RECOGNITION MEMORY OF VISUAL OBJECTS: THE EFFECT OF HUMOR AND RELATEDNESS OF ASSOCIATED TEXTS

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RECOGNITION MEMORY OF VISUAL OBJECTS: THE EFFECT OF HUMOR AND RELATEDNESS OF ASSOCIATED TEXTS

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ABSTRACT

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This study investigates the effect of text type (humorous, positive, neutral) and relatedness (related, unrelated) and their possible interaction on memory of visual objects (chocolate bars) associated with those texts, using recognition memory and on-line eye-tracking methodologies. After studying object-text pairs during which their eye-gaze was monitored, participants performed an immediate and a delayed (2 weeks later) recognition memory task for the visual objects. Recognition memory results (hits, *d'*) replicated the previously found "humor effect" in the literature, i.e., objects associated with humorous texts were recognized less as compared to positive and neutral texts. Relatedness had no effect. Furthermore, there was no interaction. Eye-tracking results confirmed the effect of text type in parallel with the recognition memory results, thus supporting the attention hypothesis which states that objects attended longer in the study phase are recognized better in the test phase. Contrary to recognition, eye-tracking results revealed an interaction between humor and relatedness, as hypothesized: while objects related with humorous texts were looked at longer and caused more switches between text and object, those unrelated with humorous texts were looked at shorter and caused fewer switches, a pattern that was not observed for the other text types (positive, neutral). This finding suggests that while attentional differences exist for objects associated with related *vs*. unrelated humorous texts, they were not reflected in recognition memory performance, possibly because the semantic relation was not explicit enough. The study also shows how behavioral performance measures (recognition memory) can be complemented by on-line measures (eye-tracking).

Keywords: Humor Effect, Recognition Memory, Relatedness, Eye-tracking

ÖZ

GÖRSEL NESNELERİN TANIMA BELLEĞİ: BAĞLANTILI METİNLERDE MİZAH VE İLİNTİLİLİĞİN ETKİSİ

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Bu çalışma, metin türünün (mizahi, olumlu ve nötr) ve ilintililiğin (ilintili, ilintisiz) bu metinlerle bağlantılı olan görsel nesnelerin (çikolatalar) hafızası üzerindeki etkilerini ve olası etkileşimlerini tanıma belleği ve çevrim-içi göz-izleme yöntemleri kullanarak araştırmaktadır. Katılımcılar nesne ve metin çiftlerini incelerken göz hareketleri kaydedildikten sonra görsel nesneler için anlık ve gecikmeli (2 hafta sonra) tanıma belleği testlerine katıldılar. Tanıma belleği sonuçları (isabetli kararlar, *d'*) daha önceden literatürde var olan "mizah etkisi"ni tekrarladı, başka bir deyişle mizahi metinlerle bağlantılı nesneler olumlu ve nötr metinlerle bağlantılı nesnelere göre daha az tanındı. İlintililiğin bir etkisi yoktu. Ayrıca, etkileşim de yoktu. Göz-izleme sonuçları, tanıma belleği sonuçları ile aynı doğrultuda metin türünün etkisini doğruladı, yani çalışma evresinde daha uzun süre bakılan nesnelerin test evresinde daha iyi tanındığını belirten dikkat hipotezini destekledi. Tanımanın aksine, göz-izleme sonuçları varsayıldığı üzere mizah ve ilintililik arasında bir etkileşim olduğunu gösterdi: mizahi metinlerle ilintili olan nesnelere daha uzun süre bakılırken ve bu nesneler metin ve nesne arasında daha fazla geçişe sebep olurken, mizahi metinlerle ilintili olmayan nesnelere daha kısa süre bakıldı ve bu nesneler metin ve nesne arasında daha az geçişe sebep oldu. Bu yapı diğer metin türleri (olumlu, nötr) için gözlemlenmedi. Bu bulgu, ilintili ve ilintisiz mizahi metinlerle bağlantılı nesnelerde dikkat farklılıklarının mevcut olduğunu ancak muhtemelen anlamsal ilişkinin yeterince belirgin olmamasından dolayı bu farklılıkların tanıma belleğine yansımadıklarını önermektedir. Bu çalışma ayrıca davranışsal performans ölçümlerinin (tanıma belleği) çevrim-içi ölçümlerle (göz-izleme) nasıl tamamlanabildiğini de göstermektedir.

Anahtar kelimeler: Mizah Etkisi, Tanıma Belleği, İlintililik, Göz-izleme

To my family and Mehmet…

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CHAPTER 1

INTRODUCTION

1.1 Why Study Humor from a Cognitive Science Perspective?

Humor is ubiquitous in our everyday life. During a typical day, we perceive and produce humor on many occasions. Humor that we perceive or produce can be in various forms, such as jokes, cartoons, witticism, unexpected practical jokes, unintentionally funny utterances and so on. Sometimes we intentionally produce humor, such as telling a joke to friends, and other times we unintentionally produce it as in the example of an unintentional funny utterance in a crowd. As a response to humor we generally laugh, chuckle or smile. However, what we laugh about and how we perceive humor depends on factors such as age, gender, culture, personality, social context and so on. Human beings from various cultures, socio-economic backgrounds, and geographies can comprehend and process humor as a cognitive experience via action, speech or writing, which excites amusement, comicality, fun, or oddity (Martin, 2007). Although humor is one of the main sources of amusement and comicality and most of the time used in a friendly and playful way in our daily routine it can be used for a variety of other purposes as well. For example, it can be a didactic way of giving advice to others, a type of strategy for dealing with stressful conditions or illnesses, a cause of relaxation, a way of communicating with strangers, an indicator of sarcastic thought and so on. To some extent, anyone in any society is familiar with these usages and forms of humor. As this familiarity suggests humor and laughter are universal for human beings.

In addition to its frequent use and universality, humor comprehension is one of the first cognitive abilities that infants acquire. In their first year of life, human infants acquire the ability to respond to humorous actions (Sroufe and Wunsch, 1972) and before the age of two, they can produce humor by way of copying others (Hoicka and Gattis, 2008). Humor is one of the safest and funniest ways in which young children can exercise and realize their own abilities (Martin, 2007).

Although humor is a frequent and universal behavior, which is one of the first cognitive abilities that an infant acquires and has a number of aspects that need to be studied scientifically and brought to light, from ancient times to the 20th century

humor has attracted little attention in science and philosophy. Especially the facts that it has a non-serious structure, is seen unnecessary as a topic of academic study and does not have clear boundaries due to the lack of even a complete definition can be listed as the reasons of this disinterest (Martin, 2007). However, humor is a topic broad enough to be included in studies in various disciplines besides psychology, such as computer science, biology, neuroscience, linguistics, philosophy, anthropology, and literature. For instance, the regions in the brain that take part in humor comprehension or the humor processes of patients who suffer from injuries in various parts of the brain could be a topic of neuroscience. The mechanisms by which humor has evolved, its relations with verbal and non-verbal communication during evolution, and playful activities and laughter seen in other species such as primates are topics of biology. Moreover, as it is observed more often in a social context when people are together with others than they are alone and the interaction between humor and culture, can be studied in social sciences. Due to which structures or what kind of context written texts are perceived as humorous is a research question for linguistic studies. In addition, a robot that can comprehend and produce language-based humor could be a scientific challenge for AI, thus computer science.

At this point one can question the relation between cognitive science and humor. Is humor a suitable topic for cognitive science? Why is it worth to study humor in a cognitive science perspective?

Cognitive science actually develops with its own particular methodology and as an integrated science of many scientific branches (Bermúdez, 2014) which can include humor in their study areas such as psychology, linguistics, philosophy, computer science, anthropology and neuroscience. In addition, humor is a term relating to various cognitive processes such as memory, language skills, theory of mind, symbolism, abstract thinking, problem solving, perception of incongruity, and social perception, among others, which are the main areas of research in cognitive science. Thus, studying humor will enrich our knowledge of cognition, and studying the effect of humor on cognitive processes such as memory, perception, problem solving and creativity will enable the addition of new information in the literature and will bring cognitive science one step further in an attempt to investigate cognition and the mind. This fact makes humor a suitable and beneficial topic to study from a cognitive science perspective.

1.2 Statement of the Problem

One of the interesting and enlightening research areas for cognitive science especially for cognitive psychology could be the relation between humor and memory. There are many questions that we can ask from a cognitive science perspective about memory and humor such as: are humorous items recalled better compared to non-humorous items? Additionally, does humor aid memory? If so, what are the underlying mechanisms of the effect of humor on memory? These questions are asked for three decades by especially those who study memory, educational science, and advertising and several controversial results are reported on the effects of humor on memory with different methodological setups. While some

researchers reported an enhancing effect of humor on memory (Schmidt, 1994, 2002; Schmidt and Williams, 2001; Kaplan and Pascoe, 1977; Ziv, 1988; Summerfelt, Lippman, and Hyman, 2010), others reported either no effect (Berg and Lippman, 2001; Özdoğru and McMorris, 2013) or negative effects (Gelb and Zinkhan, 1986; Fisher, 1997). In one decisive study, Schmidt (1994) performed a series of experiments with carefully controlled data, and pilot studies about the effects of humor on memory. In his experiments, Schmidt showed the importance of experimental design on the results of the effects of humor on memory. He found that humorous material is recalled better in within-list experiments but not in between-list experiments for both free and cued recall. In other words, when participants saw both humorous and non-humorous sentences in a mixed list they remembered humorous sentences better at the expense of the non-humorous ones. Contrarily, in between-list designs, that is, if a participant either sees humorous or non-humorous sentences, there was no significant difference between the recall rates of lists of humorous sentences and recall rates of lists of non-humorous sentences (Schmidt, 1994). This phenomenon is called "humor effect" (Schmidt, 1991, 1994, and 2012). Why is humorous material better recalled only when participants see both humorous and non-humorous material in the same list? In addition, why does humorous material have no enhancing effect on memory in a list that only contains humorous material? In the literature, there are various answers to these questions trying to explain the underlying mechanisms of the humor effect (for a review of these explanations, see literature review chapter, Schmidt, 1994, 2012; Summerfelt, Lippman and Hyman, 2010). One of the salient explanations for the humor effect is the incongruity hypothesis (Schmidt, 2012). The incongruity hypothesis suggests a combination of item distinctiveness and relational distinctiveness in order to explain the humor effect. According to the item distinctiveness part of the hypothesis, because of the incongruity that the humorous material generally comprises, increased attention is needed in order to experience and resolve the incongruity. While this part states why humorous material attracts more attention compared to non-humorous material, it does not still explain why the humor effect occurs only in within-list designs. The second part of the hypothesis, which concerns relational distinctiveness, tries to explain the humor effect that is seen in within-lists. According to relational distinctiveness, being exposed to both humorous and non-humorous material in the same list may encourage participants to pay more attention on humorous items. Additionally, this condition creates diverseness in the list and makes humorous ones more salient and memorable. Contrarily, for between-list experiments, participants see either humorous items or non-humorous items as a whole, hence, this condition yields no humor effect (Schmidt, 2012).

Most experimental studies on humor and memory employ behavioral paradigms such as recognition of humorous vs. non-humorous stimuli or of other stimuli in the context of humorous and non-humorous stimuli. Few studies have been carried out using on-line methodology trying to reveal the perceptual basis of humor processing. In addition, one of the best experimental tools to test the incongruity hypothesis on enhanced attention on humor may be using eye-tracking technologies. This is mainly because eye-tracking technologies assume that longer looking times indicate more attention paid on the items. To the best of our knowledge, only one study was carried

out on the humor effect by using eye-tracking methodologies (Strick, 2010). According to Strick et al. (2010), humorous texts attract more attention compared to other stimuli and participants spend more time looking at humorous texts – at the expense of other stimuli in the context of the humorous texts.

1.3 Aim of the Study

In previous studies, notably Strick et al. (2010), only the bare association of visual objects with texts has been studied; however, the relatedness of texts with visual objects has not been included. The humor effect, however, may be modulated by the kind of relation the text has with its associated visual object. It could be that the "humor effect" is only observed if the humorous text is unrelated to the picture in its context, however, is absent when some relation exists between the product and the humorous text it describes. The factor "relatedness" is therefore included in our experimental design in order to investigate the possible effects of relatedness on the humor effect. In addition, it is unclear whether the humor effect persists over longer periods of time, i.e., how visual object recognition is affected by short vs. long delays in recognition. Therefore, in the present study, accuracy and response times in immediate and delayed (2 weeks later) recognition memory tasks depending on the kind of text (humorous, positive, neutral) and its relatedness with the visual objects (related, unrelated) were measured. In addition, response times in the recognition part of the experiment were measured. Lastly, on-line attention-related variables were measured by way of eye-tracking in an attempt to account for the humor effect in recognition memory. Total looking times of visual objects (here: chocolate bar brands), total reading times of humorous, positive and neutral texts, and the total number of saccades (switches) between visual object and text for each pair were measured.

Our main research hypotheses are as follows:

1.3.1 Recognition Memory Hypotheses:

i. If the text is humorous, the visual object associated with the humorous text will be recalled less in both immediate and delayed recognition memory tests across all conditions.
ii. If the texts are related with the visual objects, the visual objects near the related texts are recalled more compared to the visual objects near the unrelated texts in both immediate and delayed recognition memory tests.
iii. If text and visual object are related, visual objects in combination with humorous texts will be recalled more compared to visual objects associated with the humorous texts in the unrelated condition.
iv. The number of correct answers (hit scores) in each condition (related, unrelated; neutral, positive, humorous) in immediate recognition memory test will be higher than the number of correct answers (hit scores) in delayed recognition memory test.

1.3.2 Response Times Hypotheses:

v. Response times of visual objects associated with humorous texts will be longer compared to objects associated with positive and neutral texts in both immediate and delayed recognition memory tests.
vi. Response times of visual objects associated with related texts will be shorter compared to visual objects associated with unrelated texts in both immediate and delayed recognition memory tests.
vii. If the text and visual object are related, response times of visual objects associated with humorous texts will be shorter compared to response times of visual objects associated with humorous texts in the unrelated condition in both immediate and delayed recognition memory tests. This difference between related and unrelated texts will not be observed as strongly for positive and neutral texts as it is for humorous texts.

1.3.3 Eye-Tracking Hypotheses:

viii. If the text is humorous, looking time for the text will increase in comparison with the other texts.
ix. If the text is humorous, looking time for the visual object associated with humorous text will decrease in comparison with the objects associated with other texts.
x. If the texts are related with the visual objects, total viewing time of the related texts will be less compared to the unrelated texts.
xi. If the texts are related with the visual objects, total viewing time of the objects in related conditions will be more compared to the unrelated conditions.
xii. If text and visual object are related, total viewing time of humorous text will be less and total viewing time of visual object associated with humorous text will be more compared to viewing time of the unrelated humorous condition.
xiii. The number of saccades (switches) between the text and its associated visual object will be higher in related texts and visual object pairs compared to unrelated texts and visual object pairs.
xiv. There is a positive correlation between the looking times in the behavioral experiment and correct answers in the recognition memory tests for the visual objects.

1.4 Outline of the Thesis

Chapter 2 consists of three main parts which summarizes the literature on theories of humor, the humor effect and recognition memory. Firstly, theories trying to understand and explain the underlying mechanisms of humor, will be summarized. Secondly, the effects of humor on memory, and theoretical explanations and experimental studies of the literature on the humor effect will be reviewed. Lastly, literature on recognition memory methodologies will be briefly summarized in an attempt to clarify the methodology of the thesis. In chapter 3, the details of the method of the present study including both pilot studies and main study will be given. Chapter 4 presents the results of the study with statistical analyses. In chapter

5, the findings of the study will be discussed, main findings of the study will be compared to the existing literature, directions for future research will be suggested, and the conclusion of the study will be presented.

CHAPTER 2

LITERATURE REVIEW

2.1 Theories of Humor

Humor can be explained with the help of different theoretical approaches. Although picking up speed after the 20th century, theories trying to explain the underlying mechanisms of humor have been suggested by many philosophers since antiquity. Although philosophers firstly viewed and interpreted humor as psychological abnormality (Morreall, 2013), today there exist robust theories about the mechanisms of humor, what makes us laugh, and what is perceived as humorous. Some of these theories are the superiority theory, the relief theory, the incongruity theory, the play theory, and the benign-violation theory (see, Martin, 2007; McGraw and Warren, 2010 for a review of theories of humor). Among these theories, the superiority theory, the relief theory, the incongruity theory, the semantic script theory of humor (SSTH) and the general theory of verbal humor (GTVH) are considered in this literature overview. Incongruity and SSTH theories are studied in more detail since they are the most widely accepted contemporary humor theories and they can explain the mechanisms of the humorous texts used in this study.

2.1.1 Superiority Theory

Today humor is known for its positive effect, its use in a friendly way and its feature of diminishing stress. Furthermore, it is acknowledged as a cognitive ability. However, especially in from the ancient times until the 20th century most philosophers have viewed humor and laughter under a negative aspect, as in the superiority theory in which the feeling of superiority and aggression are considered as the fundamental elements of humor (Martin, 2007; Morreall, 2008). This theory is one of the first theories of humor which goes back to Aristotle and Plato (Martin, 2007). According to Plato, humor can express our feelings of pleasure when someone is in misfortune (as cited in Martin, 2007; Carrell, 2008). According to Aristotle, comedy is “the species of the ugly”, the imitation of men worse than the average (as cited in Carrell, 2008; Martin, 2007). Thus, while some philosophers such as Aristotle and Plato suggested aggression as a fundamental part of humor,

others such as Thomas Hobbes claim that the feeling of superiority is a fundamental part of humor. According to Hobbes, laughter is a "sudden glory" and the cause of laughter is the feeling of superiority over other people's experiences, for example, a mishap or over one's own past experiences of such mishaps (as cited in Martin, 2007; Smuts, 2010; Carrell, 2008).

Consequently, be it a friendly joke or the most creative story of a comedian, according to the superiority theory, no form of humor is possible without the feeling of superiority or aggression, disparagement or malice. For many types of humor such as ethnic jokes mostly about minorities, jokes about the shortcomings or inadequacies of people, or slapstick humor this theory seems applicable. However, this theory is criticized for falling short in explaining all forms of humor (Morreall, 2008, 2013; Martin 2007). In one of these critics, Morreall argues that in some scenes of Charlie Chaplin's silent movies, the hero gets into trouble and while making some acrobatic movements, which are almost impossible to perform in real life, he escapes from the trouble and saves his life. Laughing at these scenes does not imply that we compare ourselves with the hero of the movie and feel superior over him (Morreall, 2008).

On the other hand, Charles Gruner who is one of the latest supporters of the superiority theory and the writer of the book "The Game of Humor: A Comprehensive Theory of Why We Laugh", interprets superiority theory in a different way and suggests a metaphor that defines humor as a kind of game and laughter as an indication of winning, thus claiming that the basic mechanism of humor is not aggression but playful aggression (Gruner, 2000). According to Gruner, all types of humor can be explained by the superiority theory. Furthermore, according to Gruner, we need "…to think of all humor as a succession of *games*" (Gruner, 2000, p.2). He also adds that, a game does not only consist of fun and entertainment, but also of losers and winners in a set of competition (Gruner, 2000). Defining laughter in a broader sense as "getting what we want", Gruner suggests that laughter is like a victory following a lengthy effort in sports or in a competition (Gruner, 2000, p.8).

2.1.2 Relief Theory

The superiority theory of humor was the most widely accepted theory until the 17th century (Morreall, 2013). In the 17th century, in his essay "The Freedom of Wit and Humor", Lord Shaftesbury was the first to use humor as in its current meaning as "funniness" in a published article and proposed the relief theory to explain humor (as cited in Morreall, 2008). In a pre-scientific sense, the relief theory of humor suggests that the cause of laughter is a release of "nervous energy" from the body (Martin, 2007; Morreall, 2008; Carrell, 2008). According to Shaftesbury, humor allows relieving repressed nervous energy (as cited in Morreall, 2008). After Shaftesbury, the views about humor of Herbert Spencer in the 19th century and Sigmund Freud in the 20th century have played an important part in moving this theory to a central place among theories of humor (Morreall, 2008). According to Spencer (1860), our feelings assume the form of nervous energy in our nervous system and have to be

released from the body via some muscular movements (as cited in Martin, 2007; Morreall, 2008). Laughter is one of the ways of releasing this accumulated energy. Of course, this "hydraulic" explanation of the nervous system is not in line with the modern neuroscientific explanations of today.

According to Freud, who is another fundamental defender of relief theory, there are three different laughter situations which are: joking or wit, the comic, and humor (Freud, 1905). In all these situations nervous energy is stored and repressed and then discharged by laughter (Freud, 1905). Freud, in his "Jokes and Their Relation to the Unconscious" claims that suppressed impulses of a person appear in dreams and jokes, among others. That is, the more people suppress themselves in terms of sex and aggression, the more they are interested in and laugh at jokes about those topics. Consequently, they release the suppressed nervous energy via laughter (Freud, 1905).

However, the relief theory is criticized since there is no clear definition of the stored energy and no explanation why it is released only via humor and dreams. It is not supported by experimental research and it tries to explain humor just with the suppressed energy of the individual without referring to the position of humor within social context. Lastly, it is criticized that it does not include all types of humor (Morreall, 2008; Martin, 2007).

2.1.3 Incongruity Theory

Incongruity theory is one of the most referenced, accepted and prevailing theories of humor over the last 250 years by philosophers and scientists (Morreall, 2008, 2013; Martin, 2007). In addition, incongruity theory emphasizes the importance of cognitive aspects and processes while trying to explain humor in more detail than other theories (Martin, 2007). The incongruity theory mainly states that the presence of incongruity is what makes things humorous (Suls, 1977; Morreall, 1989, 2008, 2013; Kuipers, 2008; Martin, 2007; Srinivasan and Pariyadath, 2008).

Immanuel Kant was one of the first philosophers who wrote about the incongruity theory in his "Critique of Judgment", in 1790 (as cited in Morreall, 2008). In this study, Kant claims that "there should be something absurd" for genuine laughter (as cited in Morreall, 1989, 2008). Chronologically, philosophers from the 19th and the 20th centuries, namely Arthur Schopenhauer, William Hazlitt, and Soren Kierkegaard developed and supported the incongruity theory (as cited in Morreall, 2008). With their contributions to incongruity theory, the idea that humor cannot be explained with just aggression and superiority as the superiority theory claims was started to be widely accepted. Now, instead of studying which feelings, thoughts and motivations cause humor to emerge, the focus was shifted to the characteristics of humorous stimuli and studying humor with scientific experiments (Morreall, 2008).

One of the outstanding theorists of the incongruity theory from the 20th century, Arthur Koestler, suggested that, mental processes of humor, creativity and scientific discoveries have some common points. In "The act of Creation" (1964), he suggested the term *bisociation* in an attempt to explain the fundamental mechanisms of humor, art and science. According to him, "perceiving of a situation or idea in two self-

consistent but habitually incompatible frames of reference" is the underlying pattern of any creative act, including humor (Koestler, 1964, p. 35). After the perception of an aforementioned situation or idea, this idea or situation is not only associated with incompatible frames of reference but is *bisociated* with both. According to Koestler, while routine thinking can be considered as thinking on one level creative thinking occurs on multiple levels when two incongruous frames intersect – which Koestler calls *bisociation* (Koestler, 1964).

