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The Mental Organization of People's Permanent and Situational Attributes

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THE MENTAL ORGANIZATION OF PEOPLE'S PERMANENT

AND SITUATIONAL ATTRIBUTES

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ABSTRACT

The Mental Organization of People's Permanent and Situational Attributes

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This thesis investigated whether readers would integrate physical descriptions of characters into one coherent mental representation or if they would keep mental representations separate. The integration of multiple concepts has been examined in the context of the *fan effect,* which is the finding that an increase in the number of learned associations for a concept can result in an increase in retrieval times and error rates (Anderson, 1974). However, there is typically not a fan effect when people are able to organize the related information into a single integrated situation model (Radvansky & Zacks, 1991). Previous studies investigating the fan effect have focused on objects and locations, but few studies have examined how people organize physical traits about individuals. Thus, the current experiments examined whether situational (i.e., temporary, or based on the situation) and permanent physical attributes from multiple sentences are stored separately or can be integrated, and this was examined in the context of predictions made by situation model theory (Radvansky & Zacks, 1991; Radvansky, Spieler, & Zacks, 1993) and ACT-R theory (Anderson & Reder, 1999). Consistent with situation model theory, all experiments showed evidence of a differential fan effect, however, in some cases, integration did not occur in patterns that were predicted by situation model theory. Other explanations for the pattern of results are discussed.

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DEDICATION

I wish to dedicate this thesis to my parents, Sherri and Joseph Larson. I am tremendously grateful for their love and support. I would also like to dedicate this thesis to my aunt and uncle, Signa and David Gundlach, who have been sources of great support and wisdom throughout the pursuit of this degree. Finally, I would like to dedicate this thesis to my former undergraduate advisor, Dr. Susan Zimny, for encouraging me to pursue post-baccalaureate study.

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CHAPTER 1

INTRODUCTION

Imagine that you were at a wedding reception and you met a woman who was wearing a cocktail dress, a pearl necklace, and high heels. You also met three groomsmen who were all wearing red bowties. If, later, you were asked about these guests, would it be easier to recall who were wearing red bowties or what the woman was wearing? Or would they be similarly difficult to recall? One possibility is that it would be easier to recall what the woman was wearing because people can integrate the attributes into a single mental representation. Another possibility, that they would be similarly difficult to recall, could be due to the fact that both scenarios consist of multiple associations connected with one concept. The *fan effect* (Anderson, 1974) is a finding that when there are more facts learned about a concept, it can take longer (and there can be more errors) when retrieving specific facts related to that concept. The focus of this thesis was to explore how people organize fictional characters' physical attributes in memory and what factors influence that process. Specifically, I examined whether people integrate character attributes into a single representation or maintain them in separate representations. In addition, this study examined whether this organization is affected by the type of attribute (permanent or situational), whether attributes conflict with one another, the description of spatial locations, and the use of internal attributes (i.e., emotional state).

CHAPTER 2

REVIEW OF RELATED LITERATURE

The Fan Effect

The fan effect (Anderson, 1974) is a classic finding that an increase in the number of newly learned associations for a concept can result in an increase in retrieval times and error rates. The basic paradigm involves remembering people or objects paired with a location. Participants typically study approximately 15-30 sentences and these sentences consist of fan levels of one, two, or three. The term *fan* refers to the number of facts studied about a particular concept. Consider the following example, “The hippie is at the park,” “The hippie is at the café,” and “The hippie is at the library;” here, the concept is the hippie and there is a fan of three because people are remembering three facts about that person. The next phase is to test whether readers committed these facts to memory. The verification of encoding is usually achieved by asking questions like “Who is in the park?” and “Where is the hippie?” Participants will study those facts and answer these questions until they get a perfect score twice. Finally, participants take a recognition test where they confirm whether sentences were studied or not. Typically, people show longer retrieval times and higher error rates when there are more facts associated with a concept; that is, performance is worse when there is a larger fan level.

Thus, in the fan effect paradigm, there appears to be a cost to learning more information. On a basic level, this cost is thought to be a result of interference; the ideas associated around the same concept interfere with one another, resulting in longer response times and higher error rates. At this point, it is important to note that while the fan effect has been demonstrated in many research studies, an increase in response times and error rates are not always observed when multiple facts are associated with a concept (e.g., Radvansky & Zacks, 1991). These exceptions are explored in more detail later, in the context of the two major theories that have been used to explain the fan effect: (1) the Adaptive Control of Thought-Rational (ACT-R, Anderson & Reder, 1999) and (2) Situation Model Theory (Radvansky & Zacks, 1991). The following sections explore these theories.

