VISUAL SIMILARITY MODERATES SEMANTIC INFLUENCES IN THE MOSES ILLUSION

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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To my husband, Dustin, for his unwavering love, support, and encouragement

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When participants read questions like How many animals of each kind did Moses take on the ark?, they often experience a "Moses illusion", answering “two” despite knowing that Noah sailed the ark. While shared semantic features typically induce the illusion, this experiment examined the role of shared visual concepts (facial features). Questions contained a semantic distractor name that was high or low in visual similarity to the target name. Results showed that compared to unrelated distractors, participants experienced more illusions when the question contained a semantic distractor high in visual similarity than one low in visual similarity. Furthermore, presenting a picture of the target prior to the question reduced the number of illusions experienced. Results challenge theoretical explanations of the Moses illusion as resulting from shallow semantic processing and demonstrate the importance of visual information in processing proper names, even in written form.

CHAPTER 1
INTRODUCTION

It has been well documented that proper names are more difficult to retrieve than other classes of words or person-specific biographical information (Barresi, Obler, & Goodglass, 1998; Fraas, Lockwood, Neils-Strunjas, Schidler, Krikorian, & Weiler, 2002; James, 2004; Stanhope & Cohen, 1993; Young, Hay, & Ellis, 1985). This occurs for a number of reasons; for example, proper names are not as descriptive as other types of words (Fogler & James, 2007), and they do not convey a universal message about the information they represent (e.g., the name Stephen does not automatically indicate that the person is an author; Semenza, 2006). Combined with other problematic characteristics, these factors make proper names more difficult to encode and subsequently retrieve, resulting in more naturally-occurring retrieval failures such as tip-of-the-tongue (TOT) states (e.g., Brown & McNeill, 1966; Burke, MacKay, Worthley, & Wade, 1991; Cohen & Faulkner, 1986; Evrard, 2002). Research in this area has aimed to observe what differences, if any, exist between the way proper names and common names are represented and subsequently accessed in the lexical system, and consequently, several theoretical frameworks have been proposed to understand proper name retrieval and person recognition. The primary purpose of this study was to use these theories to examine factors that influence accurate name recognition in the Moses illusion, an error where people fail to recognize that the wrong name has been presented (e.g., Moses instead of Noah). The present experiment focuses on the role of shared visual concepts, specifically facial features that two people have in common, in inducing the Moses illusion.

An expansive literature has been devoted to person misidentification, with one of the most intriguing areas focusing on question-based recognition errors. Consider the following question: How many animals of each kind did Moses take on the Ark? Most people who are familiar with the biblical story of Noah would erroneously answer “two”, only realizing their failure to catch the mistake after the real answer had been revealed (e.g., Erickson & Mattson, 1981). This miscomprehension of such questions is called the Moses illusion. Various explanations have been ruled out as the cause of the Moses illusion. For example, people do not erroneously believe that they are actually reading about Moses; people report having seen a question about Noah during the experiment, even though Moses was the name embedded into the question (e.g., Erickson & Mattson, 1981; Shafto & MacKay, 2000). Secondly, perceptual errors in which participants do not actually read the name in the question, but rather, only infer the name based on semantic context, are not responsible for the Moses illusion. Erickson and Mattson (1981) demonstrated that people still experience the illusion despite overtly reading the name Moses aloud, indicating that the illusion did not result from simply glossing over the name, which was further substantiated in Shafto and MacKay's (2000, 2010) auditory shadowing experiments. Lastly, the prior biasing semantic context before the name (How many animals of each kind…) is not solely responsible for activating the wrong name because participants were still prone to illusion errors when the question was reworded so that the distractor name was the first name in the sentence (e.g., Moses took two animals of each kind on the Ark.; Erickson & Mattson, 1981; van Jaarsveld, Dijkstra, & Hermans, 1997).

Causes of and Influences on the Moses Illusion

Although a number of different possible explanations have been posed to explain the Moses illusion (see Park & Reder, 2003, for a detailed overview), the majority converge on the idea that illusions result from shallow semantic processing of the sentence's meaning, where only the gist of the sentence is checked against what the person knows (e.g., Erickson & Mattson, 1981; Song & Schwarz, 2008; van Oostendorp & de Mul, 1990; see also Reder & Kusbit, 1991, and Kamas, Reder, & Ayers, 1996, for a detailed explanation of the partial-match hypothesis). Because not every word's meaning will be thoroughly checked for congruity, a distractor name that is semantically similar to the meaning of the question (e.g., Moses) will not be detected as anomalous, whereas a distractor name that is semantically dissimilar is more easily detected (e.g., Nixon).

Previous research has documented a number of factors that either aggravate or reduce the Moses illusion. In regards to increasing susceptibility to the Moses illusion, van Oostendorp and de Mul (1990) found that participants experienced more illusions when the distractor name had high semantic overlap with the target name (e.g., Moses – Noah) compared to cases when the distractor name had low semantic overlap with the target name (e.g., Adam – Noah), an effect that was replicated by van Jaarsveld and colleagues (1997). Both experiments suggested that the degree of semantic similarity moderates the effect of the illusion, with higher overlap resulting in greater susceptibility. Additionally, Shafto and MacKay (2000) observed that high semantic overlap was not the only contributor to the illusion: Distractors overlapping both semantically and phonologically with their targets led to substantially more illusions than overlap on either single dimension. This study supported the idea that more overlap between distractors and targets leads to higher frequencies of experiencing an illusion (as with low/high overlap semantic distractors) and also extended it to include phonology, a factor that was largely ignored in previous experiments. Finally, Kamas and colleagues (1996) showed that when participants were exposed to inaccurate semantic associations (e.g., Moses-Ark) via distractor questions shown during the main experiment (e.g., How many animals of each kind did Moses take on the ark?), they were more likely to experience an illusion when subsequently asked an open-ended version of the question on a post-experiment questionnaire[1] (e.g., responding Moses to the question Who took animals on the ark?) compared to when they were shown a valid version of the question or (How many animals of each kind did Noah take on the ark?) or a question without a name in it (How many animals of each kind were taken on the ark?) during the main experiment. Thus, inaccurately integrating the distractor with the semantic information made participants even less likely to notice incongruities.

In terms of reducing susceptibility to the illusion, Reder and Kusbit (1991) found that presenting a relevant fact about the target (e.g., Noah took two animals of each kind on the ark) before presenting the illusion question strengthened the connection between the question (e.g., ark) and the target name (e.g., Noah), making the correct information more salient and increasing participants' awareness of the distortion in the sentence. Kamas and colleagues (1996) further demonstrated that presenting a question that specifically highlighted the differences between the target and distractor

[1] This post-experiment open-ended question was used as verification that participants actually knew who the correct agent of the sentence should be, ruling out the possibility that participants experienced an "illusion" because they did not know that Noah sailed on the ark.

(e.g., What sea did Moses part?) was also sufficient to reduce the illusion, in this case by increasing the salience of the distractor so as to emphasize the incapability of the name with the question context. They similarly found that simply drawing more attention to the distractor name by capitalizing it (e.g., MOSES) increased the salience of relevant semantic information and resulted in greater anomaly detection as well[2]. Song and Schwarz (2008) found that presenting an illusion question in a difficult-to-read font led participants to experience fewer illusions as opposed to an easy-to-read font (see Figure 1-1). This indicated that when questions were difficult to read, participants were less likely to rely on their initial interpretations of the sentence and had to examine the sentence more thoroughly in order to comprehend it. Thus, because task conditions required a more critical examination of the question, participants were more likely to notice the inconsistency. Consistent with this assertion, Bredart and Modolo (1988) found that placing the distractor name in the focus of the sentence (e.g., It was Moses who took two animals of each kind on the ark – True or False?) reduced participants' frequency of experiencing an illusion, suggesting that specific emphasis on the distractor and not the target per se is relevant to influencing susceptibility to the illusion.

Taken cumulatively, research has demonstrated that many factors influence the frequency with which people experience illusions. For instance, while semantic overlap was presumed to influence the Moses illusion, research has shown that the illusion is specifically dependent on the level of semantic overlap, where the illusion is enhanced if

[2] Readers are directed to Kamas and colleagues (1996) for a more detailed discussion for the role of response bias in participants' choices.

distinctions between the targets and distractors are more difficult to distinguish (e.g., greater semantic overlap), and the illusion is mitigated if participants are specifically alerted to those distinctions. Importantly, one novel experiment (Shafto & MacKay, 2000) revealed that phonological overlap also influenced the Moses illusion, both independently (illusions occurred when two names only overlapped phonologically, e.g., Neil Armstrong and Louis Armstrong) and in conjunction with semantics (the Moses illusion was enhanced when semantic distractors were also phonologically similar to targets, e.g., Lyndon Johnson - Andrew Johnson). Given predominant theories of the Moses illusion that focused on shallow semantic processing, Shafto and MacKay (2000) concluded that a more comprehensive explanation was needed that could account for both phonological influences and semantic influences on susceptibility to the Moses illusion, and they proposed an explanation within Node Structure Theory (NST).

Node Structure Theory: A New Approach to the Moses Illusion

Shafto and MacKay (2000) explained the Moses illusion in the context of NST, an interactive activation model of lexical access, wherein language is argued to be organized in an interconnected network of nodes (MacKay, 1987). The organizational network proposed by NST not only allows for separate semantic and phonological routes by which illusions can occur, but it also accounts for a distinction between the representation of proper names and other classes of words to explain why proper names might be especially vulnerable to illusion errors, something not specifically addressed in previous explanations. This model arguably provides the most well-developed explanation for the Moses illusion, and its theoretical assumptions are described in detail below.

To illustrate the way language is represented in NST, first consider a person you know named *John Smith*. In the NST network, the name itself is represented by lexical nodes, one for each of the first and last names as well as one for the name phrase, which is the unique identifier of that person. The name phrase lexical node connects upward to semantic information about a person, which is represented in the form of propositional nodes (facts like *fixes cars)* and visual concept nodes (what a person looks like). The individual name lexical nodes for *John* and *Smith* connect downward to phonological nodes (which contain the name's sounds, such as its syllables and phonemes; see Figure 1-2). The information housed in these nodes becomes activated and available for retrieval when the associated node receives sufficient priming. All links between nodes are bi-directional such that activation can be transmitted both top-down (from propositional nodes to lexical nodes to phonological nodes, for production) and bottom-up (from phonological nodes to lexical nodes, as would occur in recognition of a spoken or written name).

The bi-directional nature of NST explains mistakes in the Moses illusion as a result of convergent priming from the target and distractor names, where the distractor (e.g., *Moses*) receives bottom-up priming (perceiving the written word "Moses") while the correct target name (e.g., *Noah*) receives top-down semantic priming (via information listed in the question). However, because the distractor and the target share semantic nodes (e.g., both are biblical figures, leaders, etc.), reading the name of the distractor also sends priming to the target via these shared semantic links. Thus, instead of activating the distractor (which would allow people to detect that the name did not fit the question context), the non-presented target receives the most priming and causes miscomprehension of the distractor (*Moses*) as the correct name (*Noah*), resulting in the illusion (see Shafto & MacKay, 2000, for further discussion). Participants *misidentify* the distractor name as the target name, in that they temporarily associate the lexically-activated word form *Noah* with the written phonology of *Moses* (see Figure 1-3). This same effect, where the target name receives priming from multiple sources, also accounts for illusions that result when the target and distractor overlap phonologically (e.g., *Neil Armstrong* and *Louis Armstrong*; the Armstrong illusion) and explain why the effect is significantly amplified when the target and distractor overlap both semantically *and* phonologically (e.g., *Lyndon Johnson* and *Andrew Johnson*; the mega-Moses illusion). Note that this differs from purely semantic explanations, which suggest that the distractor is activated during the Moses illusion, but it (as well as any associated semantic information) is only evaluated to a minimal degree.

The Role of Visual Concepts in Person Recognition

One factor represented in NST that has not been investigated in the Moses illusion is the role of the visual concept system. Person-specific visual concepts such as facial features are helpful cues that are employed in everyday person recognition (e.g., Young, Hay, & Ellis, 1985), although the information these visual concepts convey may differ from what is typically conveyed during object recognition. While the visual characteristics of objects can be suggestive of other semantic traits, such as how the object functions or for what it may be used (e.g., the handle of the hammer suggests it should be held; see Marques, Mendes, & Raposo, 2012, for more detailed information regarding form-function relationship), visual features of people are not so discerning. For example, a certain set of features, like blue eyes or blond hair, does not indicate anything reliable about an individual's personality or occupation. Consequently, there may be heavier reliance on (and likewise, greater salience of) idiosyncratic visual features for accurate person recognition as opposed to object recognition. However, despite how useful or influential visual features might be in person identification, they can also lead to confusion or misidentification (e.g., Burton, Bruce, & Hancock, 1999; Young, Hay, & Ellis, 1985). In the same way that many people can share certain semantic information (e.g., both *Joe Lieberman* and *Joe Biden* are politicians, are currently active in the political sphere, were vice-presidential candidates, etc.), many people can also share visual features (e.g., both *Joe Lieberman* and *Joe Biden* are older males, have gray hair, etc.). While previous research has shown that semantic overlap influences the Moses illusion, the fact that individuals can overlap in their visual features raises the question as to whether such features also play a role in the Moses illusion. The answer would first involve examining the ways in which visual information influences person recognition, which is explored here using two different theories: The Interactive Activation and Competition (IAC) model (Bruce & Young, 1986; Burton & Bruce, 1992), a prominent model of face recognition, and NST, which describes the organization of visual concepts (in addition to other person-specific information) in relation to person recognition.

The IAC model focuses mainly on bottom-up processes involved in person recognition as a function of activation within a hierarchical network. This network consists of *facial recognition units* (FRUs), which contain information regarding the facial patterns of a specific person; *person identity nodes* (PINs), otherwise described as a token marker for an abstract representation of a person; *semantic information units* (SIUs), which contain semantic information (e.g., biographical information) and abstract name representations; *name recognition units* (NRUs), in which name phrases are stored; and *word recognition units* (WRUs), which contain specific components of the name (see Figure 1-4). When a name is viewed in written form (e.g., from reading a name in a question), WRUs become activated. WRUs then send activation to appropriate NRUs, where the name phrase becomes activated, which in turn sends activation to the appropriate PIN. Only when the PIN becomes activated is familiarity with the name achieved, and activation is sent to SIUs to access semantic information and the abstract name representation. A similar route exists for face recognition. When a face is presented (e.g., in a picture naming task), the corresponding FRU becomes activated. This activation is then sent to the appropriate PIN to signal familiarity with the face, and then finally activates associated SIUs and NRUs. Mistakes occur during face recognition as a function of low or high distinctiveness; faces that are very distinct from one another are more rapidly and accurately accessed, whereas "typical" faces are more difficult to remember and identify (Burton et al., 1999; Metzger, 2011). Following this logic, individuals who have little variation in their facial features may be more easily confused, such that the incorrect FRU becomes activated to trigger a false sense of familiarity.

Theoretical Explanations for Visual Concepts Influencing the Moses Illusion

NST and the IAC model propose different ways in which visual concepts (facial features) are represented, which can fundamentally impact the Moses illusion. As mentioned previously, the NST describes physical features as being housed in "visual concept nodes" containing information in the form of visualizable propositions (e.g., symmetrical/handsome face). These nodes are connected to other propositional nodes at the semantic level (MacKay & Burke, 1991). Visual concepts become activated not only when recognizing an image of the person, but even when discussing a person, indicating that this information is accessed even when the task does not explicitly require identification of visual characteristics (e.g., a task that involves reading biographical questions about a person). Under this theory, it seems plausible that substituting a correct name (e.g., *Natalie Portman*) with a semantically-related incorrect name that is also visually similar (e.g., *Keira Knightley*) would increase errors in a Moses illusion task, more so than one would anticipate if the incorrect name were not visually similar. Recall that misidentification errors in the Moses illusion resulted when convergent priming from the distractor and the target led to activation of the target's lexical node in spite of the presence of the distractor name. Similarly, a visually-similar semantic distractor (*Keira Knightley*) would receive bottom-up priming from being read in the question and would also semantically prime the target (*Natalie Portman*); thus the target (*Natalie Portman*) receives the most priming, becomes activated, and the distractor (*Keira Knightley*) is misidentified as the target (*Natalie Portman*). Again, the critical aspect of this claim is that despite reading the distractor phonology (*Keira Knightley*), the correct target (*Natalie Portman*) is activated, such that the distractor is misidentified *as* the target. However, the shared visual concept nodes (in additional to other semantic/propositional nodes) would make the original semantic association between the target and distractor even stronger, resulting in even greater susceptibility to the illusion than traditionally demonstrated by exclusively semantic primes (see Figure 1-5). This prediction would extend results obtained by van Oostendorp and de Mul (1990), who found participants experienced more illusions when the distractor name was highly similar to the target name (e.g., *Moses* – *Noah*) as opposed to when the two names were low in semantic similarity (e.g., *Adam* – *Noah*).

In contrast, the IAC model does not suggest that "visual confusability" can influence *name* recognition errors in the same way that it influences *face* recognition errors; that is, while two visually-similar individuals be confused in the context of face recognition (by activation of the incorrect FRU), visual confusability would not impact a task that does not involve recognizing a face (e.g., the Moses illusion). Recall again that the structure of the IAC model stipulates that PINs are directly connected to SIUs, and multiple PINs can share SIUs. Thus, when SIUs become activated, activation is thus sent to all associated PINs. However, visual information is not part of the SIU pool; each individual PIN shares a one-to-one connection with a FRU that houses visual information. This means that no two PINs can "share" visual information. More importantly, this means that when a set of SIUs becomes activated, it doesn't matter whether the SIUs belong to visually-similar distractors (e.g., *Keira Knightley*) or visually-dissimilar distractors (e.g., *Amy Adams*); they will both send equivalent activation to an associated target PIN (e.g., *Natalie Portman*). Furthermore, recognizing a name only sends activation to the associated PIN, not to FRUs, meaning that visual information does not automatically become available from reading the name (the task must explicitly or intentionally require the activation of facial features, such as when viewing a picture or trying to imagine the details of a face; Cabeza, Burton, Kelly, & Akamatsu, 1997). Thus, substituting a visually-similar semantic distractor for a target in a Moses illusion question should not elicit any errors more than a visually-dissimilar semantic distractor.