According to theorists who claim that only perception of incongruity is sufficient (e.g. Nerhardt, 1977), just the presence of stimuli which are different than what is normally expected, surprising, absurd or odd is sufficient for humor as in the examples of unexpected practical jokes, unintentional funny utterances, and slapstick comedy. There is no need to resolve incongruity in many kinds of humor (Martin, 2007). However, while the idea that incongruity explains many kinds of humor is a commonly accepted among incongruity theorists, it is also an issue of discussion whether the presence of incongruity alone is sufficient for humor or whether other factors such as incongruity resolution, suddenness, playful environment and such in addition to incongruity play a part in humor as well (Suls, 1977; Shultz, 1976; Rothbart, 2007). The main question can be illustrated by the following question: are all incongruous, abnormal, and odd stimuli humorous? For example, seeing a fight between two best friends could be something unexpected, incongruous, and odd, but not humorous. Thus, according to many theorists, the presence of incongruity alone is not sufficient to produce and perceive humor (Suls, 1977, 1983; Shultz, 1976; Rothbart, 2007).

According to Suls (1972, 1983) and Shultz, (1972) resolution of incongruity is necessary for humor. Shultz suggests the necessity of the resolution of the incongruity for humor (Martin, 2007), claims that in order to perceive intended humor one needs to realize and solve the incongruity in humorous stimuli (Shultz, 1972). According to his incongruity resolution theory of humor, the punch line of the joke serves as an incongruity to the setup part of the joke. During the exposure to the setup part, one has an understanding of the joke setup; however, when the punch line comes one realizes that the initial setup and the punch line do not match and thus are incongruous. After the punch line, one goes back to the setup part and searches for an ambiguous item which may have a different, alternative meaning thus making the punch line of the joke understandable. If one can find the hidden meaning in the ambiguity and can find its relation with the punch line, then one can resolve the incongruity and comprehend the joke. As a result one generally smiles, chuckles, or laughs (Shultz, 1972). According to Shultz, linguistic ambiguities in jokes can be in the form of phonological or syntactic ambiguities, surface structure ambiguity, and deep structure ambiguity (Shultz, 1974). One of the examples in Shultz' 1974 work could be helpful in understanding his incongruity resolution model:

"The stranger asks:

- Can you tell me how long cows should be milked?

And the farmer answers,

- They should be milked the same as short ones, of course.

In this example, the stranger actually asks about the duration that cows should be milked. This is in fact the first, dominant, meaning that we construe while reading the joke. However, the farmer's answer impels us to read the stranger's question once again and understand the incongruity resulting from the ambiguity. For without understanding this incongruity the farmer's answer, thus the joke, is totally meaningless. When we realize that the lexical string can be parsed in two ways, (1) [[how long] [cows]] and (2) [[how] [long cows]], then the humorous answer of the farmer makes sense and the incongruity is resolved. Thus, according to Shultz, the perception and the resolution are the essential parts of humor comprehension and the incongruity resolution in the stimuli is the main reason that makes it humorous (Shultz, 1972, 1974).

The second important model for the incongruity resolution of humor is the two-stage model of Suls (Suls, 1972). According to this model, during reading or listening to a joke setup, we presume how the story will end and constitute a probable ending. However, when we hear or read the punch line, we realize that the initial setup and the punch line are incongruous, that is, our expectations do not conform with the punchline and comprehension of the joke does not occur until we find a cognitive rule between the setup and the punch line. It is when we find the cognitive rule and can resolve the incongruity, that we comprehend the joke and laugh. Suls likens these processes of humor to processes in problem solving (Suls, 1983). Srinivasan and Pariyadath (2008) suggest an algorithm based on Suls's two-stage model as follows:

- As text is read, make predictions
- While no conflict with predictions, keep going
- If input conflicts with predictions:
  - If not ending—PUZZLEMENT
  - If it is the ending, try to resolve:
    - No rule found—PUZZLEMENT
    - Cognitive rule found—HUMOUR

It should be highlighted that both Suls's and Shultz's theories claim that humor appears after the elimination or the resolution of the incongruity, and humor cannot emerge if there is no resolution.

In conclusion, incongruity theory tries to explain what is necessary for a stimulus to be identified as humorous and according to this theory incongruity is a crucial element of humor. However, for many others, the presence of an incongruity or its resolution is not enough by itself (Suls, 1972; Shultz, 1972). For instance, according to Suls (1983), the timing of the punch line and "play" cues are also important in addition to incongruity. For Rothbart (2007), incongruity causes humor only in a safe and nonthreatening context. Additionally, according to Rothbart, incongruity does not only cause humor and laughter but also can cause fear and curiosity. Rothbart also claims that in order for some material to be perceived as humorous one must not view it as a problem to be solved, and emphasizes that in addition to incongruity,

staying in a context of entertainment, fun, or joy is important for humor perception (Rothbart, 2007).

Martin (2007) criticizes the incongruity theory for it being solely interested in the cognitive aspects of humor and excluding emotional and social factors. According to Martin, the "emotional climate or mental set of the perceiver" must be taken into consideration as well (Martin, 2007, p. 70). Incongruity resolution theories were also criticized because they only explain the mechanisms of jokes and cartoons, but do not explain other forms of humor. However, humor does not consist merely of jokes and cartoons.

2.1.4 Schema/Script Based Theories of Humor

In order to understand these theories better, first the concepts of schema/script/frame have to be explained in terms of their correspondence to cognitive psychology.
In cognitive psychology, a schema is a knowledge structure in which information is represented and organized in our minds (Mandler, 1984; Khan and Paivio, 1988). In other words, schemata are knowledge structures that occur in our minds due to the events, things, scenes and objects in our memories and past experience, which help us distinguish between real and imaginary situations, understand situation-appropriate behavior and build mental models of the world surrounding us (Mandler, 1984; Khan and Paivio, 1988).

To illustrate, think of the schema of cars. In this schema, there are variables that are in accordance with the car schema such as car door, hatch, engine, seat, steering wheel, and so on. In addition, all cars that comply with the general car schema are included in this schema. There is a limit of the variables which we include in this schema and the initial schema of cars is violated when we see something incongruous to the information in this schema, such as a car driven on sea.

Scripts, on the other hand, are structures that express the order of events occurring in a known and specific setting (Schank and Abelson, 1975). For example, when someone tells us she is going to a restaurant, a restaurant script is activated in our minds and we assume that the person carries out activities such as going to the restaurant, sitting at a table, asking for the menu and talking to the waiter, eating and paying the bill in a certain order, even if the person did not tell us the whole story (Schank and Abelson, 1975).

Many theorists used the concepts of schemas and scripts in an attempt to explain humor (Raskin, 1985; Attardo and Raskin, 1991; Wyer and Collins, 1992). Attardo and Raskin are one of the first researchers who use scripts in an attempt to explain the incongruities in verbal humor especially in jokes (Raskin, 1985; Attardo and Raskin, 1991). They developed the semantic script theory of humor (SSTH), which is one of the well-developed linguistic theories of humor. They states that by reading the first parts of the humorous stimulus people activate a script in order to understand the setup part of the joke. However, when they read the rest of the joke, something incongruous to the first activated script is presented by the punch line of the joke. In

an attempt to give meaning to the punch line, subjects need to go back and search for an alternative script. Thus, a new meaningful second script is needed in order to give meaning to the punch line of the joke. According to their theory, the first and the second script in a joke should be overlapping scripts and the meaning of the second one should be opposite of the first (Raskin, 1985; Attardo and Raskin, 1991; Attardo, 1994, 2001, 2008). Raskin states the most common oppositions in jokes: good/bad, life/death, obscene/non obscene, money/no money, high stature/low stature (Raskin, 1985).

To illustrate what the theory suggests, a typical example of Raskin's (1985) may be helpful:

"Is the doctor at home?" the patient asked in his bronchial whisper. "No," the doctor's young and pretty wife whispered in reply. "Come right in."

In this joke, there are two scripts which are the "doctor script" and the "lover script". In the beginning of the joke, the reader activates the doctor script in his mind. However, when the punch line of the joke is read, a second overlapping schema activates, which is the lover script. The scripts are meaningful in their own right, however, they are opposite to each other on the no sex/sex basis (Raskin, 1985; Attardo, 2001; Martin, 2007; Ruch, 2008).

Attardo and Raskin later revisited and expanded their SSTH to the General Theory of Verbal Humor (GTVH). According to Attardo, while SSTH is a semantic theory, GTVH is a linguistic theory which includes other areas of linguistics such as pragmatics and discourse analysis (Attardo and Raskin, 1991; Attardo, 2001, 2008). They also suggest five more Knowledge Resources (KR) in addition to the script oppositions (SO) in SSTH. They suggested that the six KR's are involved in cognitive representations of verbal humor which are Script Oppositions (SO), Logical Mechanisms (LM), Target (TA), Narrative Strategy (NS), Language (LA), and Situation (SI). SO refers to script oppositions of SSTH, while LM refers to the mechanism used to activate the second script in the joke. According to Attardo, LM corresponds to the resolution part of the incongruity-resolution theories. SI refers to the textual materials in the joke, which are not funny on their own such as objects, activities, places. TA refers to the victim of the joke. NS refers to the "genre" or the format of the joke and LA refers to the actual wording of the joke, i.e. the lexical, syntactic, phonological choices of the writer (Attardo and Raskin, 1991; Attardo, 2001, 2008). In "The semantic foundations of cognitive theories of humor", Attardo discusses the similarities and differences between GTVH and the incongruity-resolution models (1997). According to him, the incongruity phase in the incongruity-resolution models corresponds to the SO component of GTVH and the resolution phase corresponds to the LM component. Furthermore, he suggests a three-stage model (setup, incongruity, resolution) of joke comprehension instead of the two-stage model (incongruity, resolution) (Attardo, 1997). According to the three-stage model, there is no need for incongruity elimination opposed to what incongruity-resolution theories suggest; instead, it is the activation of the two scripts simultaneously that yields humor.

In light of the reviewed theories of humor, we need to highlight that humorous texts in this study generally conform to the SSTH, thus, in every one of those texts there are two incongruous scripts. However, as discussed in Chapter 5 the levels of script oppositions vary between texts (See also Appendices for texts).

2.2 Humor and Memory

As explained in the first part of the literature section, underlying mechanisms of humor are tried to be explained by many philosophers and researchers for a long time. According to incongruity theories, incongruity or its resolution is crucial (Nerhardt, 1977; Suls, 1977, 1983; Shultz, 1972). According to the second-most salient theory of humor, SSTH, which is summarized in the first part, the presence of two scripts that are consistent in themselves but incongruent with each other on the basis of oppositions such as sex / no sex, money / no money, is critical for humor (Raskin, 1985; Attardo and Raskin, 1991). Although most of the theories essentially try to explain what makes things humorous each one suggests different terms and mechanisms. However, there is a point of convergence for all, which is the distinctive structure of humor. Incongruity theories explain this distinct structure with incongruity and SSTH with opposite scripts.

Humor has a relation to memory, which will be explored in the present section. The literature on the effects of distinct items on memory shows that memory for any kind of distinct stimuli such as weird or bizarre images, strange faces, extraordinary memories such as flashbulb memories or traumas, actions, sentences, and emotions that are out of one's daily routine, and many others, is different from our memory for ordinary and frequent stimuli (see Schmidt, 1991, 2012, for a review). However, several controversial results have been reported in the literature on the effects of humor on memory (Strick et al., 2010; Schmidt, 1994, 2002; Schmidt and Williams, 2001; Kaplan and Pascoe, 1977; Ziv, 1988; Takahashi and Inoue, 2009; Berg and Lippman, 2001; Özdoğru and McMorris, 2013; Abed, 1994; Furnham, Gunter, and Walsh, 1998; Summerfelt, Lippman and Hyman, 2010; Krishnan and Chakravarti, 2003).

Before reviewing of these controversial results, an important point must be clarified: the definition of distinctiveness (in relation to a humorous item), for, as Hunt (2006) cites from Tulving (2000), "the "what" question is just as important as the "how" and "why" questions that dominate normal research activities" (Hunt, 2006, p.22).

There are various different definitions of distinctiveness. While according to some researchers it can be defined as the opposite of "similarities" (Eysenck, 1979; Nelson, 1979; Tversky, 1977) according to some others (Murphy and Medin, 1985), distinctiveness must be explained with some mental structures (such as schemas, or scripts). In a classical article on distinctiveness, Schmidt (1991) argues that the definition of the concept of distinctiveness can be defined by the help of "different experimental manipulations and their consistent and shared effects on memory" (Schmidt, 1991, p. 525). As a result of this perspective, Schmidt suggests a

classification for distinctiveness and comes up with the distinction of primary and secondary distinctiveness (Schmidt, 1991, 2006, 2012). This distinction is reminiscent of the primary (short-term memory) and secondary (long-term memory) memory distinction of James in 1890 (Schmidt, 2012). According to his classification, primary distinctiveness refers to distinct items in a specific context. In other words, a comparison between a distinct item and non-distinct items in a specific context does not match in primary memory (working memory) and thus, yields the primary distinctiveness. For example, a red-colored word with surrounding black-colored words in a sentence causes primary distinctiveness. On the other hand, secondary distinctiveness refers to the comparison between a distinct item and all previous experiences, thus secondary memory (long-term memory). Bizarre imagery, unusual stimuli, and humor can be classified within secondary distinctiveness (Schmidt, 2012). For example, a novel joke can be classified as secondary distinctiveness because we have never experienced that specific joke before and it is distinct from our all previous experiences.

To the best of our knowledge, memory for extraordinary and distinct stimuli such as images, faces, sentences, actions, emotions, hence, distinctive items, is different from our memory for ordinary, hence, similar stimuli (Schmidt, 2012). As explained above, humor can be classified as a distinct item and thus its memorability differs from that of commonplace stimuli. Accordingly, there are quite a few empirical studies on humor and memory in educational science and advertising. For the sake of brevity, only some of the important studies in educational science are mentioned. Because of the possible contributions of the present study to advertisement research and the use of product brands as material, advertisement research on memory is presented as well. Finally yet importantly, theoretical explanations and empirical studies in the literature on the humor effect are reviewed.

2.2.1 Educational Science Research on Humor and Memory

In many studies in this field, positive effects of humor on test performance and learning were shown (Kaplan and Pascoe, 1977; Ziv, 1988; Fitzpatrick, 2010), while some others state that students preferred humorous learning material and that their motivation for the class increased with the use of humor (Özdoğru and McMorris, 2013; White, 2001). However, some studies report that humor has no effect (Özdoğru and McMorris, 2013) or even a negative effect on learning some material (Fisher, 1997). Only a few of these studies are mentioned in the following section.

As an early investigation of the effects of humor on comprehension and retention, Kaplan and Pascoe (1977) compared immediate and delayed test (6 weeks later) results of 508 university students for lectures including humorous examples versus non-humorous examples. The lectures including humorous examples came in three different versions; (1) concept humor: the humorous examples were related to the concept of the lecture, (2) non-concept humor: the humorous examples were not related to the concept of the lecture, (3) mixed humor: both related and unrelated humorous examples were presented during the lectures. Lectures were about Freudian psychology and shown as white-black 20 minutes video tapes. Prior to the experiment, the students were informed that they would be given a quiz after the

video but this quiz would not affect their class grades. In addition, 6 questions in the test were about the concepts explained by the target examples while 5 questions were about other class material. Their results showed that immediate quiz performances of students on target examples in humorous lectures were insignificantly higher than their performance on target examples in serious lectures. Another important result of the immediate test was that while students in the concept humor group answered the 6 questions about the concepts explained by humorous examples more correctly, albeit insignificantly; they were also the group that got the least number of correct answers for the other 5 questions in this test. In other words, the presence of humorous examples yielded poorer memory for other class material. However, surprisingly, in the delayed test, which was conducted 6 weeks later, students' performances on target examples in concept humor was significantly better than their performance in serious lectures. Thus, their results revealed that, the presence of concept humor in educational material yields significantly positive improvement in long-term memory. However, also, the presence of concept humor may be disadvantageous for other class material.

Ziv (1988) also conducted a series of experiments on the effects of humor on learning of the course material. Ziv divided 161 students, both female-male, that were registered in an introductory statistical course for a whole semester (14 weekly lessons) into two groups and both groups took a statistical course from the same lecturer. The lecturer used humorous examples relevant to the course material in the experiment group while not using any humorous examples for the control group. A test of 50 questions was given as an evaluation at the end of the semester. The results of this study showed that students that took the lectures with the relevant humorous examples showed better performance than the other group. Wondering whether the personality and the way of lecturing of the lecturer, the content of the lecture and the student profiles had any effects on this result, Ziv repeated the experiment with a new group consisting only of females. An introductory psychology course was selected as the lecture and the lecturer was not the one from the first experiment. Ziv obtained the same results as in the first experiment. This is a basic study on the positive effect of the use of humor in a relevant context and an optimum level on long-term memory and learning.

On the other hand, Özdoğru and McMorris (2013) investigated the effects of content-related humorous cartoons on students' test performance and memory and found no significant effect of cartoons on students' memory for learning material and text performance. 156 undergraduate and graduate students participated in their study. One-page instructions about six different psychology concepts (therapies based on classical conditioning, aggressive motivation, compliance, exercise and health, obsessive-compulsive disorder, controlled and automated processing) were presented to the participants as experiment material. Two forms for each of these one-page instructions were created, one with humorous cartoons and one without cartoons. Each participant received 3 humorous and 3 non-humorous instructions relevant to these 6 concepts. In addition, participants were divided into two groups, one receiving some concepts humorously and some concepts non-humorously, while the other received the concepts vice-versa. A multiple-choice test that contained 24

questions (4 from each of the 6 concepts) was applied as the test measure. Their results showed that, contrarily to their hypothesis, humorously instructed concepts did not result in significantly more positive test performance. In addition to their 24 multiple-choice test questions, participants were also given a sense of humor test (Multidimensional Sense of Humor Scale (MSHS), see also Thorson and Powell, 1993 for details), and were asked questions about their preference for humor use in learning material. Results showed that there was a positive relation between participants' sense of humor and their preference for humor use in educational material.

2.2.2 Advertising Research on Humor and Memory

TV, radio, the internet, and all types of media frequently use humor in advertisements. Most advertisers think that using humor in their advertisements their product will be remembered better, recognized more often in markets and their product liking will increase. Studies in this field have yielded very diverse results and very different methodologies were used in these studies (Takahashi and Inoue, 2009; Berg and Lippman, 2001; Furnham, Gunter, and Walsh, 1998). Some salient studies are summarized in the following section (see also Weinberger and Gulas, 1992; Gulas and Weinberger, 2006; for a review of effects and use of humor in advertising).

When studying the effects of humor in the field of advertising, one must endorse an essential classification based on the idea that the purchaser applies different decision making mechanisms for different product groups. This classification is known as the "Foote, Cone and Belding" (FCB) matrix which is developed and supported by Vaughn (1980, 1986), Berger (1981), Ratchford (1987), and Zaichkowsky (1987). According to this matrix, the behavior of the consumer is determined by two dimensions, namely low involvement/high involvement and thinking/feeling (details of the FCB matrix can be found in Vaughn, 1980, 1986; a similar Product Color Matrix (PCM) can be found in Weinberger, Spotts, Campbell and Parsons, 1995). According to the FCB matrix, the consumer purchase decision process relies on the feelings of the consumer for some products (jewelry, hair coloring, drinks, snacks and so on) while it relies on the thoughts of the consumer for others (insurances, bank loans, business instruments, cleaners, analgesics and so on) (thinking/ feeling dimension). Furthermore, the low/high involvement dimension refers to the consideration of the products and the information needed to purchase the product (Vaughn, 1980; Tanner and Raymond, 2012). For example, while snacks, drinks, paper products belong to the low involvement categories; houses, cars, jewelry, business instruments belong to the high involvement categories. In this matrix, in the intersection of feeling and low involvement are products also referred to as "life's little pleasures" (Weinberger and Campbell, 1990) such as alcohol, candies, snacks, drinks and so on. In their study in 1991, Weinberger and Campbell classified 2500 radio ads in accordance with the FCB matrix (only 1660 out of 2500 could be unambiguously classified) and showed that humor was most frequently used in the advertisements for products in the low-involvement category (39.6 %) and positively affected the recall of products in this category the most.

Similar to Weinberger and Campbell (1990) Chung and Zhao (2003) also reported that the use of humor in ads for products in the low involvement group was more effective compared to its use in the high involvement group. Chung and Zhao (2003) have shown that the use of humorous ads in this group positively reflects on product memory. Methodologically, different from Weinberger and Campbell (1990), they reached participants via telephone after Super Bowl games between 1992-1997 and asked them to indicate the ads they recall from the games (unaided recall) and pick the ads they had seen during the game from a list (aided recall). Regression analysis showed that there was a positive relationship between humorous ads and aided as well as unaided recall.

Starting out from the claim that learning of linguistic material, attention, and comprehension are affected by the context information that the material is presented in, Furnham, Gunter, and Walsh (1998) studied the effects of TV show contexts on the recalling of humorous and non-humorous ads. Working on 92 young people aged between 16 and 18, Furnham, Gunter, and Walsh randomly divided this group in four; showing humorous show with humorous advertisements to the first group, non-humorous show with non-humorous advertisements to the second, humorous show with non-humorous advertisements to the third and non-humorous show with humorous advertisements to the fourth. A comedy show was selected as the humorous show and morning news was selected as the non-humorous one, and the total length of these shows was about 24 minutes. 6 humorous and 6 non-humorous ads were used in the experiment. The participants were tested in recall and recognition measurements after the show they had seen. Their results showed that, when participants saw humorous advertisements in the context of non-humorous programs their free recall was better than their memory for non-humorous advertisements in the context of non-humorous programs. The opposite was also valid, thus, non-humorous advertisements were recalled better in the context of humorous programs compared to humorous advertisements in the context of humorous programs.

Berg and Lippman (2001) proposed that purchasing behavior is mainly based on brand name recognition instead of recalling the brand name and thus they studied the effects of humor on brand recognition in radio advertisements with 60 undergraduate students. Instead of listing the brand names solely, they imitated real radio advertisements. They used 12 humorous and non-humorous sentences (adopted from Schmidt, 1994) with novel and unfamiliar brands in a within-subject design. They hypothesized that the brand names which had been presented in the context of humorous advertisements would be recognized better compared to the brands presented with nonhumorous advertisements. After participants listened to the material from audio tapes, they were asked to attend an unexpected recognition memory test comprising 24 items (12 previously seen, 12 not previously seen). Hit rates (which can be calculated based on the correct identification of a brand which was presented during the study phase), false alarm rates (which can be calculated based on the incorrect judgment of a participant on a brand which was not presented in the study phase), and *d'* (d-prime) were calculated and analyzed. (Hit rate, false alarm rate and *d'* will be explained in more detail in the last chapter of the literature

sections) Researchers reported that neither *d'* nor hit rate analyses showed a significant difference between humorous and non-humorous material. After the study in which they could not verify their hypothesis, the researchers discussed that they had obtained these results probably because the task was difficult, that the texts adapted from Schmidt may have lost their effectiveness when transferred to the audio environment, or that the market environment could not be fully emulated. However, the choice of study material and controlling the data has similarities with the present study in terms of the application of an unexpected recognition memory test. As will be elaborated on in the discussion section, the results of the present study may explain why the hypotheses of this study were not supported.