Adaptive Control of Thought – Rational (ACT-R)

The results of the fan effect studies have been explained by some researchers in terms of the Adaptive Control of Thought – Rational (ACT-R) model (previously coined ACT) and, according to this model, information is structured in memory as nodes and links (Anderson & Reder, 1999). The nodes are the concepts and the links are the associations. The fan effect occurs because several of the links have to be activated when a node has associations to other nodes and this activation of several nodes causes a slowdown in response times and more errors. For example, when presented with "The hippie is at the park," the nodes of café and library will automatically be activated as well, causing a person to search those associations in memory before verifying if the statement was previously studied.

ACT-R theory is based on a multiple access retrieval model. In this model, people use both serial and parallel search processes when verifying whether a sentence is in memory. More specifically, when presented with a sentence, for serial processing a person has to search all ideas associated with one particular concept from that sentence in a sequential order. For instance, participants presented with "The hippie is at the park" also have to mentally search through "The hippie is at the café" and "The hippie is at the library”. The greater number of items to search leads to the increase in response times that is typically found in fan effect paradigms. In addition, it is explained that parallel processing occurs in that people can conduct a similar serial search for a different concept from the sentence; in this example, a person would, in parallel, conduct serial searches for ideas related to hippie and ideas related to park.

Situation Model Theory

Overview of Situation Model Theory

After people read text, they could remember the words that were presented or they could remember what the text was about (or both). Situation models (also called mental models) are mental representations that people form of the situation the text describes rather than the text itself (Johnson-Laird, 1983; van Dijk & Kintsch, 1983). A situation model is essentially a mental simulation of a real or possible world described by the text. For instance, if people read the sentence, “Michelle and Dan met at a steakhouse,” the situation model may include inferences such as, “Michelle and Dan had dinner” or “Michelle and Dan were on a date.” This representation is clearly an elaborated version of the original description that is based on some combination of prior knowledge, expectations, inferences, or other contextual information. In this case, prior knowledge of why two people meet at a steakhouse can be used to make inferences.

The situation model level is considered the highest level of mental representation because it includes integrated ideas as well as inferences that can be based on prior knowledge, what was mentioned earlier, or what is expected to be mentioned later. However, cognitive psychologists still believe that people can create mental representations of the text itself (e.g., Schmalhofer & Glavanov, 1986). Readers create a surface level, which is the actual text that was presented, such as remembering the exact words, “Michelle and Dan met at a steakhouse.” In addition, people also create a propositional textbase, which is memory for the idea, regardless of what words are used to express it. For example, someone’s textbase representation of that sentence could be, “Dan and Michelle got together at a steakhouse.” Here, the same idea is being expressed, but different words (e.g., synonyms) and ordering of the words can be used. An important difference between the situation model level and the other levels, the surface and textbase levels, is that the latter two consist of separately stored representations while the former can consist of integrated representations.

When discussing situation models, it is important to note what distinguishes them from schemata. As described earlier, a situation model is a mental representation of a specific situation; in contrast, schemata are mental representations of stereotypical situations (Alba & Hasher, 1983). One common type of schema is a script, which contains information about events that are frequently experienced (Schank & Abelson, 1977), and a classic example is the restaurant script. When a person goes to a restaurant, there are usually always the same props (e.g., table, food, etc.), roles (e.g., waiter), scenes (e.g., ordering), and typical order of events (e.g., reading a menu before ordering). There appears to be script norms in that people largely agree on the general components of scripts (Bower, Black, & Turner, 1979). The distinction between situation models and scripts can appear fuzzy but, essentially, schemata are the building blocks for situation models (van Dijk and Kintsch, 1983). When people construct a situation model for a specific situation, they will often retrieve information from scripts they have created through past experience to use as a foundation for their situation model representation.

Situation models are a crucial element in language comprehension because they help people integrate information across sentences to form a coherent understanding of what they read (van Dijk & Kintsch, 1983). Otherwise, people would store things in separate chunks. Situation models are also needed at a larger level for when someone is learning about a domain from multiple sources (Perfetti, Britt, & Georgi, 1995). For example, someone writing a thesis in a particular area would need a situation model to integrate the information. Situation models also help people integrate information from multiple modalities (Baggett, 1979). For example, someone could integrate what they saw on a television news show with information from a news article that they read.

