	**3.50 (50%)**	**3.38 (44%)**	O benzeno é um diluente que ataca o sistema imunológico e pode causar paralisia
A Casa Branca tem mais de 100 quartos	**4.38 (50%)**	**5.25 (59%)**	**O organismo humano sintetiza quase a totalidade de vitamina K necessária**
O benzeno é um diluente que ataca o sistema nervoso e pode causar leucemia	**4.56 (56%)**	**5.13 (59%)**	**O primeiro semáforo foi colocado nos EUA e era vermelho, branco e verde**
O organismo humano sintetiza metade da quantidade de vitamina K necessária	**5.11 (56%)**	3.38 (13%)	**A expressão "peste negra" tem a sua origem na utilização da palavra "negra" como significado de "terrível"**
O primeiro semáforo foi colocado nos EUA e era apenas vermelho e verde	4.00 (33%)	4.63 (50%)	**A baleia azul, pesando cerca de 100 t necessita apenas de 4 t de alimento diário**
A expressão "peste negra" tem a sua origem no aspecto físico do doente, visto que a pele seca e escurece assinalando a morte.	3.44 (22%)	2.50 (25%)	A cerveja fabricada desde A.C. foi gaseificada a partir do século XIX
A baleia azul, pesando cerca de 100 toneladas necessita de 40 kg de alimento diário.	6.22 (89%)	4.13 (38%)	A Dinamarca tem o dobro de tamanho do estado de Massachusetts dos EUA
A cerveja fabricada desde A.C. foi gaseificada a partir do século X	4.11 (22%)	**5.25 (65%)**	A água do corpo humano tem um papel importante na sua regulação térmica
O estado de Massachsetts dos EUA, tem o dobro de tamanho da Dinamarca	**4.67 (56%)**	**5.38 (58%)**	A bazuca foi desenvolvida pelo exército americano e utilizada pela primeira vez em 1942
A água do corpo humano não tem papel na sua regulação térmica	**4.75 (53%)**	4.13 (23%)	**As traças têm cerca de 6 milímetros de comprimento**
A bazuca foi desenvolvida pelo exército americano e utilizada pela primeira vez em 1922	5.00 (50%)	4.13 (35%)	**Uma dona de casa lava em média 2,5 milhões de artigos de vestir na sua vida**.
As traças têm cerca de 1 centímetro de comprimento	4.25 (38%)	4.38 (55%)	Numa colher de chá cabem mais de 38 baratas recém-nascidas.
Uma dona de casa lava em média 2,5 milhões de artigos de cozinha na sua vida.	3.38 (25%)	6.13 (89%)	Noah Webster demorou 40 anos a fazer o seu famoso dicionário de língua inglesa
Numa colher de chá cabem mais de dezoito baratas recém-nascidas.	3.50 (50%)	3.88 (38%)	O comprimento total dos vasos sanguíneos do nosso corpo perfaz cerca de 45 mil km
Noah Webster demorou 20 anos a fazer o seu famoso dicionário de língua inglesa	4.22 (33%)	3.38 (25%)	As pessoas não podem falar sem fazer vibrar as cordas vocais
O comprimento total dos vasos sanguíneos do nosso corpo perfaz mais de 95 mil km	3.56 (22%)	4.63 (38%)	O mel contém dois tipos de açúcar: dextrose e levulose
As pessoas podem falar sem fazer vibrar as cordas vocais	4.11 (33%)	4.25 (35%)	Para fazer uma camisola de caxemira é necessário tosquiar 40 cabras
O mel contém dois tipos de açúcar: glucose e levulose	4.75 (50%)	3.13 (35%)	No decurso de um dia normal produzimos mais ou menos 950ml de saliva
Para fazer uma camisola de caxemira é necessário tosquiar 10 cabras	4.50 (50%)	**4.88 (58%)**	Stephen Foster, escritor da letra de canções muito famosas morreu com 42 anos pobre e alcoólico
No decurso de um dia normal produzimos mais de 250ml de saliva	**4.88 (63%)**	3.88 (38%)	As unhas das mãos não crescem todas ao mesmo ritmo, sendo a do dedo indicador a mais rápida
Stephen Foster, escritor da letra de canções muito famosas morreu com 38 anos pobre e alcoólico	2.44 (0%)	4.57 (50%)	**É da ordem das centenas de milhares o número de espermatozóides expelidos durante o orgasmo masculino**
As unhas das mãos não crescem todas ao mesmo ritmo, sendo a do dedo médio a mais rápida	2.88 (13%)	5.00 (88%)	As pestanas e os pelos das sobrancelhas têm a duração de alguns meses
É da ordem das centenas de milhões o número de espermatozóides expelidos durante o orgasmo masculino	4.63 (50%)	3.71 (63%)	Os nossos ossos têm uma força compressora inferior à do mármore e betão
As pestanas e os pelos das sobrancelhas têm a duração de alguns anos	3.63 (13%)	5.57 (88%)	O Japão é o país onde se verificou o maior número de tremores de terra
Os nossos ossos têm uma força compressora superior à do	2.25 (13%)	4.14 (25%)	O ser humano tem cerca de 630 ossos
	3.50 (25%)		Os coreanos têm igual número de glândulas odoríferas na sua