Although he has not studied with advertising material, another study that measures memory with the recognition test instead of a recall test is Abed's study (1994). Abed conducted two experiments on the effects of visual puns on recognition memory (1994). According to Abed, complex interactive illustrations (visual puns in his study) are mostly created by bringing two different symbols together and forming an active or spatial relationship. Mainly because it brings two ideas together, it requires higher-level cognitive ability and thus, the indirect relation between two symbols facilities memory. He tested his hypotheses, by showing 15 interactive visual puns to one group of participants and 15 non-interactive images with the same message to another group. In the recognition memory tests (immediate, 2 weeks and 8 weeks later), he showed 60 non-meaningful distractors (pictures of only certain objects without a specific message) and 15 visual puns to the first group and 60 non-meaningful distractors and 15 non-interactive images to the other group. His results showed that recognition memory scores of the visual pun group was higher than the recognition memory scores of non-pun group only in 8 weeks delayed recognition memory test but not in the immediate and 2 weeks delayed tests. In other words, these results show the advantage in long term memory of visual puns over non-puns shown among distractors consisting of non-meaningful common pictures. In his second experiment, he studied how recognition memory was affected by the distractors' meaningfulness. That is, he did not just used pictures of objects as in the non-meaningful condition but instead used distractors that send a message to the reader and replicated the first experiment. Surprisingly, however, in the visual pun group the advantage of puns on distractors was seen only in immediate and 2 weeks delayed tests but not in the 8 weeks delayed test. He suggested that the presence of a message conveyed by meaningful distractors might hinder long-term memory. He concluded that visual puns were recognized in a better way than non-puns even when the distractors were meaningful.

Although not directly related to humor use in advertising and memory, a study by Chattopadhyay and Basu in 1990 is important for both because of its contribution to the literature and, more concretely, it helped select the material for the present study. They showed the importance of prior brand knowledge and evaluation on the effectiveness of humor use in advertisements. 80 participants aged between 18 and 22 took part in the experiment. Participants were reimbursed for the products they purchased in the experiment in order to be able to measure consumer behavior properly. They were firstly briefed with a one page form about the products they

would see in the experiment and later they were subject to a test that assessed their evaluations about these products. In the main experiment, the participants were shown 3 product ads placed in TV programs of 15 minutes. Half of the participants saw 1 humorous ad of the target brand and 3 filler brands while the other half saw 1 non-humorous ad of the target brand which is the counterpart of the humorous ad and 3 filler brands. At the end of the main study, the participants were given a questionnaire and asked if they liked the ad they had seen in the experiment and if they wanted to purchase the product that was advertised. Their results showed that, if the participants had a positive prior evaluation about the advertised brand, then humorous advertisement of that brand was more effective on the attitude and choice behavior of the consumer compared to non-humorous advertisements. Furthermore, in the opposite condition, that is when the prior brand evaluation of the consumer was negative, humorous ads were less effective in changing consumers' attitude and choice behavior compared to non-humorous ads, as well. Instead of concluding that humorous ads are always more effective or always affect brand memory and purchasing behavior positively, Chattopadhyay and Basu concluded that studies have to be conducted regarding the prior knowledge of the consumer.

In studies about education and advertising, very different methodologies, measuring methods and age groups were used. Some studies took only minutes, others a somewhat longer period of time (weeks), while others even took years. Recall was used in some and recognition memory in others. A number of variables, however, have to be controlled in studies about the effect of humor in these areas. One of the most important variables, as Schmidt (2012) points out, is that humor has to be presented in relation with the context material (learning material for education and the product or brand that is advertised for advertising). In addition, the study by Chattopadhyay and Basu (1990) has shown that prior knowledge has an impact on the effectiveness of humor on purchasing behavior. If we review this study in a broader perspective, we can conclude that in experiments which tap the episodic memories of the participants it could be more difficult to investigate the effect of humor. In other words, it may be helpful to take into account that the context material used in empirical studies should not be something that the participants are already familiar with prior to the experiment. In addition, especially for the studies in the field of advertising, the product regions in the FCB matrix and in which of these regions humor enhances brand memory must be assessed properly. In respect to all these factors, studies from the field of educational science and advertising are very important in unraveling the relation between humor and memory.

2.2.3 Humor Effect

Although theoretical explanations about distinctiveness presume an enhancing effect of humor on memory, as summarized above, the humor and memory literature is full of controversial results. It is for this reason that there is need for studies in which both the variables and experimental methods are controlled.

In the 1994 study "Effects of Humor on Sentence Memory", Schmidt performed a series of experimental studies which can be considered as one of the most systematical studies in the field. In experiment 1, which is the pilot study, Schmidt

and his team collected sentences and formed both humorous and non-humorous versions of the same sentences. 45 undergraduate students rated these sentences on humorousness, bizarreness, difficulty, meaningfulness, and familiarity dimensions. Results revealed significant differences only in the humorousness dimension. Thus, in the other dimensions the data was controlled. After the pilot study, 38 new participants were presented 20 humorous and 20 non-humorous sentences within one list and before the experiment, participants were made aware that they would be asked to recall the sentences later (intentional memory task). Results showed that humorous sentences were recalled significantly better than non-humorous sentences. Furthermore, the number of recalled words from humorous sentences was higher than the recalled words from non-humorous sentences. Thus, when bizarreness, difficulty, meaningfulness, and familiarity dimensions, which can affect memory performance, were controlled and sentences were presented in a within-list experiment, humorous sentences were recalled better than non-humorous sentences in an intentional memory task.

In experiment 2, the first experiment was replicated however, this time within and between-list presentations of sentences were systematically explored. In this experiment 2, a group of 40 new participants saw only humorous sentences, and another group of 40 saw only non-humorous sentences (between-list manipulations) and a group of 40 saw both humorous and non-humorous sentences (within-list manipulations). As in the first experiment, the participants were briefed that they would be given a memory test at the end of the experiment. "Experimental design" (within vs. between-list presentation) was included as a factor in this study. The results showed that, for within-list manipulation, that is when the participants saw both humorous and non-humorous sentences together, the humorous sentences and words in these sentences were recalled more, while for between-list manipulation there was no effect of humor on sentence recall. This phenomenon is called "humor effect" in the literature (Schmidt, 1991, 1994, 2002, and 2012) Also, another important result was that the non-humorous sentences in the mixed list were recalled significantly less than the non-humorous sentences in the between-list condition. That is, humorous sentences in the within-list condition have a negative effect on the recall rates of non-humorous ones. Thus, there seems to be a tradeoff between the two, such that recall of humorous sentences is enhanced at the expense of recall of non-humorous sentences. Schmidt concluded that the increase in recalling humorous sentences in within-lists supported the increased attention hypothesis (named incongruity hypothesis by Schmidt, 2012). Furthermore, the reason that recall rates of non-humorous sentences in within-lists were lower in comparison to between-lists can be explained by the rehearsal hypothesis (these hypotheses are explained below).

In experiment 3, Schmidt investigated the relation between recalling humorous sentences better in the within vs. the between-list experiment and surprise (unexpected memory task) and whether the within-list advantage of humorous sentences changed between cued or free recall. According to Schmidt, if seeing humorous sentences unexpectedly among non-humorous ones this has an effect of surprise on the participant, which might explain the recall superiority of humorous sentences in the within-list condition over the between-list condition. For this reason,

the within-list experiment was adjusted and not only before the experiment participants were told that half of the sentences they will see would be humorous and the other half would be non-humorous but also during the experiment while each sentence was presented it was indicated whether the sentence was humorous or non-humorous, thus eliminating the surprise factor. If surprise is the underlying mechanism of this recall difference, then recall performance of the participants who were informed that they would see humorous sentences should not differ for humorous and non-humorous sentences seen in a single list. In addition, in the cued recall group for each sentence a word was underlined and it was indicated that this word would be included in a memory test at the end of the experiment. The results show that the surprise hypothesis was invalid since humorous sentences were still recalled at higher rates in comparison to non-humorous sentences in both free and cued recall.

In experiments 4 and 5, Schmidt investigated how participants' recall of humorous and non-humorous sentences recall was affected when being informed about the memory test after the experiment and being asked to rate the sentences they saw unexpectedly at the end of the experiment in terms of humor. Differently than the previous experiments, after presenting the sentences to the participants, they were asked how humorous they found each sentence and later an unexpected free recall test was applied. The results showed that the sentences that the participants found more humorous were recalled at higher rates. Moreover, the memory results of the incidental memory task was found to be lower than the results of the intentional memory task, indicating that if participants know that they will be tested in comparison to an unexpected memory test the memory results are found to be higher. However, Schmidt and Williams (2001), Takahashi and Inoue (2009), Strick et al. (2010) showed that, the humor effect did not disappear when an unexpected memory task was applied as well.

The experiments conducted by Schmidt in 1994 clarified many theories trying to explain the reason why humor has positive effects on memory. Some of the salient theoretical explanations of the humor effect according to this study are surprise, arousal, incongruity and rehearsal.

According to surprise explanations, encountering humorous material may cause surprise, attraction of attention to the humorous material, and hence better remembering of such material. However, as revealed by the third experiment of Schmidt, even if participants were informed that they were going to read humorous sentences, and each sentence was explicitly labeled humorous or non-humorous, the humor effect was not eliminated. Participants were still able to remember the humorous sentences better.

Arousal explanations mainly state that it is the arousal caused by humor that makes humorous sentences being remembered better. This explanation is based on the argument that both materials that cause positive or negative arousal are remembered better (Mather and Sutherland, 2011). Arousal can be measured by increased heart rate, for example (Burke, Heuer, and Reisberg, 1992). This argument nevertheless fails to explain why the potential arousal caused by humor affects memory positively

in within-list presentation while it does not do so in between-list presentation. However, Schmidt (2002) also showed in his study with humorous cartoons, weird cartoons, and non-humorous cartoons that humorous cartoons did not imply significantly higher heart rates.

Another explanation is based on rehearsal. It argues that humorous materials are rehearsed more often than non-humorous materials, and this makes humorous materials better remembered (Atkinson and Shiffrin, 1968). This explanation is considered successful as an explanation of the humor effect in two ways (Schmidt, 2012). First, superior remembering of humorous material observed in within-list manipulations causes non-humorous materials to be remembered less. Non-humorous materials in the within-list are remembered less than non-humorous materials in the between-list, as well. Non-humorous materials may be remembered less since participants rehearse humorous materials more frequently (Schmidt, 2012). The second evidence is supported only partially. While the humor effect is observed more clearly in studies which involve informing the subjects that a memory test would be made at the end of the experiment, this rate is lower in incidental experiments which involve unexpected memory tests (Schmidt, 1994). However, as discussed earlier, the humor effect was still observed to be powerful in unexpected memory tests in many studies (Schmidt, 2012).

According to the incongruity hypothesis, perception and resolution of incongruity in humorous materials by participants leads to increased attention (item distinctiveness). Increased attention on humorous materials leads in turn to remembering such materials better (Schmidt, 2012). However, remembering and resolving the incongruity is common to humorous materials both in the within-list and in the between-list condition. In other words, the incongruity hypothesis cannot explain why such materials still lead to superior memory in within-list as compared to between-list presentation. At this point, Schmidt argues that another type of incongruity comes into play (Schmidt, 2012). He says that humorous materials in within-lists are different from other items in the list, and that they therefore form a different group than other items in the humorous items list (relational distinctiveness). On the contrary, non-humorous items in the list do not share a common ground that can attract attention other than being non-humorous. Thus, in within-lists both the incongruous structure of humorous material and the relational distinctiveness caused by the presentation of humorous and non-humorous materials together may improve remembering the humor by way of encouraging participants to pay more attention to humorous items. However, in between-lists humorous or non-humorous materials are strictly separate by design and the attention is confined to either humorous or non-humorous materials.

As specified in the incongruity hypothesis, by employing on-line attention measurements, it is possible to measure whether humor attracts more attention. The only study made to this end in the literature is the one using eye-tracking technology by Strick et al. (2010).

According to Strick et al. (2010), humorous texts attract more attention compared to other stimuli and participants spend more time looking at humorous texts – at the

expense of other stimuli in the context of the humorous texts. In their first experiment, they showed 15 positive, 15 neutral and 15 humorous texts combined with three energy drink brands to the participants. Each of the three brands was presented next to 15 different texts of one type, leading to 45 experimental trials. In experiment 1, they asked participants to focus their attention directly on the texts, which were humorous, positive or neutral. During stimulus presentation, participants' eye movements were recorded. This study was a repeated measures design with the type of texts (humorous, positive, neutral) as within-subject factor. After presentation of the material, participants were asked to complete an unexpected recognition task. In this task, participants saw 24 different brand names (pictures of energy drinks) which also included the target brands in the stimulus presentation phase. They were asked to respond as accurately and quickly as possible whether they had seen the brands in the previous section. It was found that the times spent on viewing humorous texts were higher than those spent on positive and neutral texts, which means that participants paid more attention to the humorous texts than to the other kinds of text. The attention allocated to the humorous texts was then lacking for the study and encoding of the brand names in the context, resulting in impaired recognition of context information, i.e., brands. In experiment 2, they did not give any instruction and rather tried to investigate attention patterns when text and brand viewing were left free to participants. Their aim was to investigate whether attention for humorous stimuli and brand memory correlated linearly, i.e., the more time was spent on processing the humorous text, the less brand names were recognized. They used each type of text with three different brands instead of one. Other material and the design were the same as the experiment 1 except the instruction about the stimuli on which participants should focus. No significant difference in participants' correct answers to the recognition task was found between the conditions (humorous, neutral, and positive texts). However, reaction times of correct answers gave some indication about the accessibility of the brands in participants' memory. The analyses indicated that type of text had a significant effect on brand recognition speed such that brands paired with humorous texts were recalled slower than brands paired with positive texts and control ones. In addition, there was no significant difference in recognition speed between the brands paired with positive texts and control ones. In conclusion, according to the results of Strick et al.'s eye-tracking study humor stimuli receive enhanced attention relative to non-humorous positive and neutral stimuli, and thereby encoding of non-humorous context information (pictures of brands) is reduced.

Based on the literature, the present study took into consideration important factors for the construction of its stimulus set and its design. Thus, the tests applied by Schmidt (1994) for the dimensions of bizarreness, difficulty, meaningfulness, and familiarity of the textual material were tested by pilot studies in this research. Since the product range categorized as "life's little pleasures" in the FCM matrix are the products that conform the most to the use of humor and reveal the highest impact on memory, chocolate brands were chosen as visual objects in this experiment. Further, as the study conducted by Chattopadhyay and Basu in 1990 showed an effect of prior knowledge on humorousness. In order to eliminate this possible confound, unknown chocolate brands were used in the present study. In addition, because there is an

uncertainty on the effects of humor in delayed memory tests (see Kaplan and Pascoe, 1977; Abed, 1994), a delayed recognition memory test was therefore included in the present study. Finally yet importantly, Strick et al.'s (2010) study in particular played an important role in shaping the methodology of the present study. Strick et al. showed that humorous texts attracted more attention and reduced the encoding of context information (brand pictures) by using eye-tracking methodology; however, there was no relation between the texts and the visual objects shown together in that study in terms of content. Relatedness was discussed in the literature however with very different material and design which is not directly comparable to our design (Kaplan and Pascoe, 1977; Ziv, 1988; Özdoğru and McMorris, 2013). We also considered relatedness as an important factor because in case of relatedness between the visual object provided as context information and the text, this may eliminate or weaken the humor effect, causing a reduction in the attention entirely focused on the text. Rather, the relation between the text and the visual object will be strengthened which will lead to better recognition of the visual object later on. Thus, such a relation may cause better memory for the context information associated with humorous texts as compared to cases in which such a relation is absent. Therefore, the relatedness factor was added to the present study and eye-tracking methodology was used in order to elucidate the on-line perceptual and cognitive processes underlying humor processing.

2.3 Recognition Memory Tasks and Signal Detection Theory Measurements

In the present study, memory of chocolate brands will be studied with a recognition paradigm. In this section, important measurements in this paradigm and the underlying theory will be presented, briefly. As previously studied in several memory recognition experiments (Starns, 2014; Hamrick, 2014; Yeung, Ryan, Cowell, and Barense, 2013; Parks, 2013; Starns, Rotello, and Hautus, 2014; Lanska, Olds, and Westerman, 2014) recognition memory tasks comprise two main phases: study phase and test phase. According to Macmillan, recognition memory experiments can be called discrimination experiments, as well (Macmillan, 2002). In the study phase, participants are shown, for a certain time, target items that are made up of texts, objects and other materials, chosen according to the aim of the study. In the test phase, participants are shown both target items which were studied in the study phase and new items (which can be named distractors, lures, or noise trails) which were not presented in the study phase. In the test phase, participants are asked to discriminate between old (targets) and new (distractors) items, i.e., they have to indicate, by way of a key press, whether they have seen the item before or not.

When participants give the answer "I have seen this item in the study phase" for an item, and if the item was present in the study phase then the answer is counted as a "hit" (see Table 1, for an overview of recognition memory terms). The hit rate can be calculated by dividing the total number of hits of a participant by the total number of target items. Accordingly, if the item was not presented in study phase but the participant thought that the item had been shown in the study phase and thus responded "I've seen the item", then the answer is classified as a "false alarm". In order to calculate the false alarm rate of a participant, one has to divide the total

number of false alarms of that participant by the total number of distractors in the test phase. Furthermore, if the item was presented in study phase but the participant thought that the item had not been shown in the study phase then the answer is counted as a "miss". Lastly, if the item was not presented in the study phase and the participant thought that the item had not been shown in the study phase then the answer is counted as a "correct rejection". In the present study, only hits and false alarms are used in order to measure recognition memory, which are therefore highlighted in Table 1.

Table 1 Recognition Memory Terms

	Targets	Distractors
Response: "I've seen"	**Hit**	**False alarm**
Response: "I haven't seen"	Miss	Correct rejection

Although, hit rates and false alarm rates are valuable in an attempt to assess recognition memory, the calculation of "*d'*" (d-prime) and the measure "*C*" is also necessary for better interpretation of recognition memory. *d'* and *C* are measurements of Signal Detection Theory (SDT). Although SDT is a theory that originally relates to signal processing systems such as detectors, radars, navigation systems, biomedical signal processing, wireless communications, underwater signal processing, and so on (Tuzlukov, 2001) it can be applied to decision-making processes, recognition memory tasks, lie detection processes, medical diagnosis detection, industrial inspections, as well (Stanislaw and Todorov, 1999, also see Heeger, 1997; Macmillan, 2002 for a better understanding of SDT and its applications to psychology and other areas). *d'* or "discriminability index" basically refers to the discriminability of an item from distractors. *C* is a measure of bias (being more liberal or more conservative in one's responses). In order to calculate *d'* and *C* the *z*-scores of the hit rates and the false alarm rates were used. The formulae of *d'* and *C* for yes/no recognition memory tasks are as follows (Macmillan, 2002):

d' = *z*-score (hit rates) – *z*-score (false alarm rates)

C= - ½ [*z*-scores (hit rates) + *z*-scores (false alarm rates)]

When participants truly discriminate between target and noise items, *d'* scores increase. Also, *C* values above 0 indicate a conservative bias which in our case means that participants are more willing to say "no, I haven't seen this visual object in the study phase". *C* values below 0 indicate a liberal bias which in our case means that participants are more willing to say "yes, I have seen this visual object in the study phase". *C* values equal to 0 indicate no bias.

CHAPTER 3

METHOD

The current study is a recognition memory study on visual objects (chocolate bar brands) that have been paired with various kinds of texts (see Appendix A and B for texts). It involves the presentation of text-brand pairs, a filler task, and two unexpected recognition memory tests in which the participants decided whether they had seen the brands in the presentation part or not. Participants' eye movements in the presentation part were monitored by an eye-tracker device (Tobii Studio, 3.2.1.). At the beginning of the thesis research, a series of pilot studies were conducted in order to confirm that the texts and brands fitted our manipulation goals.

Methodologically, it should be noted that the eye-tracking hypotheses of the present study are not derived from any specific theory; instead they were designed as a tool in an attempt to investigate the humor effect from the perspective of cognitive theories.

3.1 Pilot Studies

3.1.1 First Pilot Study

In the first pilot study, in an attempt to select five texts for of the each six conditions in the main study, various numbers of texts and chocolate bar brands were investigated. Texts were either selected from Internet pages of comic stories, funny quotes and so on or created by the experimenter. Brand pictures were selected from the Internet, as well. After the selection of texts and brands, to test the appropriateness of the texts and the brands for the main study in certain dimensions, the first pilot study was conducted.

The six conditions in the current study result from the combination of two factors: (1) relatedness (related, unrelated) and (2) text type (neutral, positive, and humorous). They are as follows: (1) Related neutral condition (The text consists of a neutral story and the text and the brand are semantically related). (2) Related positive condition (The text consists of a positive story and the text and the brand are semantically related). (3) Related humorous condition (The text consists of a

humorous story and the text and the brand are semantically related). (4) Unrelated neutral condition (The text consists of a neutral story and the text and the brand are semantically unrelated). (5) Unrelated positive condition (The text consists of a positive story and the text and the brand are semantically unrelated). (6) Unrelated humorous condition (The text consists of a humorous story and the text and the brand are semantically unrelated).

The dimensions according to which we selected the stimuli were: (1) humor, (2) positivity, (3) relatedness, (4) ease of textual understanding, (5) familiarity with brands, and (6) familiarity with texts. Subjects in this first pilot study were supposed to rate the texts according to the first 4 dimensions on a 7-point Likert-type scale and judge the last two dimensions categorically as "known" or "unknown". First of all, we aimed to obtain a significant main effect of text type (neutral, positive, humorous) on humor ratings. We expected to see that the humorous texts were rated more humorous compared to both positive and neutral texts. However, we did not expect to see an effect of relatedness on the humor ratings of the texts. Secondly, we aimed to see a significant main effect of text type (neutral, positive, humorous) on positive feelings that were evoked by the texts. Positive and humorous texts should evoke more positive feelings compared to the neutral texts. However, positive texts should be more positive compared to both humorous and neutral texts. Also, neutral texts should be evaluated as neutral. Furthermore, we did not expect to see an effect of relatedness on the positivity ratings of the texts. Thirdly, we expected to obtain a significant relatedness difference between the chocolate-related and unrelated texts irrespective of the text type. Fourthly, in order to guarantee equal understandability of the texts across participants, we aimed to obtain no significant effect of text type, relatedness, and interaction of text type and relatedness on ease of textual understanding. Fifthly, in order to eliminate any possible effect of familiarity with the brands for the sake of the recognition tests, chocolate brands were chosen from outside of Turkey, thus they should be unknown in the country. Lastly, we aimed to obtain no familiarity effect with the texts.

Participants

Twenty volunteer participants (ten female, M = 26.85 years, SD = 4.29, ranging from 22 to 41 years) performed in the pilot study.

Stimuli

In the initial stimulus sample, there were 7 related humorous texts, 6 related neutral texts, 7 related positive texts, 8 unrelated humorous texts, 6 unrelated neutral texts, and 7 unrelated positive texts, from which 5 texts for each condition had to be finally selected, according to the manipulation goals in the main experiment. The relatedness between texts and brands was realized explicitly by mentioning the name of the product type (related texts included the word "chocolate"). Participants saw a text (related or unrelated; neutral, positive, or humorous) and a brand in the same visual display (See Figure 1). There were forty-one different chocolate bar brands in total, and each brand was located near to one text. The font and size for the texts was Calibri, 12.

Figure 1 An example of a text and chocolate bar pair from the related humorous condition (English translation: "Add chocolate to the top of your daily to-do list. Thus, you make sure that you have done at least one of the items.")

The word count of the texts in the experiment ranged between thirteen and eighteen words. The texts were written in formal language and exclamation points, quotation marks, smileys, etc., were eliminated in order not to disrupt reading. The frequencies of the words were counted one by one by using the Word Frequency List of the Turkish National Corpus (Aksan et al., 2012) and "Yazılı Türkçenin Kelime Sıklığı Sözlüğü" (Word Frequency Dictionary of Written Turkish) (Göz, 2003). A mean frequency value for each text was calculated.

The chocolate bar brands were supposed to be largely unknown in the country. The pictures of the chocolate bars were 8 cm in width. Chocolate bars which were in chocolate wafer form were 2.5 cm in length and chocolate bars which were bar form were in 3 cm in length (based upon 1366×768 screen resolution).