The Present Experiment

The present experiment investigates the influence of visual similarity of semantic distractors on person recognition using the Moses illusion task. To my knowledge, no research has been conducted on visual similarity as a factor, which may increase the interference caused by semantically-related distractors utilized in the Moses task. The rationale for this experiment is based in the theoretical framework of the NST, which suggests that such visual concepts are stored in nodes which link to other semantic information (propositional) nodes. These visual concept nodes can become activated even when the task does not explicitly require viewing or recalling someone's appearance/facial features, and instead only involves thinking or talking about a person more generally (MacKay & Burke, 1991). Thus, in the same way that a semantically-similar distractor can interfere with target recognition in a Moses question as a result of convergent priming, a visually-similar semantic distractor would likely induce even further competition. This would not be expected by the IAC model.

A secondary aim of this experiment investigates the extent to which briefly viewing the target picture reduces recognition errors when reading subsequent Moses illusion questions, as a function of the distractor's visual similarity. Reder and Kusbit (1991) observed that presenting a relevant fact about the target strengthened the link between the relevant fact (e.g., *ark*) and the target name (e.g., *Noah*), making it more resistant to semantic confusion when the participants later read the illusion question (such that participants would become aware of the anomaly). While Reder and Kusbit presented semantic information in text form, the present experiment used picture presentation of the target to explore the degree to which activation of visual concepts moderates subsequent recognition errors.

If visual "cuing" is effective in the same way that semantic cuing has been in previous research, the following predictions can be derived. When a target picture is presented (e.g., *Natalie Portman*), the target's visual concepts nodes become activated. When this visual information is unique to the target (such that the target does not share visual concept nodes with the distractor embedded into the proceeding Moses question; e.g., *Maria Sharapova* or *Amy Adams*), this visual information should provide priming *only* for the target name and not the distractor. Because the visual and semantic information would become activated for the target *uniquely*, participants should be more successful at recognizing semantic inconsistencies within the distractor sentence and thus reduce recognition errors. Consistent with this prediction, participants were expected to benefit less from target picture presentation for high visually similar (HVS) distractors because presentation of a target picture would provide visual information that is not *unique* to the target (since both the target and HVS share visual information) and thus be less helpful in raising participants' awareness of the illusion. Essentially, participants were expected to identify the target picture, but upon reading the HVS distractor name, would erroneously assume that the picture they saw was actually a picture of the HVS distractor because the two look similar. On the other hand, participants would likely not visually confuse the low visually similar (LVS) or unrelated distractors for the preceding target, which assist in accurate target identification. For these types of distractors, presentation of the target picture provides the augmented amount of visual "cuing" necessary for participants to recognize the subsequent incongruity between the information in the question and the distractor name.

Presentation of the target picture (rather than a written fact about the target, as demonstrated in Reder & Kusbit, 1991) prior to the target question also addresses the role of priming modality. Cross-modal priming is possible and has been demonstrated in the IAC model (such that activation of a NRU will subsequently send a small amount of priming to other related units, strengthening the overall system), but this effect is short-lived and may not produce consistent priming advantages, as activation of an FRU-PIN link does not necessarily provide sufficient priming to also strengthen other links, such as the SIU-PIN link (Burton et al., 1999; Burton, Bruce, & Johnston, 1990; Burton, Kelly, & Bruce, 1998). However, the NST contends that visual concepts are directly connected to other semantic information, so presentation of a picture should generally lead to an increase in subsequent name recognition (however, see above to for specific predictions on the influence of target picture-naming on visually-similar distractors). Indeed, Valentine, Hollis, and Moore (1998) observed this effect in terms of speed; when participants produced a name after seeing a picture of a famous face, they were quicker to make recognition decisions when that name was later presented in written form. This experiment, therefore, seeks to explore whether cross-modal priming (from presentation of a target picture) will increase in accuracy (error identification) when a Moses question (pertaining to that target picture) is presented immediately thereafter.

The final aim of this experiment was to examine measures not consistently collected during Moses illusion tasks: (1) participants' response times for selecting answers to the general knowledge questions, and (2) question reading times. With respect to response times, and Reder and Kusbit (1991; see also Reder & Cleeremans, 1990) found similar responses times in answering valid questions (the target was the name presented in the question) and invalid questions (a distractor was presented in the question), whereas Kamas and colleagues (1996) found longer response times for invalid questions compared to valid questions. Van Oostendorp and de Mul (1990) as well as van Jaarsveld and colleagues (1997) compared trials where the target and semantic distractor shared many semantic traits ("high-related") versus only a few semantic traits ("low-related"). On trials where participants detected the illusion, response times were longer for high-related than low-related questions. On trials where participants experienced the illusion, Van Oostendorp and de Mul found no difference in response times between the high- and low-related questions, while van Jaarsveld and colleagues found longer response times for high-related questions. Although these findings are not always consistent, they nonetheless illustrate that failure to detect the Moses illusion in these experiments was not a consequence of answering too quickly or dedicating insufficient time to choosing the correct answer (i.e., speed-accuracy tradeoff). We similarly recorded response times so that if HVS distractors were more susceptible to the Moses illusion, we could ensure that this finding was not a result of faster response times in responding to questions containing these distractors.

With respect to reading times, Reder and Kusbit (1991) used a "moving window" technique (Just, Carpenter, & Wooley, 1982) in which the question was hidden except for one word presented in the "window", and the participant pressed a key to move the "window" from left to right to view each word in the question one at a time. The time from each key press to the next was recorded, which permitted the authors to compare reading times for different words throughout the sentence. They found that participants read distractor names more slowly than other content words in the question, especially while experiencing an illusion. They interpreted these results as demonstrating that the Moses illusion was not due to overlooking the distractor name or failing to adequately encode it. For our purposes, we recorded reading times to ensure that HVS distractors (both first and last names) were not read more quickly than the other distractor types or other words in the sentence. We also wanted to assess whether reading times were comparable when participants experienced an illusion versus when they correctly detected it.

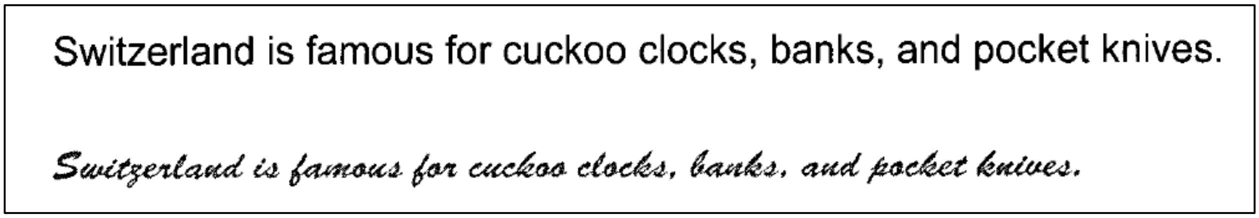


Figure 1-1**.** Sample easy-to-read font (top line) and difficult-to-read font (bottom line). Note that in the main experiment, participants were presented with questions, not statements (including *How many animals of each kind did Moses take on the ark?*). From Song and Schwarz (2008).

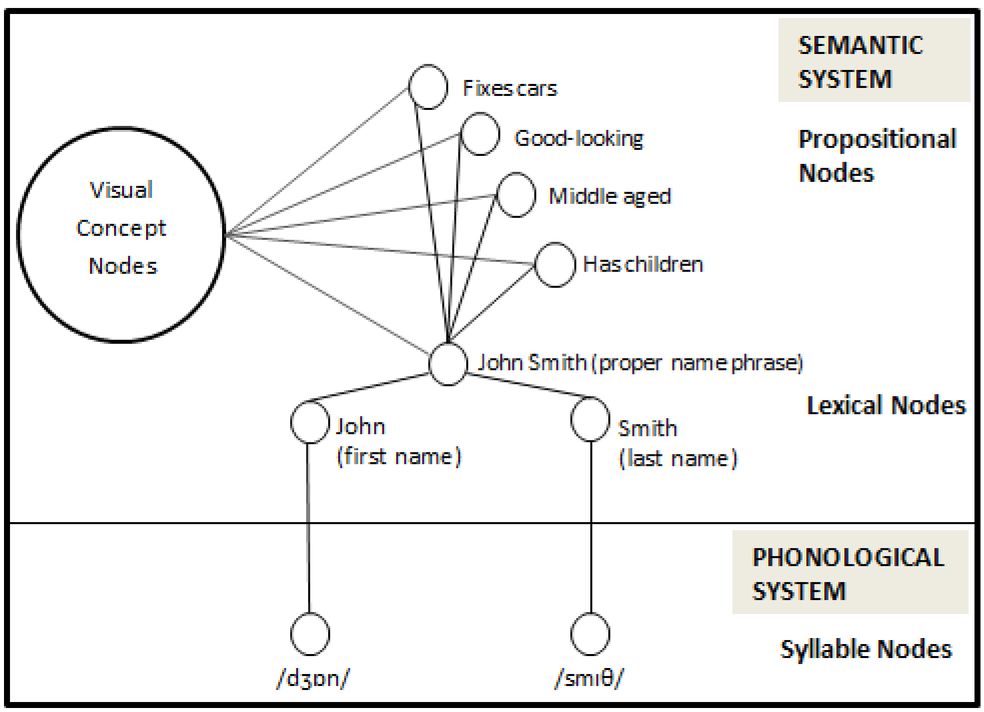


Figure 1-2**.** Semantic and phonological systems proposed by the NST to illustrate the representation of a proper name *John Smith*. Information about names is represented in multilevel systems, including propositional nodes (e.g., biographical information), visual concept nodes (e.g., what the person looks like), lexical nodes (each individual name as well as the proper name phrase), and phonological nodes (the names' sounds). Adapted from MacKay and Burke (1991).

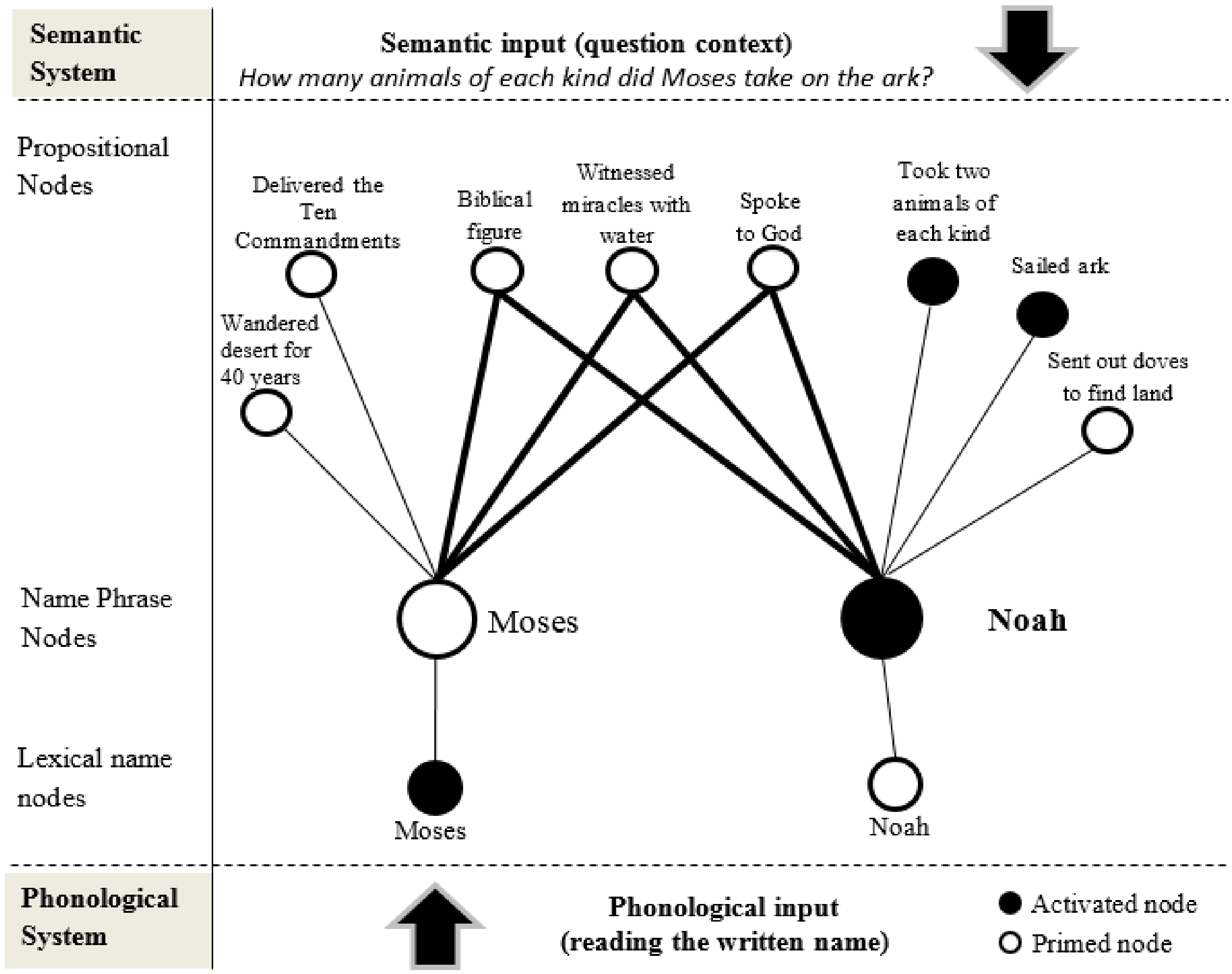


Figure 1-3**.** The bi-directional semantic and phonological systems involved in the Moses illusion. The distractor name (*Moses*) receives bottom-up priming from its presence in the question, whereas the non-presented target name (*Noah*) receives priming from two sources: information directly presented in the question, and additional priming sent by the distractor name via shared semantic links (bolded here for emphasis). The target name becomes activated and causes the illusion. Adapted from Shafto and MacKay (2000).

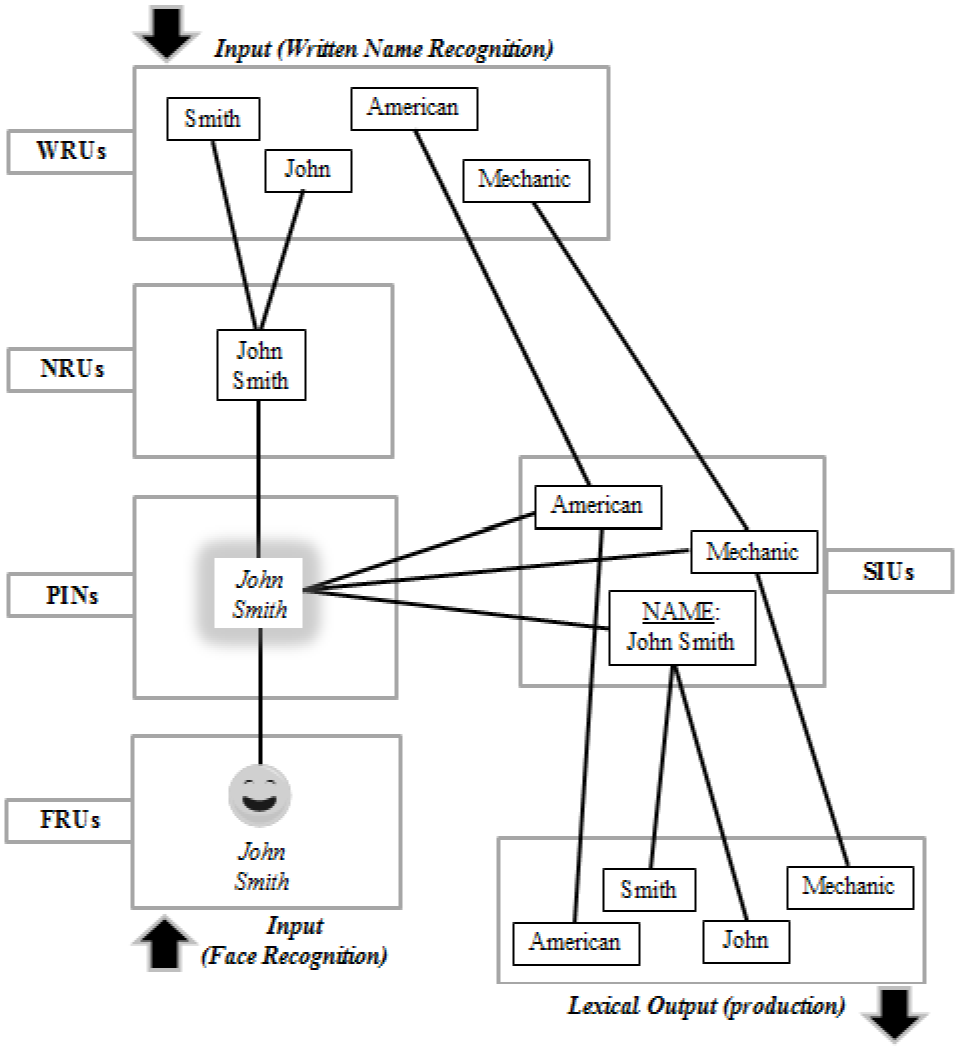


Figure 1-4**.** The units involved in face and name recognition as proposed by the Interactive Activation and Competition model. During name recognition, activation is first sent from WRUs to NRUs, which then send activation to associated PINs where person familiarity is achieved. Once familiarity is established, the abstract name representation as well as other semantic information in the form of SIUs become activated. During face recognition, the FRU becomes activated and sends activation to the appropriate PIN and then associated SIUs and NRUs. Adapted from Burton, Bruce, and Hancock (1999).