The process of constructing a situation model involves three essential components: (1) the current model, (2) the integrated model, and (3) the complete model (Zwaan & Radvansky, 1998). The *current model* is the model that a reader creates sentence by sentence (or clause by clause) while reading the text. The *integrated model* is an online process where they connect each clause or sentence together to form a more coherent model. Finally, the *complete model* is the model a reader constructs after reading a story and is the model that gets stored into long-term memory.

The process of connecting the current model into the integrated model is referred to as *updating*. Ericsson and Kintsch (1995) proposed that this process happens by forming links between the current model and the integrated model, which is stored in long-term memory. Long-term memory can be used as an extension of working memory, which is made possible for highly practiced activities like language comprehension. In the context of text processing, readers keep the integrated model in long-term memory while simultaneously constructing the current model in working memory. Basically, the integrated model in long-term memory is a cumulative record of the events, and the current model in working memory consists of what is currently *foregrounded*; that is, what is currently in focus or part of the current event. The information that is deemed relevant can be based on world knowledge (Zwaan, 1994) or linguistic cues in the text (Gernsbacher, 1990; Givon; 1992).

Situation models are multifaceted because readers monitor several aspects of events during text comprehension and this view has been coined the *event indexing model* *(*Zwaan, Magliano, & Graesser, 1995). This model suggests that readers monitor five dimensions simultaneously: time (when the described events take place), causality (what caused certain events to take place), intention (goals that characters are pursuing), space (where people and objects are located), and character/entity. These dimensions are the building blocks that people will combine to form an integrated whole of what they read. For example, someone might read a story and form a situation model about how yesterday (time), Andrea (character), a fiery redhead (attributes of Andrea), walked into her boss's office (space) and asked for a promotion (intentionally) because she felt that her responsibilities exceeded those listed on her job description (causation).

Situation Model Theory and the Fan Effect

Radvansky and Zacks (1991) applied the idea of integrating common elements of a single situation to the fan effect. For instance, when people are presented with facts, such as "The desk is in the office," "The desk is in the hotel," and "The desk is in the library," people will demonstrate the traditional fan effect. In this example, the fact that the desk is associated with three different locations creates a fan of three. In contrast, if presented with the following facts, "The desk is in the office," "The phone is in the office," and "The plant is in the office," people will retrieve those facts faster than in the former case. These results were explained in terms of situation models where people will create three separate situation models when given three locations (e.g., office, hotel, and library). However when presented with one location (e.g., office), people will integrate the ideas into one situation model based on that spatial location.

The Radvansky and Zacks (1991) study was partially based on the idea that people regularly integrate common ideas that are learned. For example, earlier work by Bransford and Franks (1971, 1972) had participants study sentences describing four different ideas about one topic, such as, "The ants were in the kitchen," "The ants ate the jelly," "The jelly was sweet," "The jelly was on the table." During a recognition test, participants would falsely recognize an integrated idea that was never presented during study (e.g., "The ants in the kitchen ate the sweet jelly that was on the table"). This finding indicates that people can fuse separate, but related, information into integrated wholes in memory. A more recent study by Gómez-Ariza and Bajo (2003) built on this by asking participants to remember sentences about people that could be integrated into one idea unit. For example, "The fireman went to the store," "The fireman bought a bone," "The fireman has a dog," could be integrated into "The fireman went to the store to buy a bone for his dog." When sentences were memorized that could be fused into one idea or mental representation, it eliminated the fan effect.

Myers, O'Brien, Balota, and Toyofuku (1984) studied integration in the form of causality. They had participants study sets of sentences that were either highly casually linked to each other (e.g., "The banker found the baseball game boring" and "He went home early") or else they were related but not casually linked. There was a reversed fan effect for the materials that could be casually integrated; that is, there was a speed up in response time. Although, Myers et al. (1984) used an elaborated ACT model to explain the results, they can be better explained from a situation model view. It is possible that giving reasons for the character actions allowed participants to better integrate the sentences into one coherent mental representation.