mármore e betão		**4.25 (53%)**	pele ao de qualquer outro povo
O Chile é o país onde se verificou o maior número de	**4.13 (48%)**	3.25 (38%)	A tribo dos zulus na África do Sul tem cerca de 8,35 milhares de
tremores de terra	4.83 (50%)		membros
O ser humano tem cerca de 630 músculos		2.14 (0%)	**A cólera apenas desapareceu da Europa no século XIX**
Os coreanos têm menos glândulas odoríferas na sua pele do	3.38 (38%)		O trigo não deve ser cultivado dois anos seguidos no mesmo
que qualquer outro povo		3.75 (38%)	terreno
A tribo dos zulus na África do Sul tem cerca de 8,35 milhões	3.88 (38%)		A pimenta um condimento muitíssimo apreciado passa de moda
de membros		4.50 (50%)	em 1860
A cólera apenas desapareceu da Europa no século XX	2.75 (0%)		A população do mundo está a aumentar à proporção de 500
O trigo deve ser cultivado dois anos seguidos no mesmo		4.38 (25%)	indivíduos por dia
terreno	5.25 (88%)		A quantidade média de água da chuva que caí na terra, por
		5.00 (63%)	hora, é de 18 toneladas
A pimenta um condimento muitíssimo apreciado passa de	3.63 (0%)	4.50 (38%)	O maior terminal de autocarros do mundo é o de Port Authority
moda em 1650	3.38 (13%)	3.00 (25%)	em Nova York
A população do mundo está a aumentar à proporção de 500	3.63 (38%)	5.13 (88%)	Alexandre I, Czar da Rússia, nunca foi vencido por Napoleão
indivíduos por hora	5.14 (86%)	3.38 (25%)	Na Grécia 50% dos dentistas são do sexo feminino
A quantidade média de água da chuva que caí na terra, por	3.88 (25%)		O tempo de vida normal de um canário é de 20 anos
segundo, é de 18 toneladas		3.38 (13%)	Angola é a sétima potência africana em grandeza territorial
O maior terminal de autocarros do mundo é o de Port	4.88 (75%)		É a pulga fêmea que é utilizada para exibição de saltos em
Authority em Chicago		5.14 (88%)	circos e não a macho
Alexandre I, Czar da Rússia, foi três vezes vencido por Napoleão	3.88 (38%)	**4.71 (50%)**	Os caminhos de ferro da Bélgica têm uma extensão de cerca
Na Grécia 20% dos dentistas são do sexo feminino	**4.38 (50%)**	**4.86 (61%)**	de 1800 Km
O tempo de vida normal de um canário é de 12 anos	**3.88 (50%)**	5.25 (88%)	A aranha tem uma duração média de cerca de dois meses
Angola é a quinta potência africana em grandeza territorial	4.75 (63%)	3.13 (38%)	**A árvore que consome 10 litros de água por dia é a Faia**
É a pulga macho que é utilizada para exibição de saltos em	3.75 (50%)		**A altura média da mulher americana é de 1,69 cm**
circos e não a fêmea		**4.29 (50%)**	De um Cedro médio pode-se fazer 300 000 lápis
Os caminhos de ferro da Grécia têm uma extensão de cerca	**4.25 (42%)**	**5.86 (58%)**	A maior presa (dente) de elefante registada até hoje tinha
de 1800 Km	**4.50 (50%)**	3.71 (13%)	11,32m.
A aranha tem uma duração média de cerca de dois anos	4.13 (38%)		**O coelho tem um tempo de vida superior ao de um pombo**
A árvore que consome mais de 190 litros de água por dia é a Faia		4.63 (50%)	**As beringelas, de forma ovóide, têm cor roxa ou castanha**
A altura média da mulher americana é de 1,65 cm	4.13 (38%)		É bem mais fácil ensinar uma papagaio fêmea a falar do que
De um Cedro médio pode-se fazer 500 000 lápis			um macho
A maior presa (dente) de elefante registada até hoje tinha		**4.50 (60%)**	O bombardeamento mais mortífero de Londres envolveu o
14,23m	**4.50 (50%)**		dobro de mortes das causadas pelo bombardeamento mais
O pombo tem um tempo de vida superior ao de um		4.00 (38%)	mortífero de Paris
coelho	3.25 (13%)	**4.25 (50%)**	**Os ratos domésticos atingem velocidades**
As beringelas, de forma ovóide, têm cor roxa ou branca	**4.13 (50%)**	2.88 (25%)	**aproximadamente de 10 km/hora**
É bem mais fácil ensinar um papagaio macho a falar do que	3.88 (38%)		Um bébé em mil, nasce com lábio leporino
uma fêmea		4.00 (25%)	**Uma cria de urso ao nascer pesa apenas cerca de 3,5kg**
O bombardeamento mais mortífero de Paris envolveu o dobro	4.38 (50%)		As bananeiras não são árvores mas sim plantas de grandes
de mortes das causadas pelo bombardeamento mais		3.63 (38%)	dimensões
mortífero de Londres	4.25 (38%)		Os peixes não conseguem permanecer de olhos fechados, mas
Os ratos domésticos atingem velocidades			do mesmo modo que os mamíferos, dormem
aproximadamente de 15 km/hora		**4.63 (50%)**	Dois pregos colocados, um acima do outro, num tronco de uma
Um bébé em 5 mil, nasce com lábio leporino	**5.25 (56%)**		árvore, aumentaram a distância um do outro à medida que a
Uma cria de urso ao nascer pesa apenas cerca de 5,5kg		5.38 (88%)	arvore cresce
As bananeiras não são árvores mas sim uma espécie	4.88 (75%)	**4.88 (50%)**	**Os cornos da Camurça apresentam nas extremidades uma**
de cana	**4.00 (40%)**		**curvatura em gancho dirigida para a frente**
Os peixes não conseguem permanecer de olhos fechados,		4.63 (50%)	Em vinte doentes de gota, 11 são do sexo masculino
pelo que não dormem do mesmo modo que os mamíferos	5.25 (75%)		**Napoleão casou por procuração com Maria Luísa, filha do**
Dois pregos colocados, um acima do outro, num tronco de		**4.25 (42%)**	**Imperador da Áustria**
uma árvore, permanecerão exactamente à mesma distância	**4.25 (50%)**		O suco da cana do açúcar que serve de base ao açúcar é
à medida que a arvore cresce		4.63 (50%)	igualmente a base do fabrico do gim
Os cornos da Camurça apresentam nas extremidades	3.00 (30%)	**4.88 (50%)**	**Carlos Magno foi coroado Imperador do Ocidente, pelo**
uma curvatura em gancho dirigida para traz	**4.50 (50%)**		**Papa, no dia de Páscoa**
Em vinte doentes de gota, 19 são do sexo masculino		**4.25 (50%)**	Os chapéus "panamá" são uma indústria do Equador
Luís XVI casou por procuração com Maria Luísa, filha do	**4.38 (50%)**		**Lord Byron após se ter separado da sua mulher, saiu de**
Imperador da Áustria		3.50 (25%)	**Inglaterra e nunca mais lá voltou**
O suco da cana do açúcar que serve de base ao açúcar é	2.88 (38%)	3.50 (13%)	**Para congelar álcool puro é necessária uma temperatura**
igualmente a base do fabrico do rum	3.75 (25%)	5.00 (75%)	**abaixo de 90 graus negativos**
Carlos Magno foi coroado Imperador do Ocidente, pelo	4.13 (38%)		A África tem uma área três vezes superior à da Europa
Papa, no dia de Natal		**4.50 (42%)**	Os chitas são mais de 16 milhões e vivem quase todos no Irão

Os chapéus "panamá" são uma indústria do México	**4.00 (50%)**	5.13 (75%)	A zona mais profunda do pacífico tem cerca de 9 mil metros de profundidade
Lord Byron após se ter separado da sua mulher, saiu de Inglaterra por uns tempos	3.88 (38%)	5.88	**O coelho pode ter de 3-12 crias num intervalo de 2-3 meses**
Para congelar álcool puro é necessária uma temperatura abaixo de 40 graus negativos	4.88 (75%)	(100%)	Se nos colocarmos meio metro acima do nível das águas do mar, podemos ver uma distância de cerca de 10 km
A África tem uma área quatro vezes superior à da Europa	2.63 (25%)	6.00 (88%)	O primeiro sistema de distribuição de águas pelas cidades, parece ter sido construído pelos Maias.
Os chitas são cerca de 8 milhões e vivem quase todos no Irão	5.25 (75%)	4.13 (38%)	Os escorpiões são imunes ao seu próprio veneno, pelo que não se podem suicidar
A zona mais profunda do pacífico tem cerca de 11 mil metros de profundidade	4.50 (38%)	4.75 (63%)	A temperatura do lado oculto da lua atinge valores abaixo de
O coelho pode ter de 3-12 crias num intervalo de 5-6 semanas	3.63 (25%)	4.63 (50%)	150 graus negativos
Se nos colocarmos meio metro acima do nível das águas do mar, podemos ver uma distância de cerca de 6 km	5.00 (75%)	5.25 (50%)	A principal condecoração de França é a da Cruz de Ferro Quando a Imperatriz Elizabeth da Áustria, morreu possuía 150 mil vestidos nos seus armários
O primeiro sistema de distribuição de águas pelas cidades, parece ter sido construído pelos fenícios	**5.38 (63%)**	**4.38 (48%)**	Cada extracção de cortiça tem de respeitar um período mínimo de 2 anos
Os escorpiões não são imunes ao seu próprio veneno, pelo que se podem suicidar	3.50 (25%)	4.75 (63%)	**É possível obter diamantes cristalizando o carbono puro, por o submeter a temperaturas muito elevadas e a fortes pressões**
A temperatura do lado oculto da lua atinge valores de cerca de 50 graus negativos	4.25 (50%)	4.63 (38%)	As cascavéis mudam de pele 5-6 vezes num ano
A principal condecoração de França é a da Legião de Honra	3.63 (38%)	4.63 (50%)	A maior estrela classificada tem um diâmetro 2000 vezes superior ao do sol
Quando a Imperatriz Elizabeth da Rússia, morreu possuía 150 mil vestidos nos seus armários	4.38 (50%)	4.13 (50%)	A velocidade máxima que um pombo pode atingir em pleno ar, é superior a 100 km/hora
Cada extracção de cortiça tem de respeitar um período mínimo de 9 anos	**3.25 (48%)**	**4.13 (60%)**	Quimicamente o açúcar de milho é a mesma substancia que
É possível obter diamantes cristalizando o hidrogénio puro, por o submeter a temperaturas muito elevadas e a fortes pressões	5.25 (88%) 4.50 (38%)	4.00 (50%) 5.13 (88%)	o açúcar de beterraba ou de cana **D.Pedro e D.Inês de Castro tiveram um filho**
As cascavéis mudam de pele 3-4 vezes num ano			O esófago tem 30 cm de comprimento e 3cm de diâmetro
A maior estrela classificada tem um diâmetro 2000 vezes superior ao da terra	3.75 (13%)	4.75 (50%)	Os poços petrolíferos de Israel produzem anualmente mais de 420 mil toneladas de petróleo
A velocidade máxima que um pombo pode atingir em pleno ar, é inferior a 100 km/hora	2.63 (0%)	3.75 (50%)	Um ex-escravo, George Carver, enriqueceu por ter desenvolvido mais de 300 produtos à base de maça
Quimicamente o açúcar de milho não é a mesma substancia que o açúcar de beterraba ou de cana	4.38 (75%)	3.25 (25%)	O pescoço das girafas tem cerca do dobro das vértebras do
D.Pedro e D.Inês de Castro tiveram três filhos	5.25 (88%)	4.38 (50%)	pescoço de uma ave
O esófago tem 20 cm de comprimento e 2cm diâmetro	4.63 (63%)	3.88 (25%)	Em Portugal o voto feminino tornou-se efectivo a apartir de 1931
Os poços petrolíferos de Israel produzem anualmente mais de 220 mil toneladas de petróleo	3.75 (38%)	3.75 (25%)	A esfinge de Gizé esculpida em plena rocha tem 22 m de altura
Um ex-escravo, George Carver, enriqueceu por ter desenvolvido mais de 300 produtos à base de amendoim	5.50 (75%)	3.75 (50%)	O Infante D.Fernando foi o oitavo e ultimo filho de D.João I e D.Filipa de Lencastre
O pescoço das aves tem cerca do dobro das vértebras do pescoço de uma girafa	3.63 (25%)	3.75 (50%)	Os pontos mais altos e mais baixos dos EUA situam-se no mesmo estado- Califórnia
Em Portugal o voto feminino tornou-se efectivo a partir de 1901	4.63 (50%)	5.38 (88%)	O mar onde se verificam ondas de maior envergadura (cerca de 21 m) é o Atlântico
A esfinge de Gizé esculpida em plena rocha tem 70 m de altura	5.38 (100%)	5.25 (100%)	A espécie mais pequena de peixe tem apenas 1mm de comprimento nunca ultrapassando os 1.5mm As quatro diferentes modalidades do hóquei diferem no terreno, suas dimensões mas não no número de jogadores
O Infante D.Fernando foi o sexto e ultimo filho de D.João I e D.Filipa de Lencastre	**4.38 (50%)**	**4.38 (50%)**	Portugal figura entre os sete primeiros produtores de azeite do mundo
Os pontos mais altos e mais baixos dos EUA situam-se no mesmo estado - Alasca	4.63 (50%) **4.13 (50%)**	4.13 (38%) **3.50 (48%)**	**O maior lago do mundo situa-se na fronteira da Europa e Asia**
O mar onde se verificam ondas de maior envergadura (cerca de 21m) é o Pacífico	**4.13 (42%)**	**5.25 (55%)**	O principal rio da Europa é o Reno **O coração de uma galinha chega a bater 24 horas após se ter separado a cabeça do seu corpo**
A espécie mais pequena de peixe tem apenas 10mm de comprimento nunca ultrapassando os 11mm	**5.75 (58%)**	**3.63 (38%)**	**O plasma representa cerca de 55% do volume total do sangue circulante**
As quatro diferentes modalidades do hóquei diferem no terreno e suas dimensões bem como no número de jogadores	**4.29 (48%)** 4.88 (63%) 4.13 (13%)	**4.25 (40%)** 3.13 (13%) 4.75 (50%)	**O basquetebol foi inventado nos EUA em 1801** **A dinastia Chinesa Chang é anterior à dinastia Chang**
Portugal figura entre os cinco primeiros produtores de azeite do mundo	3.75 (38%)	4.38 (75%)	Los Angeles tem um numero de habitantes superior a Nova York Existe maior produção de coelhos na Hungria do que na França
O maior lago do mundo situa-se na América do Norte			A altura máxima é alcançada no sexo masculino aos 18 anos e
O principal rio da Europa é o Danúbio			no feminino aos 16 anos
O coração de uma cobra chega a bater 24 horas após se			