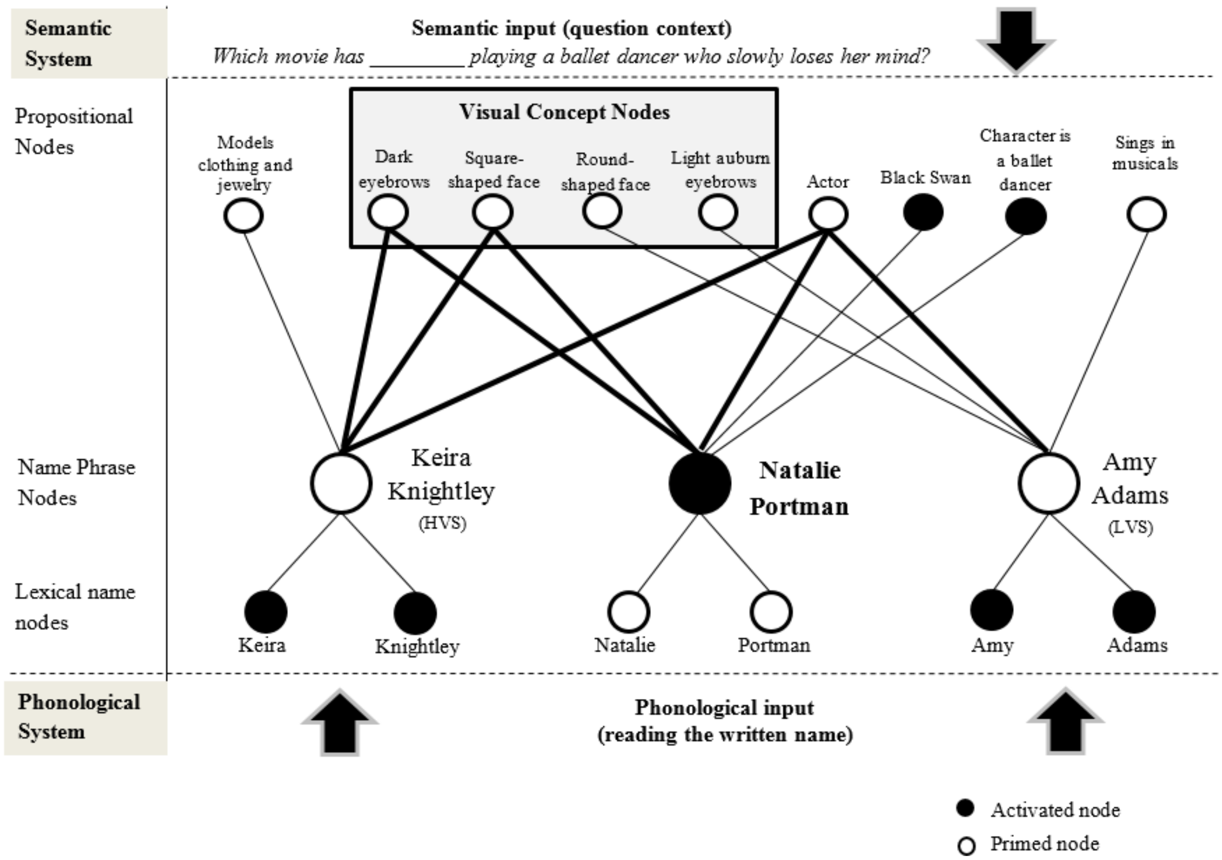


Figure 1-5. Differential priming as a function of high or low visual similarity. Semantic distractors of high visual similarity (HVS; *Keira Knightley*) contribute more priming to the target name (*Natalie Portman*) than semantic distractors of low visual similarity (LVS; *Amy Adams*) due to shared connections to visual concept nodes. Shared links are bolded for emphasis. Adapted from Shafto and MacKay (2000).

CHAPTER 2
PILOT STUDY

Method

Participants

Eighty-five young adult participants (M=19.6, *SD*=1.5; aged 18-26; 57 females, 28 males) were recruited from general psychology courses at the University of Florida and received partial fulfillment of a course requirement for participation. Of those 85, 37 participated in the familiarity judgment task and 34 participated in the similarity judgment task. Sixteen participants from the familiarity judgment task also rated targets for attractiveness. Fourteen participants, along with 33 of the 34 participants from the similarity judgment task, participated in the general knowledge task. Participants were English speakers, with normal or corrected-to-normal vision, and no known diagnosis of reading difficulties or dyslexia.

Materials

Targets. The initial stimuli set consisted of 96 to-be-named target pictures of famous people taken from Google images. These famous people were actors, singers, athletes, politicians, and TV personalities.

Distractors. Each target (e.g., Natalie Portman) was paired with three written distractor names: two semantically related distractors and one unrelated distractor. Semantic relatedness was defined in terms of occupation (see White, Abrams, & Frame, 2013). Both semantic distractors had the same occupation as their associated targets (e.g., Actor/Actor), while unrelated distractors (e.g., Maria Sharapova) had different occupational categories (e.g., Actor/Athlete). Semantic distractors for a particular target varied in visual similarity to the targets such that one was high in visual similarity (e.g., Keira Knightley) and the other was low in visual similarity (e.g., Amy Adams). High visual similarity (hereafter referred to as HVS distractors) was determined using websites or blogs that commented on the similarity of celebrities (e.g., www.totallylookslike.com, www.imdb.com), while low visual similarity (LVS distractors) reflected an absence of such comments. To control for confounding factors, all distractors were of similar age to the target (birth year within two decades of one another), the same gender as the target, and same race as the target.

Procedure

Familiarity. Participants assessed familiarity with the target pictures to ensure that pictures selected for use in the main experiment were ones that people could recognize. Familiarity was also assessed with the distractors in order to confirm that the names were famous people known to our participants. The experiment consisted of four versions, each containing 24 target pictures and 72 written distractor names presented in six alternating blocks, three blocks of targets and three blocks of distractor names. Target blocks presented eight pictures, while distractor blocks presented 24 distractor names. Within each version, no presented distractors or targets were associated with one another (e.g., if a target picture or distractor name was presented, none of its other associated distractors were also presented), and names within each block were randomly presented. The experiment began by presentation of a distractor block and alternated the presentation of target/distractor blocks. When a target picture was presented, participants were asked to indicate whether they knew the name of the person, did not know the name, or were having a TOT for the name. If known, they were then asked to produce the target name. Participants were also asked to provide any biographical information describing the target name. If participants gave an unknown or

TOT response, they were asked to produce any information they could recall about the name (e.g., the first letter of the name) as well as any biographical information about the target that they knew. Then, participants received a multiple-choice recognition question from which they were instructed to choose the correct target name from four possible answer choices. These answer choices shared the same occupation, gender, and race as the target, and were aged within 2.5 years of the target. After the recognition question, a follow-up question asked participants to indicate if they really knew the name of the person or whether they selected the name by eliminating the other answer choices.

In blocks when a written distractor name was presented, participants were asked to indicate whether they knew or did not know the individual. After indicating their response, participants were asked to say any biographical information that they could remember about the person. In all tasks, participants gave responses verbally, and the experimenter typed them into the computer.

Similarity. In order to evaluate visual similarity between the target and distractors, a separate set of participants were presented with a target picture and written name of the distractor side-by-side, with the target on the left side and the distractor on the right side of the computer screen. Specifically, a target picture (e.g., Natalie Portman) was paired with the written name of the corresponding HVS semantic distractor (e.g., Keira Knightley), the written name of the corresponding LVS semantic distractor (e.g., Amy Adams), or an unrelated distractor (e.g., Maria Sharapova). The target-distractor pairs were divided into three main versions, which were counterbalanced so that 1/3 of the targets within the version were paired with their associated HVS semantic distractors, 1/3 were paired with their associated LVS semantic distractors, and 1/3 were paired with their associated unrelated distractors. Each version was then divided into two subversions, where half of the targets were presented as names and half were presented as pictures in each subversion. Target-distractor pairs were presented in a pseudo-random order, where targets alternated in whether they were presented as pictures or names, until all pairs were shown.

When participants were presented with the target-distractor pairs, they were first instructed to rate the visual similarity between the two individuals in the pictures using the following 3-point Likert scale: 1 (Not similar at all) – Except for obvious features (e.g., both have hair, both have eyes, etc.), these two people do not look alike at all; 2 (Somewhat similar) – These two people look somewhat alike and share a few physical features (e.g., similar hair color); and 3 (Highly similar) – These two people look very much alike and share many physical features (e.g., similar hair color or style, facial features, etc.).

After participants gave a visual similarity rating, they were asked to rate the semantic similarity between the target and distractor independent of visual similarity to ensure that the two semantic distractors differed only in visual similarity and that the unrelated distractor had no semantic similarity with the target. Participants were then instructed to indicate how similar the target and the distractor were in terms of their biographical characteristics (e.g., age, era, occupation), personality features (funny, mysterious), and public personas (e.g., political enemy, villain) using the following scale: 1 = completely unrelated; besides gender, the two people do not have a single feature in common, 2 = somewhat related; the two people have the same occupation, and probably 1 or 2 additional features in common, and 3 = strongly related; the two people have the same occupation and age range, and 3 or more additional features in common. If a participant did not know one or both names, they were instructed to select 9 (unknown).

Attractiveness. To ensure that susceptibility to the illusion was not moderated by attractiveness of the target, participants were asked to rate how attractive each of the targets were. In this task, participants were shown all 96 pictures of the target faces, and were informed that they would see some pictures that they previously saw in the judgment task (which would differ, depending on which version of the familiarity judgment task they received), in addition to new pictures that had not been previously shown. Participants were instructed to make their ratings using a sliding scale, which ranged from "not attractive at all" (left side of scale) to "very attractive" (right side of scale). The computer then converted that rating into a score from 0 to 100, respectively. Using a sliding scale allowed participants to give a more precise estimation of the target's attractiveness instead of using a Likert scale, which does not permit participants to provide scores between ordinal levels.

General Knowledge Task. Participants were presented with general knowledge questions containing biographical information about the targets. These general knowledge questions were created using comments provided from the previous familiarity pilot so that a commonly-known fact about a target could be asked (e.g., Which movie has Natalie Portman playing a ballet dancer who slowly loses her mind?). Answers were presented in multiple-choice format where the correct answer was displayed with three incorrect (but semantically similar) options and a “don’t know” option. The “don’t know” option was always presented as the last answer choice (e.g., d), and the correct answer was counterbalanced across stimuli so that it appeared in one of the first three positions (e.g., a, b, or c).

Results

Means and standard errors for familiarity ratings, semantic similarity ratings, and visual similarity ratings as a function of distractor type (HVS, LVS, Unrelated) are presented in Table 2-1.

Familiarity. The initial 96 target pictures were analyzed for “known” responses (correct and incorrect), “TOT” responses (correct and incorrect), and “unknown” responses. Correct known responses were cases where both the correct first and last names were produced, whereas incorrect known responses included known responses where participants produced either an incorrect first or last name or an entirely different name. TOTs were considered correct if participants accurately chose the target’s name from the multiple-choice answers without using a process of elimination (know vs. guess); otherwise, they were categorized as incorrect TOTs. Correct known and correct TOTs responses reflected accurate knowledge of the target name, whereas unknown, incorrect known, and incorrect TOT responses reflected a lack of knowledge of the target name. Therefore, 42 target pictures with low familiarity (i.e., > 75% of participants responded either unknown, incorrect known, or incorrect TOT) were removed from the data set, leaving 54 familiar target pictures with a high percentage of correct responses (M = 76.3%, SD = 22.5%).

Target familiarity was assessed in another way by having the experimenter review the biographical information provided by the participant and assign a familiarity score based on the following criteria:

1. completely unfamiliar (no details were produced)
2. somewhat unfamiliar (participant provided information only hinted at familiarity, such as "Name sounds familiar"/ "Looks familiar", "May be an actor", or "I think he is an author, but I'm not sure")
3. vaguely familiar (participant provided only a single distinguishing fact about the person; e.g., actor).
4. familiar (participant provided only 2 distinguishing facts about the person)
5. very familiar (participant produced 3 or more distinguishing facts about the person)

When presented as pictures (*M* = 3.8, *SD* = .6) or written names (*M* = 3.7, *SD* = .8), the 54 targets had overall mean familiarity scores that were considered familiar.

The 162 written distractors (54 HVS, 54 LVS, and 54 unrelated) were also assigned familiarity scores based on the aforementioned scale. An analysis of variance by items indicated a main effect of distractor type, F (2, 159) = 3.960, *MSE* = .734, $\eta\rho^2$ = .047, p = .029, such that LVS distractors (*M* = 3.6, *SE* = .1) had higher familiarity scores than unrelated distractors (*M* = 3.1, *SE* = .1; p = .006), but did not differ from HVS distractors (*M* = 3.3, *SE* = .1, p = .084). Additionally, HVS distractors did not differ from unrelated distractors (p = .296).

Similarity. The 162 target-distractor pairs were analyzed for semantic and visual similarity, as measured by participants' semantic similarity ratings from the previously mentioned 1-3 Likert scales. A 2 (similarity; visual, semantic) x 3 (distractor type; HVS, LVS, unrelated) repeated-measures analyses of variance by items revealed a significant main effect of similarity, F (1,52) = 84.38, *MSE* =.068, $\eta\rho^2$ = .777, p < . 001, and a significant main effect of distractor type, F (2,104) = 180.719, *MSE* =.117, $\eta\rho^2$= .619, p

$< .001$, qualified by a significant two-way interaction between similarity and distractor type, F (2,104) = 64.86, *MSE* = .081, $\eta\rho^2 = .555$, $p < .001$.

Decomposing the interaction effect by looking within each level of similarity, pairwise comparisons indicate that for semantic similarity, HVS (M = 2.3, SE = .04) and LVS (M = 2.2, SE = .05) distractors did not differ from one another (p = .202), but were rated as more semantically similar than unrelated distractors (M = 1.3, SE= .04; $p <$ .001). For visual similarity, pairwise comparisons indicated that HVS distractors (M = 2.2, SE = .05) were rated as more visually similar to their associated targets than both LVS (M = 1.5, SE = .04; $p <$ .001) and unrelated (M = 1.4, SE = .05; $p <$. 001) distractors, but LVS and unrelated did not differ (p = .288). In sum, the manipulations of semantic and visual similarity were successful: Both LVS and HVS distractors were rated as more semantically similar to their associated targets than the unrelated distractors but did not differ from each other, and HVS distractors were rated as more visually similar to targets than LVS distractors and unrelated distractors.

Attractiveness. The 54 target faces were analyzed for each target's mean attractiveness rating (where higher = more attractive, with a minimum possible score 0 to maximum100). A one sample t-test indicated that compared to a mean rating score reflecting "neutral" attractiveness (i.e., neither attractive nor unattractive; μ = 50), target faces had marginally higher attractiveness ratings (M = 55.0, SD = 19.0, p = .058).

General Knowledge Questions. The general knowledge questions for the 54 targets were analyzed for number (percentage) of correct responses. The mean correct response percentage across all questions was 76.7% (SD= 17%). Two questions, which had percentages below 50% (0% and 45%), were subsequently modified for use in the main experiment.

Table 2-1. Means and standard errors for familiarity ratings and similarity ratings in the pilot study

	Distractor Type		
	HVS	LVS	Unrelated
	M (*SE*)	*M* (*SE*)	*M* (*SE*)
Familiarity Rating[1]	3.34 (.12)	3.63 (.12)	3.16 (.12)
Semantic Similarity Rating[2]	2.36 (.04)	2.27 (.05)	1.34 (.04)
Visual Similarity Rating[3]	2.21 (.05)	1.51 (.04)	1.45 (.05)

[1]Familiarity ratings are based on a 5 point scale (1= Completely unfamiliar, 5= Very familiar)

[2]Semantic similarity ratings are based on a 3 point scale (1= Completely unrelated, 3= Strongly related)

[3]Visual similarity ratings are based on a 3 point scale (1 = Not similar at all, 3 = Highly similar)

CHAPTER 3
MAIN EXPERIMENT

Specific Aims and Hypotheses

Specific Aim 1

The first aim of this study was to investigate if recognition errors observed in reading Moses illusion questions about proper names are sensitive to variations in facial similarity.

Hypothesis 1. Semantic distractors of high visual similarity to a given target will elicit more response errors than semantic distractors with low visual similarity to that target or unrelated distractors. If this hypothesis is supported, a significant effect of distractor type will emerge, replicating and extending the findings of Shafto and MacKay (2000), in which semantically-related distractors produced lower rates of correct response accuracy than did unrelated distractors, demonstrating a Moses illusion. However, I also predict an effect of visual similarity, with lower accuracy for questions containing HVS distractors than questions containing LVS distractors.

In an exploratory approach to analyzing the Moses illusion, additional analyses will be conducted on response times to select answers and on reading times to examine any potential effects of visual similarity on these measures.

Specific Aim 2

The second aim of this study was to examine if the degree of visual similarity between targets and distractors influences the effect of prior presentation of the target picture on Moses illusion errors.