There were six questions for each text-brand pairs. For the first four of them participants answered the questions by ticking a value from 1-7 on a 7-point Likert scale. For the last two questions, participants answered yes-no questions. In the first question, participants answered how funny they found the text. In the second question, participants were asked to rate the positive feeling that text evoked. In the third question, they were asked to rate how much they found the text and brand related to each other. In the fourth question they were asked to rate how easy the text was to understand. In the fifth and sixth questions they were asked whether they had prior knowledge of the brand and the text, or not, respectively.

Trials were randomized between subjects. The localization of brands and texts (left or right) in the display and the assignment of brands to texts was randomized within subjects. The trials were created by using PowerPoint presentation Program 2010. The online survey was created by using psychsurveys.org.

Procedure

All participants saw the entire set of forty-one brands and text pairs in the survey. Participants acquired the survey link via e-mail and they voluntarily attended the pilot survey. There were no reaction time measurements and time limit, they freely answered the questions. To complete the survey took approximately 35 minutes.

3.1.2 Second Pilot Study

After the analysis of the first pilot study, the need for a second pilot study arose in order to clarify the results of the first pilot study. In the first pilot study, there was a significant difference between the funniness ratings of related and unrelated humorous texts such that related texts were found less funny than unrelated texts. In order to understand whether the presence of the visual image decreased the funniness of the humorous texts because of the relation between the text and image, we conducted a second pilot study with only humorous texts but without images.

Participants

Thirty-six new volunteer participants (seventeen female, M = 28.4 years, SD = 7.27, ranging from 20 to 56 years) participated in the second pilot study.

Stimuli

In the second pilot study, there were only 7 related humorous texts and 8 unrelated humorous texts without their images. These 15 texts were the same as the humorous texts in the first pilot study. Participants saw texts in randomized order. Participants were only asked to rate the funniness of the texts on a 7-point scale.

The trials were created using PowerPoint presentation Program 2010. The font was Calibri and the size of the texts was 12. The online survey was created by using psychsurveys.org.

Procedure

Participants acquired the survey link via e-mail and voluntarily attended to the pilot study. There were no reaction time measurements and time limit, they freely answered the questions. To complete the second pilot study took approximately 10 minutes.

3.2 Main Study

3.2.1 Participants

Thirty-six new participants (eighteen female, M = 28.19 years, SD = 5.33, ranging from 20 to 39 years) participated voluntarily in the main study. Written informed consent was obtained from the participants and the Ethics Committee of Middle East Technical University (METU) had approved the study.

3.2.2 Study Phase

Stimuli

There were 5 related humorous texts, 5 related neutral texts, 5 related positive texts, 5 unrelated humorous texts, 5 unrelated neutral texts, and 5 unrelated positive texts in the main study. These texts were selected according to the first and second pilot studies. As in the first pilot study, the relatedness of texts and brands was made explicit by mentioning the product type "chocolate". All of the texts and brands were the same as in the first pilot study. The trials were created using PowerPoint presentation Program 2010. The font and size for the texts were Courier New, 20, respectively. Texts were centered in the text frame and the line space was 2.

The pictures of the chocolate bars were 10.3 degrees of visual angle in width. Chocolate bars which were in chocolate wafer form were 3.6 degrees of visual angle in length and chocolate bars which were bar form were in 3.9 degrees of visual angle in length. The stimulus presentation was created by using Tobii Studio 3.2.1. The resolution of the screen was 1280 X 1024. Trials were randomized between subjects. The localization of brands and texts (left or right) on the display and the assignment of brands to text conditions were randomized as well.

Procedure

The study took place in the Human Computer Interaction Laboratory at METU. Participants were seated in front of the eye-tracker device. They were only informed about the eye-tracker part of the study at the beginning and they were informed about the filler task and the subsequent recognition test at the end of the each part. They were instructed to read the texts and look at the pictures during the trials freely. They were informed about the eye-tracker device and a calibration was done for every subject before the experiment started. When the fixation cross appeared on the screen, participants were told to focus on it directly. Each brand-text pair was presented for 10 seconds. A fixation cross which was located at the bottom of the center of the screen was presented between each trial for 1 second. Before the main presentation there was a practice presentation to familiarize the participants with the experimental design. In the practice presentation, participants saw one text and brand pair for each condition yielding six pairs which were selected from the discarded material of the first pilot study. After the practice trials when they felt ready, participants started the main session by pressing the space key on the keyboard. During the presentation of the trials participants did not have to press any button. They only read the texts and looked at the pictures on the screen while the eye-tracking device was recording their eye movements. It took approximately 6 to 7 minutes to complete the eye-tracking part of the study.

3.2.3 Filler task

After the study phase, participants were unexpectedly asked to solve 15 mental arithmetic questions during approximately 4 minutes on the same computer (M = 3.63, SD = 0.84). The purpose of this filler task was to introduce a short delay

between the study phase (eye-tracking part) and the subsequent recognition test. During the filler task no eye-tracking recording was done. The questions were made up by the experimenter and SuperLab 4.0. was used for the presentation of the questions. The questions included additions, subtractions, multiplications, and divisions as in the examples below:

36x2-37=?

2+4+6+8-1-3-5-7=?

Participants typed their answers by using the keyboard and pressed "enter" for the new questions. There was a 1 second fixation cross between the questions. Participants were instructed to look at the fixation cross when it was on the screen. The font and size of the questions were Courier New, 16, respectively.

3.2.4 Recognition Test Phase

Immediate Recognition Memory Test

After the filler task, participants were asked to complete an unexpected recognition memory test on the same computer. In the beginning of the recognition study, participants read an instruction and when they felt ready to start the experiment they pressed the space bar. In the recognition memory test, there were 60 chocolate bars of which 30 had been shown to the participants during the eye-tracking presentation part of the main study (targets) and 30 of which had not been shown (distractors). Participants were asked whether they had seen the image in the eye-tracking part or not. Participants were not instructed to give a speedy response. Half of the participants were instructed to press the button 1 if they had seen the image in the previous section and the button 3 if they had not seen the image. The other half of the participants used the opposite buttons for the same purpose.

Delayed Recognition Memory Test

The second recognition memory test was conducted in order to find out whether the factors manipulated in the study (relatedness; type of text) were affected by time. After approximately two weeks (range: 12 and 14 days) participants were called for the second recognition memory test. 24 out of 36 participants came to the second test. As in the first recognition memory test, they were exposed to the same 60 chocolate brands and they were asked to indicate whether they had seen that chocolate bar or not in the eye-tracking part.

CHAPTER 4

RESULTS

In this chapter, firstly the results of the first and the second pilot studies are summarized. Secondly, the results of the main study are presented according to the hypotheses of the present study. This main analysis relies on subject-wise Analyses of Variance (ANOVAs), i.e., the variance between the experimental conditions is analyzed as it arises between subjects. Moreover, the results of an item-wise analysis are summarized and evaluated with respect to the subject-wise analysis. This alternative ANOVA analyzes the variance as it arises between items. Lastly, the results of three additional analyses on (1) the probability of recognizing visual objects, (2) the probable effects of the filler task duration on recognition memory and (3) the probable effects of ambiguity in the texts on looking times of texts are summarized.

4.1 Results of the Pilot Studies

4.1.1 Results of the First Pilot Study

30 out of 41 texts were selected according to their appropriateness for the manipulation dimensions. All of the 41 texts were examined one by one and the ones which had the highest or lowest scores in comparisons with the other category members were eliminated. In the following section, the results of the first pilot study with all 41 text-visual object pairs are summarized and the results of the selected 30 pairs are reported.

Results of the Analysis before Elimination

Frequencies of the Words in Texts

Levene's test showed that the variances between the categories were equal, F (5, 35) = 2.48, $p > .05$. A factorial ANOVA revealed that there was no significant effect of text type F (2, 35) = .92, p = .913, η^2_p = .005, relatedness F (1, 35) = .006, p = .939, η^2_p = .0001, and interaction effect between relatedness and text type F (2, 35) = .012,

p = .988, η^2_p = .001, on the frequencies of the words. Consequently, the frequencies of the words in the texts were not significantly different.

Humor

Levene's test showed that the variances between the categories were not equal, F (5, 35) = 5.177, p = .001. A factorial ANOVA showed that there was a significant main effect of text type on humor ratings F (2, 35) = 345.612, p < .001, η^2_p = .952. The contrast *Level 1 vs. Later (2 and 3)*[1] showed that neutral versus positive and humorous texts were rated significantly different [d = -1.828 (*SE* = 0.128), 95% *CI* [-3.295, -2.73], p < .001]. The contrast *Level 2 vs. Level 3* showed that positive and humorous texts were also rated significantly different [d = -3.014 (*SE* = 0.138), 95% *CI* [-3.295, -2.73], p < .001]. Pairwise comparisons revealed that humorous texts are significantly more humorous (*M* = 5.19, *SE* = 0.09) than both positive (*M* = 2.12, *SE* = 0.09) and neutral texts (*M* = 1.80, *SE* = 0.10) (both *p*s < .001). However, the difference between neutral (*M* = 1.80, *SE* = 0.10) and positive texts (*M* = 2.12, *SE* = 0.09) was not significant (p = .105). There was also a significant effect of relatedness on humor ratings, F (1, 35) = 5.228, p < .05, η^2_p = .131. Unrelated texts (*M* = 3.15, *SE* = 0.08) were found significantly more humorous compared to related humorous texts (*M* = 2.88, *SE* = 0.08). Also, there was a significant interaction effect between text type and relatedness on humor ratings, F (2, 35) = 9.25, p < .05, η^2_p = .346.

Positivity

Levene's test showed that the variances between the categories were not equal, F (5, 35) = 3.355, p = .014. A factorial ANOVA showed that there was a significant main effect of text type on positivity ratings F (2, 35) = 30.643, p < .001, η^2_p = .637. The contrast *Level 1 vs. Later (2 and 3)* showed that neutral versus positive and humorous texts were rated significantly different [d = -0.903 (*SE* = 0.129), 95% *CI* [-1.164, -0.642], p < .001]. The contrast *Level 2 vs. Level 3* showed that positive and humorous texts were also rated significantly different [d = 0.498 (*SE* = 0.139), 95% *CI* [0.215, 0.781], p < .01]. Pairwise comparisons revealed that positive texts (*M* = 5.28, *SE* = 0.10) were rated significantly more positive than both humorous (*M* = 4.78, *SE* = 0.09) and neutral texts (*M* = 4.13, *SE* = 0.10) (both *p*s < .01). There was no significant effect of relatedness on positivity F (1, 35) = .507, p = .481, η^2_p = .014. In addition, there was no significant interaction effect between text type and relatedness on positivity, F (2, 35) = 2.699, p = .081, η^2_p = .134.

Relatedness

Levene's test showed that the variances between the categories were significantly different, F (5, 35) = 3.184, p = .018. According to the results of the factorial ANOVA only the relatedness factor had a significant main effect on the dependent

[1] Contrast *Level 1* refers to the difference between neutral texts and the other two text types (positive, humorous). Contrast *Level 2* refers to the difference between positive and humorous texts.

variable relatedness F (1, 35) = 487.384, $p < .001$, $\eta^2_p = .933$. According to pairwise comparisons, chocolate-related texts (M = 4.55, SE = 0.08) were found significantly more related compared to chocolate-unrelated texts (M = 1.86, SE = 0.08) ($p < .01$). There was no significant effect of text type on relatedness, F (2, 35) = 1.952, p = .157, $\eta^2_p = .100$. Moreover, there was no significant interaction effect between the text type and relatedness, F (2, 35) = 1.292, p = .288, $\eta^2_p = .069$.

The Ease of Textual Understanding

Levene's test showed that the variances between the categories were not equal, F (5, 35) = 2.898, p = .027. A factorial ANOVA showed that there was a significant main effect of text type on the ease of textual understanding F (2, 35) = 3.422, $p < .05$, η^2_p = .164. The contrast *Level 1* vs. *Later (2 and 3)* was not significant [d = -0.097 (SE = 0.132), 95% *CI* [-0.365, 0.172], $p > .05$]; however, the contrast *Level 2 vs. Level 3* showed that positive texts were rated significantly easier than humorous texts [d = -0.358 (SE = 0.143), 95% *CI* [-0.65, -0.067], $p < .05$]. Pairwise comparisons, however, did not confirm this difference (p < .052, due to more severe correction of family-wise type 1 error). In addition, there was no significant effect of relatedness on ease of textual understanding F (1, 35) = .676, p = .417, η^2_p = .019 and no significant interaction between the text type and relatedness on ease of textual understanding, F (2, 35) = .174, p = .841, $\eta^2_p = .010$.

Familiarity with The Visual Objects (chocolate bar brands)

According to results of Chi-square tests, there was no significant effect of text type on the familiarity with visual objects for related texts $\chi 2$ (2) = .007, p = .997. Similarly, there was no significant effect of text type on the familiarity for unrelated texts $\chi 2$ (2) = .007, p = .997. Participants hardly ever reported familiarity with the visual objects.

Familiarity with the Texts

According to the results of Chi-square tests, there was no significant effect of text type on text familiarity for related texts $\chi 2$ (2) = .697, p = .706. Similarly, there was no significant effect of text type on text familiarity for unrelated texts $\chi 2$ (2) = 1.469, p = .480. Participants hardly ever reported familiarity with the texts.

Results of the Analysis after Elimination

Frequencies of the Words in Texts

Levene's test showed that the variances were equal, F (5, 24) = .434. A factorial ANOVA revealed that there was no significant effect of text type F (2, 24) = 1.144, p = .335, $\eta^2_p = .087$, relatedness F (1, 24) = 1.082, p = .309, $\eta^2_p = .043$, and interaction of relatedness and text type F (2, 24) = .239, p = .789, $\eta^2_p = .020$ on the frequencies of words. Thus, the words in texts were equally frequent words.

Humor

Levene's test revealed that the variances were equal, F (5, 24) = 1.95. A factorial ANOVA showed that there was a significant main effect of text type on humor ratings, F (2, 24) = 400.55, p < .001, η^2_p = .971. The contrast *Level 1 vs. Later* showed that positive and humorous texts and were rated significantly different [d = -1.822 (SE = 0.112), 95% CI [-2.054, -1.591], p < .001]. The contrast between *Level 2 vs. Level 3* showed positive text and humorous texts were also rated significantly different [d = -3.005 (SE = 0.13), 95% CI [-3.273, -2.737], p < .001]. Pairwise comparisons revealed that humorous texts (M = 5.17, SE = 0.09) were rated significantly more humorous than both positive (M = 2.17, SE = 0.09) and neutral texts (M = 1.85, SE = 0.09) (both ps < .001). However, humor ratings for positive and neutral texts were not significantly different. There was no significant effect of relatedness on humor ratings, F (1, 24) = .525, p = .476, η^2_p = .021. In addition, there was no significant interaction effect between text type and relatedness on humor ratings, F (2, 24) = 2.42, p = .11, η^2_p = .168.

Positivity

Levene's test revealed that the variances were equal, F (5, 24) = 1.43. A factorial ANOVA showed that there was a significant main effect of text type on positivity ratings, F (2, 24) = 61.48, p < .001, η^2_p = .837. The contrast *Level 1 vs. Later* showed that neutral versus positive and humorous texts were rated significantly different [d = -0.953 (SE = 0.097), 95% CI [-1.152, -0.753], p < .001]. The contrast between *Level 2 vs. Level 3* showed that positive and humorous texts were also rated significantly different [d = 0.565 (SE = 0.112), 95% CI [0.335, 0.795], p < .001]. Pairwise comparisons revealed that positive texts (M = 5.35, SE = 0.07) were rated significantly more positive than both humorous (M = 4.79, SE = 0.07) and neutral texts (M = 4.12, SE = 0.07) (both ps < .001). There was no significant effect of relatedness on positivity, F (1, 24) = 3.48, p = .074, η^2_p = .127. In addition, there was no significant interaction between text type and relatedness on positivity, F (2, 24) = .993, p = .385, η^2_p = .076.

Relatedness

Levene's test revealed that the variances were significantly different, F (5, 24) = 2.94, p < .05. According to the results of the factorial ANOVA only the relatedness factor had a significant main effect on the dependent variable relatedness, F (1, 24) = 334.14, p < .001, η^2_p = .933. Chocolate-related texts (M = 4.59, SE = 0.10) were found significantly more related compared to chocolate-unrelated texts (M = 1.9, SE = 0.10) (p < .001). There was no significant effect of text type on relatedness, F (2, 24) = 1.627, p = .217, η^2_p = .119. Furthermore, there was no significant interaction between text type and relatedness on relatedness, F (2, 24) = 1.738, p = .197, η^2_p = .126.

The Ease of Textual Understanding

Levene's test revealed that the variances were equal, F (5, 24) = 1.81. A factorial ANOVA showed that there was no significant main effect of text type, F (2, 24) = 3.155, p = .061, η^2_p = .208 and relatedness, F (1, 24) = 0.64, p = .803, η^2_p = .003 on the ease of textual understanding. Furthermore, there was no significant interaction between text type and relatedness on ease of understanding, F (2, 24) = 1.097, p = .35, η^2_p = .084.

Familiarity with the Visual Objects (Chocolate Bar Brands)

According to the results of Chi-square tests, there was no significant effect of text type on familiarity with the visual objects for related texts, $\chi 2$ (2) = .000, p = 1.000. Also, there was no significant effect of text type on familiarity with the visual objects for unrelated texts, $\chi 2$ (2) = .007, p = .997. Participants hardly ever reported familiarity with the visual objects.

Familiarity with the Texts

According to the results of Chi-square tests, there was no significant effect of text type on text familiarity for related texts, $\chi 2$ (2) = .212, p = .900. In addition, there was no significant effect of text type on text familiarity for unrelated texts, $\chi 2$ (2) = .177, p = .915. Participants hardly ever reported familiarity with the texts.

4.1.2 Results of the Second Pilot Study

The analysis was conducted only with 7 related and 8 unrelated humorous texts in order to see whether there was an effect of visual objects (the chocolate bar brands) on funniness ratings.

Levene's test showed that variances were equal, F (1, 13) = 1.427. A factorial ANOVA revealed that there was an effect of relatedness on funniness ratings, F (1, 13) = 5.229, $p < .05$, η^2_p = .287. Thus, related humorous texts (M = 2.9, SE = 0.26) were found significantly less humorous than unrelated humorous texts (M = 3.72, SE = 0.24) independent of the presence of visual objects.

However, after the selection of the final 5 text and brands pairs for the two relatedness categories, the selected humorous texts were re-analyzed with the same analysis as above. Variances were equal, F (1, 8) = 0.584. Now, there was no significant effect of relatedness on funniness ratings of the chosen 10 humorous texts, F (1, 8) = 1.056, p = .334, η^2_p = .117.

4.2 Results of the Main Study

Results of the main study are investigated with both subject-wise and item-wise analyses. Firstly, the results of the subject-wise analysis, which is the main analysis for the present study, are presented with respect to the hypotheses. Subsequently, the results of the item-wise analysis and additional analyses are presented. Greenhouse-Geisser p values were referred for ANOVA's, through the analyses.

4.2.1 Results referring to the Recognition Memory Hypotheses

Signal Detection Theory (SDT) measurements *d'* and *C* values for each condition are calculated in an attempt to investigate recognition memory. Consequently, for evaluating the recognition memory hypotheses the analyses of hit scores, *d'* and *C* are presented together.

On target items, "yes, I have seen this image" answers were correct and they counted as" hits". On the other hand, on noise items (distracters), "yes, I have seen this image" answers were incorrect and they counted as "false alarms". To calculate the hit rate the number of hits of a participant can be divided by the total number of target items. In an attempt to calculate the false alarm rate the number of false alarms of a participant can be divided by the total number of distractors.

In an attempt to discriminate the recognition memory of items which are associated with different kind of texts, we need to calculate hit rates for every condition (there are six conditions in the present study) of the experiment instead of only one hit rate which can be calculated by dividing hit scores by the total number of targets. Thus, to calculate hit rates the number of hits was divided by the total number of target items in each condition (i.e. 5). However, at this point one should note that, the different categories (text type; relatedness) in the present experiment do pertain to the target items (the visual objects), but to the texts instead which were shown next to the targets in the study phase. Thus, all of the 60 items (targets and distractors) have common features, common colors, and the same shape. However, the distractors do not belong to a specific experimental condition. In other words, there is no specific distractor for a specific target in any specific condition since distractors had not been encountered before. However, in order to apply the same calculation process to distractors, the total number of distractors, which is 30, was also divided by 6 which is the number of items in each condition. Accordingly, the number of false alarms that the participants made was also divided by 6. By doing this correction we assign a specific distractor category to each target category (experimental condition). Afterwards, the number of false alarms for each category was calculated by dividing the false alarms in that category by the number of distractors (i.e. 5). To illustrate the procedure, think of a participant who had a 15 false alarms in 30 distractors. First, 30 was divided by 6, which is 5. 5 is the number of items in the experimental condition. Then, 15 was divided by 6 in order to see how many false alarms were made for each "imaginary" distractor category, which is 2.5. The false alarm rate was then calculated by dividing 2.5 to 5, which is 0.5. For checking purposes, dividing 15 by 30 equals dividing 2.5 by 5. The results are equal in both calculations. However, the important point is applying the same calculation process to both hits and false alarms.

d' is a measure of discriminability and *C* is a measure of bias (the general bias to respond yes or no). In order to calculate *d'* the *z*-scores of the hit rates and the false alarm rates were used. The formulas of *d'* and *C* are as follows (Macmillan, 2002):

d' = *z*-score (hit rates) – *z*-score (false alarm rates)

C= - ½ [*z*-scores (hit rates) + *z*-scores (false alarm rates)]

As explained at the end of literature chapter, *d'* is higher when participants truly discriminate between targets and distractors and lower when they do not. In addition, *C* values below 0 (zero) indicate a liberal bias which means that participants are more willing to say "yes, I have seen this image before" irrespective of the stimulus. Thus, the liberal bias reflects both high hit rates and high false alarm rates. Contrarily, *C* values above 0 show a conservative bias which means that participants are more willing to say "no, I haven't seen this image before" irrespective of the stimulus. Thus, the conservative bias reflects both low hit rates and false alarm rates.

Hypothesis 1

Hypothesis 1 states that if the text is humorous, the visual object associated with humorous text will be recalled less in both immediate and delayed recognition memory tests across all conditions. This hypothesis aims to test the "humor effect" in the literature.

Hit scores, *d'* and *C* in the immediate recognition memory test

Hit scores

A significant effect of text type on hit scores in the immediate recognition memory test was found, F (1.821, 63.742) = 5.769, $p < .05$, $\eta^2_p = .142$. The contrast *Level 1* vs. *Later (2 and 3)* was not significant [F (1, 35) = 3.182, $p = .083$, $\eta^2_p = .083$]; The Helmert contrast *Level 2 vs. Level 3* showed that the hit scores for visual objects associated with positive and humorous texts were significantly different [F (1, 35) = 7.355, $p < .05$, $\eta^2_p = .174$]. Pairwise comparisons showed that there was a significant difference between hit scores of visual objects associated with humorous texts and positive texts ($p < .05$). In addition, there was a significant difference between hit scores of visual objects associated with humorous and neutral texts ($p < .05$). The hit scores for visual objects associated with humorous texts ($M = 3.13$, $SE = 0.15$) was significantly lower than those with neutral texts ($M = 3.62$, $SE = 0.14$) and those with positive texts ($M = 3.65$, $SE = 0.17$) (for a summary of the descriptive statistics (*M, SE*) of all dependent variables across text type and relatedness, see Table 2). Figure 2 shows the average hit scores according to text type and relatedness, respectively. Thus, results revealed that visual objects associated with humorous texts were recognized significantly less than both visual objects associated with positive and neutral texts.