ter separado a cabeça do seu corpo			
O plasma representa cerca de 55% do volume total do sangue circulante			
O basquetebol foi inventado em Inglaterra em 1891			
A dinastia Chinesa Ching é anterior à dinastia Ching			
Los Angeles tem um numero de habitantes inferior a NovaYork			
Existe maior produção de coelhos na França do que naHungria			
A altura máxima é alcançada no sexo masculino aos 25 anos e no feminino aos 18 anos			

Statement	True / False	% False	% True
Os macacos fêmea reconhecem as suas crias pela altura e peso.	F	65,31%	34,69%
O cantor Frank Sinatra não queria gravar o tema "My Way", mas a sua editora forçou-o a fazê-lo.	F	63,27%	36,73%
O nosso cabelo cresce mais rápido durante a manhã do que em qualquer outra altura do dia.	F	75,51%	24,49%
A altura do dia em que é mais frequente os patos porem ovos é à tarde.	F	85,71%	14,29%
O território de Marrocos está dividido em 12 regiões.	F	48,98%	51,02%
O maior rio da Europa é o rio Danúbio, com 3 688 km de comprimento.	F	40,82%	59,18%
A primeira fotografia com cor permanente foi conseguida em 1900 por um físico escocês.	F	53,06%	46,94%
O Departamento de Estado americano reconhece 201 países independentes no Mundo.	F	42,86%	57,14%
São precisos 5 minutos e 40 segundos para a luz do Sol chegar à Terra.	F	63,27%	36,73%
O eclipse solar total mais longo de que há registo durou 12 minutos.	F	44,90%	55,10%
Por segundo, são recicladas cerca de 350 latas.	F	42,86%	57,14%
A cidade de Veneza sustenta-se sobre cerca de 55 pequenas ilhas.	F	67,35%	32,65%
O Taj Mahal, na Índia, demorou 26 anos a ser construído.	F	38,78%	61,22%
Os limpa pára-brisas foram inventados em 1923.	F	55,10%	44,90%
O lugar mais seco da Terra é Saguia el-Hamra, no deserto do Sahara.	F	6,12%	93,88%
O nome original da cidade de Xangai era Edo.	F	57,14%	42,86%
A força exercida pela dentada de um crocodilo pode chegar aos 20 000 pascais.	F	36,73%	63,27%
O planeta Marte gira ao contrário dos outros planetas do sistema solar.	F	85,71%	14,29%
Desde o início da exploração do espaço, 14 homens já foram à lua.	F	57,14%	42,86%
Na Croácia acenar a cabeça para cima e para baixo significa não.	F	59,18%	40,82%
O cravo da Índia é a especiaria mais cara do mundo.	F	51,02%	48,98%
O maior rubi do mundo pesa 5634 gramas.	F	46,94%	53,06%
A mais alta barragem da Europa encontra-se na Suíça e tem 385 metros.	F	46,94%	53,06%
A estação de metro mais profunda do mundo é em Moscovo e tem 150 metros de profundidade.	F	38,78%	61,22%
A maior biblioteca do Mundo é a Biblioteca Nacional da China, em Pequim.	F	30,61%	69,39%
O último prisioneiro a deixar Alcatraz foi Alan Wilson.	F	48,98%	51,02%
Os ratos podem sobreviver até 40 dias sem comida.	F	51,02%	48,98%

Os postais foram patentados nos Estados Unidos da América em 1761.	F	36,73%	63,27%
A pele é o maior órgão humano, ocupando uma superfície de cerca de 3 m2.	F	36,73%	63,27%
O tecido de uma bola de basebol é cosido com 90 pontos.	F	32,65%	67,35%
O maior glaciar da Europa é o Vatnajökull, na Islândia.	V	38,78%	61,22%
O avião boeing 747-400 tem capacidade para transportar 416 passageiros em 3 classes.	V	30,61%	69,39%
O estado do Alasca é o maior estado dos EUA, cobrindo uma área de 1 717 854 km2.	V	34,69%	65,31%
O primeiro campeão dos Jogos Olímpicos da era moderna foi James B. Connolly.	V	51,02%	48,98%
Mozart era o mais novo de 7 irmãos.	V	40,82%	59,18%
A tenista Steffi Graf anunciou a sua retirada do desporto no dia 13 de Agosto de 1999.	V	40,82%	59,18%
A primeira caneta esferográfica foi inventada na década de 1930 por um jornalista húngaro.	V	65,31%	34,69%
Os inventores do primeiro balão tripulado foram os irmãos Joseph e Jaques Montgolfier.	V	32,65%	67,35%
O nome da bebida Pepsi tem origem no ingrediente pepsin.	V	67,35%	32,65%
Os primeiros 3 países a terem televisão foram a Inglaterra, os Estados Unidos e a Alemanha.	V	12,24%	87,76%
Uma cana de bambu pode crescer 100 cm em 24 horas.	V	71,43%	28,57%
O corpo humano tem cerca de 100 000 km de veias.	V	40,82%	59,18%
Os dentes dos roedores crescem continuamente até ao final de vida do animal.	V	46,94%	53,06%
O tempo de vida de uma pestana é aproximadamente 150 dias.	V	57,14%	42,86%
A língua de uma baleia azul pesa mais do que um elefante.	V	53,06%	46,94%
O Central Park, em Nova Iorque, tem quase duas vezes o tamanho do Mónaco.	V	44,90%	55,10%
Os pássaros têm cerca de 175 músculos diferentes.	V	55,10%	44,90%
Existem cerca de 6000 espécies de borboletas nas florestas tropicais da América do Sul.	V	16,33%	83,67%
A medalha do Prémio Nobel da Paz tem 3 homens com as mãos pousadas nos ombros uns dos outros.	V	59,18%	40,82%
Um gato tem 32 músculos em cada orelha.	V	59,18%	40,82%
A maior árvore do mundo é uma sequóia que mede 115,56 metros.	V	16,33%	83,67%
O batimento cardíaco pode subir 30% durante um bocejo.	V	57,14%	42,86%