Hypothesis 2. Similar to Reder and Kusbit (1991), who observed that presenting a relevant fact about the target increased accuracy on subsequent Moses questions, I predict that brief presentation of a target prior to reading the Moses illusion question will result in increased accuracy for questions containing LVS and unrelated distractors, but will have a lesser effect on questions containing HVS distractors.

Method

Participants

Fifty-four participants (*M* = 18.67, *SD* = 1.06; aged 18-26; 35 females, 19 males; see Table 3-1) were recruited from general psychology courses at the University of Florida and received partial fulfillment of a course requirement for participation. Participants were English speakers, with normal or corrected-to-normal vision, and no known diagnosis of reading difficulties or dyslexia.

Materials

Moses Illusion Task. The Moses illusion task consisted of 54 general knowledge questions pertinent to the target name. Targets were famous people including actors, singers, athletes, politicians, and TV personalities who are known to be familiar to college students, as assessed from the previous pilot study. Each target question was designed so that a person's first and last names were embedded into the text of the question, with four possible variants. In the valid target condition, the target name was embedded into the question (e.g., Which movie has Natalie Portman playing a ballet dancer who slowly loses her mind?). In the invalid conditions, distractor names replaced the target name to create a false question based on a fact about the target; specifically, either (1) an associated HVS semantic distractor was embedded into the question (e.g., Which movie has Keira Knightley playing a ballet dancer who slowly loses her mind?), (2) an associated LVS semantic distractor was embedded into the question (e.g., Which movie has Amy Adams playing a ballet dancer who slowly loses her mind?), or (3) an unrelated distractor was embedded into the question (e.g., Which movie has Maria Sharapova playing a ballet dancer who slowly loses her mind?). Forty-two unrelated filler questions about targets other than those used as experimental stimuli always had a valid correct answer. Fillers were included so that there were an equal number of questions whose answers were valid and questions without a correct answer (i.e., invalid questions), but fillers were not analyzed further.

Both target and filler questions were drawn from previous pilot testing to ensure that participants were familiar with the facts being asked. Nine versions of the Moses illusion task, administered across participants, were created such that each had 96 questions: 6 valid target questions, 16 invalid target questions with a HVS semantic distractor, 16 invalid target questions with a LVS semantic distractor, 16 invalid target questions with an unrelated distractor, and 42 valid filler questions. Only one question was asked about a particular target within each version, and the question type was counterbalanced across participants. Within each of the 9 versions, half of the experimental questions were designated to be preceded by a target picture, and presentation of each target with or without a picture was counterbalanced across participants.

In addition, each question was followed by five multiple choice answers: (1) the correct "target" answer for the valid version of the question (i.e., the answer that would have been correct if the target name were actually in the question; Which movie has Natalie Portman playing a ballet dancer who slowly loses her mind? Correct answer: Black Swan), (2) two answers that were semantically-related to the target answer but were incorrect for the valid version (e.g., Requiem for a Dream, Eyes Wide Shut), a “don’t know” option, and a “can't say” option. Participants were instructed to choose “don’t know” if they did not know the answer to the questions and “can't say” if there was something wrong with the question or if it contained an anomaly (e.g., if the information in the question does not actually describe the person mentioned in the question). The “don’t know” and “can’t say” responses were always presented as the fourth and fifth multiple choice options (respectively), while the order of the other multiple-choice responses was counterbalanced so that the target answer appeared in any one of the first three positions equally often across participants.

Picture Stimuli. For the picture presentation manipulation, 54 color pictures taken from Google images were selected for each target. Each picture was 4 inches wide by 4 inches high, and pictures were selected so that the faces were not obstructed and were clearly recognizable.

Procedure

The task was presented via computer using a program written in Visual Basic 5.0. Prior to beginning the task, participants first received four practice trials. For each trial, participants saw a “+” onscreen to indicate that the trial was ready to begin. When the participant pressed the enter key, a blank screen was presented for 100 ms. For half of the experimental questions, the Moses illusion question was preceded by brief presentation (200 ms) of the target picture, whereas the other half of the experimental questions proceeded directly to showing the first word of the general knowledge question in the center of the screen. Participants pressed the spacebar key to present the next word of the question, with previous words disappearing, until the entire question was displayed. This methodology differs from that used in the majority of previous studies of the Moses illusion, which presented the entire question at one time (but see Reder & Kusbit, 1991).

After each question was fully presented, the associated multiple choice answer appeared onscreen. Participants were instructed to press the letter key (a, b, c, d, or e) associated with the correct multiple-choice option as quickly as possible. When a key was pressed, the multiple choice options disappeared, and the response time for making the multiple-choice was recorded. If no key press was made after six seconds had elapsed, the multiple choice options disappeared, and a feedback warning appeared, encouraging participants to respond as quickly as possible. The entire session took approximately one hour.

Results

Individual cases were excluded from the analyses if participants either took longer than six seconds to choose a multiple choice answer (timed out responses; 2.6% of cases) or selected "don't know" (24.2% of cases), as both responses reflected a lack of familiarity with the target or target question. In addition, one question was excluded from analyses due to unintended semantic overlap with incorrect general knowledge answer choices (target Seth Rogen; 1.7% of cases). Analyses were conducted by both participants and items, although participant analyses were given more weight when conflicts arose due to their increased power. It is worth noting that the means in item analyses always trended in the same direction as those in the participant analyses.

Response Accuracy

Can't say responses. Similar to Shafto and MacKay (2000, 2010), invalid questions were analyzed for participants' selection of the "can't say" option from the possible answer choices. Selection of "can't say" is the correct answer for these types of questions, whereas selecting another answer choice indicates susceptibility to the Moses illusion.

A 2 (picture presence: picture not shown, picture shown) x 3 (distractor type: HVS, LVS, unrelated) repeated measures ANOVA was conducted by participants (F_1) and items (F_2) on percentage of "can't say" responses. Means and standard deviations from this analysis are shown in Table 3-2, and means and standard errors are shown graphically in Figure 3-1. Analyses indicated a significant main effect of distractor type, F_1 (2, 106) = 9.69, MSE_1 = .029, p_1<.001, $\eta\rho^2_1$ = .155, F_2 (2, 104) = 3.84, MSE_2 = .050, p_2 = .025, $\eta\rho^2_2$ = .069. Pairwise comparisons revealed that questions with HVS distractors (M_1 = 61.8%, SE_1 = 3.5%) resulted in fewer "can't say" responses (i.e., more illusions) than questions with LVS distractors (M_1 = 68.5%, SE_1 = 3.8%, p_1 = .007) and unrelated distractors (M_1 = 71.7%, SE_1 = 3.6%, p_1 < .001), which did not differ from one another (p_1 = .121). Analyses also indicated a marginally significant main effect of picture presence, F_1 (1, 53) = 2.85, MSE_1 = .092, p_1=.097, $\eta\rho^2_1$ = .051, F_2 (1, 52) = 5.49, MSE_2 = .042, p_2 = .023, $\eta\rho^2_2$ = .096 where participants produced slightly more "can't say" responses (i.e., had fewer illusions) when a question was preceded by a picture (M_1 = 70.2%, SE_1 = 3.8%) compared to when a question was not preceded by a picture (M_1 = 64.5%, SE_1 = 3.7%).The two-way interaction between distractor type and picture presence was not significant, F_1 < 1, F_2 (2, 104) = 1.15, MSE_2 = .044, p_2 = .320, $\eta\rho^2_2$ = .022. Furthermore, the above results cannot be attributed to a lack of familiarity with targets and/or the facts asked about them in the questions: For valid versions of the experimental questions, participants correctly selected the target answer 86.8% of the time.

The next analyses focused on participants' selection of specific answer choices and whether distractor type increased selection of the target answer and/or the non-target answer choices.

Selection of target answers. An analysis was conducted to assess the degree to which participants' susceptibility to the illusion resulted in them specifically selecting the target answer on invalid questions (i.e., answering the question as though the correct target name were actually in the sentence instead of the incorrect distractor name; hereafter referred to as "target illusions"). A 2 (picture presence: picture not shown, picture shown) x 3 (distractor type: HVS, LVS, unrelated) repeated measures ANOVA was conducted by participants (F_1) and items (F_2) on percentage of target illusions, and means and standard deviations from this analysis are shown in Table 3-3, while means and standard errors are shown in Figure 3-2. Analyses illustrated a significant main effect of distractor type, F_1 (2, 106) = 4.98, MSE_1 = .035, p_1 =. 009, $\eta\rho^2_1$ = .086, F_2 (2, 104) = 2.55, MSE_2 = .041, p_2 = .083, $\eta\rho^2_2$ = .047, where participants had more target illusions for questions containing HVS distractors (M_1 = 32.8%, SE_1 = 3.3%) compared to those containing LVS distractors (M_1 = 27.1%, SE_1 = 3.3%, p_1 = .030) or unrelated distractors (M_1 = 25.0%, SE_1 = 3.3%, p_1 = .007), which did not differ (p_1 = .356). The main effect of picture presence was not significant, F_1 (1, 53) = 1.52, MSE_1 = .082, p_1 = .223, $\eta\rho^2_1$ = .028, F_2 (1, 52) = 3.25, MSE_2 = .042, p_2 = .077, $\eta\rho^2_2$ = .059, nor was the two-way interaction between distractor type and picture presence, $F_1 < 1$, $F_2 <$ 1.

Selection of answers other than the target answer. An additional analysis was conducted to analyze how frequently participants selected answers other than the target answer (i.e., one of the two remaining incorrect, semantically-related answers, hereafter referred to as "other errors"). A 2 (picture presence: picture not shown, picture shown) x 3 (distractor type: HVS, LVS, unrelated) repeated measures ANOVA was conducted by participants (F_1) and items (F_2) on percentage of non-target answers. Descriptive statistics are reported in Table 3-4, and means and standard deviations are illustrated in Figure 3-3. Analyses demonstrated a significant main effect of picture presence, F_1 (1, 53) = 4.18, MSE_1 = .006, p_1 = .046, $\eta\rho^2_1$ = .073, F_2 < 1, where questions preceded by a picture (M_1 = 3.5%, SE_1 = .8%) resulted in fewer selections of other, non-target answers compared to questions that were not preceded by a picture (M_1 = 5.3%, SE_1 = 1.0%). However, the main effect of distractor type was not significant, F_1 (2, 106) = 1.68, MSE_1 = .007, p_1 = .192, $\eta\rho^2_1$ = .031, F_2 (2, 104) = 1.12, MSE_2 = .011, p_2 = .329, $\eta\rho^2_2$ = .021, nor was the two-way interaction, F_1 < 1, F_2 (2, 104) = 1.01, MSE_2 = .014, p_2 = .367, $\eta\rho^2_2$ = .019.

Attractiveness and response accuracy. Bivariate correlations (by items; see Table 3-5) were conducted to measure potential relationships between target attractiveness and susceptibility to the Moses illusion. Separate correlations were conducted between target mean attractiveness and percentage of "can't say" responses for each of the six levels of picture presence and distractor type (e.g., HVS questions without preceding picture, HVS questions with preceding picture, LVS questions without preceding picture, etc.). None of the correlations between target attractiveness and number of "can't say" responses were significant, *p*s > .2. Similarly, none of the correlations between target attractiveness and percentage of target illusions were significant, *p*s > .3 .These results suggest that susceptibility to the Moses illusion was not driven by attractiveness of the target (i.e., participants did not exhibit differences in name recognition for targets who were attractive as opposed to targets who were unattractive).

Response Times

Response times (answer RTs, in ms) for participants' selection of the "correct" multiple-choice answer (i.e., "can't say"), as well as participants' selection of the target answer, were analyzed for invalid questions. To identify outliers, an overall mean was calculated for answer RTs across conditions (M = 2444.2, SD = 1121.1), and RTs exceeding 2 *SD*s from the mean were excluded from analyses, resulting in the loss of 4.3% of cases.

Can't say. A 2 (picture presence: picture not shown, picture shown) x 3 (distractor type: HVS, LVS, unrelated) repeated measures ANOVA was conducted by participants (F_1) and items (F_2) on answer RTs for correctly selected "can't say" responses[1], whose descriptive statistics are presented in Table 3-6 and illustrated graphically in Figure 3-4. Analyses indicated a main effect for distractor type, F_1 (2, 80) = 3.13, MSE_1 = 188705.15, p_1 = .049, $\eta\rho^2_1$ = .073, F_2 (2, 90) = 5.54, MSE_2 = 356276.67, p_2 = .005, $\eta\rho^2_2$ = .110, with equivalent response times for questions containing a HVS distractor (M_1 = 2271.4, SE_1 = 86.6) and LVS distractor (M_1 = 2235.5, SE_1 = 88.2, p_1 =.615), which both exhibited slower response times than questions containing an participants answered invalid questions more quickly when they were preceded by a

[1] Thirteen participants and 7 items could not be included due to missing data (i.e., extreme scores, incorrect answers, or an excessive number of "don’t know"/timed out responses).

picture (M_1 = 2092.1, SE_1 = 90.2) compared to questions not preceded by a picture (M_1 unrelated distractor (M_1 = 2109.74, SE_1 = 85.94, p_1 =.029 and p_1 =.044, respectively). There was a main effect of picture presence, F_1 (1, 40) = 9.62, MSE_1 = 328919.88, p_1 = .004, $\eta\rho^2_1$ = .194, F_2 (1, 45) = 17.43, MSE_2 = 303573.25, $p_2 < .001$, $\eta\rho^2_2$ = .279, where = 2318.99, SE_1 = 81.16). Neither analysis indicated a significant two-way interaction, F_1 < 1, F_2 (2, 90) = 1.52, MSE_2 = 284284.39, p_2 =. 223, $\eta\rho^2_2$ = .033.

Can't say compared to selection of other answers. To compare RTs for correct and incorrect answers, RTs were analyzed for trials when participants selected "can't say" as opposed to trials when participants selected any of the three answer choices (i.e., "other responses", consisting of the target answer or the two semantically-related answers). This analysis necessitated collapsing across the variable of picture presence to avoid excessive data loss, but this was acceptable given that picture presence did not interact with distractor type in the previous analysis. A 3 (distractor type: HVS, LVS, unrelated) x 2 (answer choice: can't say, illusion response) repeated measures ANOVA was conducted by participants (*F*1) and items (*F*2) on answer RTs[2]. Analyses illustrated only a significant main effect of answer choice, F_1 (1, 37) = 32.32, MSE_1 = 431628.86, $p_1 < .001$, $\eta\rho^2_1$ = .466, F_2 (1, 42) = 110.63, MSE_2 = 321004.69, p_2 < .001, $\eta\rho^2_2$ = .725, where answer RTs for selection of "can't say" answers (M_1 = 2348.6, SE_1 = 80.3) were faster than answer RTs for selection of an illusion response (M_1 = 2843.3, SE_1 = 78.1). Analyses did not indicate a main effect of distractor type, F_1 (2, 74) = 1.66, MSE_1 = 214788.97, p_1 = .198, $\eta\rho^2_1$ = .043, F_2 < 1, nor a significant two-way

[2] Sixteen participants and 11 items could not be included due to missing data.

interaction effect, F_1 (2, 74) = 1.14, MSE_1 = 270042.64, p_1 = .324, $\eta\rho^2_1$ = .030, F_2 (2, 84) = 10.12, MSE_2 = 198140.82, p_2 < .001, $\eta\rho^2_2$ = .194.

Reading Times

Reading times (in ms) were obtained individually for each word presented in the question. To identify outliers for these analyses, an overall mean reading time was calculated for each question (M = 460.9, SD = 160.2), and average word reading times exceeding 2 *SD*s from the mean were excluded from analyses, resulting in the loss of 1.6% of cases.

Overall question reading times. A 2 (picture presence: picture shown, picture not shown) x 3 (distractor type: HVS, LVS, unrelated) repeated measures ANOVA was conducted by participants[3] (F_1) and items (F_2) on mean question reading times, whose means and standard deviations are reported in Table 3-7. Analyses illustrated only a marginal main effect of distractor type, F_1 (2,104) = 2.84, MSE_1 = 1473.89, p_1 = .063, $\eta\rho^2_1$ = .052, F_2 < 1, and pairwise comparisons indicated that words in questions containing an unrelated distractor (M_1 = 445.0, SE_1= 11.4) were read slightly more quickly than questions containing a HVS distractor (M_1 = 455.4, SE_1= 12.8, p_1 = .061) and significantly more quickly than questions containing a LVS distractor (M_1 = 456.1, SE_1= 12.9, p_1 = .042), which did not differ from each other (p_1 = .887). The main effect of picture presence was not significant, F_1 < 1, F_2 < 1, nor was the two-way interaction effect, F_1 < 1, F_2 < 1.

[3] One participant was excluded due to missing data.

Comparing reading times for correct and incorrect responses. A subsequent analysis was conducted to compare reading times between trials when participants subsequently correctly chose the "can't say" response to trials when participants succumbed to the illusion (i.e., other responses, where participants selected any other answer than "can't say" or "don't know"). A new "word position" variable was also created to capture reading times at different points in the question, which contained four levels: (1) reading time *before* the distractor name, in which reading times for all words preceding the distractor's first name were averaged, (2) reading time for the distractor first name, (3) reading time for the distractor last name, and (3) reading time *after* the distractor name, in which reading times for all words following the distractor's last name were averaged[4]. A 3 (distractor type: HVS, LVS, unrelated) x 4 (word position: words before distractor name, distractor first name, distractor last name, words after distractor name) x 2 (answer choice: can't say, illusion response) repeated measures ANOVA was conducted by participants (F_1) and items (F_2) on mean reading times[5]. Similarly to RTs, we could not include picture presence as a variable in this analysis due to excessive data loss. Analyses illustrated a main effect of answer choice, F_1 (1, 36) = 14.14, MSE_1 = 17985.11, p_1 = .001, $\eta\rho^2_1$ = .056, F_2 (1, 44) = 1.60, MSE_2 = 25323.45, p_2 = .212, $\eta\rho^2_2$ = .033, and a main effect of word position, F_1 (3,108) = 17.79, MSE_1 = 9630.69, p_1 < .001, $\eta\rho^2_1$ = .331, F_2 (3, 132) = 18.55, MSE_2 = 10661.65, p_2 < .001, $\eta\rho^2_2$ = .297, which were qualified by a marginally significant three way interaction effect, F_1 (6,216) = 2.11,

[4] When distractors had three names (e.g., Jennifer Love Hewitt), the middle name was excluded from analyses.