Smith, Adams, and Schorr (1978) studied integration in terms of world knowledge. In their fan effect experiments, they manipulated whether the facts could be integrated or not. For instance, all participants were presented with sentences such as "Ryan remained expressionless. Ryan found mistakes were expensive." In the integrated condition, people were then given a theme sentence that helped the previous two sentences make sense (e.g., "Ryan was learning to play poker"), whereas in the nonintegrated condition, which also served as the control, people were given a neutral sentence (e.g., "Ryan was expecting to meet someone"). Integrated sentences produced smaller fan effects than the nonintegrated sentences. This was true whether the theme sentence was given before or after the other two sentences. The integration did not eliminate the fan effect to the extent that was observed using the manipulation by Radvansky and Zacks (1991), but it does show how integration can influence the size of the fan effect.

Ricks and Wiley (2010) examined integration with domain knowledge. Across two studies, participants memorized player-location sentences (e.g., "The catcher is on the mound") and the pairings were either random or consistent with baseball expectations. When the pairings were random, people showed a fan effect; however, when pairings were plausible, participants did not demonstrate a fan effect for studied sentences. These results suggest that expertise in a particular domain can promote integration.

Research has also examined other factors that can influence the fan effect and whether concepts are integrated or not. Radvansky (2005) manipulated the format of encoding by comparing the memorization of complete object-location sentences (e.g., "The tanning bed is in the gas station") to the memorization of probe pairs (e.g., tanning bed-gas station). The complete sentences led to integration, but the probe pairs produced the typical fan effect. In addition to this study, Radvansky and Copeland (2006) showed that integration can occur when presenting object-location facts in pictures (as opposed to sentences). Thus, the integration of information into situation models appears to happen when people can construct a plausible representation around a single event.

People / Characters

While much of the research with the fan effect has used objects and locations, it is also possible to learn multiple pieces of information about people. Because this thesis focuses on people / characters in relation to the fan effect, I will first review some findings of people / characters in memory and learning. This will be followed by a consideration of the fan effect research that has explored information learned about people.

Most of the research with characters has been studied in the realm of narrative comprehension. Characters have been described as the "meat" of a situation model (Zwaan & Radvansky, 1998). This is because most stories are essentially about what happens to characters. Characters are the foundation for the other dimensions - what their goals are (intention), where they go in the story world (space), the decisions they make (causality), and the time frame in which the story takes place (time). Reading times slow down when new characters are introduced because readers are updating their current model (Zwaan, Radvansky, Hillard, & Curiel, 1998).

Readers' mental representations of the character dimension become enhanced when a main character is rementioned and weakened when a new character is introduced (Gernsbacher, Robertson, Palladino, & Werner, 2004). For example, participants responded faster to the main character's name after a character was rementioned than when a new character was introduced or no characters were mentioned. This same effect was found when objects associated with the character were used as probes. This demonstrates that a character becomes more accessible in a reader's mental representation after the character is rementioned; however, when a new character is introduced it interferes with the accessibility of an old character.

The use of proper names also enhances character representations. Naming a character (e.g., Jake) focused readers' attention on a specific character more than when she/he was named with a role description, such as "the insurance agent" (Sanford, Moar, & Garrod, 1988). Sentences that contained anaphoric references to characters mentioned by proper name were read more rapidly than those referring to a character named by a role. It is possible that readers more readily include named characters into their situation models because they believe that they will have more significance to the story than unnamed characters.

People do not only construct situation models of characters, but when reading narratives they also include information about characters' attributes and how those characters should behave. For instance, readers will slow down when presented with trait inconsistent information (Albrecht & O'Brien, 1993), such as, if a character was previously described as a vegetarian but then later in the story that character ate a hamburger. Similarly, Rapp and colleagues (Mensink & Rapp, 2011; Rapp, Gerrig, & Prentice, 2001) found that readers will track protagonists' traits and apply that information to how the character will act in pursuit of a goal. For example, people may be more likely to agree with an outcome such as, "Henry helped the kid," after reading a story about Henry being sympathetic. Reading times are also likely to slow down when stories end with trait-inconsistent actions (e.g., "Henry did not help the kid") because this outcome is surprising to readers who remember that Henry is sympathetic. This suggests that readers monitor information about traits during normal comprehension and keep those traits active in their current model.