Um piscar de olhos dura entre 300 e 400 milissegundos.	V	24,49%	75,51%
A construção da Casa Branca foi iniciada em 1792 e estava pronta para habitar em 1800.	V	44,90%	55,10%
O sangue das aranhas é transparente.	V	69,39%	30,61%
Um rinoceronte pode viver até 50 anos.	V	18,37%	81,63%
A guerra mais curta da história foi entre Zanzibar e a Inglaterra e durou cerca de 40 minutos.	V	61,22%	38,78%
Um feto começa a desenvolver os dedos das mãos às 8 semanas de gestação.	V	42,86%	57,14%
É ilegal vender ou possuir pastilha elástica em Singapura desde 1992.	V	65,31%	34,69%

Appendix B: Pre-testes of Similarity of Meaning of Original – Paraphrased Statements

We construed paraphrases of the 52 statements validated as neutral by Garcia-Marques (1999; previous appendix), half in their true version, and half in their false version (randomly selected). The resulting 52 pairs of original-paraphrased statements were divided in two groups, with an equal number of true and false pairs of statements (13 true and 13 false). These two versions of the pre-test were then evaluated by 20 university students each.

Participants were asked to indicate for each pair of statements how similar their meaning was. Participants gave their answers on 7-point a rating scale, anchored in 1- The phrases don't have the same meaning, and 7- The phrases have the same meaning.

To include as material in the experiments, we selected the 42 (21 factually true and 21 factually false) pairs that were evaluated as having the greater meaning similarity (see the table below). Overall mean similarity of the selected pairs was $M_{\text{similarity}} = 6.21$, $SD = 1.37$).

After this validation of the material, we construed the paraphrases of the remaining statements validated by Garcia-Marques (1999). That is, for the pre-test we selected 26 of the statements in their true version (and other 26 in their false version), and after validating the material we applied the same changes to the false (or true) versions of those statements. This procedure guarantees that the true and the false versions of the paraphrases kept the same equivalence as the original true and false versions of the statements.

Table 1. Means associated with each pre-tested pair. In bold - statements selected for the experiments.

Original	Paraphrase	True / False	M	SD	CI L.L-U.L
São necessários 20 dias para que uma mosca doméstica seja bisavó.	**Até que uma mosca doméstica tenha bisnetos são precisos 20 dias.**	**T**	**6,9**	**0,31**	**[6,77;7,03]**
A flor mais pequena do mundo encontra-se no Brasil e mede 1 milimetro.	**No Brasil encontramos uma flor com 1 milímetro, a menor do mundo.**	**F**	**6,85**	**0,37**	**[6,69;7,01]**
D. Pedro e D. Inês de Castro tiveram três filhos.	**Três filhos resultaram da relação entre D. Inês de Castro e D. Pedro.**	**T**	**6,85**	**0,37**	**[6,70;7,01]**
Para congelar álcool puro é necessária uma temperatura de cerca de 90 graus negativos.	**Para solidificar álcool puro são precisas temperaturas na ordem dos 90 graus abaixo de zero.**	**F**	**6,75**	**0,55**	**[6,51;6,99]**
O coelho pode ter entre 3 e 12 crias num intervalo de 2 a 3 meses.	**Num período de 2 a 3 meses um coelho pode ter de 3 até 12 filhos.**	**F**	**6,65**	**0,81**	**[6,29;7,01]**

O basquetebol foi inventado nos EUA em 1891.	Foi em 1891 nos EUA que foi criado o basquetebol.	T	6,65	0,67	[6,36;6,94]
O primeiro piano foi construído em Itália em 1709.	Em Itália, no ano de 1709, construiu-se o primeiro piano.	F	6,6	0,82	[6,24;6,96]
A maior distância a que uma bola de basebol foi lançada é cerca de 130 metros.	130 metros é o record de distância percorrida por uma bola de basebol depois de ser lançada.	F	6,6	0,82	[6,24;6,96]
Uma dona de casa lava na sua vida em média 2,5 milhões de artigos de vestir. (2 milhoes e meio)	Uma média de 2,5 milhões de peças de roupa são lavados por uma dona de casa durante a sua vida.	F	6,55	1,00	[6,11;6.99]
As unhas dos dedos das mãos crescem mais rapidamente que as dos pés.	Em comparação com as unhas das mãos, as dos pés crescem mais lentamente.	F	6,55	1,00	[6,11;6.99]
O número de rotações de uma máquina de lavar roupa pode ir de 500 a 1100 por minuto.	A cada 1 minuto uma máquina de lavar roupa pode dar entre 500 a 1100 rotações.	T	6,55	1,28	[5,99;7,11]
A primeira bandeira da Confederação nos EUA designava-se "Antiga Glória".	"Antiga Glória" foi o nome dado à primeira bandeira dos Estados Confederados dos EUA.	F	6,5	0,89	[6,11;6,89]
O presidente John Taylor dos EUA adoptou 14 crianças.	O presidente Norte Americano John Taylor teve 14 filhos adotivos.	T	6,5	1,00	[6,06;6,94]
É da ordem das centenas de milhares o número de espermatozóides expelidos durante o orgasmo masculino.	Quando um homem atinge o clímax sexual, ejacula centenas de milhares de espermatozoides.	F	6,45	0,89	[6,06;6,84]
O sangue do corpo humano completa um circuito de 23 em 23 segundos.	A cada 23 segundos completa-se um novo ciclo da circulação do sangue no corpo humano.	T	6,45	1,47	[5,81;7,09]
Uma cria de urso ao nascer pesa apenas cerca de 5,5kg.	Perto de 5,5 kg é o peso de um filhote de urso quando nasce.	T	6,45	1,15	[5,95;6,95]
O maior lago do mundo situa-se na América do Norte.	É em território norte-americano que se encontra o lago de maior dimensão do mundo.	T	6,45	1,32	[5,87;7,03]
O pombo tem um tempo de vida superior ao de um coelho.	Um coelho vive menos tempo que um pombo.	T	6,45	1,32	[5,87;7,03]
A cólera apenas desapareceu da Europa no século XIX.	Só no século XIX é que a cólera foi erradicada do continente europeu.	F	6,4	1,31	[5,82;6.98]
Uma mão direita e esquerda juntas eram o símbolo da amizade para os romanos.	A figura que representava a amizade para o povo romano era a mão esquerda e a direita unidas.	F	6,35	1,23	[5,81;6,89]
Lord Byron após se ter separado da sua mulher, saíu de Inglaterra e nunca mais lá voltou.	Depois da separação entre Lord Byron e a sua esposa, o poeta ausentou-se de Inglaterra para sempre.	F	6,35	1,23	[5,81;6,89]
A máxima velocidade atingida por um réptil em terra é de 46km/hora. (por)	A rapidez máxima de um réptil em terra é 46km/hora.	F	6,3	1,49	[5,65;6,95]
Os crocodilos dormem de olhos abertos.	Os crocodilos não fecham as pálpebras quando dormem.	F	6,15	1,23	[5,61;6,69]