[5] Seventeen participants and 8 items were excluded due to missing data.

$MSE_1 = 3989.57$, $p_1 = .053$, $\eta\rho^2_1 = .055$, $F_2 < 1$. No other effects were significant, p_1s > .170, p_2s > .020.

The three-way interaction was decomposed by conducting separate 3 (distractor type: HVS, LVS, unrelated) x 4 (word position: words before distractor name, distractor first name, distractor last name, words after distractor name) follow-up repeated measures ANOVAs on each level of answer choice ("can't say" responses, other responses) by participants[6] (F_1) and items[7] (F_2) on reading times. Means and standard deviations are reported in Table 3-8, and means and standard errors are represented graphically in Figure 3-5. For trials where participants accurately selected the "can't say" response, analyses revealed only a significant main effect of word position, F_1 (3, 150) = 31.09, $MSE_1 = 5923.88$, $p_1 < .001$, $\eta\rho^2_1 = .383$, F_2 (3, 156) = 46.0, $MSE_2 = 4218.7$, $p_2 < .001$, $\eta\rho^2_2 = .470$, where reading times for distractor last names ($M_1 = 486.5$, $SE_1 = 17.7$) were significantly longer than reading times for words *after* the distractor name ($M_1 = 458.6$, $SE_1 = 12.4$, $p_1 = .005$), both of which exhibited significantly longer reading times than distractor first names ($M_1 = 416.2$, $SE_1 = 11.9$, p_1s < .001) or reading times for words *before* the distractor name ($M_1 = 415.2$, $SE_1 = 12.4$, p_1s < .001), which did not differ ($p_1 = .872$). The main effect of distractor type was not significant, $F_1 < 1$, $F_2 < 1$, nor was the two-way interaction effect, F_1 (6, 300) = 1.78, $MSE_1 = 2529.05$, $p_1 = .103$, $\eta\rho^2_1 = .034$, F_2 (6, 312) = 1.52, $MSE_2 = 3442.77$, $p_2 = .170$, $\eta\rho^2_2 = .087$.

[6] In analyses constrained to other responses, 14 participants were excluded due to missing data, whereas for analyses constrained to "can't say" responses, 3 participants were excluded due to missing data.

[7] In analyses constrained to other responses, 8 items were excluded due to missing data.

For trials where participants selected an illusion response, analyses revealed a significant main effect of word position, F_1 (3, 117) = 5.94, MSE_1 = 9012.79, p_1 = .001, $\eta\rho^2_1$ = .132, F_2 (3, 132) = 3.65, MSE_2 = 15006.98, p_2 =.014, $\eta\rho^2_2$ = .077, similar to that when participants selected can't say, and a marginally significant two-way interaction effect, F_1 (6, 234) = 2.13, MSE_1 = 5463.95, p_1 = .052, $\eta\rho^2_1$ = .052, F_2 < 1. Pairwise comparisons illustrated that reading times for words *before* the distractor, distractor first names, and words *after* the distractor did not differ as a function of distractor type. However, for reading times for distractor last names, analyses revealed that HVS last names (M_1 = 508.8, SE_1= 30.5) were read marginally more slowly than unrelated distractors (M_1 = 471.0, SE_1= 20.6, p_1 = .088).

Discussion

The results of this study supported a novel factor, visual similarity, in influencing name recognition in the Moses illusion. With respect to the proposed specific aims, the first hypothesis was supported: Overlapping visual features between semantically-related targets and distractors increased susceptibility to the Moses illusion. Consistent with predictions, participants were more susceptible to the illusion when reading questions with HVS distractors compared to reading questions with either LVS or unrelated distractors, as evidenced by participants' fewer selections of the "can't say" answer choice. Upon further investigation, results demonstrated that HVS distractors did not increase participants' selection of non-target answers (i.e., semantically-related answers that would have been incorrect if the questions were valid), but rather, specifically increased participants' erroneous selection of target answers (i.e., answers that would have been correct if the questions were valid) compared to LVS or unrelated distractors, suggesting that participants were indeed mistakenly thinking of the target name while reading the invalid HVS question. Importantly, these results cannot be explained as reflecting a lack of familiarity with the questions or targets, as participants responded to valid versions of the questions with high accuracy. Surprisingly, LVS distractors did not exhibit susceptibility to the Moses illusion, as they had equivalent accuracy to unrelated distractors (number of correct "can't say" responses or target illusions). One possibility is that because visual information was highly salient in the present experiment (targets and distractors were well-known celebrities, whose faces are frequently exposed), non-visual semantic information alone may have been insufficient to induce an illusion. The implications of this claim are described in greater depth in the general discussion.

Analyses of response times (to select an answer) and question reading times confirmed that HVS distractors' greater susceptibility to the Moses illusion was not a result of differences in the time spent reading or answering questions containing these distractors. Consistent with previous research (e.g., Reder & Kusbit, 1991; van Oostendorp & de Mul, 1990), there was no evidence of a speed-accuracy tradeoff. Questions containing a HVS distractor had similar response times to those with a LVS distractor, and overall reading times were equivalent for questions containing a HVS distractor or a LVS distractor. Furthermore, when reading times were examined as a function of participants' subsequent response (can't say vs. illusion answer choices), reading times were equivalent for all distractor types for can't say responses, and the only reading time difference that emerged for other responses was a marginal slowing in reading a HVS distractor last name compared to an unrelated distractor last name.

These timing measures also suggest that the illusion did not result from hasty or incomplete perceptual processing of the HVS distractor name. In general, participants read distractor last names more slowly than other words in the sentence, demonstrating increased attention to the distractor name, and this was especially true for HVS distractors. Even though people spent more time reading a HVS distractor, they nonetheless experienced greater susceptibility to target illusions. Independent of distractor type, participants took longer to select an illusory answer relative to "can't say", and they took longer to read questions for which they experienced an illusion versus those they did not. Together, these findings indicate that susceptibility to the Moses illusion did not result from speeded processing of invalid questions in general.

The second hypothesis, that presenting the target picture prior to the Moses illusion question will reduce susceptibility to the illusion for LVS and unrelated distractors, was partially supported. Target picture presentation prior to reading an invalid general knowledge question generally improved participants' response accuracy (resulted in fewer illusions), as demonstrated by selection of more "can't say" responses and fewer non-target answers. Presentation of a target picture decreased the time participants needed to select correct answer choices (answer RTs associated with selection of the "can't say" response), further demonstrating a facilitative effect of picture presence. These findings are consistent with a view where presentation of the target picture leads to activation of unique visual information that assists in successful identification of the target name, allowing for greater anomaly detection and consequently higher accuracy. Specifically, because the target is identified (via a picture) before the distractor name has been presented, the distractor no longer interferes with correct target detection (i.e., detection of an anomaly), making it easier and quicker to choose correct answers. This is unique in light of previous research (e.g., Reder & Kusbit, 1991), which reduced Moses illusions via semantic cuing as a function of presenting a relevant fact about the target, such as "Noah took two animals of each kind on the ark”. Unlike semantic cuing, which specifically directed participants' attention to the source of the illusion (Noah-ark), visual cuing was indirect, meaning that participants were given visual information not directly related to the fact being tested. It is also worth noting that this effect emerged even though participants were not instructed to study the picture, which was briefly presented (200 ms) (whereas Reder and Kusbit instructed their participants to study the relevant fact), indicating that this effect occurred without participants' conscious awareness. Thus, visual cuing's effect on reducing the Moses illusion is in line with a theoretical framework like NST, where visual concept nodes can directly transmit priming to other relevant semantic information stored in propositional nodes as well as the proper name phrase's lexical node, highlighting the distractor as anomalous in the question.

Unexpectedly, the results of picture presence occurred independent of distractor type, so that even HVS distractors benefitted from prior presentation of the target picture. There are several possible explanations for this finding. First, the level of visual overlap for HVS distractors might not have been as strong as originally anticipated. Although HVS distractors in this study shared overlapping visual features with their targets, the visual features were not identical. Thus, the differences between their visual features might have been distinct enough to provide participants with a unique visual "cue" for the target, facilitating anomaly detection to a similar degree as LVS and unrelated distractors. Second, the targets utilized in this study were very recognizable celebrities whose faces were frequently encountered (e.g., screen actors, talk show hosts, popular politicians, etc.), which may have made the targets particularly easy to distinguish from the distractor when a target picture was presented. This is consistent with the NST, which indicates that information is more quickly and readily accessed when it is consistently primed for use (i.e., when the connections between visual concepts and associated targets are frequently traversed; e.g., Burke et al., 1991; MacKay, 1981).

Table 3-1. Main experiment descriptive characteristics (N = 54)

	M	*SD*
Age	18.67	1.06
Education (in years)	12.68	1.14
Forward Digit Span	7.59	1.37
Backward Digit Span	5.01	1.15
Vocabulary (out of 25)	14.60	3.79

Table 3-2. Percentage of "can't say" responses as a function of distractor type and picture presence

	M (%)	*SD* (%)
Picture Not Presented		
HVS	59.2	32.77
LVS	63.7	33.91
Unrelated	70.5	29.94
Picture Presented		
HVS	64.3	31.82
LVS	73.3	29.76
Unrelated	72.9	32.14

Table 3-3. Percentage of target illusions as a function of distractor type and picture presence

	M (%)	*SD* (%)
Picture Not Presented		
HVS	34.1	30.7
LVS	30.5	31.7
Unrelated	26.2	29.4
Picture Presented		
HVS	31.5	30.0
LVS	23.8	26.6
Unrelated	23.8	28.7

Table 3-4. Percentage of other errors as a function of distractor type and picture presence

	M (%)	*SD (%)*
Picture Not Presented		
HVS	6.7	13.5
LVS	5.8	12.3
Unrelated	3.3	7.9
Picture Presented		
HVS	4.2	8.6
LVS	2.9	8.3
Unrelated	3.3	8.8

Table 3-5. Pearson correlation coefficients of attractiveness as a function of response type.

	Measure	
	"Can't Say" Responses	Target Illusions
Picture Not Presented		
HVS	.138	-.059
LVS	.168	.125
Unrelated	.509	.087
Picture Presented		
HVS	.177	-.003
LVS	.537	-.069
Unrelated	.360	.093

Table 3-6. Answer reaction times (in ms) for "can't say" responses as a function of distractor type and picture presence

	M	*SD*
Picture Not Presented		
HVS	2354.7	708.6
LVS	2392.1	687.2
Unrelated	2210.2	555.5
Picture Presented		
HVS	2188.3	716.7
LVS	2078.9	659.9
Unrelated	2009.3	692.5

Table 3-7. Overall question reading times (in ms) as a function of distractor type and picture presence

	M	*SD*
Picture Not Presented		
HVS	457.9	99.5
LVS	454.7	105.7
Unrelated	446.0	93.6
Picture Presented		
HVS	452.8	95.0
LVS	457.6	93.3
Unrelated	443.8	80.4

Table 3-8. Reading times (in ms) as a function of distractor type, picture presence, and word position

	Distractor Type					
	HVS		LVS		Unrelated	
	M	(*SD)*	*M*	(*SD)*	*M*	(*SD)*
"Can't Say" Responses						
Before Distractor	411.1	(88.4)	422.4	(99.8)	412.5	(97.9)
Distractor First Name	407.1	(96.9)	427.5	(95.7)	414.3	(92.5)
Distractor Last Name	488.6	(139.9)	481.3	(144.1)	489.6	(132.6)
After Distractor	469.9	(102.4)	460.6	(101.5)	445.3	(83.7)
Other Responses						
Before Distractor	449.6	(120.7)	439.3	(100.4)	436.7	(112.8)
Distractor First Name	432.8	(113.5)	434.2	(157.3)	463.7	(123.7)
Distractor Last Name	508.8	(193.1)	475.4	(137.7)	471.0	(130.3)
After Distractor	457.5	(114.8)	477.8	(120.4)	476.4	(128.9)

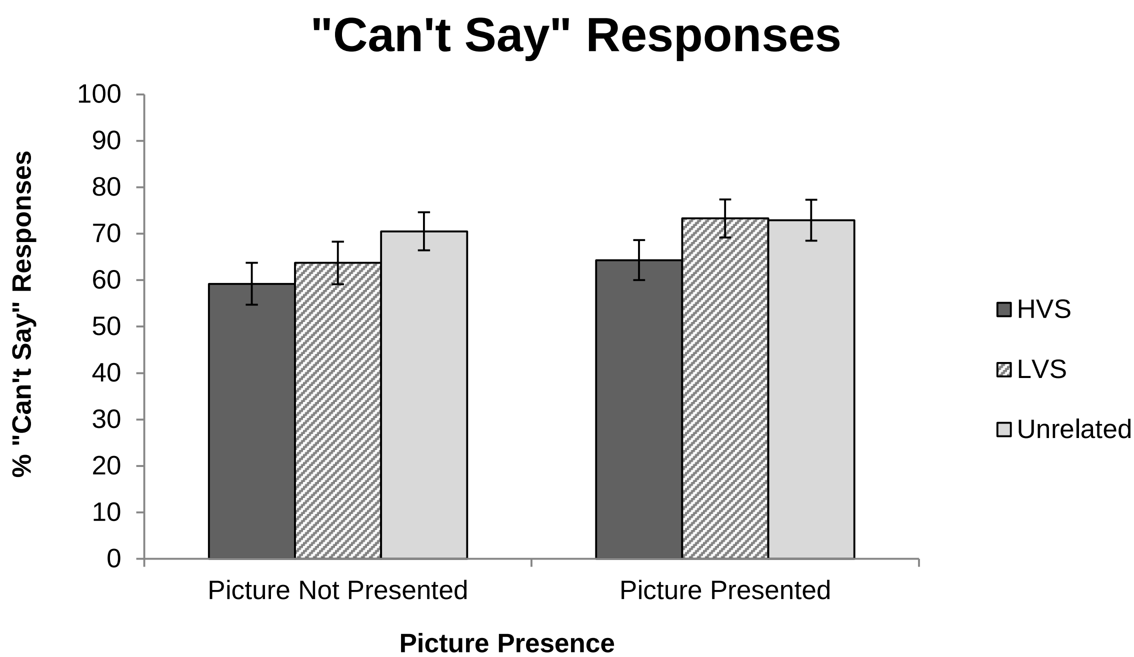


Figure 3-1. Percentage of correct "can't say" responses for invalid questions as a function of distractor type and picture presence

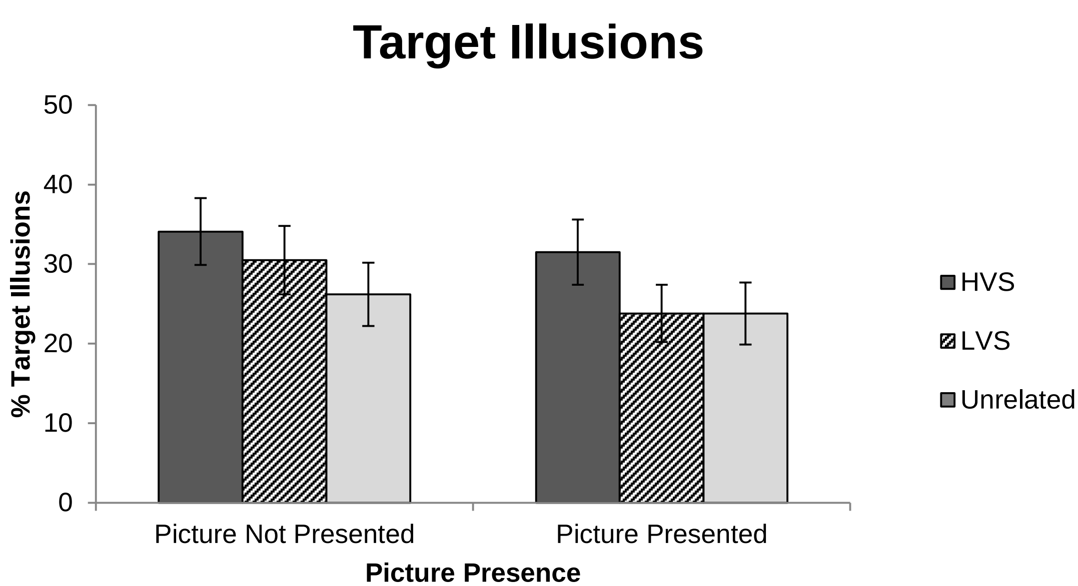


Figure 3-2. Percentage of target illusions (i.e., choosing the correct target answer if the question were valid) for invalid questions as a function of distractor type and picture presence