Readers will also keep track of objects that are related to the characters. Glenberg, Meyer, and Lindem (1987) created stories where objects were either associated or dissociated with the character. For example consider, "Gina put on a scarf on before going outside." In this example, the scarf would be associated with Gina. On the contrary, for the sentence, "Gina took off a scarf before going outside," the scarf is dissociated from Gina. As people continued reading, they were presented with the name of the critical object and had to indicate if the object was in the story. Response times were slower for objects that were dissociated than for objects that were associated, even though the same number of words intervened since the object was mentioned in either condition. This finding suggests that characters will keep objects that are associated with the character in their current model. In another study (Morrow, Bower, & Greenspan, 1989), people responded faster to object probes that were in the room the character was thinking about (e.g., “Gina really wanted to go to the park”) than the room the in which the character was actually located. Again, this suggests that people keep track of objects in relation to characters. Furthermore, it shows how readers place more priority on the character than other dimensions like space.

Other studies have examined memory recall for characters, but these studies did not use narratives. Kole and Healy (2007) examined how memory set size influences retention and response times for fictional characters. They had participants memorize 48 facts total, with one group memorizing 4 facts about 12 individuals, and the other group memorizing 12 facts about 4 individuals. The four individual group made fewer errors and had faster response times on the cued recall test than the 12 individual group. The results of this study suggest that having information presented in a way that can be grouped in a smaller number of categories gives the learner an advantage because they can form a smaller number of more highly integrated mental representations.

Together, whether narratives are used to introduce characters or not, these studies show that people can monitor and update information about characters. Some studies even suggest that people actively integrate related information about a character. The following section describes research involving people / character information that was specifically examined in the context of the fan effect.

The Fan Effect and People

Radvansky, Spieler, and Zacks (1993) examined whether readers would organize their mental representations around people instead of locations if they used study sentences involving people in locations, rather than objects in locations (as used by Radvansky & Zacks, 1991). In other words, they investigated if there would be a reversal of the fan effect found in previous experiments where several people associated with one location will show a fan effect but several locations associated with one person will not. This person-based rather than location-based organization was found but only for locations where only one person could occupy the space For example, a set of sentences such as, “The banker is in the phone booth,” “The banker is in the voting booth,” and “The banker is in the tanning bed,” would lead to no fan effect, but a set of sentences such as, “The banker is in the phone booth,” “The police officer is in the phone booth,” and “The firefighter is in the phone booth,” would lead to a fan effect. When locations were used in which multiple people could occupy it (e.g., airport), the data were more consistent with Anderson’s (1974) finding and there is no difference between single locations and multiple locations. Interestingly, when both small and large locations were used in a material set, a person-based organization emerged.

In addition to small spaces, there are other factors that determine whether one uses a person-based organization or location-based organization. Radvansky, Wyer, Curiel, and Lutz (1997) manipulated ownership through verb phrases (e.g., *is buying* versus *owns*) and the likelihood of the objects being in the same location (e.g., drugstore items versus unrelated items). They found a person-based organization when the verb phrase *is buying* was used and when the objects were ones that could be purchased at a drugstore (e.g., “The teacher is buying the toothpaste”). It is important to note that participants were not explicitly told that these objects could be purchased at a drugstore. A person-based organization was not found for conditions where objects were unlikely to be bought in the same location (e.g., diamond ring, toothpaste, and DVD) or when the verb phrase *owns* was used. This study demonstrates that ownership and facts related to specific situations can together guide memory organization.

Other researchers have also examined how people organize information about people in memory. Lewis and Anderson (1976) had participants study true and false statements about well-known people and then verified if the statements were true. A fan effect was found with the more false statements memorized about a person resulting in longer reading times. Reder and Ross (1983) had participants study statements about a character and varied the number of themes related to that character. They found that the greater number of themes studied about a character, the longer the reading times

Prior knowledge of a character can also influence the size of the fan. Anderson (1981) varied the amount of information that participants were given about individuals through paragraphs, sentences, or a list of names. Participants then went on to learn person-location facts about the individuals that were unrelated to the previously learned information about the individuals. The results showed that there were smaller fan effects when they were given prior knowledge. This suggests that the prior knowledge may have caused some people to integrate the information into a representation centered around those individuals.

Jones and Anderson (1987) examined integration of person concepts in the context of the fan effect. They manipulated whether sets of words were related with a given person (e.g., Shane, hunter, rifle, forest) or unrelated (e.g., Mike, opera, kingdom, lover). The related sets of words produced a smaller fan effect than the unrelated set of words. It is likely that in the related condition it was easier to create a single mental representation than in the unrelated condition; however, the authors interpreted these findings in the context of the indirect-pathway model where participants were able to use pre-experimental associations to aid them in decisions.