A altura média da mulher americana é de 1,69 metros. (um metro e 69 cm)	**Em média uma mulher natural dos EUA mede 1,69 m.**	**F**	**6,15**	**1,63**	**[5,44;6,86]**
A dinastia Chinesa Ching é anterior à dinastia Chang.	**Os imperadores chineses da linhagem Chang reinaram depois dos imperadores da linhagem Ching.**	**F**	**6,15**	**1,76**	**[5,38;6,92]**
Uma joaninha recém-nascida é amarela e vermelha.	**Quando nascem, as Joaninhas são encarnadas e amarelas.**	**T**	**6,15**	**1,50**	**[5,49;6.81]**
A expressão "peste negra" tem a sua origem no aspecto físico do doente, visto que a pele seca e escurece assinalando a morte.	**O aspecto ressequido e escuro com que fica a epiderme dos doentes indicando a morte é o que está por trás do nome "peste negra".**	**T**	**6,1**	**1,55**	**[5,42;6,78]**
A infecção com maior prevalência no mundo é a malária.	**A malária é a doença infecciosa mais predominante no mundo.**	**T**	**6**	**1,84**	**[5,20;6,80]**
As traças têm cerca de 1 centímetro de comprimento.	**O tamanho das traças é de aproximadamente 1 centimetro.**	**T**	**6**	**1,62**	**[5,29;6,71]**
O gelado de cone surgiu nos EUA em 1924.	**Foi em 1924 na América que surgiu o gelado de cone.**	**F**	**5,95**	**1,64**	**[5,23;6,67]**
As beringelas, de forma ovóide, têm cor roxa ou branca.	**AS beringelas de formato oval podem ter roxo ou branco como sua cor.**	**T**	**5,95**	**1,76**	**[5,18;6,72]**
O plasma representa cerca de 45% do volume total do sangue circulante.	**Aproximadamente 45% do sangue que circula no nosso corpo é plasma.**	**F**	**5,9**	**2,00**	**[5,02;6,78]**
Carlos Magno foi coroado pelo papa no dia de Páscoa Imperador do Ocidente.	**Foi no domingo de pascoa que o Papa corou Carlos Magno Imperador do Ocidente.**	**F**	**5,9**	**1,94**	**[5,05;6,75]**
A graduação do vinho da Madeira situa-se entre os 20 e 22 graus.	**O vinho da Madeira varia entre 20 e 22 graus de teor alcoólico.**	**T**	**5,85**	**2,06**	**[4.95;6,75]**
O primeiro semáforo foi colocado nos EUA e era apenas vermelho e verde.	**Os EUA apresentaram o primeiro sinal de trânsito luminoso, que tinha apenas luz verde e vermelha.**	**T**	**5,85**	**1,90**	**[5,02;6,68]**
O coração de uma cobra chega a bater 24 horas após se ter separado a cabeça do seu corpo.	**Mesmo um dia depois de se cortar a cabeça a uma cobra o seu coração pode continuar a bater.**	**T**	**5,75**	**1,83**	**[4,95;6,55]**
A baleia azul, pesando cerca de 100 toneladas, necessita de 40kg de alimento diário.	**Diariamente, uma baleia azul com 100 toneladas ingere aproximadamente 40 kg de comida.**	**T**	**5,75**	**1,59**	**[5,06;6,44]**
As balizas do polo aquático têm 2 metros de largura.	**A distância entre os postes de uma baliza de polo aquático é de 2 metros.**	**F**	**5,65**	**2,28**	**[4,65;6,65]**
Os cornos da Camurça apresentam nas extremidades uma curvatura em gancho dirigida para trás.	**As Camurças têm chifres com forma de curva virada para trás nas pontas.**	**T**	**5,65**	**1,53**	**[4,98;6,32]**
O Egipto tem apresentado nos últimos anos as taxas mundiais mais baixas de suicídio.	**É no Egipto que se tem encontrado recentemente o menor rácio de suicídio por habitante.**	**F**	**5,55**	**1,85**	**[4,74;6,36]**
Napoleão casou por procuração com Maria Luísa, filha do imperador da Áustria.	O casamento de Napoleão e Maria Luísa, filha do imperador Austríaco, aconteceu através de procuradores.	F	5,4	2,11	[4,47;6,32]

O primeiro cão-guia para cegos foi apresentado a um cego em 1948.	A primeira vez que um deficiente visual teve contacto com um cão-guia foi em 1948.	F	5,25	2,20	[4,29;6,21]
Uma ervilha não mastigada deixa vestígios nas fezes.	**Se uma ervilha for engolida inteira, os seus resquícios serão detectados nos excrementos.**	**T**	**5,2**	**2,33**	**[4,18;6,22]**
O preço mais elevado alguma vez pago por uma orquídea foi de 250 euros, em 1906.	**Em 1906 o preço de uma orquídea atingiu o recorde de 250 euros.**	**T**	**4,9**	**2,53**	**[3,79;6.01**
A Faia é uma árvore que consome cerca de 10 litros de água por dia.	A árvore que bebe diariamente à volta de 10 litros de água é a Faia.	F	4,75	2,59	[3,61;5,89]
Nenhum lugar na terra está livre de tempestades eléctricas.	Todos os locais da terra estão sujeitos às tempestades com raios.	T	4,75	2,15	[3,81;5,69]
Os selos de via aérea foram pela primeira vez emitidos em 13 de Maio de 1918.	Foi a 13 de Maio de 1918 que se iniciou a circulação dos selos de correio aéreo.	T	4,65	2,39	[3,60:5,70]
Os ratos domésticos atingem velocidades aproximadamente de 15 km/hora.	Os ratos domésticos conseguem a rapidez de 15 km / hora.	T	4,6	2,19	[3,64;5,56]
O organismo humano sintetiza metade da quantidade de vitamina K necessária.	Os órgãos do corpo humano conseguem fabricar metade da vitamina K que é precisa.	T	4,4	2,33	[3,38;5,42]
A estátua do Cristo Rei tem 38m de altura.	A altitude do monumento Cristo Rei é de 38 m.	F	4,2	2,80	[1,23;2,97]
A fritura em óleo consiste na criação de uma película de glúcidos coagolados e colorados.	A fritura a óleo consiste na produção de uma camada sólida de glúcidos colorados.	T	3,85	2,13	[2,91;4,79]
O primeiro de desenhos animados é inglês.	Em Inglaterra foi feita a primeira película de animação.	F	3,8	2,69	[2,62;4,98]

Appendix C: Instructions of the Experiments in Empirical Article 1

Exposure phase (experiments 1 and 2)

Nesta sessão vai participar num estudo composto por diversas tarefas.

Algumas dessas tarefas estão relacionadas com a leitura de frases apresentadas em diferentes cores, enquanto outras tarefas se relacionam com a percepção e avaliação de imagens.

Pressione a barra de espaços para continuar.

A sua primeira tarefa nesta sessão será ler um conjunto de afirmações. Metade das afirmações que vai ler são verdadeiras e metade são falsas.

Pressione a barra de espaços para continuar.

De seguida vai iniciar-se a apresentação das frases. Estas afirmações vão ser-lhe apresentadas uma a uma de forma rápida nos próximos ecrãs.

Quando estiver pronto(a) para iniciar a visualização das afirmações, pressione a barra de espaços.

Filler task (evaluation of images; Experiments 1 and 2

Na próxima fase, irá realizar uma tarefa relacionada com a percepção e avaliação de imagens. As imagens a avaliar serão de várias categorias: pessoas, animais, plantas, objectos, etc.

Pretendemos que nos forneça a sua opinião relativamente ao conteúdo da imagem:
se é bom ou mau; se gosta ou não dele.

Pressione a barra de espaços para continuar.

Para a avaliação de cada imagem por favor responda às duas escalas abaixo, pressionando o número (de 1 a 9) que melhor representa a sua opinião sobre o seu conteúdo:

Mau	1	2	3	4	5	6	7	8	9	Bom
Gosto Pouco	1	2	3	4	5	6	7	8	9	Gosto Muito

Pressione a barra de espaços para continuar.

Estamos interessados na avaliação espontânea, pelo que as imagens serão mostradas durante breves segundos.
Deve tentar responder o mais rapidamente possível.

Para se habituar à tarefa, iremos realizar alguns ensaios de treino onde lhe será dado feedback da rapidez da sua resposta.

Por favor, tente que o número apresentado a seguir à resposta às 2 escalas seja inferior a 1000.

Pressione a barra de espaços para começar o treino.

A fase de treino terminou.
Vamos continuar a tarefa, agora sem receber qualquer tipo de feedback quanto à rapidez da sua resposta.

No entanto, é importante que continue a avaliar as imagens nas 2 escalas o mais rapidamente que lhe for possível.

Pressione a barra de espaços para começar.

Examples of images presented in the filler task (Experiments 1 and 2)

Learning phase (Experiments 1 and 2)

Na próxima fase deste estudo vai ser-lhe apresentado um novo conjunto de frases.