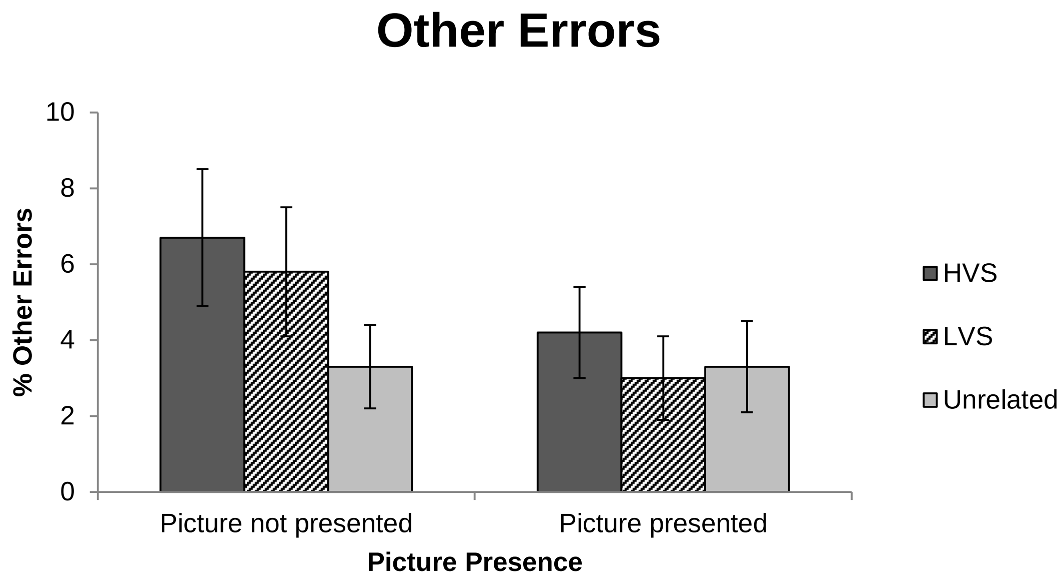


Figure 3-3. Percentage of other errors (i.e., choosing an incorrect, semantically-answer if the question were valid) for invalid questions as a function of distractor type and picture presence

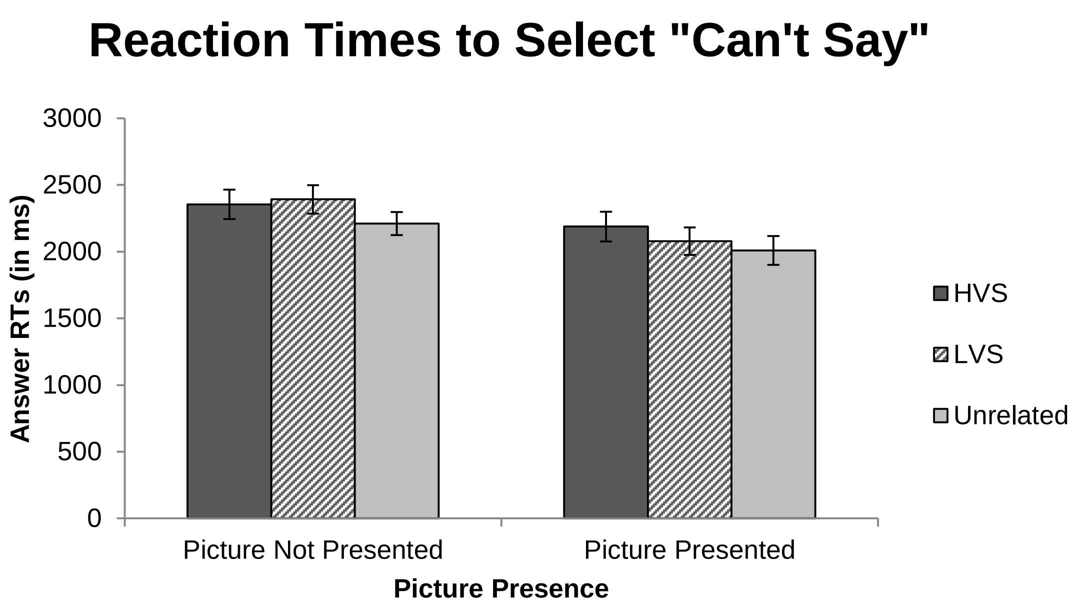
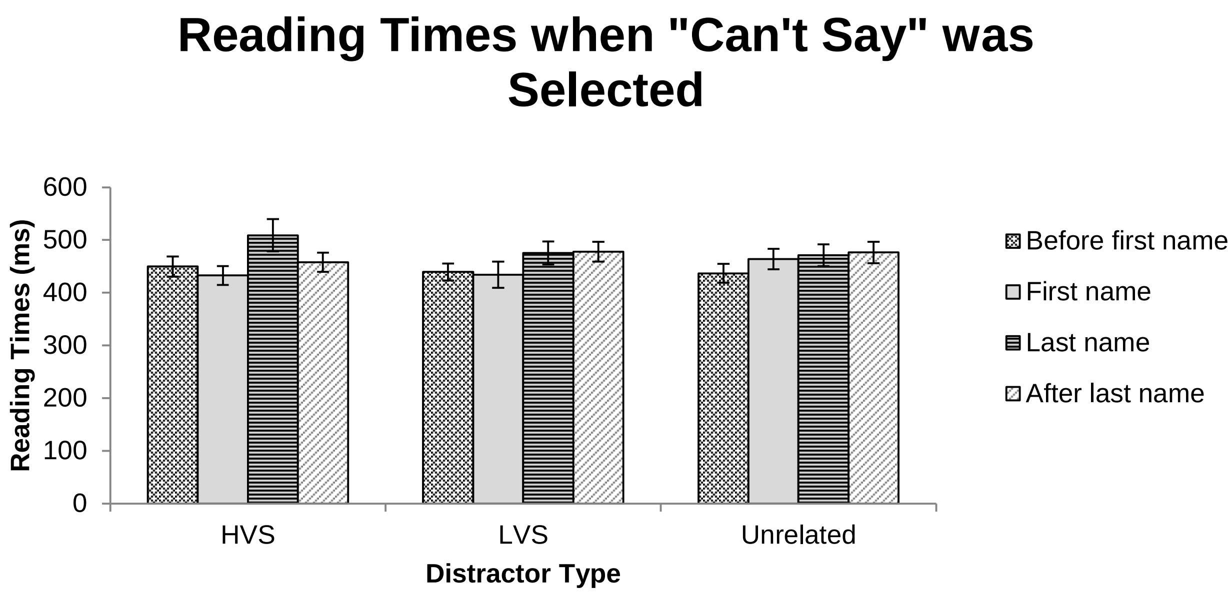


Figure 3-4. Response times to select the correct "can't say" answer for invalid questions as a function of distractor type and picture presence



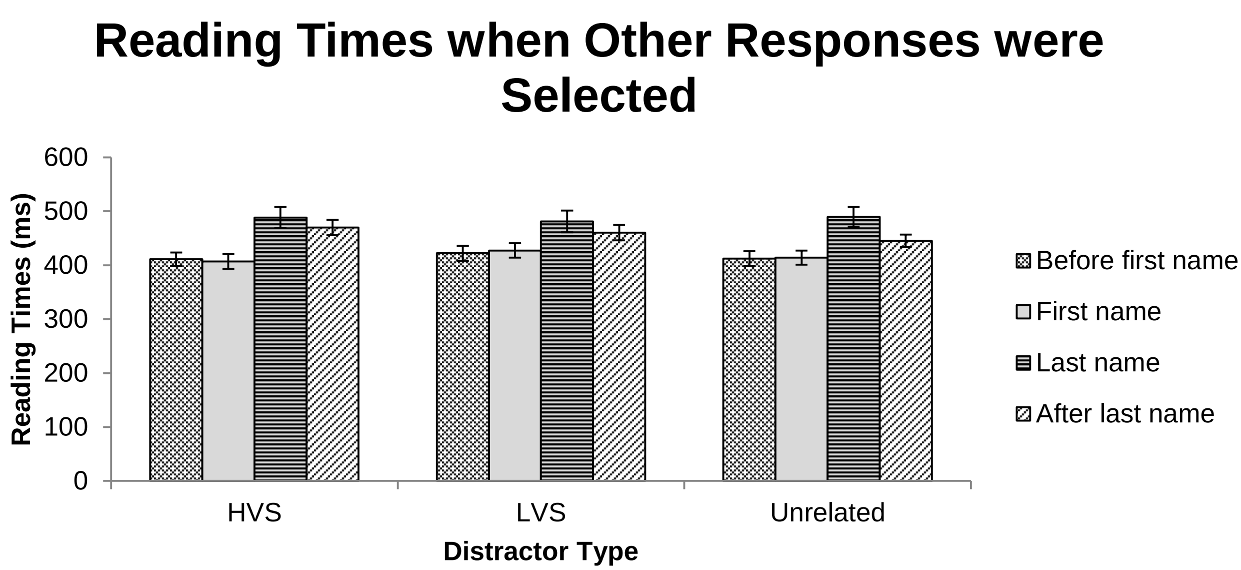


Figure 3-5. Reading times as a function of answer choice ("can't say" vs. other responses), word position, and distractor type.

CHAPTER 4
GENERAL DISCUSSION

The overarching goal of this thesis was to uncover specific factors that influence lexical retrieval of proper names, specifically examining the factors that contribute to proper name recognition failures. Much past research has shown that proper names are more difficult to retrieve than common names (e.g., Brédart & Valentine, 1998; Evrard, 2002; Young, Ellis, & Flude, 1988) or even other person-specific (i.e., biographical) information (e.g., James, 2004; Stanhope & Cohen, 1993), and past research has explained this disproportionate impairment in terms of proper names' inherent fragility in the lexical system, due to a number of possible causes. For example, compared to other words, proper names are less descriptive and less meaningful (e.g., Fogler & James, 2007; Semenza, 2006) and are associated with a limited set of semantic and phonological components whose activation is necessary for name retrieval, such that a deficit in any one link could lead to a retrieval failure (e.g., Burke et al., 1991). However, much of the research on proper name retrieval failures has focused on retrieval failures in name production, although intuitively, the same factors that increase production failures may also be attributed to name recognition failures, as both name production and recognition necessitate accurate lexical retrieval. Because proper names are exceptionally difficult to encode and retrieve, they may also be particularly susceptible to interference during recognition, as observed in the Moses illusion.

While research has demonstrated that illusions result when a semantically related distractor name (Moses) interferes with accurate retrieval of a target name (Noah), the primary question of interest in this project was in regards to the role of visual (i.e., facial) similarity between targets and distractors, which previous research has not considered. Specifically, this project revealed two key factors that influenced the Moses illusion: (1) overlapping visual concepts enhance the Moses illusion above and beyond semantic overlap alone, and (2) visual similarity between targets and distractors enhances the Moses illusion even when not explicitly presented with visual information, indicating that visual information is activated even in the absence of external stimulation (e.g., picture presentation).

Convergent evidence from analyses of "can't say" responses and target illusions clearly demonstrates that HVS distractors were more likely to induce illusions compared to LVS or unrelated distractors. The only measurable difference between HVS and LVS distractors was in their degree of visual similarity, as pilot testing revealed that they did not differ in their semantic similarity or familiarity; therefore, the enhanced illusion for HVS distractors cannot be attributed solely to the sharing of semantic characteristics. The impact of visual similarity on the Moses illusion is consistent with the theoretical assumptions posited by the NST: Visual concepts (i.e., facial features) are stored and retrieved in a manner similar to other semantic information (MacKay & Burke, 1991), and likewise exacerbate the semantic interference that has been traditionally implicated in the Moses illusion. In contrast, the assumptions posed by the IAC (Burton & Bruce, 1992) are difficult to reconcile with the present results[1]. Specifically, because each individual is presumed to possess only a single, unique FRU housing distinctive visual concepts, visual concepts cannot be "shared" among individuals, indicating that high

[1] It is important to note that the IAC has never specifically been used to explain the effects of the Moses illusion, and these authors acknowledge the possibility that certain presently-unknown mechanisms can account for the effect of the illusion, although this might require modification of the current model.

visual similarity should not influence susceptibility to the Moses illusion.

Another novel finding of this study is that the level of visual similarity between targets and distractors influences the Moses illusion even in the absence of a visual cue (when a picture was not presented). Specifically, HVS distractors led to more illusions than any other distractors, an effect that was not moderated by picture presence on any measure of accuracy (e.g., "can't say" responses, target illusions, or other errors). This demonstrates that visual concepts are indeed among many other pieces of semantic information activated during lexical retrieval whether intentional or not. Furthermore, visual concepts are relatively salient characteristics whose activation has the capability to influence lexical retrieval, even when it is beyond the realm of awareness or when the task does not seemingly require face recognition (e.g., the Moses illusion task). The present findings bring a new role for visual concepts in name recognition that has not been previously identified.

Another interesting observation lends support to the unique importance of visual overlap, in which questions containing LVS distractors did not elicit more illusions than questions containing unrelated distractors (both in terms of number of "can't say" responses and number of target illusions). This was somewhat unexpected because previous research specifically implicated semantic overlap as the source of the Moses illusion (e.g., Bredart & Modolo, 1988; Erickson & Mattson, 1981; Reder & Kusbit, 1991; Shafto & MacKay, 2000; van Oostendorp & de Mul, 1990). In the present experiment, LVS distractors overlapped only in semantics with their targets but nonetheless did not result in a Moses illusion. One possibility is that our LVS distractors did not exhibit the same strength of semantic association to their targets that previous experiments described. Here, semantic overlap was determined solely via shared occupation (e.g., both the target and distractor were actors), which is only a single relevant biographical connection. Stimuli in other studies may have required multiple sources of overlap; for example, in the classic example, Moses and Noah were both biblical characters, performed miracles in water, and spoke directly to God, all of which constitutes considerably more semantic overlap than one's occupation. Similarly, some studies (e.g., Bottoms, Eslick, & Marsh, 2010; Reder & Cleeremans, 1990; Reder & Kusbit, 1991) investigated the Moses illusion by using non-names (e.g., computer as a distractor for calculator) which reliably share many characteristics and are arguably stronger in terms of their semantic associations than proper names. Another stimuli difference worth noting is that many previous studies used targets and distractors that overlapped both semantically and phonologically to varying degrees (e.g., computer/calculator; thermostat/thermometer; abortion/adoption; Joshua/Jonah; from Reder & Kusbit, 1991), which has been shown to enhance the Moses illusion (the mega-Moses illusion; Shafto & MacKay, 2000). In our experiment, targets and distractors did not share phonology, given that visual similarity dictated which distractors we could use.

While visual similarity was the critical factor for inducing the Moses illusion in our experiment, it is possible that people rely more on semantic similarity when visual characteristics are unknown or less salient. For example, for questions like What is the nationality of Thomas Edison, inventor of the telephone? (Erickson & Mattson, 1981), participants may not have well-developed visual concepts for either the target (Alexander Graham Bell) or the distractor (Thomas Edison). If individuals cannot access visual concepts for these kinds of questions, semantic information (in the form of biographical facts) may be sufficient to lead to a Moses illusion. Contrastively, all targets and distractors in the present study were popular, well-known celebrities whose visual characteristics were very salient as a function of high media exposure (as from television, internet, etc.). In these situations with high salience and high familiarity with associated visual concepts, semantic association without visual overlap may be insufficient to cause a Moses illusion.

The results of this experiment open the door to various questions for future research. While this experiment demonstrates that visually-similar semantic distractors increase the Moses illusion, it does not specifically address the unique role of visual information independent of semantic association. One could address this question by expanding the present stimuli to include a "visually similar, unrelated" distractor condition so as to differentiate the effects of visual and semantic overlap. Another question could extend the finding that presenting a target picture prior to question with a distractor decreased participants' susceptibility to the illusion, specifically examining if cuing participants with visual information in the form of descriptive sentences (e.g., Natalie Portman has long brown hair and a beauty mark on her cheek) would reduce the frequency of the Moses illusion to the same degree as picture presentation. If so, this would illustrate two key factors: (1) the relevant fact presented prior to the illusion question does not need to explicitly address the source of the distortion (e.g., Noah-Ark) to reduce the illusion, and (2) providing visual information in written form is just as powerful of a cue to reduce the illusion as visual information in picture form, despite being arguably less profound or impactful. Addressing these questions would not only expand our understanding of the Moses illusion, but many of these research ideas would also contribute to a more global understanding of the ways in which visual concepts are organized within the lexical system to influence accurate name recognition.

In sum, this experiment provides evidence for a new, non-linguistic factor (overlapping visual concepts) contributing to the process of name recognition; specifically Moses illusion errors. Furthermore, it has effectively demonstrated that visual similarity is influential even when visual features are not necessary for successful name recognition (e.g., reading biographical questions), supporting a view where visual concepts other person-specific information are accessed in parallel and can work interactively as opposed to in isolation of one another. More importantly, this research effectively demonstrates the ways in which two seemingly disparate fields of research (face recognition and lexical access) can coalesce to enhance the current understanding of a single phenomenon like name recognition errors, and in doing so, is a starting point for contributing to a literature devoted to developing a more complete and comprehensive grasp of the ways in which language is organized and subsequently retrieved. If with a specific focus on what leads to and/or enhances proper names' particular susceptibility to different types of speech (production/recognition) errors.

APPENDIX A
PARTICIPANT FAMILIARITY AND SIMILARITY JUDGEMENT RATINGS

Table A-1. Target names, distractor names, and familiarity with general knowledge questions.