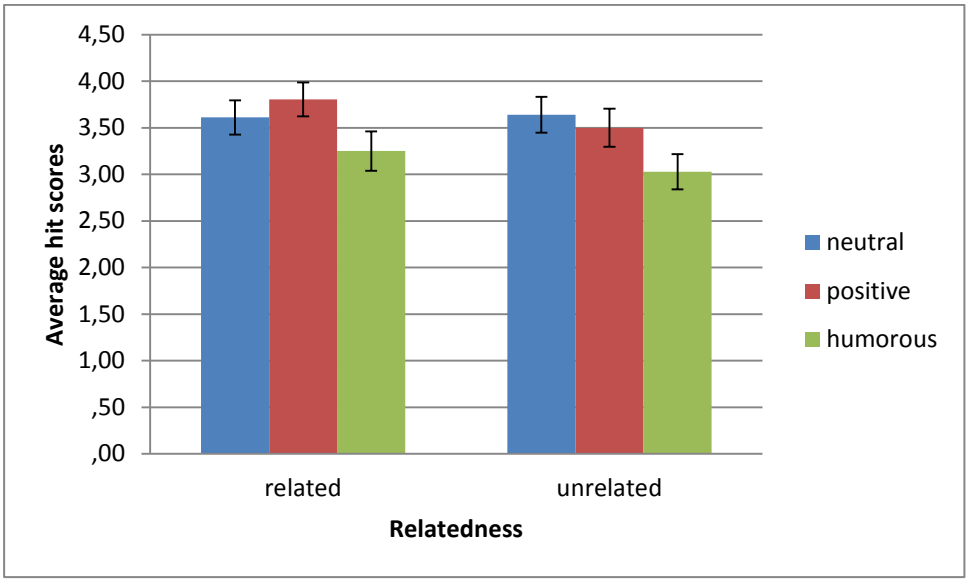

Figure 2 Average hit scores, according to text type and relatedness in the immediate recognition test. Error bars represent *SE*s.

d'

A significant effect of text type on *d'* scores was found, F (1.978, 69.229) = 5.787, p < .01, η^2_p = .142. The contrast *Level 1* vs. *Later (2 and 3)* was not significant [F (1, 35) = .513, p = .479, η^2_p = .014]; the Helmert contrast *Level 2 vs. Level 3* showed that the *d*'s of the visual objects associated with positive and humorous texts were significantly different [F (1, 35) = 11.012, p < .01, η^2_p = .239]. Pairwise comparisons showed a significant difference between *d'* scores of the visual objects associated with humorous texts and positive texts (p < .05). The discriminability (*d'*) of the visual objects associated with humorous texts (M = 1.58, SE = 0.10) was significantly lower than those with positive texts (M = 1.87, SE = 0.12) but insignificantly lower than those with neutral texts (M = 1.78, SE = 0.12) (see Table 2). Figure 3 shows the average *d'* scores according to text type and relatedness, respectively. Thus, the discriminability index (*d'*) of visual objects associated with humorous texts was significantly lower than *d'*s of visual objects associated with positive texts and insignificantly lower than *d'*s of visual objects associated with neutral texts.

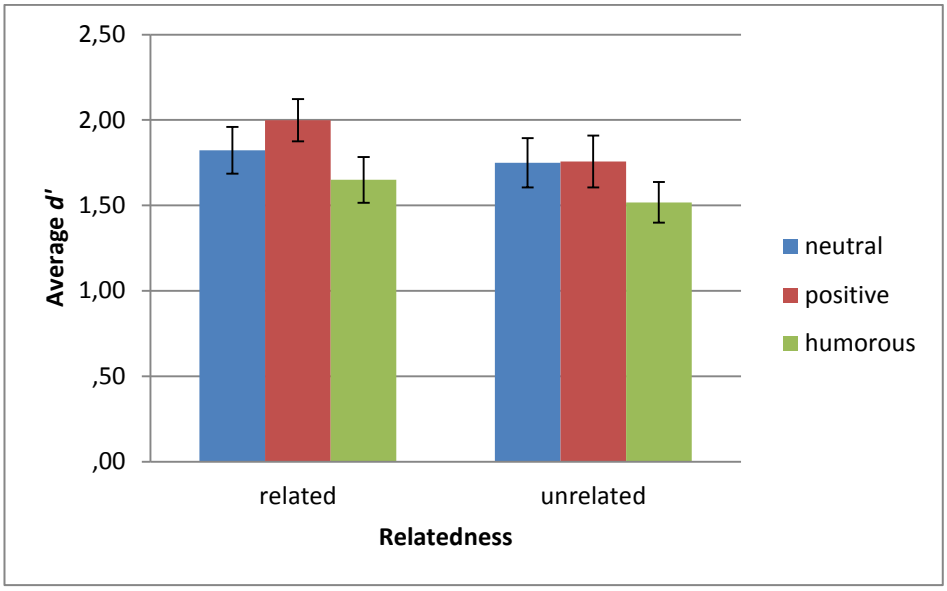

Figure 3 Average *d'*s, according to text type and relatedness in the immediate recognition memory test. Error bars represent *SE*s.

Table 2 Means (*M*) and standard errors (*SE*) of hit scores, *d'*, and *C* for the visual objects associated with the texts in the immediate recognition memory test.

Condition	Hits (*M* (*SE*))	*d'* (*M* (*SE*))	*C* (*M* (*SE*))
Related neutral texts	3.61 (0.18)	1.82 (0.13)	0.32 (0.06)
Related positive texts	3.81 (0.18)	1.99 (0.12)	0.23 (0.05)
Related humorous texts	3.25 (0.21)	1 .64 (0.13)	0.40 (0.07)
Unrelated neutral texts	3.64 (0.19)	1.74 (0.14)	0.35 (0.07)
Unrelated positive texts	3.5 (0.20)	1.75 (0.15)	0.35 (0.06)
Unrelated humorous texts	3.03 (0.18)	1.51 (0.11)	0.47 (0.07)

Criterion *C*

A significant effect of text type on *C* was observed, F (1.978, 69.229) = 5.787, p < .01, η^2_p = .142. The contrast *Level 1* vs. *Later (2 and 3)* was not significant [F (1, 35) = .513, p = .479, η^2_p = .014]; the Helmert contrast *Level 2 vs. Level 3* showed that the *d*'s of the visual objects associated with positive and humorous texts were significantly different [F (1, 35) = 11.012, p < .01, η^2_p = .239]. Pairwise comparisons

showed that there was a significant difference between the *C* scores of the visual objects associated with humorous texts and positive texts ($p < .05$). The *C*'s of the visual objects associated with humorous texts ($M = 0.43$, $SE = 0.06$) were significantly higher than those with positive texts ($M = 0.29$, $SE = 0.05$) but insignificantly higher than those with neutral texts ($M = 0.33$, $SE = 0.05$) (see Table 2). Figure 4 shows the average *C* scores according to text type and relatedness, respectively.

Criterion *C* is above 0 for the visual objects associated with neutral, positive and humorous texts which means that participants have a general, conservative bias for all visual objects and are more willing to say "no, I haven't seen this visual object before". However, participants have a stronger conservative bias for the visual objects associated with humorous texts than visual objects associated with neutral and positive texts.

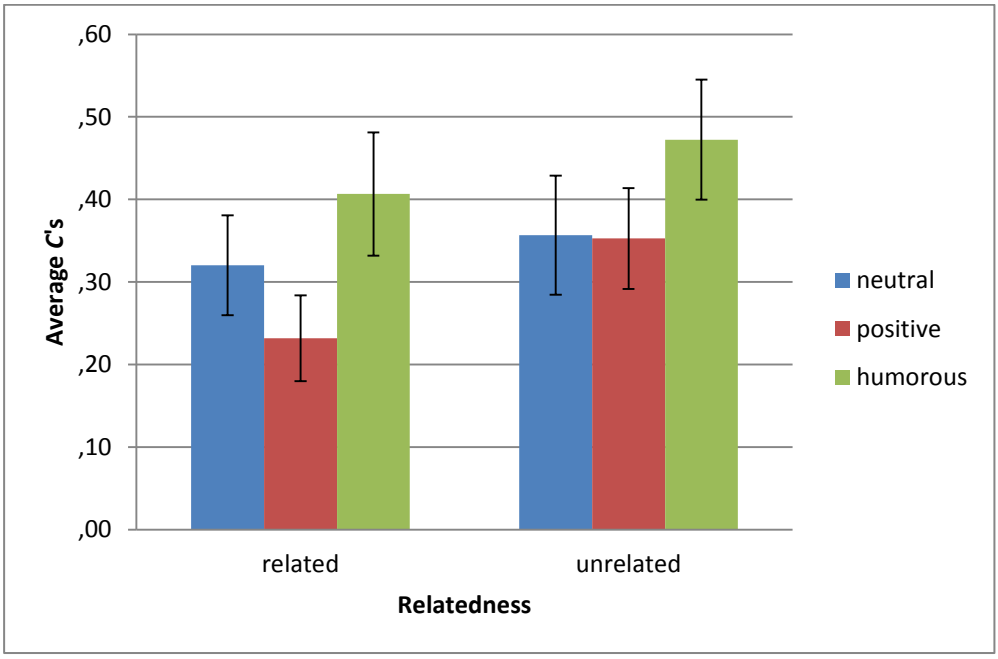

Figure 4 Average *C*'s according to text type and relatedness in the immediate recognition memory test. Error bars represent *SE*s.

Hit scores, *d'* and *C* in the delayed recognition memory test

Hit scores

A repeated measures ANOVA revealed no significant effect of text type F (1.85, 42.556) = 2.832, $p = .074$, $\eta^2_p = .110$ on hit scores in the delayed recognition memory test. Figure 5 shows average hit scores according to text type and relatedness.

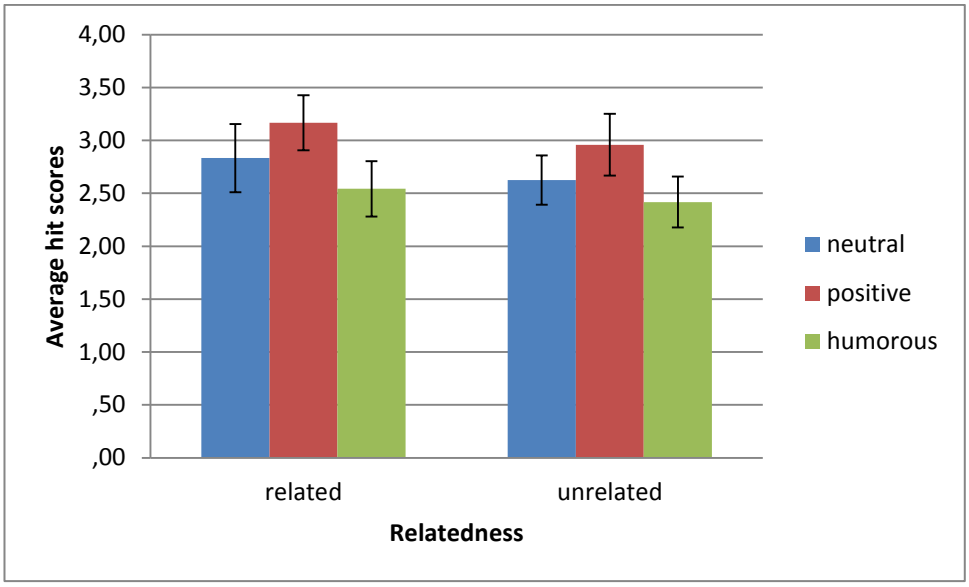

Figure 5 Average hit scores according to text type and relatedness in the delayed recognition memory test. Error bars represent *SE*s.

d'

A significant effect of text type on *d'*s was found, F (1.905, 43.82) = 3.444, $p < .05$, $\eta^2_p = .130$. The contrast *Level 1* vs. *Later (2 and 3)* was not significant [F (1, 23) = .003, $p = .956$, $\eta^2_p = .0001$]; the Helmert contrast *Level 2 vs. Level 3* showed that the *d*'s of the visual objects associated with positive and humorous texts were significantly different [F (1, 23) = 7.072, $p < .05$, $\eta^2_p = .235$]. Pairwise comparisons showed that there was a significant difference between *d'*s of the visual objects associated with humorous texts and positive texts ($p < .05$). The discriminability (*d'*) of the visual objects associated with humorous texts ($M = 0.50$, $SE = 0.09$) was significantly lower than those with positive texts ($M = 0.85$, $SE = 0.12$) but insignificantly lower than those with neutral texts ($M = 0.67$, $SE = 0.10$). Figure 6 shows the average *d'*s according to text type and relatedness (for a summary of the descriptive statistics (*M*, *SE*) of all dependent variables across text type and relatedness, see Table 3).

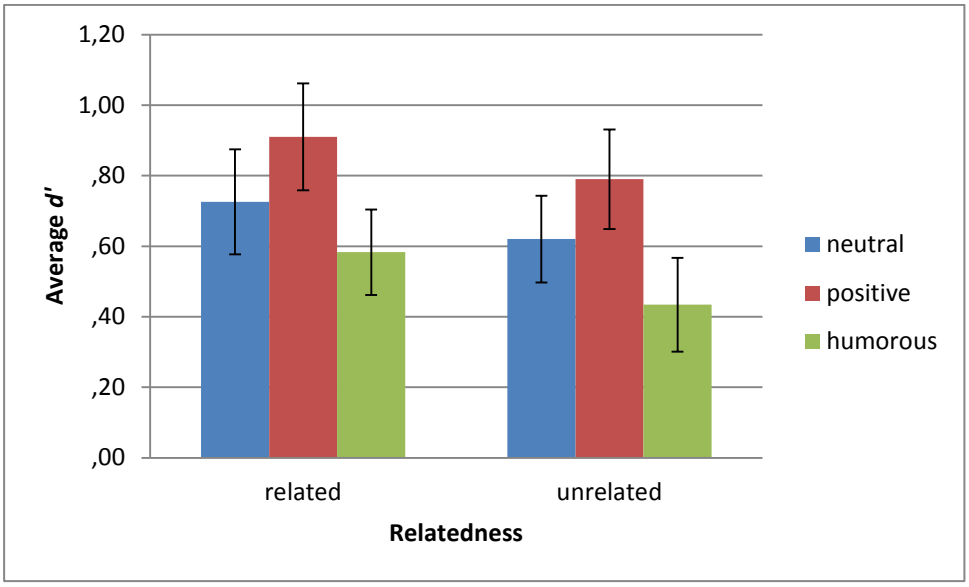

Figure 6 Average *d'*s according to text type and relatedness in the delayed recognition memory test. Error bars represent *SE*s.

Table 3 Means (*M*) and standard errors (*SE*) of hit scores, *d'*, and *C* for the visual objects associated with the texts in the delayed recognition memory test.

Condition	Hits (*M* (*SE*))	*d'* (*M* (*SE*))	*C* (*M* (*SE*))
Related neutral texts	2.83 (0.32)	0.72 (0.14)	0.18 (0.11)
Related positive texts	3.17 (0.26)	0.90 (0.15)	0.09 (0.09)
Related humorous texts	2.54 (0.26)	0.58 (0.12)	0.26 (0.10)
Unrelated neutral texts	2.63 (0.23)	0.61 (0.12)	0.24 (0.09)
Unrelated positive texts	2.96 (0.29)	0.79 (0.14)	0.15 (0.11)
Unrelated humorous texts	2.42 (0.24)	0.43 (0.13)	0.33 (0.09)

Criterion *C*

A significant effect of text type on *C* was found, F (1.905, 43.82) = 3.444, $p < .05$, $\eta^2_p = .130$. The contrast *Level 1* vs. *Later (2 and 3)* was not significant [F (1, 23) = .003, $p = .956$, $\eta^2_p = .0001$]; the Helmert contrast *Level 2 vs. Level 3* showed that the *C*'s of the visual objects associated with positive and humorous texts were significantly different [F (1, 23) = 7.072, $p < .05$, $\eta^2_p = .235$]. Pairwise comparisons

showed that there was a significant difference between the *C*'s of visual objects associated with humorous and positive texts ($p < .05$).

The *C*'s of the visual objects associated with humorous texts ($M = 0.29$, $SE = 0.09$) were significantly higher than those with positive texts ($M = 0.12$, $SE = 0.09$) but insignificantly higher than those with neutral texts ($M = 0.21$, $SE = 0.09$) Figure 7 shows average *C*'s, according to text type and relatedness (see Table 3).

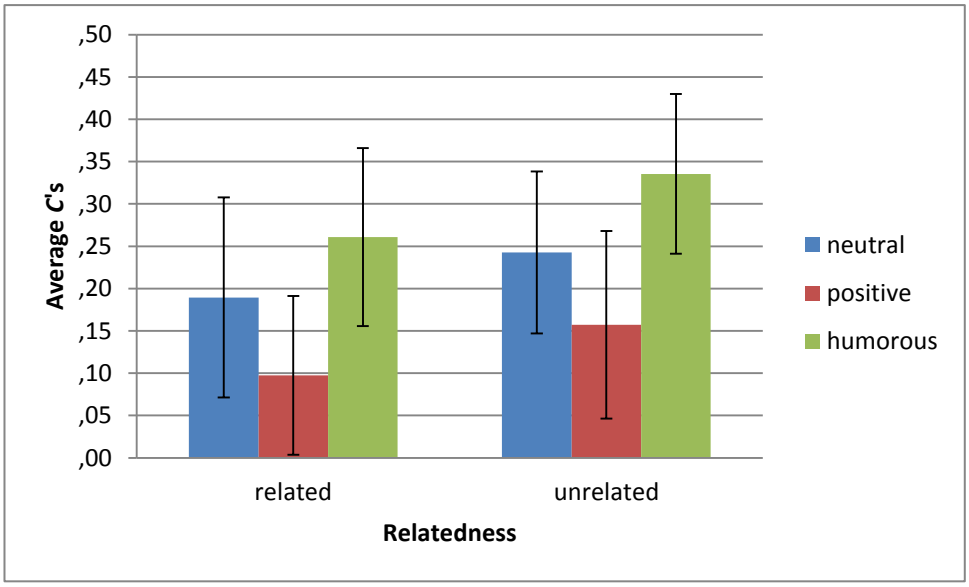

Figure 7 Average *C*'s, according to text type and relatedness in the delayed recognition memory test. Error bars represent *SE*s.

Hypothesis 1 is confirmed. Hypothesis 1 revealed negative effects of humorous texts on the recognition memory of the visual objects associated with those texts compared to the recognition memory of the visual objects associated with positive and neutral texts. Results of the immediate and the delayed recognition memory tests were in the same line, however, in the immediate recognition memory test the effect of text type, relatedness, and the interaction effect between text type and relatedness were more powerful. In addition, results of hypothesis 1 are in line with the humor effect literature. Therefore, hypothesis 2 investigates further whether the relation between text and its associated visual object affects the humor effect.

Hypothesis 2

Hypothesis 2 refers to the effects of relatedness on the humor effect. Accordingly, if texts are related with visual objects, they are recalled better as compared to visual objects associated with unrelated texts in both immediate and delayed recognition memory tests.

Hit scores, *d'* and *C* in the immediate recognition memory test

A repeated measures ANOVA revealed no significant effect of relatedness on hit scores, F (1, 35) = 1.275, p = .266, η^2_p = .035, on *d'*, F (1, 35) = 2.733, p = .107, η^2_p = .072 and on *C*, F (1, 35) = 2.733, p = .107, η^2_p = .072 in the immediate recognition memory.

Hit scores, *d'* and *C* in delayed recognition memory test

A repeated measures ANOVA revealed no significant effect of relatedness on hit scores, F (1, 23) = 1.025, p = .322, η^2_p = .043 on *d'*, F (1, 23) = 1.498, p = .233, η^2_p = .061 and on *C*, F (1, 23) = 1.498, p = .233, η^2_p = .061 in the delayed recognition memory test. Hypothesis 2 is therefore rejected.

Hypothesis 3

Hypothesis 3 refers to the interaction effect between relatedness and text type and states that if text and visual object are related, visual objects in combination with humorous texts will be recalled better compared to visual objects associated with humorous texts in the unrelated condition.

Hit scores, *d'* and *C* in the immediate recognition memory test

A repeated measures ANOVA revealed no interaction effect between relatedness and text type on hit scores, F (1.99, 69.642) = .64, p = .53, η^2_p = .018, on *d'*, F (1.955, 68.412) = .504, p = .602, η^2_p = .014, on *C*, F (1.955, 68.412) =.504, p = .602, η^2_p = .014 in the immediate recognition memory.

Hit scores, *d'* and *C* in delayed recognition memory test

A repeated measures ANOVA revealed no interaction effect between relatedness and text type on hit scores, F (1.911, 43.962) = .025, p = .972, η^2_p = .001 on *d'*, F (1.93, 44.385) = .019, p = .978, η^2_p = .001 on *C*, F (1.93, 44.385) = .019, p = .978, η^2_p = .001 in the delayed recognition memory test. Hypothesis 3 is therefore rejected.

Hypothesis 4

Hypothesis 4 refers to the comparison between hit scores in immediate and delayed recognition memory test. It is hypothesized that the number of correct answers (hit scores) in each condition (related, unrelated; neutral, positive, humorous) in the immediate recognition memory test will be higher than the number of correct answers (hit scores) in the delayed recognition memory test.

In an attempt to test hypothesis 4, an independent variable “test time (immediate, delayed)” was added to the repeated measures ANOVA analysis in addition to the independent variables text type and relatedness. Results showed that test time had a significant effect on hit scores F (1, 23) = 20.778, p < .01, η^2_p = .475. The grand mean of hits in the immediate recognition memory test was 3.55 (*SE* = 0.15) out of 5 and the grand mean of hits in the delayed recognition memory test was 2.75 (*SE* =

0.17) out of 5. In addition, an effect of text type on hit scores, which is investigated in hypothesis 1, was observed, F (1.691, 38.894) = 4.556, $p < .05$, $\eta^2_p = .165$. Furthermore, none of the interaction effects (test time and text type, F (1. 912, 43.979) = .496, $p = .604$, $\eta^2_p = .021$; test time and relatedness, F (1, 23) = .558, $p = .463$, $\eta^2_p = .024$; test time, text type and relatedness, F (1.888, 43.426) = 1.347, $p = .27$, $\eta^2_p = .055$) were significant.

Hypothesis 4 is therefore confirmed. Participants were significantly better at recognizing items in the immediate recognition memory test compared to the delayed recognition memory test.

4.2.2 Results referring to the Response Times Hypotheses

Hypotheses 5-6-7

Hypotheses 5, 6 and 7 refer to the effects of text type, relatedness and the interaction effect between text type and relatedness on the response times. It is hypothesized that response times for visual objects associated with humorous texts will be higher (Hypothesis 5). In addition, the relation between text and its associated visual object will decrease response times (Hypothesis 6). Furthermore, in hypothesis 7, it is hypothesized that the relatedness of visual object and text would decrease response times mostly for related humorous text and visual object pairs compared to unrelated humorous text and visual object pairs in both immediate and delayed recognition memory tests. Additionally, the response time difference between related and unrelated texts will not be observed as strongly for positive and neutral texts as it is for humorous texts.

Response times in the immediate recognition memory test

The grand mean of response times was 2855.8 (SE = 52.82) milliseconds and the grand mean of response times of hits was 2689.7 (SE = 51.39) milliseconds for the immediate recognition memory test. A repeated measures ANOVA revealed that there was no significant effect of relatedness, F (1, 35) = 2.413, $p = .129$, $\eta^2_p = .065$, text type, F (1.838, 64.342) = 1.762, $p = .182$, $\eta^2_p = .048$, and the interaction between text type and relatedness, F (1.95, 68.25) = .567, $p = .566$, $\eta^2_p = .016$ on response times.