A sua tarefa vai ser ler cada uma das frases e decidir se é uma afirmação verdadeira ou se é uma afirmação falsa.

Pressione a barra de espaços para continuar.

Para responder, deverá usar as teclas 'S' e 'L', em que 'S' significa que a afirmação é verdadeira, e 'L' significa que a afirmação é falsa.

S	**L**
Verdadeira	**Falsa**

Pressione a barra de espaços para continuar.

Cada afirmação que lhe for apresentada permanecerá no ecrã até que responda.

Após a sua resposta, ser-lhe-á dada informação sobre se está correcta ou incorrecta, surgindo de seguida no ecrã uma nova afirmação para realizar a mesma tarefa.

Pressione a barra de espaços para continuar.

Test Phase (Experiment 2)

Na próxima fase, a sua tarefa é muito semelhante à anterior. Irá ler mais um conjunto de afirmações e decidir se cada uma delas é verdadeira ou falsa.

No entanto, agora deve **tentar responder o mais rapidamente que conseguir**, e não receberá feedback sobre se as suas respostas estão correctas ou incorrectas.

Pressione a barra de espaços para continuar.

Nesta fase as frases vão ser-lhe apresentadas numa cor diferente das usadas até agora.

Para responder, deverá usar novamente as teclas 'S' e 'L', da mesma forma que usou na tarefa anterior.

S	**L**
Verdadeira	**Falsa**

Pressione a barra de espaços para continuar.

Lembre-se, nesta fase deve tentar responder o mais rapidamente possível.

Quando estiver pronto(a), pressione a barra de espaços para iniciar a tarefa.

Recognition test (Experiment 2)

Para terminar, vamos agora apresentar-lhe uma nova lista de frases, e sua tarefa é indicar para cada uma se apareceu na primeira fase desta sessão (a fase em que apenas teve de ler as frases que iam sendo apresentadas no ecrã).

Pressione a barra de espaços para continuar.

Para responder, deverá usar novamente as teclas 'S' e 'L'. No entanto, agora as teclas têm significados diferentes.

S – Sim, a frase apareceu na 1ª fase da sessão.
L – Não, a frase não aparece na 1ª fase da sessão.

Pressione a barra de espaços para continuar.

Lembre-se, apenas deverá responder "S – Sim" se acha que uma frase lhe foi apresentada no início da sessão (a fase em que apenas teve de ler as frases). Se achar que uma frase não foi apresentada nessa fase, então deverá responder "L – Não".

S	**L**
Sim	**Não**

Pressione a barra de espaços para continuar.

Appendix D: Instructions of the Experiment in Empirical Article 2

Exposure phase (interest ratings)

INSTRUÇÕES

Na investigação em Psicologia é frequentemente necessário conceber situações mais ou menos artificiais que nos permitam garantir a presença de uma ou outra concretização das variáveis em estudo. Para tal a própria definição da situação bem como o material que a compõe necessita de ser cuidadosamente testado antes de ser incorporado num estudo. A este conjunto de estudos preliminares que nos garantem a validade das manipulações realizadas, designamos de pré-testes.

Pré-teste: Grau de interesse percebido

Neste pré-teste a sua tarefa é a de ouvir um conjunto de 30 frases curtas.

Cada uma destas frases, pode ser verdadeira ou falsa, e refere-se ao que podemos designar de "uma curiosidade" relativa a um conjunto de temas diversos. Gostaríamos de saber se, em sua opinião, se trata de uma frase cujo conteúdo é muito interessante, apenas interessante, pouco interessante ou mesmo nada interessante.

Para o efeito pedimos-lhe que assinale a sua resposta numa escala de 7 pontos que vai desde *Nada interessante* a *Muitíssimo interessante*.

Numa gravação você irá ouvir frases do tipo "A maior cidade a sul do equador é Buenos Aires na Argentina" ou então "Um cubo de gelo não aumenta o nível da àgua de um copo à medida que derrete"

Assim, se considerar que, saber qual é a maior cidade a sul do equador é muitíssimo interessante deverá fazer um circulo em torno do número 7. Caso considere que lhe interessa apenas moderadamente o conhecimento relativo ao gelo, deverá assinalar o meio da escala, isto é o número 4. Quanto mais desinteressante achar o tema menor o número quer deverá atribuir à frase, e inversamente, quanto mais interessante maior deverá ser o número assinalado.

1-------2--------3--------4--------5---------6--------7

Nada interessante Muitíssimo interessante

A folha que se segue a estas instruções, apresenta um conjunto de escalas onde deverá **assinalar com um circulo** o número que melhor representa a sua opinião relativamente ao grau de interesse que lhe suscita este tipo de curiosidade.

As frases vão-lhe ser apresentadas oralmente, por uma gravação.

Cada frase será lida com o ritmo de uma frase por cada 10 segundos, pelo que o seu julgamento terá de ser **relativamente rápido**, não havendo muito tempo para pensar na melhor resposta. Assim:

- Oiça cada frase e logo que possível assinale um número. Caso a frase seguinte surja antes de você conseguir assinalar a sua resposta, marque rapidamente o número 4 de forma a conseguir realizar a tarefa para a frase que está naquele momento a ser proferida. Não interrompa sob qualquer pretexto a audição da gravação.

- De inicio, haverá uma certa dificuldade em adequar o seu ritmo de resposta ao ritmo com que as frases são proferidas, no entanto tal adequação é usualmente alcançada na 3º ou 4º frase. Assim as primeiras 4 frases da gravação são consideradas de Ensaio.

- O ritmo de apresentação das frases não será interrompido surgindo as frases do verdadeiro pre-teste em sequência as do ensaio. Pelo que é melhor pensar que existe apenas uma lista que será lida toda ao mesmo ritmo. Fique, no entanto descansado com algum descontrolo que poderá sentir nas primeiras frases. E já sabe, se tiver algum problema com alguma das outras frases marque o número 4 e centre de imediato toda a sua atenção na frase que está a ser proferida naquele momento.

Vire a folha e prepare-se para ouvir atentamente a gravação de 30 frases.

Truth ratings phase

Pré-teste: Grau de validade percebido

Uma das manipulações que pretendemos fazer no estudo que tem por suporte este pré-teste diz respeito à veracidade ou falsidade das frases que apresentamos aos sujeitos.

Acontece que a totalidade de conhecimentos que temos relativamente à realidade em que vivemos atinge proporções tais, que nunca a conseguiríamos inventariar. Mesmo quando, aparentemente desconheçamos pormenores dessa realidade, o conjunto de conhecimentos que possuímos permitem-nos acreditar ou duvidar de afirmações feitas sobre esta.

Assim, se nos disserem que o primeiro ministro da defesa chinês se chamava João Vasques, tendemos a considerar esta afirmação como falsa, mesmo desconhecendo na totalidade o nome que ocupou tal cargo. Se nos disserem que a primeira língua europeia com que os povos do sul de África contactaram foi o português tendemos a atribuir-lhe elevada credibilidade.

Necessitamos de saber como são percebidas as frases que seleccionamos para o nosso estudo relativamente à sua veracidade ou falsidade. Assim apresentar-lhe-emos de seguida por escrito, neste caderno de folhas, um conjunto de **afirmações metade verdadeiras e metade falsas**. Leia cada frase com atenção e diga-nos com que confiança considera que essa afirmação é verdadeira ou falsa. Faça um circulo em torno do número que melhor representa a sua resposta, tendo em conta a seguinte escala:

1.....**2**.....**3**.....**4**.....**5**.....**6**.....**7**

De certeza Falso	Provavelmente e Falso	Possivelmente e Falso	Incerto	Possivelmente Verdadeiro	Provavelmente Verdadeiro	De certeza Verdadeiro

É importante que realize esta tarefa pela ordem com que as frases lhe são apresentadas e a um ritmo mais ou menos idêntico ao utilizado na tarefa anterior. Isto é, não pare para pensar muito sobre o assunto, dê-nos a sua opinião espontânea.

Vire a folha para dar inicio à tarefa.

Appendix E: Instructions of the Experiments in Empirical Article 3

Exposure phase (interest ratings; Experiments 1 and 2)

Instruções

Na Psicologia experimental é frequentemente necessário conceber situações mais ou menos artificiais que nos permitam garantir a presença de uma ou outr concretização das variáveis em estudo. Para tal, a própria definição da situação, bem como o material que a compõe, necessita de ser cuidadosamente testado antes de ser incorporado num estudo. A este conjunto de estudos preliminares que nos garantem a validade das manipulações realizadas, designamos de pré-testes.