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which movie featuring songs by ABBA had ______ play a bride-to-be trying to find her father?	82%	Amanda Seyfried (Actor)	Dakota Fanning	Megan Fox	Colbie Caillat (Singer)	Mamma Mia
Which rap artist collaborated with ______ to sing 'Empire State of Mind'?	73%	Alicia Keys (Singer)	Leona Lewis	Natasha Bedingfield	Nastia Liukin (Athlete)	Jay Z
Which movies feature ______ as a teenager destined to become queen of the Kingdom of Genovia?	82%	Anne Hathaway (Actor)	Liv Tyler	Hayden Panettiere	Britney Spears (Singer)	The Princess Diaries
Which style of music is associated with ______ through songs like Complicated, SK8R Boi, and Girlfriend?	94%	Avril Lavigne (Singer)	Taylor Swift	Ashley Tisdale	McKayla Maroney (Athlete)	Punk

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which movie features ______ as an aggressive gym owner trying to take over his competitor's gym?	93%	Ben Stiller (Actor)	Steve Carell	Jim Carrey	Tim McGraw (Singer)	Dodgeball
Which movie features ______ attempting to rob a casino?	86%	Brad Pitt (Actor)	Chris Hemsworth	Hugh Jackman	Rick Santorum (Politician)	Ocean's 11
Which action movies have ______ as a NYC and LA police detective?	67%	Bruce Willis (Actor)	Jason Statham	George Clooney	Elton John (Singer)	Die Hard
Which movies have ______ as one of three female private investigators?	91%	Cameron Diaz (Actor)	Renee Zellweger	Angelina Jolie	Sara Evans (Singer)	Charlie's Angels
Which movie has ______ playing a wicked queen who wants to kill her beautiful stepdaughter?	61%	Charlize Theron (Actor)	Katherine Heigl	Meg Ryan	Paula Abdul (Singer/TV Personality)	Snow White and the Huntsman

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which cable channel has ______ hosting a self-named late night talk show?	64%	Chelsea Handler (Actor/TV Personality)	Elizabeth Banks	Joan Cusack	Sarah McLachlan (Singer)	E!
Which style of fighting does ______ do in action movies?	76%	Chuck Norris (Actor)	Tim Allen	Robin Williams	Billy Joel (Singer)	Martial Arts
Which sitcom had ______ playing a chef with obsessive-compulsive tendencies and living with her pal Rachel?	67%	Courteney Cox (Actor)	Demi Moore	Jodie Foster	LeeAnn Rimes (Singer)	Friends
Which movie had ______ play a cashier who tries to win an attractive co-worker's attention?	61%	Dane Cook (Actor/ Comedian)	Jeff Dunham	Vince Vaughn	Josh Groban (Singer)	Employee of the Month
Which movies had ______ play a young wizard hunted down by the dark Lord?	97%	Daniel Radcliffe (Actor)	Elijah Wood	Adam Brody	Clay Aiken (Singer)	Harry Potter

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which baseball team signed ______ for eighteen seasons, the only team he played for?	57%	Derek Jeter (Athlete)	Alex Rodriguez	Mark Sanchez	Marc Anthony (Singer)	New York Yankees
Which comedy movie has ______ embracing a rumor that she is promiscuous?	91%	Emma Stone (Actor)	Lindsay Lohan	Victoria Justice	Carly Rae Jepsen (Singer)	Easy A
Which movie had ______ play a disfigured, masked man who terrorizes a Paris musical theatre company?	76%	Gerard Butler (Actor)	Russell Crowe	Tom Cruise	Kurt Cobain (Singer)	Phantom of the Opera
Which hit song by ______ has the lyrics 'this shit is bananas'?	82%	Gwen Stefani (Singer)	Christina Aguilera	Kelly Clarkson	Anna Kournikova (Athlete)	Hollaback Girl
Which film features ______ as a bookshop owner who falls in love with a famous movie star?	---[1]	Hugh Grant (Actor)	Seth Meyers	Owen Wilson	Blake Shelton (Singer)	Notting Hill

[1] This question, as presented here, was modified from its original version before use in the main experiment due to low initial accuracy (<50%). Because this version was not piloted after being modified, it does not have an associated measure of accuracy.

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
What Disney show had ______ playing Miley Cyrus's older brother?	88%	Jason Earles (Actor)	Neil Patrick Harris	Macaulay Culkin	Adam Lambert (Singer)	Hannah Montana
Which movie featured ______ as the owner of an adorable but neurotic, naughty dog?	67%	Jennifer Aniston (Actor)	Kristen Wiig	Reese Witherspoon	Regina Spektor (Singer)	Marley and Me
Which comedy has ______ playing a young girl who makes a wish and becomes middle-aged overnight?	79%	Jennifer Garner (Actor)	Hilary Swank	Gwyneth Paltrow	Celine Dion (Singer)	13 going on 30
Which MTV reality show featured ______ in her day-to-day life with her husband?	64%	Jessica Simpson (Actor/Singer)	Faith Hill	Mariah Carey	Mia Hamm (Athlete)	Newlyweds

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
What disease was the wife of ______ battling while he was having an affair?	---[2]	John Edwards (Politician)	Rick Perry	Bill Clinton	Steve Martin (Actor)	Cancer
Which African-American singer collaborated with ______ to make the song 'No Air'?	55%	Jordin Sparks (Actor/Singer)	America Ferrera	Raven-Symoné Pearman	Gabby Douglas (Athlete)	Chris Brown
Which witty, perceptive sidekick does ______ play in the 'Sherlock Holmes' movies?	82%	Jude Law (Actor)	Ewan McGregor	Christian Bale	Dan Brown (Author)	Watson
On which reality tv program was ______ declared the champion twice?	64%	Julianne Hough (Actor/Singer)	Miley Cyrus	Miranda Cosgrove	Kate Middelton (One-News Wonder)	Dancing with the Stars

[2] This question, as presented here, was modified from its original version before use in the main experiment due to low initial accuracy (<50%). Because this version was not piloted after being modified, it does not have an associated measure of accuracy.

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which romantic comedy has ______ writing a magazine article about ways women can ruin relationships?	79%	Kate Hudson (Actor)	Blake Lively	Sandra Bullock	Sara Bareilles (Singer)	How to Lose a Guy in 10 Days
Which actor was previously married to ______ and is a committed follower of Scientology?	97%	Katie Holmes (Actor)	Maggie Gyllenhaal	Tara Reid	Nelly Furtado (Singer)	Tom Cruise
What genre of music did ______ originally sing before her debut pop song 'I Kissed a Girl'?	61%	Katy Perry (Singer)	Zooey Deschanel	Ellie Goulding	Hope Solo (Athlete)	Gospel
Who is ______ 's boyfriend, with whom she recently had 'North', her first child?	91%	Kim Kardashian (Actor)	Nicole Scherzinger	Kelly Ripa	Danica Patrick (Athlete)	Kanye West
Which film has ______ playing the love interest of a man with insect-like superpowers?	97%	Kirsten Dunst (Actor)	Drew Barrymore	Jessica Biel	Lindsey Vonn (Athlete)	Spiderman

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which movies have ______ playing a human who falls in love with a vampire?	97%	Kristen Stewart (Actor)	Emma Watson	Mandy Moore	Missy Franklin (Athlete)	Twilight
What infamous 'material' did______ wear to the MTV Video Music Awards in 2010?	85%	Lady GaGa (Singer)	Amy Winehouse	Alanis Morissette	Monica Lewinsky (One-News Wonder)	Meat
Which movie features ______ as a lawyer working a case with a sorority-girl, Harvard-law student?	91%	Luke Wilson (Actor)	David Arquette	Ashton Kutcher	Joey Fatone (Singer)	Legally Blonde
Which suspense movies feature ______ as a CIA agent with no memory?	79%	Matt Damon (Actor)	Leonardo DiCaprio	Tom Hardy	Nick Carter (Singer)	Bourne
Which movie has ______ playing a former stripper who owns a strip club?	93%	Matthew McConaughey (Actor)	Bradley Cooper	Will Ferrell	Luke Bryan (Singer)	Magic Mike

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which Chinese city featured ______ winning eight Olympic gold medals in swimming?	82%	Michael Phelps (Athlete)	Eli Manning	Tom Brady	Johnny Depp (Actor)	Beijing
Which movie has ______ playing the girlfriend of a man whose best friend is a talking stuffed bear?	85%	Mila Kunis (Actor)	Vanessa Hudgens	Uma Thurman	Ingrid Michaelson (Singer)	Ted
Which movie has ______ playing a ballet dancer who slowly loses her mind?	97%	Natalie Portman (Actor)	Keira Knightley	Amy Adams	Maria Sharapova (Athlete)	Black Swan
Which movies have ______ playing a blacksmith who fights the living dead to save the woman he loves?	85%	Orlando Bloom (Actor)	Justin Timberlake	Nicolas Cage	Chris Daughtry (Singer)	Pirates of the Caribbean
Which movie has ______ playing a salesman whose wild behavior forces him into a Big Brother program?	64%	Paul Rudd (Actor)	Ben Affleck	Brendan Fraser	Michael Buble (Singer)	Role Models

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which movie stars ______ as a woman with Alzheimer's whose husband reads her stories from his journal?	79%	Rachel McAdams (Actor)	Kate Beckinsale	Kate Winslet	Sheryl Crow (Singer)	The Notebook
Which comedy has ______ playing an intimidating father who distrusts his daughter's new boyfriend?	61%	Robert DeNiro (Actor)	Tommy Lee Jones	Kevin Bacon	Tom Petty (Singer)	Meet the Parents
What reality show features ______ hosting a nationwide singing contest?	91%	Ryan Seacrest (TV Personality)	Joel McHale	Jimmy Fallon	Tim Tebow (Athlete)	American Idol
Which comic book company created superhero movies with ______ portraying a former Russian spy?	67%	Scarlett Johansson (Actor)	Jessica Alba	Jennifer Love Hewitt	Carrie Underwood (Singer)	Marvel Entertainment

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
What Disney show features ______ as one of three supernatural siblings who compete to avoid becoming mortal?	91%	Selena Gomez (Actor)	Demi Lovato	Ashlee Simpson	Bristol Palin (One-News Wonder)	The Wizards of Waverly Place
Which movie has ______ playing a process server who witnessed the death of his marijuana dealer's boss?	61%	Seth Rogen (Actor)	Jonah Hill	Adam Sandler	Lance Bass (Singer)	Pineapple Express
Which ensemble sitcom features ______ as the second wife of a well-off older man with two adult children?	67%	Sofia Vergara (Actor/TV Personality)	Catherine Zeta-Jones	Nicole Kidman	Martina McBride (Singer)	Modern Family
Which cable station has ______ hosting a comedic, fake political news program?	64%	Stephen Colbert (Actor/TV Personality)	Bob Saget	Howie Mandel	Keith Urban (Singer)	Comedy Central

Table A-1. Continued

Target Question	Percent Correct Answers (Pilot)	Target Name	High Visual Similarity Distractor	Low Visual Similarity Distractor	Unrelated Distractor	Answer to Question
Which movie has ______ playing a career-focused character who hires an immature, obnoxious woman as a surrogate mother?	73%	Tina Fey (Actor)	Winona Ryder	Christina Applegate	Shania Twain (Singer)	Baby Mama
Which movie has ______ saying 'Life is like a box of chocolates'?	91%	Tom Hanks (Actor)	Bill Murray	Alec Baldwin	Garth Brooks (Singer)	Forrest Gump
Which Disney movies have ______ playing a teenage basketball player who secretly wanted to dance and sing?	97%	Zac Efron (Actor/Singer)	Jesse McCartney	Justin Bieber	Ryan Lochte (Athlete)	High School Musical
Which movie has ______ playing one of three groomsmen who cannot find the groom after the bachelor party?	73%	Zach Galifianakis (Actor)	Ryan Dunn	Russell Brand	John Mayer (Singer)	The Hangover

Table A-2. Familiarity with targets and distractors.

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Amanda Seyfried (Actor)	4.10	4.10	Dakota Fanning	2.50	Megan Fox	2.67	Colbie Caillat (Singer)	3.67
Alicia Keys (Singer)	3.80	3.14	Leona Lewis	4.00	Natasha Bedingfie-ld	4.50	Nastia Liukin (Athlete)	3.00
Anne Hathaway (Actor)	3.88	4.60	Liv Tyler	2.44	Hayden Panettiere	3.67	Britney Spears (Singer)	4.90
Avril Lavigne (Singer)	3.38	4.25	Taylor Swift	4.60	Ashley Tisdale	4.30	McKayla Maroney (Athlete)	2.50
Ben Stiller (Actor)	4.40	4.63	Steve Carell	3.75	Jim Carrey	4.80	Tim McGraw (Singer)	3.13
Brad Pitt (Actor)	4.13	4.88	Chris Hemsworth	3.60	Hugh Jackman	4.30	Rick Santorum (Politicia-n)	2.60

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Bruce Willis (Actor)	4.00	4.00	Jason Statham	2.38	George Clooney	4.40	Elton John (Singer)	3.88
Cameron Diaz (Actor)	4.60	4.38	Renee Zellweger	3.60	Angelina Jolie	4.13	Sara Evans (Singer)	2.60
Charlize Theron (Actor)	2.50	3.20	Katherine Heigl	3.80	Meg Ryan	2.38	Paula Abdul (Singer/ TV Personal-ity)	3.50
Chelsea Handler (Actor/TV Personality)	3.40	3.00	Elizabeth Banks	2.40	Joan Cusack	2.38	Sarah McLachl-an (Singer)	3.00
Chuck Norris (Actor)	3.86	4.10	Tim Allen	3.50	Robin Williams	4.00	Billy Joel (Singer)	3.60
Courteney Cox (Actor)	3.25	2.63	Demi Moore	4.30	Jodie Foster	3.90	LeeAnn Rimes (Singer)	2.88

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Dane Cook (Actor/ Comedian)	3.57	3.60	Jeff Dunham	3.40	Vince Vaughn	4.13	Josh Groban (Singer)	2.43
Daniel Radcliffe (Actor)	4.20	3.25	Elijah Wood	3.33	Adam Brody	2.00	Clay Aiken (Singer)	2.63
Derek Jeter (Athlete)	3.60	2.50	Alex Rodriguez	3.30	Mark Sanchez	2.38	Marc Anthony (Singer)	3.20
Emma Stone (Actor)	4.30	3.80	Lindsay Lohan	4.50	Victoria Justice	3.20	Carly Rae Jepsen (Singer)	3.90
Gerard Butler (Actor)	3.60	3.88	Russell Crowe	3.44	Tom Cruise	4.80	Kurt Cobain (Singer)	3.50
Gwen Stefani (Singer)	3.80	4.00	Christina Aguilera	4.40	Kelly Clarkson	4.38	Anna Kournik-ova (Athlete)	3.00

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Hugh Grant (Actor)	3.00	3.00	Seth Meyers	2.89	Owen Wilson	4.40	Blake Shelton (Singer)	3.00
Jason Earles (Actor)	3.90	1.70	Neil Patrick Harris	3.13	Macaulay Culkin	3.90	Adam Lambert (Singer)	2.86
Jennifer Aniston (Actor)	4.38	4.60	Kristen Wiig	2.80	Reese Withersp-oon	3.89	Regina Spektor (Singer)	2.50
Jennifer Garner (Actor)	3.60	3.25	Hilary Swank	3.00	Gwyneth Paltrow	3.60	Celine Dion (Singer)	3.67
Jessica Simpson (Actor/Singer)	4.50	4.80	Faith Hill	3.80	Mariah Carey	4.38	Mia Hamm (Athlete)	2.00
John Edwards (Politician)	2.63	3.20	Rick Perry	2.20	Bill Clinton	4.80	Steve Martin (Actor)	3.80

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Jordin Sparks (Actor/ Singer)	3.78	3.80	America Ferrera	2.63	Raven-Symoné Pearman	4.20	Gabby Douglas (Athlete)	2.29
Jude Law (Actor)	2.75	3.70	Ewan McGregor	2.70	Christian Bale	4.00	Dan Brown (Author)	2.00
Julianne Hough (Actor/Singer)	2.50	2.75	Miley Cyrus	5.00	Miranda Cosgrove	3.70	Kate Middelton (One-News Wonder)	3.70
Kate Hudson (Actor)	4.00	3.60	Blake Lively	4.00	Sandra Bullock	3.88	Sara Bareilles (Singer)	2.80
Katie Holmes (Actor)	2.50	4.30	Maggie Gyllenhaal	2.90	Tara Reid	2.00	Nelly Furtado (Singer)	3.50
Katy Perry (Singer)	4.40	4.90	Zooey Deschanel	2.75	Ellie Goulding	2.63	Hope Solo (Athlete)	3.80

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Kim Kardashian (Actor)	4.70	4.63	Nicole Scherzing-er	2.56	Kelly Ripa	2.80	Danica Patrick (Athlete)	2.00
Kirsten Dunst (Actor)	3.70	4.00	Drew Barrymore	3.38	Jessica Biel	3.50	Lindsey Vonn (Athlete)	2.90
Kristen Stewart (Actor)	4.50	4.25	Emma Watson	3.88	Mandy Moore	4.00	Missy Franklin (Athlete)	2.40
Lady GaGa (Singer)	4.50	4.00	Amy Winehouse	4.60	Alanis Morissette	2.20	Monica Lewinsky (One-News Wonder)	4.00
Luke Wilson (Actor)	3.78	2.60	David Arquette	2.56	Ashton Kutcher	4.25	Joey Fatone (Singer)	2.90
Matt Damon (Actor)	4.10	3.50	Leonardo DiCaprio	4.60	Tom Hardy	2.22	Nick Carter (Singer)	3.25

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Matthew McConaughey (Actor)	4.00	4.00	Bradley Cooper	3.50	Will Ferrell	4.50	Luke Bryan (Singer)	2.75
Michael Phelps (Athlete)	4.90	4.88	Eli Manning	4.70	Tom Brady	3.63	Johnny Depp (Actor)	4.80
Mila Kunis (Actor)	4.30	4.11	Vanessa Hudgens	4.20	Uma Thurman	3.90	Ingrid Michael-son (Singer)	2.63
Natalie Portman (Actor)	4.60	3.88	Keira Knightley	4.20	Amy Adams	2.63	Maria Sharapo-va (Athlete)	2.43
Orlando Bloom (Actor)	4.10	3.90	Justin Timberlake	4.88	Nicolas Cage	3.63	Chris Daughtry (Singer)	2.63
Paul Rudd (Actor)	3.60	1.25	Ben Affleck	3.88	Brendan Fraser	3.50	Michael Buble (Singer)	3.50