An additional response time analysis was also performed in an attempt to investigate whether response time differences were observable for hit scores. Because, as Strick et al. (2010) suggest, response times of hit scores could be an indicator of accessibility of items in recognition memory. However, a repeated measures ANOVA revealed that there was no significant effect of relatedness, F (1, 35) = 1.873, $p = .18$, $\eta^2_p = .051$, text type, F (1.823, 63.818) = 1.955, $p = .154$, $\eta^2_p = .053$, and the interaction between text type and relatedness, F (1.949, 68.205) = .223, $p = .795$, $\eta^2_p = .006$ on response times of hits.

Response times in the delayed recognition memory test

The grand mean of response times was 2755.2 milliseconds (*SE* = 71.12) and the grand mean of response times of hits was 2610.9 (*SE* = 94.06) milliseconds for the delayed recognition memory test. A repeated measures ANOVA revealed that there was no significant effect of relatedness, F (1, 23) = .039, p = .845, η^2_p = .002, text type F (1.551, 35.665) = 1.19, p = .306, η^2_p = .049, and the interaction between text type and relatedness, F (1.619, 37.234) = 1.138, p = .321, η^2_p = .047 on response times.

A repeated measures ANOVA revealed that there was no significant effect of relatedness, F (1, 23) = 2.049, p = .166, η^2_p = .082, text type F (1.882, 43.28) = .633, p = .527, η^2_p = .027 and the interaction between text type and relatedness, F (1.736, 39.933) = .239, p = .757, η^2_p = .01 on response times of the hits. Hypotheses 5, 6, and 7 are therefore rejected.

4.2.3 Results referring to the Eye-Tracking Hypotheses

Two Areas of Interest (AOI's) were determined for each object-text pair. One was located on the visual object and the other one on the text (see Figure 8). The AOI for the texts was 13 cm in height and 11.5 cm in width. The AOI for the visual object was 9.5 cm in height and 11.7 cm in width (based upon 1366×768 screen resolution). Before the determination of the AOI's all eye gazes of all participants were checked cumulatively and an AOI frame was tried to be drawn which included all gazes in order not to miss any eye gaze. In order to determine the spatial gap between the two AOI's the presence and locations of the gazes were checked.

Figure 8 The two AOI's on visual object and text

In an attempt to investigate how much time participants spend in an AOI, "Total Visit Duration" was chosen from Tobii Studio metrics. Total visit duration measures

the duration of all visits in an AOI. It starts with the first fixation of participants and lasts until the end of last fixation of participants within the same AOI.

Hypothesis 8

Hypothesis 8 tries to answer the question whether humorous texts attract more attention than positive and neutral texts and states that if the text is humorous looking times for the text will increase in comparison with the other text types.

A repeated measure ANOVA revealed that there was a main effect of text type on the total visit durations of the texts F (1.603, 56.114) = 5.957, $p < .05$, $\eta^2_p = .145$. The Helmert contrast *Level 2 vs. Level 3* was not significant [F (1, 35) = 2.637, $p = .113$, $\eta^2_p = .07$]; however, *Level 1 vs. Later (2 and 3)* showed that total visit duration for neutral vs. positive and humorous texts differed significantly [F (1, 35) = 15.792, $p < .001$, $\eta^2_p = .311$]. Pairwise comparisons revealed that there was only a significant difference between the total visit durations of humorous texts and neutral texts ($p < .05$). The average visit duration time of humorous texts ($M = 5.98$, $SE = 0.19$) was insignificantly longer than of positive ($M = 5.78$, $SE = 0.20$) ones and significantly longer than of neutral texts ($M = 5.64$, $SE = 0.18$) (for a summary of the descriptive statistics (*M*, *SE*) of all dependent variables across text type and relatedness, see table 4). Figure 9 shows the average of total visit durations of texts, according to text type and relatedness.

Table 4 Means (*M*) and standard errors (*SE*) of total visit durations of visual objects and texts, and number of switches between two AOI's.

Condition	Total visit durations of visual objects (*M* (*SE*))	Total visit durations of texts (*M* (*SE*))	Number of switches between two AOI's (*M* (*SE*))
Related neutral	3.29 (0.20)	5.85 (0.19)	2.85 (0.14)
Related positive	3.14 (0.21)	6.01 (0.20)	2.67 (0.12)
Related humorous	3.46 (0.21)	5.62 (0.19)	3.03 (0.15)
Unrelated neutral	3.67 (0.21)	5.43 (0.18)	2.84 (0.16)
Unrelated positive	3.57 (0.23)	5.56 (0.22)	2.76 (0.16)
Unrelated humorous	2.90 (0.21)	6.34 (0.21)	2.33 (0.11)

Hypothesis 8 is partially confirmed. As hypothesized humorous texts attracted more attention compared to neutral and positive texts, however, the difference between humorous texts and positive texts was not significant.

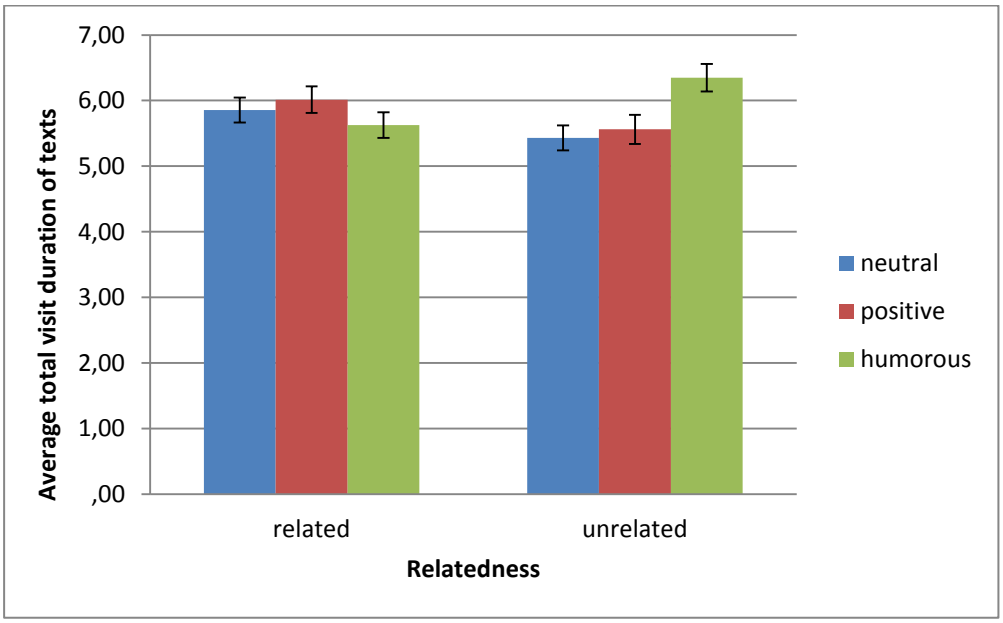

Figure 9 Average total visit durations of texts, according to text type and relatedness. Error bars represent *SE*s.

Hypothesis 9

Hypothesis 9 is the complementary hypothesis of Hypothesis 8. It is hypothesized that if the text is humorous, looking time for the visual object associated with humorous text will decrease in comparison with the objects associated with other texts.

A repeated measure ANOVA revealed that there was a main effect of text type, F (1.74, 60.907) = 4.437, $p < .05$, $\eta^2_p = .113$ on the total visit durations of the visual objects. The Helmert contrast *Level 2 vs. Level 3* was not significant [F (1, 35) = 2.195, $p = .147$, $\eta^2_p = .059$]; however, *Level 1 vs. Later (2 and 3)* showed that total visit duration for visual objects associated with neutral vs. positive and humorous differed significantly [F (1, 35) = 9.36, $p < .01$, $\eta^2_p = .211$]. Pairwise comparisons revealed that there was a significant difference between the total visit durations of the visual objects associated with humorous texts and neutral texts ($p < .05$). The average visit duration times of visual objects associated with humorous texts ($M = 3.18$, $SE = 0.20$) was insignificantly shorter than those with positive texts ($M = 3.36$, $SE = 0.21$) but significantly shorter than those with neutral ones ($M = 3.48$, $SE = 0.19$) (see table 4). Figure 10 shows the average total visit durations of visual objects according to text type and relatedness.

Hypothesis 9 is partially confirmed. Results showed that visual objects associated with humorous texts were looked at less than visual objects associated with other text types. Because each participant spent exactly the same amount of time (10 seconds) to look at each visual object and text pair, hypothesis 8 and 9 yielded complementary (and therefore redundant) results.

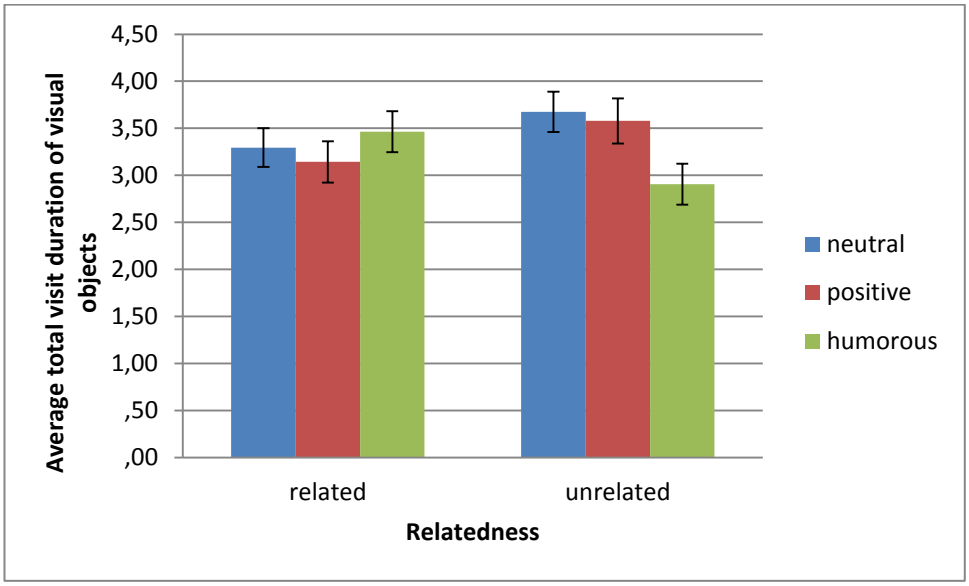

Figure 10 Average total visit durations of visual objects, according to text type and relatedness. Error bars represent *SE*s.

Hypothesis 10

Hypothesis 10 refers to the effects of relatedness on total viewing times of the texts. Accordingly, it states that if the texts are related with the visual objects, total viewing time of the related texts will be less compared to the unrelated texts.

A repeated measure ANOVA revealed that there was no main effect of relatedness on the total visit durations of the texts, F (1, 35) = .478, p = .494, η^2_p = .013.

The relatedness between text and visual object did not reveal less looking times for related pairs. In other words, the looking times of texts were not affected by the relatedness between text and visual object. Hypothesis 10 is therefore rejected.

Hypothesis 11

Hypothesis 11 refers to the effects of relatedness on total viewing times of the visual objects and states that if the texts are related with the visual objects, total viewing time of the objects in the related conditions will be higher compared to the unrelated condition.

A repeated measure ANOVA revealed that there was no main effect of relatedness on the total visit durations of the visual objects, F (1, 35) = 1.079, p = .306, η^2_p = .030.

As the results of hypothesis 10 suggest, the looking times of visual objects were not affected by the relatedness between text and visual object. Hypothesis 11 is therefore rejected.

Hypothesis 12

Hypothesis 12 refers to the interaction effect between relatedness and text type on total looking times. It is hypothesized that, if text and visual object are related, total viewing time of humorous text will be less and total viewing time of visual objects associated with humorous texts will be higher compared to viewing times of the unrelated humorous condition.

A repeated measure ANOVA revealed that there was a significant interaction effect of text type and relatedness on total visit durations of texts, F (1.749, 61.228) = 25.114, $p < .05$, $\eta^2_p = .418$ (see Figure 9). For related texts participants significantly looked longer to positive texts (M = 6.01, SE = 0.20) than to neutral texts (M = 5.85, SE = 0.19) and humorous texts (M = 5.62, SE = 0.19). However, for the unrelated texts total visit duration of humorous texts (M = 6.34, SE = 0.21) was significantly longer than positive (M = 5.53, SE = 0.22) and neutral texts (M = 5.43, SE = 0.18) (see Table 4).

In addition, there was a significant interaction effect of text type and relatedness on total visit durations of visual objects, F (1.678, 58.716) = 17.735, $p < .05$, $\eta^2_p = .336$ (see Figure 10). For related texts participants looked significantly longer at the visual objects associated with humorous texts (M = 3.46, SE = 0.21) than those with neutral texts (M = 3.29, SE = 0.20) and positive ones (M = 3.14, SE = 0.21). However, for unrelated texts total visit durations of the visual objects associated with humorous texts (M = 2.90, SE = 0.21) were significantly shorter than those with positive (M = 3.57, SE = 0.23) and neutral ones (M = 3.67, SE = 0.21) (see Table 4).

Hypothesis 12 is therefore confirmed. As hypothesized participants spent less time looking at related humorous texts compared to unrelated humorous texts. In addition, participants' looking times for related humorous texts were the lowest across related texts. Contrarily, in unrelated conditions participants spent more time looking at humorous texts as compared to other unrelated texts.

Hypothesis 13

It is hypothesized that because of the presence of a relation between texts and visual objects in related conditions the number of saccades (switches) between the text and its associated visual object will be higher in related conditions compared to unrelated conditions.

In an attempt to investigate hypothesis 13, participants' eye gaze switches between the two AOI's were counted one by one per participant and per text-visual object pair.

The results of a repeated measures ANOVA revealed a significant effect of relatedness F (1, 35) = 4.663, $p < .05$, $\eta^2_p = .118$ but no significant effect of text type

F (1.743, 61.013) =1.362, p = .263, η^2_p = .037 on the number of switches. The number of switches for related pairs was significantly higher (M = 2.85, SE = 0.12) than for unrelated pairs (M = 2.64, SE = 0.11). In addition, there was a significant interaction effect of text type and relatedness on the number of switches F (1.973, 69.069) = 9.847, p < .05, η^2_p = .22 (see Figure 11). The interaction effect showed that the difference in the switches between humorous and positive conditions was significantly different for related and unrelated conditions [F (1, 35) =18.529, p < .01, η^2_p = .346]. For related conditions, the number of switches for humorous pairs (M = 3.03, SE = 0.15) was higher than the switches for neutral (M = 2.85, SE = 0.14) and positive pairs (M = 2.67, SE = 0.12). For unrelated conditions, the number of switches for humorous pairs (M = 2.33, SE = 0.11) was lower than for positive (M = 2.76, SE = 0.16) and neutral pairs (M = 2.84, SE = 0.16) (see Table 4).

Hypothesis 13 is therefore confirmed. As hypothesized, participants' number of eye gaze switches was higher in related conditions compared to unrelated conditions. Furthermore, while in related conditions the eye gaze switches of participants were the highest for humorous texts, in unrelated conditions participants' eye gaze switches were the lowest for humorous texts.

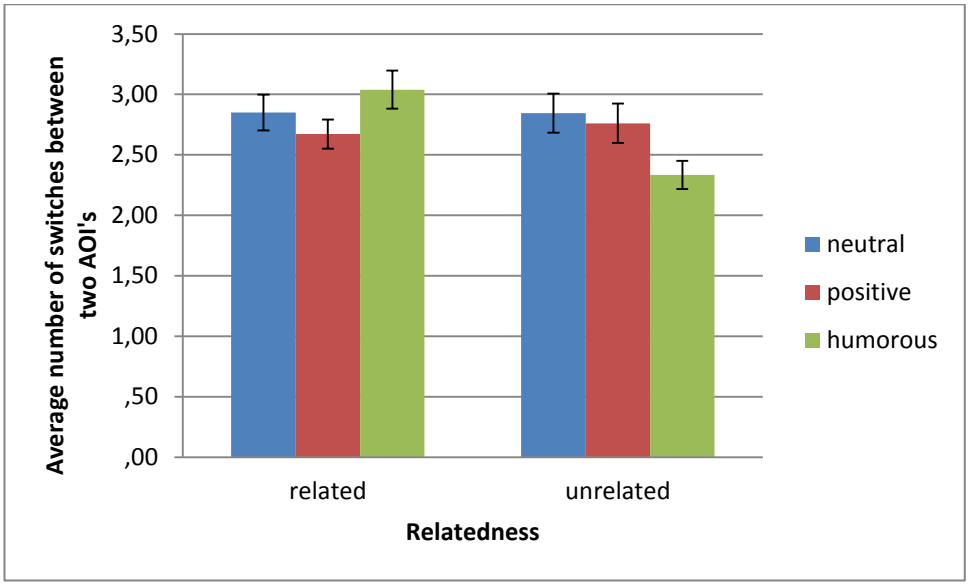

Figure 11 Average number of eye gaze switches between the two AOI's, according to text type and relatedness. Error bars represent *SE*s.

Hypothesis 14

The last hypothesis refers to the correlation between looking times and recognition memory. It is hypothesized that there is a positive correlation between the looking times in the behavioral experiment and correct answers in the recognition memory tests for the visual objects.

In an attempt to investigate the direct relation between looking times of visual objects of participants and their recognition performance in both immediate and

delayed recognition memory tests, a correlation analysis was performed between the hits of participants in immediate and delayed recognition memory tests and total visit durations of visual objects of participants. This correlation analysis should inform us whether the differential recognition performance of the visual objects in the behavioral test is based on differential looking times at these visual objects in the study phase. The expectation is that the longer a subject inspects the visual object in the study phase the more likely she will recognize them in the test phase. Recognition is then a function of study time.

Correlation between the hit scores in the immediate recognition memory test and total visit durations of visual objects

Correlation analyses with Pearson product-moment correlation coefficients revealed that there was a significant relationship between the total visit durations of visual objects and the number of hits in the immediate recognition memory test, grand r = .28, p < .01. This grand correlation showed that there was a correlation between looking times and hits in the overall data. The grand correlation only showed the overall positive correlation between the variables; however, it is also important to know the strength of the correlation in the specific conditions. Thus, in order to see the strength and the range of the correlations in separate conditions, subsequent correlation analyses were performed for each experimental condition (see Table 5). Note that the total visit durations of the visual objects in each condition were correlated with the recognition scores in that condition, respectively.

Table 5 Correlation coefficients for each experimental condition and significance values

Condition	Correlation coefficient and significance
Related neutral condition	r = .44, p < .01
Related positive condition	r = .18, p > .05
Related humorous condition	r = .35, p < .05
Unrelated neutral condition	r = .33, p < .05
Unrelated positive condition	r = .02, p > .05
Unrelated humorous condition	r = .37, p < .05

Table 5 reveals that overall, correlation coefficients are positive, ranging from .02 < r < .44. Only total visit durations of visual objects associated with related positive and unrelated positive texts were not significantly correlated with the number of hits in those conditions, r = .18, r = .02, respectively, (both ps > .05). Correlations in these conditions yielded the lowest correlations whereas correlations in the related neutral condition and unrelated humorous condition yielded the highest correlations.

These correlations suggest that participants are better at recognizing visual objects when they look at them longer in the overall data. However, there was no statistically significant relation between looking times of visual objects and hits in the immediate recognition memory test for both related and unrelated positive texts. In other words, for visual objects associated with positive texts, the total number of hits of

participants for visual objects associated with positive texts was not directly affected by the total visit duration of those visual objects. This may show that participants have a "positivity bias" for visual objects associated with positive texts. Mainly because of this positivity bias seen in the correlation results, normalized looking time scores of each subject for each visual object were calculated. The calculation was done by using the below formula (Köksal, 2012):

$$Normalized\ score = \frac{\text{hit score of a participant in a specific condition} \times \text{mean total visit duration of that condition across all subjects}}{\text{actual total visit duration of specific participant in that condition}}$$

By normalization, a ratio was obtained which shows the relation between the looking times and number of hits – irrespective of the differential looking times. In other words, by calculating normalized scores, looking times with respect to hits were equalized. The expectation was that any significant effect found in the above reported ANOVAs based on raw, non-normalized looking times should vanish. Accordingly, a repeated measures ANOVA was performed with normalized scores in an attempt to see their range in the different conditions. The results revealed no significant effect of text type, F (1.579, 55.26) = 2.909, p = .075, η^2_p = .077, relatedness, F (1, 35) = .102, p = .752, η^2_p = .003, nor any interaction between text type and relatedness, F (1.891, 66.195) = .084, p = .911, η^2_p = .002, on normalized scores.

Repeated measures ANOVA of normalized scores of total visit duration of visual objects showed that participants' performance in the immediate recognition memory test relied on the length of looking time of visual object. The repeated measures ANOVA on normalized scores can be considered as a control analysis for the previously conducted repeated measures ANOVA on non-normalized scores. Thus, both analyses, complementarily, showed that participants' hit scores and looking times correlate positively for the immediate recognition memory test.

Correlation between the hit scores in the delayed recognition memory test and total visit durations of visual objects

Correlation analyses revealed that there was no significant relationship between the total visit durations of visual objects and the number of hits in the delayed recognition memory test, grand r = .14, p > .05. Since the grand correlation was insignificant, no further analyses for the specific conditions were conducted.

Therefore, hypothesis 14 is partially confirmed. While there was a positive correlation between the hit scores in the immediate recognition memory test and total visit durations of visual objects, no correlation was found between the number of hits in the delayed recognition memory test and the total visit durations of visual objects.

4.2.4 Results of Item-wise Analyses

In our experimental dataset, one text could be distinct from another text in terms of the linguistic mechanism underlying its construction, such as ambiguity resolution in the case of humorous texts. Likewise, one visual object could be distinct from another one either because it is more colorful than others, or the writings on the chocolate bar is more attractive than others. In order to assess whether there are such differences in visual objects and texts in our dataset an item-wise analysis was performed, complementing the previously reported subject-wise analysis. Note that in an item-wise analysis the previous within-subject factors "text type" and "relatedness" now become between-item factors because each item can either be a neutral, a positive, or a humorous one and a related or an unrelated one. Thus the ANOVA type changes from within-subjects to between-items.

Behavioral Results

Immediate recognition memory test

Hits

Levene's test showed that the variances between the categories were equal, F (5, 24) = 1.196, $p > .05$. A two-way ANOVA revealed that there was no significant effect of relatedness, F (1, 24) = .702, p = .41, η^2_p = .028, text type F (2, 24) = 1.538, p = .235, η^2_p = .114 and interaction between text type and relatedness, F (2, 24) = .049, p = .952, η^2_p = .004 on hit scores.

d' is the measure showing the capability of a participant to detect old (targets) and new items (distractors) in a recognition memory test. *C* is the measure of bias of each participant. Thus, *C*s cannot be calculated for items. Because in the item-wise analysis the analysis is based upon the items of the study *d'* and *C* were not calculated for items and thus, no analysis referring to *d'* and *C* is reported in item-wise analyses.

Response times

Levene's test showed that the variances between the categories were equal, F (5, 24) = 1.769, $p > .05$. A two-way ANOVA revealed no significant effect of relatedness, F (1, 24) = 2.2, p = .151, η^2_p = .084 and no significant effect of text type on response times, F (2, 24) = 1.339, p = .281, η^2_p = .10. In addition, no interaction effect between relatedness and text type was observed, F (2, 24) = .432, p = .654, η^2_p = .035.

Response times of hits

Levene's test showed that the variances between the categories were equal, F (5, 24) = .758, $p > .05$. A two-way ANOVA revealed that there was no significant effect of relatedness, F (1, 24) = 1.626, p = .214, η^2_p = .063, text type F (2, 24) = 1.866, p = .177, η^2_p = .134, and interaction between text type and relatedness, F (2, 24) = 1.045, p = .367, η^2_p = .08 on response times of hits.