Assim, pedimos-lhe a sua colaboração para a realização de alguns pré-testes durante esta sessão.

(Pressione a barra de espaços para continuar)

Pré-teste 1

No primeiro pré-teste pedimos que avalie o interesse de um conjunto de frases numa escala de 7 pontos...

Nada Interessante	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Muitíssimo Interessante**

Por exemplo.... "A maior cidade a sul do equador é Buenos Aires na Argentina".

Quanto mais desinteressante achar o conteúdo da frase menor o número que deverá atribuir à frase, e inversamente, quanto mais interessante maior o número que deverá atribuir.

(Pressione a Barra de Espaços para continuar)

Pré-teste 1

As frases vão-lhe ser apresentadas pelos auscultadores. Cada frase será lida com o ritmo de uma frase por cada 10 segundos, pelo que o seu julgamento terá de ser relativamente rápido, não havendo muito tempo para pensar na melhor resposta. Assim:

- Oiça cada frase e logo que possível pressione o número a qual corresponde a sua opinião.
- Não interrompa sob qualquer pretexto a audição da gravação.
- De inicio, haverá uma certa dificuldade em adequar o seu ritmo de resposta ao ritmo com que as frases são proferidas, no entanto tal adequação é usualmente alcançada na 3º ou 4º frase. Logo as primeiras 4 frases da gravação são consideradas de Ensaio.

(Pressione a Barra de Espaços para continuar)

Pré-teste 1

Lembre-se que o ritmo de apresentação das frases não será interrompido surgindo as frases do verdadeiro pré-teste em sequência às do ensaio.

Pelo que é melhor pensar que existe apenas uma lista que será lida toda ao mesmo ritmo. Fique, no entanto descansado com algum descontrolo que poderá sentir nas primeiras frases.

Pressione a Barra de Espaços para iniciar o pré-teste...

Truth ratings phase (Experiments 1 and 2)

Pré-teste 2

Uma das manipulações que pretendemos fazer no estudo que tem por suporte este pré-teste diz respeito à veracidade ou falsidade das frases que apresentamos aos participantes.

Acontece que a totalidade de conhecimentos que temos relativamente à realidade em que vivemos atinge proporções tais que nunca a conseguiríamos inventariar. Mesmo quando aparentemente desconhecemos pormenores dessa realidade, o conjunto de conhecimentos que possuímos permitem-nos acreditar ou duvidar de afirmações feitas sobre ela.

Pressione a barra de espaços para continuar.

Pré-teste 2

Assim, se nos disserem que o primeiro ministro da defesa chinês se chamava João Vasques, tendemos a considerar esta afirmação falsa, mesmo desconhecendo na totalidade o nome que ocupou tal cargo.

Por outro lado, se nos disserem que a primeira língua europeia com que os povos do sul de África contactaram foi o Português, tendemos a atribuir elevada credibilidade a essa afirmação.

Pressione a barra de espaços para continuar.

Pré-teste 2

Precisamos de saber como são percebidas as frases que seleccionámos para o nosso estudo relativamente à sua veracidade ou falsidade.

Assim, nos próximos ecrans vamos apresentar-lhe um conjunto de 60 frases, metade verdadeiras e metade falsas.

Leia cada frase com atenção e diga-nos com que confiança considera que essa afirmação é verdadeira ou falsa. Para tal, pressione o número que melhor representa a sua opinião, tendo em conta a seguinte escala:

1	2	3	4	5	6	7
De Certeza Falso			**Incerto**			**De Certeza Verdadeiro**

Pressione a barra de espaços para continuar.

Pré-teste 2

Não se esqueça, **quanto mais verdadeira** considerar uma frase, **maior o número** a atribuir, e inversamente, **quanto menos verdadeira (ou mais falsa)** a considerar **menor o número** a atribuir.

1	2	3	4	5	6	7
De Certeza Falso			**Incerto**			**De Certeza Verdadeiro**

É importante que realize esta tarefa com um ritmo mais ou menos rápido. Isto é, não pare para pensar muito sobre o assunto, dê-nos a sua opinião espontânea.

Pressione a barra de espaços para começar o pré-teste.

Recognition test (Experiment 2)

Same-session condition

Reconhecimento

Para terminar, vamos apresentar-lhe o mesmo conjunto de frases (podem aparecer por outra ordem), e agora aquilo que lhe pedimos é que indique quais dessas frases foram apresentadas no pré-teste de interesse (pré-teste 1) que fez antes da avaliação de verdade.

Ou seja, para cada frase que lhe apresentarmos agora deverá decidir se a reconhece como fazendo parte do grupo de afirmações para as quais realizou a avaliação de interesse no primeiro pré-teste desta sessão.

Pressione a barra de espaços para continuar.

Reconhecimento

Para responder deverá utilizar as teclas "S" e "L":

S – Sim, a frase apareceu na avaliação de interesse
L – Não, a frase não apareceu na avaliação de interesse

Assim, apenas deverá responder Sim (S) se considerar que a frase foi apresentada no pré-teste 1 (avaliação de de interesse). A todas as frases que não reconhecer como pertencendo a esse pré-teste, deve responder Não (L).

Pressione a barra de espaços para começar o reconhecimento.

1-week delay condition

Reconhecimento

Para terminar, vamos apresentar-lhe o mesmo conjunto de frases (podem aparecer por outra ordem), e agora aquilo que lhe pedimos é que indique quais dessas frases foram apresentadas no pré-teste de interesse que fez na semana passada, logo no início da sessão experimental.

Ou seja, para cada frase que lhe apresentarmos agora deverá decidir se a reconhece como fazendo parte do grupo de afirmações para as quais realizou a avaliação de interesse há uma semana atrás.

Pressione a barra de espaços para continuar.

Reconhecimento

Para responder deverá utilizar as teclas "S" e "L":

S – Sim, a frase apareceu na avaliação de interesse
L – Não, a frase não apareceu na avaliação de interesse

Assim, apenas deverá responder Sim (S) se considerar que a frase foi apresentada no pré-teste de interesse da semana passada. A todas as frases que não reconhecer como pertencendo a esse pré-teste, deve responder Não (L).

Pressione a barra de espaços para começar o reconhecimento.

Appendix F: Statistics of the Experiments in Empirical Article 1

Experiment 1

Learning phase.

Effects of learning condition (classic vs. reversed) and fluency source (repetition vs. color contrast)

Table 1
Anova (2 x 2), discrimination ability (d') as dependent measure

	SS	df	MS	F	p	η_p^2
Corrected Model	9,630[a]	3	3,210	10,723	,000	,263
Intercept	800,678	1	800,678	2674,712	,000	,967
Learning	6,231	1	6,231	20,815	,000	,188
Fluency	3,194	1	3,194	10,669	,002	,106
Learnin * Fluency	1,197	1	1,197	4,000	,049	,043
Error	26,942	90	,299			
Total	901,587	94				
Corrected Total	36,572	93				

a. R Squared = ,263 (Adjusted R Squared = ,239)

Table 2
Anova (2 x 2), criterion (C) as dependent measure

	SS	df	MS	F	p	η_p^2
Corrected Model	,568[a]	3	,189	4,249	,007	,124
Intercept	,314	1	,314	7,041	,009	,073
Learning	,151	1	,151	3,395	,069	,036
Fluency	,188	1	,188	4,209	,043	,045
Learning * Fluency	,317	1	,317	7,108	,009	,073
Error	4,013	90	,045			
Total	4,803	94				
Corrected Total	4,582	93				

a. R Squared = ,124 (Adjusted R Squared = ,095)

Effects of learning condition (classic vs. reversed), fluency source (repetition vs. color contrast), and fluency level (high vs. low)

Table 3
Mixed Anova (2 x 2 x 2), fluency level as repeated measure. Response times (RTs) as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	13899874,966	1	13899874,966	15,075	,000	,143
Fluency	6064348,027	1	6064348,027	6,577	,012	,068
Learning * Fluency	297954,576	1	297954,576	,323	,571	,004
Error	82983334,700	90	922037,052			
F.Level	2689061,637	1	2689061,637	57,882	,000	,391
F.Level * Learning	829914,291	1	829914,291	17,864	,000	,166
F.Level * Fluency	1872893,544	1	1872893,544	40,314	,000	,309
F.Level * Learning * Fluency	127190,957	1	127190,957	2,738	,101	,030
Error (F.Level)	4181157,388	90	46457,304			

Experiment 2

Learning phase.