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Rachel McAdams (Actor)	3.88	4.10	Kate Beckinsale	2.50	Kate Winslet	3.80	Sheryl Crow (Singer)	3.70
Robert DeNiro (Actor)	3.80	2.88	Tommy Lee Jones	2.71	Kevin Bacon	3.50	Tom Petty (Singer)	3.60
Ryan Seacrest (TV Personality)	4.70	4.38	Joel McHale	2.40	Jimmy Fallon	2.63	Tim Tebow (Athlete)	4.88
Scarlett Johansson (Actor)	2.88	3.63	Jessica Alba	3.80	Jennifer Love Hewitt	3.90	Carrie Underw-ood (Singer)	4.50
Selena Gomez (Actor)	4.70	4.50	Demi Lovato	3.67	Ashlee Simpson	4.30	Bristol Palin (One-News Wonder)	3.25

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Seth Rogen (Actor)	3.86	3.56	Jonah Hill	4.70	Adam Sandler	4.70	Lance Bass (Singer)	3.00
Sofia Vergara (Actor/TV Personality)	4.00	2.00	Catherine Zeta-Jones	2.63	Nicole Kidman	4.30	Martina McBride (Singer)	3.00
Stephen Colbert (Actor/TV Personality)	2.63	2.75	Bob Saget	3.40	Howie Mandel	3.50	Keith Urban (Singer)	3.25
Tina Fey (Actor)	4.80	3.25	Winona Ryder	2.11	Christina Applegate	3.00	Shania Twain (Singer)	4.00
Tom Hanks (Actor)	4.11	4.60	Bill Murray	3.00	Alec Baldwin	3.63	Garth Brooks (Singer)	2.88
Zac Efron (Actor/Singer)	3.78	4.60	Jesse McCartney	3.25	Justin Bieber	4.60	Ryan Lochte (Athlete)	4.75

Table A-2. Continued

Target Name	Average Target Familiarity Rating (*Picture*)	Average Target Familiarity Rating (*Name*)	High Visual Similarity (HVS) Distractor	Average HVS Distractor Familiarity Rating	Low Visual Similarity (LVS) Distractor	Average LVS Distractor Familiarity Rating	Unrelated Distractor	Average Unrelated Distractor Familiarity Rating
Zach Galifianakis (Actor)	4.00	3.20	Ryan Dunn	2.38	Russell Brand	4.90	John Mayer (Singer)	3.63

Table A-3. Semantic and visual similarity between targets and associated distractors.

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Amanda Seyfried (Actor)	Dakota Fanning	2.50	1.88	Megan Fox	2.44	1.00	Colbie Caillat (Singer)	1.20	1.20
Alicia Keys (Singer)	Leona Lewis	2.20	2.50	Natasha Bedingfie-ld	2.00	1.44	Nastia Liukin (Athlete)	1.43	1.86
Anne Hathaway (Actor)	Liv Tyler	2.50	3.00	Hayden Panettiere	2.50	1.13	Britney Spears (Singer)	1.55	1.18
Avril Lavigne (Singer)	Taylor Swift	2.50	1.64	Ashley Tisdale	1.64	1.91	McKayla Maroney (Athlete)	1.00	1.00
Ben Stiller (Actor)	Steve Carell	2.80	1.90	Jim Carrey	2.82	1.90	Tim McGraw (Singer)	1.20	1.20
Brad Pitt (Actor)	Chris Hemswo-rth	2.57	2.29	Hugh Jackman	2.44	1.44	Rick Santorum (Politicia-n)	1.00	1.00

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Bruce Willis (Actor)	Jason Statham	2.33	2.33	George Clooney	2.89	1.50	Elton John (Singer)	1.18	1.18
Cameron Diaz (Actor)	Renee Zellweger	2.50	2.25	Angelina Jolie	2.64	1.46	Sara Evans (Singer)	1.60	1.80
Charlize Theron (Actor)	Katherine Heigl	2.50	2.25	Meg Ryan	2.25	2.20	Paula Abdul (Singer/ TV Personal-ity)	1.71	1.38
Chelsea Handler (Actor/TV Personali-ty)	Elizabeth Banks	1.67	1.80	Joan Cusack		1.00	Sarah McLachl-an (Singer)	1.50	1.43
Chuck Norris (Actor)	Tim Allen	2.10	1.90	Robin Williams	1.90	1.22	Billy Joel (Singer)	1.43	1.25

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Courteney Cox (Actor)	Demi Moore	2.30	2.33	Jodie Foster	2.00	1.40	LeeAnn Rimes (Singer)	1.67	1.40
Dane Cook (Actor/ Comedia-n)	Jeff Dunham	2.33	2.20	Vince Vaughn	2.50	2.14	Josh Groban (Singer)	1.83	1.50
Daniel Radcliffe (Actor)	Elijah Wood	2.71	2.71	Adam Brody	2.20	1.80	Clay Aiken (Singer)	1.50	1.38
Derek Jeter (Athlete)	Alex Rodrigu-ez	3.00	2.50	Mark Sanchez	1.33	2.00	Marc Anthony (Singer)	1.14	1.57
Emma Stone (Actor)	Lindsay Lohan	2.00	2.27	Victoria Justice	2.44	1.25	Carly Rae Jepsen (Singer)	1.50	2.00
Gerard Butler (Actor)	Russell Crowe	2.38	2.38	Tom Cruise	2.33	1.80	Kurt Cobain (Singer)	1.17	1.20

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Gwen Stefani (Singer)	Christina Aguilera	2.55	2.46	Kelly Clarkson	2.20	1.10	Anna Kourniko-va (Athlete)	1.67	2.33
Hugh Grant (Actor)	Seth Meyers	2.50	1.75	Owen Wilson	2.33	1.29	Blake Shelton (Singer)	1.30	1.44
Jason Earles (Actor)	Neil Patrick Harris	2.20	1.57	Macaulay Culkin	2.33	1.67	Adam Lambert (Singer)	1.00	1.00
Jennifer Aniston (Actor)	Kristen Wiig	2.17	2.40	Reese Withersp-oon	2.82	1.64	Regina Spektor (Singer)	1.67	1.00
Jennifer Garner (Actor)	Hilary Swank	2.71	2.71	Gwyneth Paltrow	2.22	1.33	Celine Dion (Singer)	1.50	1.78
Jessica Simpson (Actor/ Singer)	Faith Hill	2.38	1.89	Mariah Carey	2.73	1.46	Mia Hamm (Athlete)	1.00	1.20

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
John Edwards (Politician)	Rick Perry	2.00	1.67	Bill Clinton	2.71	1.50	Steve Martin (Actor)	1.00	1.00
Jordin Sparks (Actor/ Singer)	America Ferrera	2.29	2.43	Raven-Symoné Pearman	2.20	1.82	Gabby Douglas (Athlete)	1.50	2.00
Jude Law (Actor)	Ewan McGregor	2.40	2.20	Christian Bale	2.83	1.86	Dan Brown (Author)	1.00	1.50
Julianne Hough (Actor/ Singer)	Miley Cyrus	1.86	1.89	Miranda Cosgrove	1.80	1.00	Kate Middelton (One-News Wonder)	1.67	1.63
Kate Hudson (Actor)	Blake Lively	2.50	2.40	Sandra Bullock	2.45	1.55	Sara Bareilles (Singer)	1.17	1.40
Katie Holmes (Actor)	Maggie Gyllenh-aal	2.20	2.00	Tara Reid	1.75	1.50	Nelly Furtado (Singer)	1.57	1.50

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Katy Perry (Singer)	Zooey Descha-nel	1.82	2.64	Ellie Goulding	2.60	1.40	Hope Solo (Athlete)	1.67	1.33
Kim Kardashian (Actor)	Nicole Scherzi-nger	2.00	2.50	Kelly Ripa	1.29	1.00	Danica Patrick (Athlete)	1.25	1.50
Kirsten Dunst (Actor)	Drew Barrymo-re	2.40	2.00	Jessica Biel	2.30	1.60	Lindsey Vonn (Athlete)	1.33	2.33
Kristen Stewart (Actor)	Emma Watson	2.70	2.20	Mandy Moore	1.89	1.63	Missy Franklin (Athlete)	1.00	1.20
Lady GaGa (Singer)	Amy Wineho-use	2.55	1.82	Alanis Morissette	2.14	1.17	Monica Lewinsky (One-News Wonder)	1.00	1.20
Luke Wilson (Actor)	David Arquette	2.00	2.60	Ashton Kutcher	2.67	1.57	Joey Fatone (Singer)	1.80	1.86

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Matt Damon (Actor)	Leonardo DiCaprio	2.60	1.91	Tom Hardy	2.50	1.67	Nick Carter (Singer)	1.11	1.22
Matthew McConau-ghey (Actor)	Bradley Cooper	2.56	2.50	Will Ferrell	2.00	1.55	Luke Bryan (Singer)	1.50	1.80
Michael Phelps (Athlete)	Eli Manning	1.83	2.00	Tom Brady	2.33	2.00	Johnny Depp (Actor)	1.00	1.27
Mila Kunis (Actor)	Vanessa Hudgens	2.36	2.55	Uma Thurman	2.38	1.11	Ingrid Michaels-on (Singer)	1.60	1.25
Natalie Portman (Actor)	Keira Knightley	2.70	2.70	Amy Adams	2.20	1.60	Maria Sharapo-va (Athlete)	1.00	1.50
Orlando Bloom (Actor)	Justin Timberl-ake	1.89	1.90	Nicolas Cage	2.45	1.64	Chris Daughtry (Singer)	1.20	1.11

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Paul Rudd (Actor)	Ben Affleck	2.00	2.14	Brendan Fraser	2.25	1.50	Michael Buble (Singer)	1.56	2.00
Rachel McAdams (Actor)	Kate Beckins-ale	2.75	2.00	Kate Winslet	2.20	2.20	Sheryl Crow (Singer)	1.43	1.83
Robert DeNiro (Actor)	Tommy Lee Jones	2.29	1.63	Kevin Bacon	2.00	1.43	Tom Petty (Singer)	1.75	1.50
Ryan Seacrest (TV Personali-ty)	Joel McHale	2.00	2.40	Jimmy Fallon	2.25	1.38	Tim Tebow (Athlete)	1.30	1.50
Scarlett Johanss-on (Actor)	Jessica Alba	2.70	2.40	Jennifer Love Hewitt	2.22	1.56	Carrie Underwo-od (Singer)	1.60	2.00

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Selena Gomez (Actor)	Demi Lovato	2.78	2.44	Ashlee Simpson	2.40	1.40	Bristol Palin (One-News Wonder)	1.14	1.57
Seth Rogen (Actor)	Jonah Hill	2.75	2.38	Adam Sandler	2.70	1.60	Lance Bass (Singer)	1.14	1.14
Sofia Vergara (Actor/TV Personali-ty)	Catherine Zeta-Jones	2.25	2.13	Nicole Kidman	1.75	1.14	Martina McBride (Singer)	1.25	1.25
Stephen Colbert (Actor/TV Personali-ty)	Bob Saget	2.00	2.50	Howie Mandel	2.00	1.17	Keith Urban (Singer)	1.13	1.13
Tina Fey (Actor)	Winona Ryder	2.13	1.63	Christina Applegate	2.13	1.14	Shania Twain (Singer)	1.20	1.30

Table A-3. Continued

Target Name	High Visual Similarity (HVS) Distractor	Average HVS Semantic Similarity	Average HVS Visual Similarity	Low Visual Similarity (LVS) Distractor	Average LVS Semantic Similarity	Average LVS Visual Similarity	Unrelated Distractor	Average Unrelated Semantic Similarity	Average Unrelated Visual Similarity
Tom Hanks (Actor)	Bill Murray	2.67	2.17	Alec Baldwin	2.33	1.67	Garth Brooks (Singer)	1.50	1.00
Zac Efron (Actor/ Singer)	Jesse McCartn-ey	2.30	2.33	Justin Bieber	2.00	1.64	Ryan Lochte (Athlete)	1.22	1.67
Zach Galifiana-kis (Actor)	Ryan Dunn	2.00	2.00	Russell Brand	2.83	1.14	John Mayer (Singer)	1.33	1.22

APPENDIX B
FILLER STIMULI

Table B-1. Filler questions and answers.

Filler Question	Answer to Question
Which movie has Aaron Taylor-Johnson playing a normal teenager trying to be a real-life superhero?	Kick Ass
Which movie has Alicia Silverstone playing a wealthy but superficial teenager in high school?	Clueless
Which show stars Amy Poehler as a mid-level bureaucrat working for a county in Indiana?	Parks and Recreation
Which newsstation features Anderson Cooper's nightly show '360'?	CNN
What parody musical group featuring Andy Samberg debuted on Saturday Night Live?	The Lonely Island
Which movie has Andy Serkis playing a small, scraggly creature whose motto is 'my precious'?	The Lord of the Rings
What show features Anna Paquin playing a telepathic waitress who befriends vampires?	True Blood
For which city is Anthony Weiner running for the 2013 position of mayor?	New York
Which newsstation features Anderson Cooper's nightly show '360'?	Minnesota Vikings
Which TV series featured Calista Flockhart as a young lawyer in Boston?	Ally McBeal
What show features Charlie Sheen as a jingle writer who lives with his brother and nephew?	Two and a Half Men
With which political party is New Jersey governor Chris Christie associated?	Republican
What show features Charlie Sheen as a jingle writer who lives with his brother and nephew?	Dr. Who
Which movie has Dustin Hoffman playing an autistic savant?	Rain Man
Which TV series has Ed Helms playing a goofy salesman for a paper company?	The Office

Table B-1. Continued

Filler Question	Answer to Question
Which animated character voiced by Ellen DeGeneres says the the famous line 'just keep swimming'?	Dory
What movie stars Halle Berry as a shy woman endowed with animal-like speed, reflexes, and senses?	Catwoman
What movie series has Harrison Ford playing an archaeologist who goes on adventures to search for ancient artifacts?	Indiana Jones
Which movie has Jack Black portraying a wannabe musican who poses as a substitute teacher?	School of Rock
Which movie features Jack Nicholson's famous line 'Here's Johnny!'?	The Shining
What movie has James Franco depicting someone who became stuck while rock climbing?	127 Hours
Which HBO series features James Gandolfini as an Italian-American mobster from New Jersey?	The Sopranos
Which movie featuring Jason Sudeikis follows two husbands given one week to date anyone they want?	Hall Pass
In which movie does Jessie Eisenberg depict the back story of the creator of Facebook?	The Social Network
Which movie has Joaquin Phoenix depicting the life of singer Johnny Cash?	Walk the Line
Which movie has Joe Pesci playing an idiotic burglar whose plans are foiled by an 8-year old?	Home Alone
Which series features Julia Louis-Dreyfus playing a snarky politician who feels unappreciated?	Veep
In which sport was Lance Armstrong stripped of all medals and awards for illegal drug use?	Cycling
Which TV series features Leonard Nimoy as a military officer with Vulcan-Human heritage?	Star Trek
Which cartoon created by Matt Groening comedically depicts a family from the fictional town of Springfield?	The Simpsons
Which movie stars Meryl Streep as a ruthless and cynical editor for a women's magazine?	The Devil Wears Prada

Table B-1. Continued

Filler Question	Answer to Question
Which movie series directed by Michael Bay depicts two races of alien robots at war?	Transformers
Which series starring Michael C. Hall depicts a blood spatter analyst who is also a serial killer?	Dexter
Which documentary by Michael Moore explores gun violence in America?	Bowling for Columbine
Which action-drama TV series had Pamela Anderson portraying a Los Angeles County Lifeguard?	Baywatch
Which game show hosted by Pat Sajak has contestants solve word puzzles?	Wheel of Fortune
Which song by Phil Collins appeared in the animated Disney movie 'Tarzan'?	You'll be in my Heart
Which animated character voiced by Ellen DeGeneres says the famous line 'just keep swimming'?	Capote
Which movie has Ray Liotta working his way through the mob hierarchy?	Goodfellas
Which live-action movie starring Sarah Michelle Gellar was based on a children's cartoon?	Scooby Doo
Which movie based on the Stephen King novel depicts a young girl with telekinetic powers?	Carrie
Which movie produced by Steven Spielberg portrays a boy who helps a stranded extraterrestrial?	E.T.
Which series features Sylvester Stallone as a rags-to-riches boxer from Philadelphia?	Rocky
In which animated movie produced by Tim Burton does a Halloween character decide to be Santa Claus?	The Nightmare before Christmas
Which animated sitcom created by Trey Parker portrays the crude adventures of four boys living in Colorado?	South Park
What movie stars Halle Berry as a shy woman endowed with animal-like speed, reflexes, and senses?	Spice Girls

Table B-1. Continued

Filler Question	Answer to Question
In which TV series was teenager Will Smith sent to live with his rich uncle and aunt?	Fresh Prince of Bel Air
Which movie features Woody Harrelson looking for Twinkies in a post-apocalyptic world?	Zombieland

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BIOGRAPHICAL SKETCH

Danielle majored in psychology and sociology. Her program of research as a graduate student in the Department of Psychology at the University of Florida focuses on the cognitive processes underlying memory retrieval failures and language production/comprehension. She received her Master of Science degree in the spring of 2014.