In addition to these findings, time can also influence whether information is organized based on person (Radvansky, Zwaan, Federico, and Franklin, 1998). For example, people are more likely to integrate information into a single situation model if a set of sentences includes the same verb tense (e.g., present). People are also able to create single situation model when they can center it on one event in time (e.g., when the bomb went off). Perhaps, most interestingly, a single situation model can only be created when it is plausible that the activities can be performed by the same person in the same location. For example, “Ron was writing with his pen,” “Ron was eating chocolate,” and “Ron was listening to a lecture,” can occur at the same time, so only one situation model needs to be constructed, centered around Ron at that time. In contrast, “Ron was playing chess,” “Ron was swimming,” and “Ron was reading a book,” encourages readers to develop separate situation models because those events cannot occur at once. This finding indicates that people use their previous world knowledge to aid them in constructing situation models.

Focusing on one dimension during encoding can also influence the fan effect. Sohn, Anderson, Reder, and Goode (2004) manipulated participants’ focus on either person or location by using a slightly different study / test procedure. The person-focused group studied sentences such as, “The doctor is in the park,” and were then presented with a picture of the corresponding person. After the study phase, they had to identify the correct face (e.g., doctor) from 25 faces and then were asked to type in all the places associated with the person. The location-focused condition was tested in a similar matter except that they were presented with pictures of the locations (e.g., park). In addition, participants were explicitly instructed to focus on either the person or location dimension, respectively. Results showed a larger fan effect (i.e., longer response times) for the focused dimension than the nonfocused dimension, which was the opposite pattern than what would have been predicted by situation model theory. This was explained as the focus on a particular dimension created more emphasis on the multiple associations for that dimension, which then created a larger fan effect.

However, it should be noted that instructional effects do not always occur. For example, when participants were given instructions to either memorize objects organized around a location or objects, participants memorized around locations despite the instructions they were given (Radvansky and Zacks, 1991). This makes the results of the Sohn et al. (2004) study puzzling because they did not find a differential fan effect in the location condition. Perhaps the inclusion of pictures, in addition to sentences, produced the traditional fan effect because then people had the verbal representation and the picture representation competing at study. These findings together suggest that attention can influence the fan effect but it has to be a strong manipulation.

The retrieval strategy used during the testing phase can also influence the fan effect. Reder and Ross (1983) manipulated if participants made recognition judgments or consistency judgments. For recognition judgments, they had to indicate if a sentence was studied or not, which is the procedure used in most fan effect studies. For consistency judgments, they only had to determine if the sentence was consistent with what they already learned about the character. They found that there is a reversal of the fan effect when participants made consistency judgments, in that the more facts studied about a person, the shorter the reaction times. Although, they did not interrupt their results this way, it is possible that when making consistency judgments they were able to retrieve a situation model instead of searching for the fact in memory.

ACT-R Theory versus Situation Model Theory

The findings of certain materials being able to eliminate the fan effect prompted Anderson and Reder (1999) to offer some explanation as to how these results can be explained by the ACT-R theory. They refer to these alternative findings as the *differential fan effects* because they do not interpret the results as a non-fan effect, rather that the concepts are just being weighted differently. As a starting point, Anderson and Reder (1999) note that during learning for a traditional fan effect study, as long as all facts about the different concepts are presented and tested with equal frequency, then all of the weights within a fan level should be equal and that weights should be lower when fan is larger. That is, all items with a fan of 1 should have equal weights, but those items should have lower weights than items with a fan of 3. However, for a set of materials that lead to a differential fan effect, Anderson and Reder (1999) proposed that (for some reason) people focus more on one concept from an association during testing, causing it to have a lower weighting in memory (and more likely to be a differential fan effect). Consistent with this explanation, using lower weightings for some concepts in the model can indeed lead to a prediction of a differential fan effect (however, it is not clear a priori why those weightings would differ). Anderson and Reder (1999) expanded on this idea by noting that the differential fan effect can be shown with the same materials, but what differed was how testing occurred (Reder & Ross, 1983); thus, according to them, the fan effect occurs during testing. On the contrary, with the situation model view, there is a differential fan effect (i.e., no interference during retrieval) because the concepts have been integrated into one model as people organized the information during learning. Thus, a major difference between the situation model view and the ACT-R view is that the former suggests that people organize their mental models during study while the latter suggests that fan (or a differential fan) occurs during testing.