Effect of learning condition (classic vs. reversed)

Table 4
T-tests, difference between means, d' and C as dependent measures (analysed separately)

					CI 95%	
	Mean Difference	*t*	*df*	*p*	*LL*	*UL*
d'	-,262122	-1,371	45	,177	-,647204	,122960
C	,032380	,416	45	,679	-,124301	,189061

CI= Confidence interval (95%); LL= lower limit; UL= upper limit

Effects of learning condition (classic vs. reversed), and fluency level (high vs. low)

Table 5
Mixed Anova (2 x 2), fluency level as repeated measure. RTs as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	881079,129	1	881079,129	1,283	,263	,028
Error	30906510,915	45	686811,354			
F.Level	134356,355	1	134356,355	1,215	,276	,026
F.Level * Learning	1994421,892	1	1994421,892	18,033	,000	,286
Error (F.Level)	4976838,498	45	110596,411			

Test Phase

Effects of learning condition (classic vs. reversed), Repetition (old vs. new), and color contrast (high vs. low)

Table 6
Mixed Anova (2 x 2 x 2), fluency level as repeated measure. C as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	4,453	1	4,453	7,590	,008	,144
Error	26,399	45	,587			
Repetition	6,572	1	6,572	37,782	,000	,456
Repetition * Learning	,975	1	,975	5,607	,022	,111
Error (Repetition)	7,827	45	,174			
C.Contrast	,002	1	,002	,010	,921	,000
C.Contrast * Learning	1,692	1	1,692	10,159	,003	,184
Error (C.Contrast)	7,495	45	,167			
Repetition * C.Contrast	,005	1	,005	,046	,831	,001
Repetition * C.Contrast * Learning	,058	1	,058	,535	,468	,012

Table 7
Mixed Anova (2 x 2 x 2), fluency level as repeated measure. d' as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	,009	1	,009	,027	,869	,001
Error	14,794	45	,329			
Repetition	,148	1	,148	,560	,458	,012
Repetition * Learning	,210	1	,210	,792	,378	,017
Error (Repetition)	11,909	45	,265			
C.Contrast	,080	1	,080	,312	,579	,007
C.Contrast * Learning	,093	1	,093	,364	,549	,008
Error (C.Contrast)	11,497	45	,255			
Repetition * C.Contrast	1,141	1	1,141	3,514	,067	,072
Repetition * C.Contrast * Learning	,552	1	,552	1,700	,199	,036

Table 8
Mixed Anova (2 x 2 x 2), fluency level as repeated measure. RTs as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	1052326,429	1	1052326,429	,270	,606	,006
Error	175067265,242	45	3890383,672			

Repetition	22554638,504	1	22554638,504	87,075	,000	,659
Repetition * Learning	49,823	1	49,823	,000	,989	,000
Error (Repetition)	11656132,424	45	259025,165			
C.Contrast	3706786,769	1	3706786,769	15,451	,000	,256
C.Contrast * Learning	108884,531	1	108884,531	,454	,504	,010
Error (C.Contrast)	10795925,482	45	239909,455			
Repetition * C.Contrast	161338,025	1	161338,025	,838	,365	,018
Repetition * C.Contrast * Learning	251806,848	1	251806,848	1,307	,259	,028

Recognition test

Effects of learning condition (classic vs. reversed) and type of item (old vs. "new" from the test phase vs. new)

Table 9
Mixed Anova (2 x 3), type of item as repeated measures. Proportion of "old" responses as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	,001	1	,001	,013	,909	,000
Error	3,584	45	,080			
Type.Item	12,539	2	6,269	97,687	,000	,685
Type.Item * Learning	,186	2	,093	1,450	,240	,031
Error (Type.Item)	5,776	90	,064			

Conditional analysis

Effects of learning condition (classic vs. reversed) and perceived recognition status ("old" vs. "new")

Table 10
Mixed Anova (2 x 2), perceived recognition status as repeated measures. Proportion of "True" responses as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	,081	1	,081	1,760	,191	,038
Error	2,083	45	,046			
Type.Item	,834	1	,834	16,943	,000	,274
Type.Item * Learning	,080	1	,080	1,625	,209	,035
Error (Type.Item)	2,214	45	,049			

Appendix G: Statistics of the Experiment in Empirical Article 2

Effects of type of old statement (original vs. contradictory), judgment session (same-session vs. 1-week delay), and repetition (old vs. new)

Table 1
Mixed Anova (2 x 2 x 2), repetition as repeated measure. truth ratings as dependent measures

	SS	Df	MS	F	p	η_p^2
T.Old	5,833	1	5,833	14,717	,000	,214
Session	1,592	1	1,592	4,018	,050	,069
T.Old * Session	11,652	1	11,652	29,401	,000	,353
Error	21,401	54	,396			
Repetition	,093	1	,093	,272	,604	,005
Repetition * T.Old	3,148	1	3,148	9,196	,004	,146
Repetition * Session	1,811	1	1,811	5,291	,025	,089
Repetition * T.Old * Session	4,576	1	4,576	13,366	,001	,198
Error (Repetition)	18,486	54	,342			

Table 9
Mixed Anova (2 x 3), type of item as repeated measures. Proportion of "old" responses as dependent measures

	SS	Df	MS	F	p	η_p^2
Learning	,001	1	,001	,013	,909	,000
Error	3,584	45	,080			
Type.Item	12,539	2	6,269	97,687	,000	,685
Type.Item * Learning	,186	2	,093	1,450	,240	,031
Error (Type.Item)	5,776	90	,064			

Appendix H: Statistics of the Experiments in Empirical Article 3

Experiment 1

Effects of type of old statement (original vs. paraphrase), judgment session (same-session vs. 1-week delay), and repetition (old vs. new)

Table 1
Mixed Anova (2 x 2 x 2), repetition as repeated measure. Truth ratings as dependent measures

	SS	Df	MS	F	p	η_p^2
T.Old	,087	1	,087	,158	,692	,002
Session	1,271	1	1,271	2,317	,131	,022
T.Old * Session	1,427	1	1,427	2,601	,110	,025
Error	55,421	101	,549			
Repetition	31,542	1	31,542	105,535	,000	,511
Repetition * T.Old	,053	1	,053	,176	,675	,002
Repetition * Session	4,126	1	4,126	13,806	,000	,120
Repetition * T.Old * Session	,167	1	,167	,560	,456	,006
Error (Repetition)	30,187	101	,299			

Experiment 2

Effects of type of statement (original vs. paraphrase vs. contradictory vs. contradictory paraphrase vs. new), and judgment session (same-session vs. 1-week delay)

Table 2
Mixed Anova (5 x 2), type of statement as repeated measures. Truth ratings as dependent measures

	SS	Df	MS	F	p	η_p^2
Session	,084	1	,084	,107	,745	,003
Error	30,531	39	,783			
Type.Statement	43,649	4	10,912	31,483	,000	,447
Type.Statement * Session	12,939	4	3,235	9,332	,000	,193
Error (Type.Item)	54,070	156	,347			

Recognition test

Effects of type of statement (paraphrase vs. contradictory vs. contradictory paraphrase vs. new), and judgment session (same-session vs. 1-week delay)

Table 3
Mixed Anova (4 x 2), type of statement as repeated measures. d' (discrimination of old-new statements) as dependent measures

	SS	Df	MS	F	p	η_p^2
Session	13,636	1	13,636	15,127	,000	,279
Error	35,154	39	,901			
Type.Statement	78,918	3	26,306	76,163	,000	,661
Type.Statement * Session	6,908	3	2,303	6,667	,000	,146
Error (Type.Item)	40,411	117	,345			

Conditional analysis

Perceived "old" statements: Effects of type of statement (original vs. paraphrase vs. contradictory vs. contradictory paraphrase), and judgment session (same-session vs. 1-week delay)

Table 3
Mixed Anova (4 x 2), type of statement as repeated measures. Truth ratings as dependent measures

	SS	Df	MS	F	p	η_p^2
Session	,082	1	,082	,063	,804	,002
Error	49,950	38	1,314			
Type.Statement	18,105	3	6,035	7,209	,000	,159
Type.Statement * Session	3,037	3	1,012	1,209	,310	,031
Error (Type.Item)	95,429	114	,837			