Delayed recognition memory test

Hits

Levene's test showed that the variances between the categories were equal, F (5, 24) = 2.032, $p > .05$. A two-way ANOVA revealed no significant effect of relatedness, F (1, 24) = .271, p = .607, η^2_p = .011 and no significant effect of text type on hit scores, F (2, 24) =.951, p = .400, η^2_p = .073. Also, no interaction effect between relatedness and text type was observed, F (2, 24) = .006, p = .994, η^2_p = .001.

Response times

Levene's test showed that the variances between the categories were equal, F (5, 24) = 1.42, $p > .05$. A two-way ANOVA revealed that there was no significant effect of relatedness, F (1, 24) = .041, p =.842, η^2_p = .002, text type, F (2, 24) = 1.218, p = .313, η^2_p = .092 and interaction between relatedness and text type, F (2, 24) = 1.386, p = .269, η^2_p = .104 on response times.

Response times of hits

Levene's test showed that the variances between the categories were equal, F (5, 24) = 2.053, $p > .05$. A two-way ANOVA revealed that there was no significant effect of relatedness, F (1, 24) = .26, p = .872, η^2_p = .001, text type F (2, 24) = 1.174, p = .326, η^2_p = .089, and interaction between text type and relatedness, F (2, 24) = .256, p =.777, η^2_p = .021 on response times of hits.

From these overall null-results of the item-wise analysis, we can conclude that items did not differ substantially between the experimental conditions, in contrast to the subject-wise analysis. This finding may be due to the small number of items in each category, namely n=5, as compared to the much higher number of subjects in the subject-wise analysis, namely n=36. Furthermore, the item-wise analysis was a factorial, between-items analysis as compared with the repeated-measures, within-subject analysis in the subject-wise analysis. Both these factors may have reduced the power of the analysis to detect any effects related to the experimental variables "relatedness", "text type", and their interaction.

Eye-Tracking Results

Total visit durations of visual objects

Levene's test showed that the variances between the categories were not equal, F (5, 24) = 2.833, p = .038. A two-way ANOVA revealed that there was no significant effect of relatedness, F (1, 24) = .339, p = .566, η^2_p = .014 and text type F (2, 24) = 1.407, p = .264, η^2_p = .105 on total visit durations of the visual objects. However, there was a significant interaction effect of text type and relatedness on total visit durations of visual objects, F (2, 24) = 4.815, $p < .05$, η^2_p = .286. For related texts, visual objects associated with humorous texts were looked at significantly longer (M = 3.46, SE = 0.21) than those with positive texts (M = 3.14, SE = 0.21) and neutral

ones (M = 3.29, SE = 0.20). However, for unrelated texts, visual objects associated with humorous texts were looked at (M = 2.90, SE = 0.21) significantly shorter than those with positive (M = 3.57, SE = 0.23) and neutral ones (M = 3.67, SE = 0.21).

Total visit durations of texts

Levene's test showed that the variances between the categories were equal, F (5, 24) = 1.653, $p > .05$. A two-way ANOVA revealed that there was no significant effect of relatedness, F (1, 24) = .103, p = .751, η^2_p = .004 and text type F (2, 24) = 1.6, p = .223, η^2_p = .118 on total visit durations of texts. However, there was a significant interaction effect of text type and relatedness on total visit durations of visual objects, F (2, 24) = 5.989, $p < .01$, η^2_p = .333. For related texts, positive texts were looked at significantly longer (M = 6.01, SE = 0.20) than humorous (M = 5.62, SE = 0.19) and neutral texts (M = 5.85, SE = 0.19). However, for unrelated texts, humorous texts (M = 6.34, SE = 0.21) were significantly looked at longer than positive (M = 5.56, SE = 0.22) and neutral texts (M = 5.42, SE = 0.18). This result of the visit durations of texts mirrors the results of the visit durations of their associated visual images, reported above.

Number of switches between visual objects and texts

Levene's test showed that the variances between the categories were equal, F (5, 24) = .242, $p > .05$. A two-way ANOVA revealed that there was no significant effect of relatedness, F (1, 24) = 1.961, p = .174, η^2_p = .076, text type F (2, 24) =.445, p = .646, η^2_p = .036, and interaction between text type and relatedness, F (2, 24) = 2.862, p=.077, η^2_p = .193 on the number of switches between visual objects and texts.

To sum up, according to the results of the item-wise analysis, no distinctive differences between texts or visual objects were detected in our dataset.

The results of item-wise analysis were much weaker than those of the subject-wise analysis. Many of the significant effects in the subject-wise analysis were not found significant in the item- wise analysis. This could be because of the difference in the number of items which we included in the analyses. In the subject-wise analysis there were 36 measures for each subject and in each column the results of the behavioral or eye-tracking measurements of each participants for each experimental condition were located separately. Thus, the behavioral and eye-tracking measurements were our within-subject factors in the repeated measures ANOVA. However, in the item-wise analysis there were only 5 measures for each visual object and text pairs. Also, behavioral and eye-tracking measurements were between-item factors and a two-way between-item ANOVA was performed. While in the item-wise analysis items were collapsed over 5 items, i.e., there were few items in each category, in the subject-wise analysis items were collapsed over 36 subjects. Therefore, in the item-wise analysis the previously significant effects and were not observable anymore. Mainly because of this reason, the subject-wise analysis was chosen as the main analysis for this study.

4.2.5 Additional Analysis 1: Probability of Recognizing Visual Objects by Chance Only

A one sample *t*-test was performed in order to see whether participants answered the questions in immediate and delayed memory tests by chance only or whether they attended the task intentionally and attentively. It is assumed that if participants did not pay attention to visual objects and answered the questions by chance they would answer either "No, I haven't seen this visual object" or "Yes, I have seen this visual object" to all questions randomly. In such a case, participants would have, on average, produced 50%, i.e., 30 correct and 30 incorrect answers in total because there are 60 total visual objects of which 30 had previously been seen in the study phase and 30 of which had not been seen.

In an attempt to analyze whether participants' total correct scores differed significantly from 30, a one sample *t*-test was performed. In order to conduct this analysis, the total number of correct answers of participants, which is the total number of hits plus the total number of correct rejections, were counted for both immediate and delayed recognition memory tests separately. To analyze whether participants' total correct scores differed from 30, a test value of 30 (corresponding to 50%) was chosen against which the actual number of participants' correct answers was compared.

The result of the one sample *t*-test revealed that the mean correct answers score in the immediate recognition memory test (M = 46.69, SE = 0.92) was significantly higher than the score of 30. In other words, the statistically significant mean difference is 16.69, 95% *CI* [14.82, 18.56], t (35) = 18.08, $p < .01$.

A one sample *t*-test revealed that the mean correct answers score in the delayed recognition memory test (M = 37.83, SE = 0.77) was significantly higher than the score of 30. In other words, the statistically significant mean difference is 7.83, 95% *CI* [6.23, 9.43], t (23) = 10.11, $p < .01$.

Summarizing the results of the one-sample *t*-tests, there is a significant difference between the total number of correct answers of participants in both recognition memory tests, as compared against the test value of 30. These results suggest that participants intentionally attended both recognition memory tests and did not answer the questions by chance only – not even in the delayed recognition test.

4.2.6 Additional Analysis 2: Probable Effects of Filler Task Duration on Recognition Memory Measurements

The filler task occurred between the study phase and the immediate recognition memory test and it consisted of 15 mental arithmetic questions. It was a self-paced experiment and each participant completed the task in approximately 4 minutes (M = 3.63, SD = 0.84). Although the duration of the filler task did not vary widely across participants, for the purposes of checking an additional repeated measures ANOVA with the covariate "filler task duration" was performed in an attempt to investigate whether participants' hit scores were affected by the different duration of the filler

task or not. One should note that, because there was no effect of relatedness, text type and interaction effect on the hit scores of the delayed recognition memory test, the probable effects of filler task duration were checked only for hit scores of the immediate recognition memory test.

Accordingly, the results showed that filler task duration did not affect the hit scores F (1, 34) =.026, p = .872, η^2_p = .001. In addition, none of the interaction effects (filler task duration and text type, F (1. 808, 61.455) = 2.558, p = .091, η^2_p = .07; filler task duration and relatedness, F (1, 34) = .028, p = .867, η^2_p = .001; filler task duration, text type and relatedness, F (1.989, 67.611) =.188, p = .828, η^2_p = .005) were significant. Results suggest that, the difference in the filler task durations of participants did not significantly affect their recognition memory performance in the immediate recognition memory test.

4.2.7 Additional Analysis 3: Probable Effects of Ambiguity in the Texts on Looking Times of Texts

In each of the humorous texts in the present study, there are two scripts that are consistent in their own right but incongruous with each other. Thus, the humorous texts conform to the Incongruity Theory and the Semantic Script Theory of Humor (SSTH). As explained in the literature part, ambiguous words can be used in order to create incongruity in humor (Shultz, 1972, 1974). In the related humorous texts no ambiguous words were used and humor was created with the incongruity between the first and second parts of the jokes. However, two unrelated texts consisted of homograph words which created ambiguity. In addition, in order to understand the joke one needs to resolve those ambiguities (see Appendix A, B and Discussion for further details). Consequently, in an attempt to investigate the effects of ambiguous words in texts on participants' looking times of texts, an additional paired samples *t*-test was conducted. Before the analysis, total looking times of texts were normalized with respect to the exact number of words in texts[2]. The paired samples *t*-test revealed that looking times of unrelated humorous texts containing ambiguous words (M = 6.62, SE = 0.28) and unrelated humorous texts not containing ambiguous words (M = 6.22, SE = 0.19) did not differ significantly, 95% CI [-0.008, 0.812], t (35) = 1.988, p = .055. Although the significance value (p = .055) is relatively close to being statistically significant, strictly statistically, results revealed no statistically significant difference between texts containing ambiguous words and texts not containing ambiguous words (see also Discussion chapter).

[2] The normalized score of a specific subject for a specific text was calculated as follows: (looking time of that participant in a specific text × grand mean of number of words in either ambiguity containing or not containing texts) / number of words in a specific text (adopted from Köksal, 2012)

CHAPTER 5

DISCUSSION

In this section, after a short summary of the procedure of the study, the results pertaining to the recognition memory experiment and eye-tracking methodology will be discussed.

The main aim of the present study was to investigate the effects of relatedness on the humor effect both in immediate and delayed recognition memory tests and to investigate the attentional patterns that underlie the humor effect by using eye-tracking technology. In an attempt to reach our goals, detailed pilot studies were conducted with visual objects (chocolate bars) that were either related or unrelated to neutral, positive and humorous texts. The items were controlled for relevant stimulus dimensions as suggested by Schmidt (1994), namely humorousness, positivity, relatedness, and ease of textual understanding. Furthermore, as suggested by Chattopadhyay and Basu (1990) in order to eliminate prior brand knowledge, the familiarity of participants with the visual objects was also controlled and unknown brands were selected for the study. Moreover, the visual objects belonged to the low involvement and feeling category of the FCB matrix which includes the products more suitable to be used with humor (Weinberger and Campbell, 1990). In addition, familiarity with the texts dimension was also controlled in order not to affect participants' attention patterns and thus, novel texts were selected for the study. In pilot studies, frequencies of the words in sentences were also controlled and equally frequent words were chosen for the sentences. For related texts, the relation between the text and visual object was in terms of their semantic relation. Thus, related texts included the word "chocolate" compatible with the story of the text while unrelated texts did not include the word "chocolate" and any other word related to chocolate. Additionally, in order to choose the final 30 visual objects and 30 texts, a total of 41 texts and 41 visual objects were examined. In pilot studies, participants were also asked whether they were familiar with the chocolate bars and texts. Participants hardly ever reported that they were familiar with them. Thus, only after when it was guaranteed that all requirements on the dimensions were met, with the first and second pilot studies, the main study was conducted. In the main study, each pair, which consists of a visual object and a text, was presented for 10 seconds invariantly.

Participants were not asked for a response in the study phase. They were only instructed to read the texts and look at the visual objects. There was a fixation cross between the pairs for 1 second. During the study phase, eye movements of participants were recorded by the eye-tracking device. Just after the study phase, participants were asked to complete an unexpected filler task which consisted of 15 mental arithmetic questions in order not to expose them to the recognition phase immediately. After the filler task they were asked to complete an unexpected recognition memory test (immediate recognition memory test). In the recognition memory test, they saw 60 visual objects 30 of which had previously been presented in the study phase whereas the remaining 30 had not. They were directly asked whether they had seen the visual object on the display in study phase or not. At the end of the immediate recognition memory test, they were asked whether they could attend a follow-up test two weeks later but they were not informed about the content of the follow-up test, which was a delayed recognition memory test. 24 out of 36 participants took part in the follow-up test.

5.1 Recognition Memory Hypotheses

Our results revealed that in the immediate recognition memory test, participants' hits of visual objects (chocolate bars) associated with positive and neutral texts were significantly higher than hits of objects associated with humorous texts (hypothesis 1). Thus, they were better at recognizing visual objects associated with positive and neutral texts compared to humorous texts. This finding confirms our hypothesis and is compatible with the literature, in particular with the results of Strick et al.'s 2010 study. For the immediate recognition memory test, *d'* scores and hit scores had similar patterns. Participants were less good at discriminating visual objects associated with humorous texts. This is tantamount with the humor effect (Schmidt, 1991, 1994, 2002, and 2012). The criterion C, which is the measurement of the response bias, showed that participants also had a more conservative bias for visual objects associated with humorous texts, which means that they were more willing to say "I have not seen this visual object before" for those visual objects. This result is consistent with the finding to be discussed below that participants spent less effort (time and attention) in encoding visual objects in the vicinity of humorous texts.

In the delayed recognition test which was conducted approximately 14 days after the presentation, there was no significant difference in the number of hits across conditions. However, *d'* still revealed an effect of text type. As in the immediate recognition memory test, participants were less good at discriminating the visual objects associated with humorous texts in the delayed recognition memory test. Furthermore, C's were still affected by text type, i.e., participants still had a more conservative bias for visual objects in the vicinity of humorous texts.

Contrary to our hypotheses 2 and 3, we could not find any effect of relatedness or interaction effect of relatedness with text type in our behavioral results. Based only on the analysis of the behavioral data it could be concluded that the humor effect may not be modulated by the kind of relation the text has with its associated visual object. However, our on-line eye-tracking measurements provided some evidence in this respect as discussed below.

Finally yet importantly, as hypothesis 4 suggests, *d'*, number of hits, and *C* values had decreased in the delayed recognition test compared to the immediate test. However, the pattern of recognition and bias was the same, as evidenced by the preserved effect of text type on *d'* and C. We need to consider Kaplan and Pascoe's 1977 study at this point mainly because they revealed an increased test performance in the delayed test. In their study, they had found that the test performance of students for humorous material was higher in the delayed test which was conducted 6 weeks later than the study phase, compared to the immediate test results for humorous material. However, there were 16 sections in their study each of which took 20 minutes, which yielded more exposure to the stimuli compared to our study. In addition, their experimental stimuli were not unknown sentences and unknown visual objects but instead they were lectures about psychology, of which the students probably had prior knowledge to some extent. The long exposure to the test stimuli and different test materials may have caused the different long-term memory results between Kaplan and Pascoe's study and the present study. In our study, participants were exposed to items for a relatively shorter time than the students in Kaplan and Pascoe's study and furthermore, they had no prior knowledge about the items. Thus, these differences may have yielded forgetting and lower hit scores in the delayed recognition memory test in the present study. The result patterns in our delayed test, which followed the ones in the immediate test, are, however, consistent with the idea that the humor effect is based on decreased attention towards the visual objects associated with the humorous texts, leading to weaker encoding which cannot be remedied on a later test occasion.

5.2 Response Time Hypotheses

Both in the immediate and delayed recognition memory tests, no differences in response time were observed between the conditions. This finding is compatible with the results of the first experiment of Strick et al. (2010). In Strick et al.'s experiment 1, in which the participants were asked to focus their attention directly on the texts, no difference was found in response times of hits. However, in their second experiment, in which participants looked freely at the texts and images, a significant effect of text type was observed on response times, resulting in a slower recognition of the visual objects in the vicinity of humorous texts. However, response times were not affected by text type, relatedness or any interaction of those variables in our study (hypotheses 5, 6, and 7). A comparison of response times between Strick et al. and our study showed that, in general, participants in our study were slower than the participants in Strick et al.'s study in all conditions. This may be because of the instructions that had been given to participants. In the present study, we did not instruct the participants to be as quick and accurate as possible. They were only instructed to decide whether they had seen the images or not. Differences in instruction might influence cognitive processing of the visual objects resulting in differences in recognition memory. Furthermore, response times are rather short-lived variables that may not be discriminative anymore at longer durations, during which many uncontrolled factors may enter the picture, camouflaging potential differences between the experimental conditions.

5.3 Eye-Tracking Hypotheses

Results of the eye-tracking data revealed that humorous texts attracted more attention compared to neutral and positive texts (hypothesis 8). Total visit durations of humorous texts were significantly longer than the neutral ones, however, insignificantly longer than the positive ones. One should also note that, positive texts also attracted insignificantly more attention than neutral texts. Complementarily to hypothesis 8, the total visit durations of visual objects associated with humorous texts were lower than the visual objects associated with other text types (hypothesis 9). On-line data revealed significant results relevant for our understanding of the humor effect. As summarized in the literature chapter there are numerous explanations trying to account for the humor effect. In the light of the eye-tracking data the results of the present study showed that humorous texts attract more attention than positive and neutral texts. Furthermore, the context information associated with humorous texts, which are the visual objects in the present study, was looked at less compared to the context information associated with negative and positive texts. Consequently, the results of the present study support the incongruity hypothesis of humor effect which states that increased attention on humorous material due to the experienced incongruity causes impaired memory for the context information associated with humorous material.

Results of the eye-tracking data showed that contrarily to hypotheses 10 and 11, there was no effect of relatedness on participants' total looking times for neither visual objects nor texts. However, importantly, results of on-line eye-tracking data revealed an interaction between relatedness and text type, as hypothesized (hypotheses 12 and 13). The interaction reveals that in the present study the humor effect is qualified by relatedness of text and visual object. On the one hand, participants spent significantly more time looking at visual objects in the vicinity of humorous texts than at objects in the vicinity of other texts in the related condition. On the other hand, participants spent less time looking at objects in the vicinity of humorous texts than at objects in the vicinity of other texts in the unrelated condition. Considering participants' on-line looking behavior in the related condition, this may mean that as participants become aware of the relation between the humorous text and the associated visual object they spend more time encoding the visual object, which then might lead to higher recognition scores. Considering their looking behavior in the unrelated condition, this may mean that participants, when they do not realize any relation between the humorous text and the visual object, spend more time on the humorous text, neglecting the visual object, which then might leads to lower recognition scores. In line with this finding is the finding of lower *C* values, indicating that subjects did not remember the visual objects very well and therefore tended to respond more conservatively, denying having seen them. Additionally, participants looked at the related humorous texts less than at the related positive and neutral texts. Furthermore, they spent more time looking at unrelated humorous texts compared to unrelated positive and neutral texts. This, again, is in line with the "humor effect". Furthermore, there were more switches between visual objects and texts in the related conditions compared to the unrelated conditions (hypothesis 13). This result actually shows that participants were aware of the relation between the

text and the visual object. In related humorous conditions, participants switched their eyes between the visual object and the text more often compared to related positive and related neutral conditions. However, in the unrelated humorous condition the number of switches between the text and visual object was the lowest compared to the other unrelated conditions.

In the light of these results, one may conclude that although perceptual processes reveal no discrimination between the related and unrelated conditions overall, they do reveal an interaction between relatedness and text type, as hypothesized. However, we did not see any interaction effect in the recognition memory measurements. This might mean that at a higher level such as recognition memory, participants could not possibly profit from their longer attention towards the objects associated with related humorous texts. Even though participants spent more time looking at the visual objects associated with related humorous texts, their recognition memory of those visual objects was not better than that of visual objects associated with other related or unrelated texts. This may be because the mentioning of "chocolate" in the related texts is too semantically vague, hence not informative enough to help encoding the specific visual object associated with a particular text. More specific semantic relations between text and visual object may be necessary to help in later recognition of the visual object.

Finally yet importantly, hypothesis 14 investigated the correlation between participants' hit scores and the duration of the looking times of visual objects. The results revealed a positive grand correlation between hit scores of participants in the immediate recognition memory test and their looking times of visual objects in the study phase. In addition to the grand correlation between hit scores and looking times, in an attempt to reveal the strength and the range of the correlations in the separate conditions, subsequent correlation analyses were also performed for each experimental condition. Results showed that only the total visit durations of visual objects associated with related positive and unrelated positive texts were not significantly correlated with the number of hits in those conditions. These results suggest that, total hit scores of positive conditions in immediate recognition memory test of participants may not be directly modulated by total looking times of those objects. This may show a positivity bias for the visual objects associated with positive texts. To illustrate, we can check the related positive pairs. In related conditions participants spent the least time looking at visual objects associated with positive texts, however, the hit scores of visual objects associated with related positive texts had the highest scores across related conditions. The insignificant positive correlation between visual objects associated with positive texts and hit scores of those objects may be because of the enhancing effects of emotional stimuli on memory even in situations in which not much attention was paid to those items. However, for further checking purposes, a normalization was performed on the looking times of visual objects and the number of hits. By normalization, a ratio was calculated capturing the relation between the looking times and number of hits – irrespective of the differential looking times. The results of normalized scores however yielded no effect of text type. Thus, the positivity bias seen in the previous analysis disappeared with the normalized scores. In all other conditions, however, the

specific correlations between looking times at visual objects and hit scores were significant. In the light of these two analyses, it can be stated that there was a positive correlation between looking times of visual objects and hit scores in the immediate recognition memory test. In other words, irrespective of text type, the longer they looked at the visual objects the better they recognized them in the immediate recognition memory test.

Additionally, no correlation was observed between the total visit durations of visual objects and the number of hits in the delayed recognition memory test. The insignificant results of the correlation analysis for the delayed recognition memory test yielded evidence that the dependency of recognition scores on study time of visual objects is only crucial in immediate recognition. As results suggest, long-term recognition memory scores are not related to on-line measures (anymore). This result is not surprising given that we did not find any significant effect of relatedness, text type and interaction effect on hit scores in the delayed recognition memory test. One can conclude from the results that eye-tracking measurements in our study were advantageous in immediate short-term contexts but not in delayed long-term contexts. Furthermore, because eye-tracking measurements are valuable in an attempt to investigate the perceptual basis of the humor effect they can be applied to other humor types like cartoons, as well.

5.4 Item-wise Analysis and Additional Analyses

The results of the present study were assessed with both subject-wise and item-wise analyses. Results of the item-wise analysis revealed no significant effects of any experimental variable, contrary to the subject-wise analysis. This may be because of the careful choice of homogeneous items even between items of different conditions. Thus, no distinctive texts or visual objects were present in our dataset. Furthermore, because many of the significant effects in the subject-wise analysis were not found significant in the item-wise analysis due to the different number of items in each analysis, the subject-wise analysis was chosen as the main analysis in the present study.

In the present study, it is also investigated whether participants intentionally attended the memory tests or answered the questions by chance only. Results of binomial tests suggested that both in immediate and delayed recognition memory tests, participants intentionally attended the tests instead of answering all questions with “yes, I have seen” or “no, I haven’t seen”, or randomly.

In many other experiments (Schmidt, 1994; Summerfelt, Lippman, and Hyman, 2010; Strick et al., 2010) the filler task duration was fixed at around 5-10 minutes. However, in the present study, participants’ filler task durations varied between 3 and 5 minutes. Still, the number of questions in the filler task, which is 15, was the same for all participants. For the purpose of checking this possible confound, an additional (covariate) analysis was performed on the filler task durations in order to reveal whether differences between the filler task durations had any effect on hit scores. It might be argued that longer filler task durations may have a detrimental effect on hit scores in the subsequent recognition test as compared to shorter filler

task durations. However, no effect of filler task duration on the number of hits in the immediate recognition memory test was observed. The same analysis was not applied to the hits in the delayed recognition memory test mainly because the recognition memory results of the delayed recognition memory test were not affected by the independent variables of the study at all.

The humorous texts in the present study conform to the Semantic Script Theory of Humor (SSTH), in as far as in each of them there are two opposite scripts which are incompatible with each other. Thus, the SSTH can be assessed by the texts of the present study and one can apply the general rules of SSTH based on two incongruous scripts in order to create humorous texts. Yet, main script oppositions of SSTH such as sex/no sex, money/no money were not applicable to all humorous texts of the present study; however, testing all aspects of the SSTH is beyond the scope of this study. Similarly, the incongruity theory of humor, which states that incongruous stimuli are the crucial element of humor, is supported by the present study. However, one should also note that because the aim of the present study was not to test the best applicable theory of humor texts conforming to both the SSTH and the incongruity theory of humor were selected as humorous texts of the present study. However, specifically while humor in related humorous texts is based only on incongruous scripts, humor in some of the unrelated humorous texts is based on both incongruous scripts and homographic, polysemic words or puns (for example, in one unrelated humorous joke there was the word “hala” which means both “still” and “aunt” in Turkish - see Appendix A and B for the details of the texts). One possibility is that these words evoke different cognitive or linguistic mechanisms such as ambiguity (resolution). In fact, in jokes, ambiguity can be used in the form of homographic, polysemic words in order to create the humorous incongruity (Shultz, 1974; Cui, 2006). Ambiguous stimuli are known to be problematic to process and acquire (Shatz, 2007; Felser, Marinis, Clahsen, 2003). Although cognitive processing of ambiguity seems problematic in reading, learning and acquiring contexts, at the same time its use (and resolution) in most of the humor contexts seems to be a source of pleasure. However, the presence of such a mechanism may cause a need to read the critical word back and forth to give meaning to the sentence and may increase the looking time of the text compared to sentences which do not comprise ambiguous words. In order to check this possibility, the sentences which contained homographic, polysemic words or puns were controlled in two dimensions. Firstly, the eye gaze patterns of participants were checked for those words in an attempt to clarify whether participants read back and forth when they saw the critical sentences. Participants hardly ever went back and forth on critical words. This may be because (1) they found the sentences easy and got the meaning of the joke immediately or (2) there was not enough time to go back and read that part because of the 10 sec. limit. Secondly, an additional analysis was performed in order to clarify whether participants spent more time on unrelated humorous texts that are comprised of homographic, polysemic words compared to those that are not. Results revealed no significant looking time difference between the two types of texts. Thus, participants looked only insignificantly longer to the texts which contained ambiguous examples.

In the following, some limitations of the present study will be pointed out and suggestions of how to overcome them will be presented.

5.5 Limitations

According to Özdoğru and McMorris (2013), participants' sense of humor and their appreciation and perception of humorous material are positively related to each other. Thus, for the present research, participants' sense of humor and humor preferences may have affected their performance in immediate and delayed recognition memory tests. Although in pilot studies the texts were controlled for the humorousness dimension and participants reported that the humorous texts were significantly more humorous than the other texts, still participants in the main study might not have thought that humorous texts were humorous, indeed, but rather because of their humor preferences and differences in sense of humor.

A second limitation is related to the humorous texts in the present study. Although the different cognitive and linguistic mechanisms in some of the humorous texts did not reveal significant looking time differences compared to other humorous texts, in order to be able to study with completely controlled data, the same mechanisms could have been selected for humorous texts.

5.6 General Discussion and Concluding Remarks

Effects of humor on memory are studied by many researchers from different backgrounds with different methodologies. Its underlying mechanisms are tried to be explained by surprise, arousal, rehearsal, and incongruity explanations. The incongruity hypothesis, which is one of the best recognized explanations of the humor effect, refers to the attentional patterns and states. Because humor attracts more attention than non-humorous material, it is recalled better than non-humorous stimuli at the expense of the non-humorous material. Findings of the present study support this explanation by showing the attentional differences between humorous, positive and neutral texts. Our eye-tracking data showed that humorous texts attracted more attention in terms of time spent looking at the texts compared to other texts and looking times of the context information (visual objects, chocolate bars) associated with humorous texts decreased compared to the visual objects associated with other texts. Our behavioral results showed that context information associated with humorous texts was recognized less than the context information associated with other text types.

In addition to its value for clarifying the underlying mechanisms of the humor effect, the present study may also explain why in some studies humor did not affect memory as hypothesized by the researchers. For example, in Berg and Lippman (2001) researchers hypothesized that the brand names which were presented in the context of humorous advertisements would be recognized better compared to the brands presented with nonhumorous advertisements. However, they found no significant difference between the hit scores and *d's* of brands associated with humorous sentences and the hit scores and *d's* of brands associated with non-humorous

sentences. As the present study and Strick et al.'s study, however, suggest humorous material attracts more attention and causes impaired attention for the context information of humorous material. Thus, the hypotheses of Berg and Lippman (2001) were not compatible with the humor effect literature. Consequently, instead of hypothesizing that the brands associated with humorous sentences would be recalled to a higher degree, it would be more in line with the literature of humor effect to hypothesize that, on the contrary, the brands presented with humorous sentences would be remembered less. For this reason, one needs to discuss why the brands presented with non-humorous sentences were not recalled more successfully in comparison to brands presented with humorous sentences, that is, why the humor effect was not observed, in this study.

Eye-tracking is a novel methodology in studies on humor effects. So far, there has been only one study conducted using eye-tracking in an attempt to clarify the humor effect (Strick et al., 2010). Strick et al.'s study is an important and innovative study, the design of which has been exemplary for the design of the present study. However, the present study has revealed more reliable results than Strick et al.'s study mainly because of four reasons. Firstly, in the recognition memory tests of the present study there were 60 equally balanced items consisting of 30 previously seen and 30 not previously seen ones, while in Strick et al.'s study there were only 3 seen and 21 unseen items which may have affected the decision making processes. Secondly, the present study used unique text- visual object pairs in each display, while in Strick et al.'s study pairs had been combined with only 3 brands and 45 texts in the first experiment and 9 brands and 45 texts in the second experiment. Thus, in Strick et al.'s study participants saw the visual objects more than once with different texts. This may also have affected the recognition processes. Thirdly, the texts and visual objects of the present study were controlled with respect to many dimensions, as tested in the pilot studies. Lastly, d' and C results were also calculated in the present study to account for the recognition memory more precisely.

In the literature, there are studies which investigate the effects of context related humor on memory (Kaplan and Pascoe, 1977; Ziv, 1988; Özdoğru and McMorris, 2013). However, to the best of our knowledge, the present study is the first study which investigates the effects of relatedness on attentional patterns using eye-tracking methodology. Our eye-tracking data revealed an interaction effect between text type and relatedness. Thus, related humorous texts attracted less attention than unrelated humorous texts and similarly, the visual objects associated with related humorous texts were looked at longer than the visual objects associated with unrelated humorous texts. One of the interesting findings of the study is that although participants' eye-tracking data revealed an interaction effect of relatedness and text type, this effect was not reflected on recognition memory scores of participants.

The underlying reason for the insignificant effect of relatedness in the present study could be the level of the relationship between the texts and the visual objects. In our experiment, the relation was modulated only by the word "chocolate" which is the name of the overall product type. However, this term is a very general term, not suitable for supporting later discrimination of related visual objects – which are all

chocolate bars. If the relation between the text and the visual object had been more explicit, specific, and strong, we might have been able to observe the effect of relatedness in the behavioral results as well.

The present study has both theoretical and practical implications for further studies. It is important to discriminate correctly between humorous and non-humorous materials in the studies and the context information within these materials. Researchers should consider the attention-enhancing effects of humorous material and should be aware that humorous material impairs memory for the non-humorous material. Furthermore, they should remember that although participants may be aware of a relation between the humorous material and its context information, the humor effect is a strong effect which survives even in the presence of a relation between the humorous material and its context information. There is need of future research in order to investigate which level of relatedness could overcome the humor effect and aid memory.

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APPENDICES

APPENDIX A

Original Texts that used in the Study (in Turkish)

Related neutral texts:

1. Evden çıkarken bakkaldan neler alacağını düşünüyordu. Aklına gelenler ekmek, gazete, çikolata, peynir ve zeytindi.
2. Yaşadığı mahallenin çok yakınındaki bir fabrikada işçi olan genç adam, çikolata paketleme işinde çalışıyordu.
3. Aşçılık okulunda geçirdiği sıradan bir gündü, okula gelir gelmez derse girdi, derste öğretmen çikolata üretim süreçlerini anlatıyordu.
4. Yağlıboya resimlerle ilgilenen adam, az sonra resmini çizeceği çikolatayı dikkatli bir şekilde inceliyordu.
5. O gün eve geldiğinde arkadaşı televizyon başında bir belgesel izliyordu. Programın sunucusu çikolatanın tarihinden bahsediyordu.

Related positive texts:

1. Çikolata yediği zaman, gözleri çocuklar gibi parlıyor yüzündeki ışıltı çevresindeki insanları da mutlu ediyordu.
2. Eski çarşıya yakın oturmak ona huzur veriyor, ne zaman dışarı çıksa en sevdiği çikolatalardan alıyordu.
3. Güneşli bir pazar günü çocuklarını alıp parka gitmişti. Oyunlar oynayıp eğlenmişler, eve dönerken de en sevdikleri çikolatalardan almışlardı.
4. Çocukluğumda beni en çok mutlu eden masalların birinde renk renk, çeşit çeşit çikolatalar yiyen minik tatlı bir kız vardı.
5. Ilık ve huzur dolu bir kış akşamıydı, her yer bembeyazdı. Sokaktaki insanların bazılarında şehre özgü enfes çikolatalardan vardı.

Related humorous texts:

1. Yeni yapılan bir ankete göre on kişiden dokuzu çikolata seviyor. Geriye kalan bir kişi de yalan söylüyor.
2. Günlük yapılacaklar listenizin başına çikolata ye yazın, böylece listenizdeki en az bir işi yapmış olursunuz.
3. Annemin biricik diyet nasihati her zaman işe yarar. Asla ağırlığından fazla çikolata yeme.
4. Ünlü düşünürler ne yersen osun diyorlar. Şu an beş paket çikolataya dönüşmüş olabilirim.
5. Hayatın en önemli sırlarından biri de 30 gram çikolatanın nasıl olup da insana yarım kilo aldırdığıdır.

Unrelated neutral texts:

1. Okulun kapısı her gün sabah saat yedi gibi açılıyor akşam çocuklar çıktıktan üç saat sonra da kapanıyordu.
2. Deneyin bu aşamasında uygun sıcaklık, basınç, yoğunluk ve hacim değerlerinin ölçülerek kaydedilmesi gerekiyordu.
3. Akşam iş yerinden çıktıktan sonra evine geldi, üzerini değiştirdi ve kanepeye oturup radyoyu açtı.
4. Odasındaki eşyaların yerlerini değiştirmişti ancak eski çalışma masası ve elbise dolabının yerleri aynı kalmıştı.
5. Kapıyı açıp içeri girdiğinde araştırmacılar masalarında çalışıyordu, dikkatlerini dağıtmadan sessizce kendi masasına geçti.

Unrelated positive texts:

1. Eve geldiğinde çok mutlu görünüyordu. Nedenini sorunca, sevinçle Milli Piyango büyük ikramiyesi bana çıktı dedi.
2. Pazar günü parka gittiğimde önce rengarenk çiçekleri kokladım sonra da çimenlere uzanarak güneşin tadını çıkardım.
3. Düğünde herkes çok eğleniyordu, şarkılar eşliğinde dans ediliyor, yeni evli çiftin mutluluğu herkese yansıyordu.
4. Güzel bir yaz gününde ormanda bisiklet turuna çıkmışlar, dönüşte de keyifli bir sohbete dalmışlardı.
5. Masmavi denizin altın gibi parlayan kumlarında yürüyor, kuş cıvıltılarının sesini dinliyor ve keyifle gülümsüyordu.

Unrelated humorous texts:

1. Eski sevgiline geri dönmek istiyorsan, hala seni seviyorum diye mesaj gönder. Dönerse senindir, dönmezse halama göndermiştim dersin.
2. Eli kaşınır para gelecek, ayağı kaşınır yola gideceğim, kulağı kaşınır biri beni anıyor. Abi kirlisin işte git yıkan.
3. Bir gün uçağa binen üç arkadaş uçaktan sırayla atlamış. Üç arkadaş ölmüş sıra da kırılmış.
4. Bukalemunun ikizleri olmuş, demişler ki adları ne olacak, o da Şukalemun ve Okalemun demiş.
5. Adamın biri bebeğini alıp doktora götürmüş. Bu tüp bebek hatalı, hep gaz kaçırıyor demiş.

Additional texts:

Related neutral text:

1. Kakao meyvelerinin ağaçlardan nasıl toplandığını ve hangi işlemlerden geçerek çikolataya dönüştüğünü anlatıyor, üretim sürecine dair bilgi veriyordu.

Related positive text:

1. Salondaki masaya harika bir sofra kurmuştu. Çeşit çeşit börekler, çörekler ve çikolatalar insanın iştahını açıyordu.
2. Bir bayram sabahı tüm mahalleli yaşlı adamı ziyarete gitmiş, yaşlı adam da sevinerek herkese çikolata ikram etmişti.

Related humorous text:

1. Bebek yamyam anne yamyama öğretmenimden nefret ediyorum demiş. Annesi de, o zaman sadece çikolatanı ye bebeğim demiş.
2. Adamın birine sormuşlar hayat nedir diye, hayat bir kutu çikolata gibidir demiş. İçinden ne çıkacağını asla bilemezsin.

Unrelated neutral text:

1. Her sabah işe gitmek için evinin önündeki otobüs durağına kadar yürüyor ve oradan geçen servise biniyordu.

Unrelated positive text:

1. O gün ailemle beraber mezuniyet törenime gitmiştik. Annem benimle gurur duyuyordu ve diplomamı alırken beni en çok o alkışlamıştı.

2. Sınavdan 100 tam puan almıştı ve bu büyük haberi dostlarıyla paylaşmak için can atıyordu.

Unrelated humorous text:

1. Adama sormuşlar eşinizle ortak bir noktanız var mı? Demiş ki, var aynı günde evlendik.
2. Adama sormuşlar iki acı biberin çocuğu olursa ne olur diye. O da acıların çocuğu olur demiş.
3. Babama dünyanın en iyi çocuğuna sahip olmak nasıl bir duygu dedim, ben nereden bileyim, git babaannene sor dedi.

APPENDIX B: Texts that used in the Study (English Translations with Explanations and References)

Related neutral texts:

1. He was thinking about what to buy in the grocery while leaving home. He thought of bread, newspaper, chocolate and olives.
2. The man who was employed in a factory close to his neighborhood would pack chocolates.
3. It was an ordinary day in the culinary school. When he entered the classroom, the teacher was talking about chocolate manufacturing processes.
4. The man who was interested in oil paintings was carefully examining the chocolate he was about to draw.
5. When he came home that day, his friend was watching a documentary on television. The presenter of the documentary was talking about the history of chocolate.

Related positive texts:

1. When he ate chocolate, his eyes would light up with joy, and the gleam in his face would make the people around him happy.
2. Living close to the old market place gave him peace. He would get his favorite chocolates whenever he went out.
3. He took his children to the park on a bright Sunday. They had fun playing games, and bought their favorite chocolates on their way home.
4. In one of the tales that made me happy the most featured a cute little girl that was eating colorful chocolates of every kind.
5. It was a peaceful warm winter night. The town was covered in white. Some people on the street had the delicious chocolate unique to the town.

Related humorous texts[3]:

1. According to a survey, nine out of ten people love chocolate. And the remaining one is lying.
2. Add chocolate to the top of your daily to-do list. Thus, you make sure that you have done at least one of the items.

[3] In each related humorous text, there are two scripts which are incongruous with each other and in order to get the joke one needs to resolve the incongruity. Texts 1, 2, 3, and 5 are retrieved and adapted from http://facts-about-chocolate.com/chocolate-quotes/. Text 4 is made up by the experimenter.

3. My mother's only suggestion for diet always works. Never eat more chocolate than your weight.
4. According to philosophers, you are what you eat. I think I'm turning into five packs of chocolate.
5. One of the most curious secrets of life is how 30 grams of chocolate makes you gain half a kilogram.

Unrelated neutral texts:

1. The school gate used to open at about seven in the morning and close in three hours after the children left.[4]
2. This phase of the experiment required the values of temperature, pressure, density, and volume to be measured and saved.
3. He came home after leaving work in the evening. He changed his clothes, sat down on the couch and turned on the radio.
4. He changed the places of furniture in his room but the old desk and dresser remained in the same place.
5. When he opened the door, the researchers were working on their desks. He quietly sat in his desk without interrupting them.

Unrelated positive texts:

1. He looked very happy when he came home. He said that he won the lottery to relieve our curiosity.[5]
2. When I was in the park last Sunday, I first smelled the colorful flowers, and then I lay on the grass and enjoyed the sun.
3. Everyone was having fun during the wedding. People were dancing to the music, and the newly-wed couple reflected their happiness to everyone.
4. They set out for a bicycle tour in the forest on a beautiful summer day, and moved into a deep conversation on their way back.
5. Walking on the golden sand of the deep blue sea, he was listening to birds' songs, and smiling in joy.

Unrelated humorous texts[6]:

1. If you want your ex-girlfriend to return, text her "I still love you". You'll have her if she returns. If she doesn't, just tell her that it was for your aunt.[7]

[4] Adapted from Strick et al., 2010.

[5] Adapted from Strick et al., 2010.

[6] In each unrelated humorous text, there are two scripts which are incongruous with each other and in order to get the joke one needs to resolve the incongruity. Additionally, text 1 and text 3 contain homograph words which create ambiguity.

[7] The word "hala" means both "still" and "aunt" in Turkish. Thus, the joke contains a homograph word which can cause ambiguity in addition to two incongruous scripts that need to be resolved in order to get the joke. Retrieved from

2. You say itchy hands foretell money, itchy feet foretell travel; and an itchy ear means someone's mentioning you. How about you go get a shower instead?[8]
3. One day three friends jumped off a plane in a row. The friends died and the row was smashed. [9]
4. One day, the Chameleon got twins. It named them "Chamelein" and "Chameleat"[10]
5. One day, a man took his baby to the doctor. He said "this test-tube baby is faulty, there is always a gas leak." [11]

Additional texts seen in the first pilot study:

Related neutral text:

1. He was talking about how cocoa fruits were picked from the trees, and what processes they underwent to become a chocolate.

Related positive texts:

1. He set up a wonderful table in the living room. Pastries, buns, and chocolates of all kinds whetted the appetite.[12]
2. Everyone in the neighborhood paid the old man a visit in a holiday morning. The old man got very happy and offered them chocolates.

Related humorous texts:

1. Cannibal baby told cannibal mother that he hated his teacher. "You can just have your chocolate, then" his mother said.[13]

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http://www.seheryeli.biz/index.php/kandil-bayram-ve-ak-mesajlar/1358-anlamli-soezler.html

[8] Retrieved from http://www.hukuki.net/showthread.php?559-Fikralar/page60

[9] Retrieved and adapted from http://www.hamsterim.com/archive/index.php/t-627.html

[10]The mechanism/logic of the joke is the same in Turkish. While in Turkish the joke is based on the demonstrative pronouns, in English it is based on prepositions. These kinds of jokes are known as PUNs. Retrieved and adapted from http://www.antikaeserler.com/bilmeceler.html

[11]Test-tube baby means "tüp bebek" in Turkish. Bottled gas is also called "tüp" in Turkish. The joke contains polysemic words. Retrieved and adapted from http://www.fikracenneti.com/tag/Eczac%C4%B1

[12] Adapted from Strick et al., 2010.

[13]Retrieved and adapted from http://jokes4all.net/eating

2. A man was asked what life is. He replied “life’s a box of chocolates. You can never guess what’s inside”.[14]

Unrelated neutral text:

1. Every morning, he walked to the bus stop to go to work, and took the shuttle there.[15]

Unrelated positive texts:

1. My family attended the graduation ceremony with me. My mother was proud of me, and she clapped the most while I was receiving my diploma.
2. He got full 100 points in the exam, and he was impatient to break the news to his friends.

Unrelated humorous texts:

1. A man was asked if he had anything in common with his wife. He said that they married on the same day.[16]
2. A man was asked what two hot peppers would give birth to. The man answered “the child of pain”[17]
3. I asked my dad how it feels to have the most wonderful child in the world. He responded “how am I supposed to know? Go ask your grandma”. [18]

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[14]Retrieved and adapted from http://facts-about-chocolate.com/chocolate-quotes/

[15] Adapted from Strick et al., 2010.

[16] Retrieved from http://www.sasonluyuz.com/mesajlar/komik.mesajlari.html

[17] Both “pain” and “hot” mean “acı” in Turkish. Retrieved and adapted from http://www.frmtr.com/komik-seyler/1393607-komik-espiriler-her-zaman-guncel.html

[18] Retrieved and adapted from http://sitegezgor.tr.gg/KOM%26%23304%3BK-S-Oe-ZLER-2.htm

APPENDIX C: Informed Consent Form

GÖNÜLLÜ KATILIM FORMU

Bu çalışma, Orta Doğu Teknik Üniversitesi Bilişsel Bilimler Bölümü yüksek lisans öğrencisi Deniz Zengin (Danışman: Doç. Dr. Annette Hohenberger) tarafından yüksek lisans tezi kapsamında yürütülmektedir. Çalışmanın amacı, göz izleme cihazı ile metinlerin ve görsellerin algılanma süreçlerini incelemektir. Çalışmaya katılım tamimiyle gönüllülük temelinde olmalıdır. Çalışmada, sizden kimlik belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamimiyle gizli tutulacak ve sadece araştırmacı tarafından değerlendirilecektir; elde edilecek bilgiler yalnızca bilimsel yayınlarda kullanılacaktır.

Deneyin tamamı ortalama 20 dakika sürmektedir. Sunumda, size toplamda 30 slayt olmak üzere her bir slaytta bir metin ve bir görsel nesne çifti gösterilecektir. Deneyde size gösterilecek olan sunumda, genel olarak kişisel rahatsızlık verecek görüntüler yer almamaktadır. Ancak, katılım sırasında herhangi bir nedenden ötürü kendinizi rahatsız hissederseniz sunumu yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda araştırmacıya, sunumu tamamlamadığınızı söylemeniz yeterli olacaktır. Sunum sonunda, bu çalışmayla ilgili sorularınız cevaplanacaktır. Çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için aşağıdaki numaradan veya e-posta adresinden araştırmacılara ulaşabilirsiniz.

Deniz Zengin, ODTÜ Bilişsel Bilimler Bölümü

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Doç. Dr. Annette Hohenberger, xxx xxx xx xx

Bu çalışmaya tamamen gönüllü olarak katılıyorum ve istediğim zaman yarıda kesip çıkabileceğimi biliyorum. Verdiğim bilgilerin bilimsel amaçlı yayımlarda kullanılmasını kabul ediyorum. (Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim - Soyisim İmza Tarih

----/----/2014