Radvansky (1999) acknowledged that testing procedures can influence the size of the fan effect, but he also pointed out that the participants in his differential fan effect studies (e.g., Radvansky & Zacks, 1991) were tested the same in all conditions. Radvansky (1999) also criticized the weightings explanation for a number of reasons. First, in order to get the weightings that lead to a differential fan effect, the weightings for some concepts would be less than zero; this is important because a positive weighting means that two ideas are associated whereas a negative weighting means that two ideas are dissociated. In other words, some pairings that were studied were weighted as not being highly associated, and in some cases, as being dissociated. A second criticism made by Radvansky (1999) was that in most of his experiments, the same exact concepts were used, presented the same number of times, and were questioned equally from both perspectives (e.g., "What is in __ location?" and "Where is ___ person/object?"); thus, according to Anderson and Reder's (1999) explanation, those items should receive the same weightings. However, some items led to a fan effect while others led to a differential fan effect (e.g., if they referred to a single event). Finally, Radvansky (1999) also criticized the fact that the weightings explanation was just the latest of a number of different explanations that have been proposed by Anderson and colleagues to explain the differential fan effect using the ACT model.

A major criticism of the situation model view is that the presence of a differential fan effect depends on the types of materials used. That is, the dimension that participants used to organize situation model varied across studies (i.e., in some studies people constructed situation models based on spatial locations, but in other studies people constructed situation models based on characters), which Anderson and Reder (1999) saw as a lack of converging evidence. However, Radvansky (1999) argued that people can switch the concept or dimension in which they organize their mental representation because the focus of a situation model can be different, depending on the framing of the description or the plausibility of the situation itself. Thus, organization differed across experiments because the types of materials used were different.

Anderson and Reder (1999) also noted that there were some differences among the concepts that were used by Radvansky (e.g., Radvansky et al., 1993). In particular, the location concepts had higher concrete ratings and also contained more words (e.g., nearest voting booth), which could provide more cues for retrieval. However, Radvansky (1999) argued that the concepts did not differ in concreteness and that in an earlier, unpublished study (Radvansky, 1992, as cited in Radvansky 1999) the syllable lengths were equal, but yet a differential fan effect was still observed.

In summary, according to situation model theory, people can center their representations around people much like they can around location, which can eliminate the fan effect (Radvansky et al., 1993). However, there are ways to influence the magnitude of the fan effect in relation to character. For instance, the more themes studied about a character, the larger the fan effect (Reder and Ross, 1983). Also, presenting person concepts that are related and studying concepts about characters in which participants have prior knowledge can produce smaller fan effects (Jones & Anderson, 1987). Altering the general fan effect procedure can also influence the magnitude of the fan effect with people (Sohn et al., 2004; Reder and Ross, 1983).

CHAPTER 3

OVERVIEW OF EXPERIMENTS

The goal of this thesis is to investigate the extent to which people can integrate physical attributes of characters in situation models. Specifically, in these experiments I used the basic fan effect paradigm (e.g., Radvansky & Zacks, 1991) to examine whether people would form an integrated situation model of attribute information centered around person concepts which would be consistent with the studies conducted by Radvansky and colleagues (e.g., Radvansky et al., 1993) or if they would demonstrate a classic fan effect (e.g., Anderson, 1974) where they are unable to integrate the attribute information. Most fan effect studies involving situation model representations have focused on object and location pairings. The few studies that have examined the fan effect in relation with people have looked at person and location pairings (e.g., Radvansky et al., 1993), integration based on themes (e.g., Reder & Ross, 1983), and integration based on previous knowledge (e.g., Lewis and Anderson, 1976). In contrast to those studies, in the current study people were presented with sentences that described different character attributes.

A key manipulation in this thesis was whether the described attributes were situational or permanent. A situational attribute is one that could be relevant only to a specific situation, such as a person wearing sunglasses (e.g., because it is sunny outside). In contrast, a permanent attribute is one that is stable across situations, such as a person having a large, crooked nose. This manipulation is important because permanent attributes should be more likely to be integrated into a single representation of a character, whereas situational attributes should not. The reason for this is that permanent attributes are true, regardless of the situation, and people can potentially integrate these into a single representation of that person. However, situational attributes can be dependent on specific situations and may not be included in a single representation. For example, it is possible for situational attributes to contradict each other (e.g., wearing boots while hiking through mud, but being barefoot while at the beach). The described attributes were permanent in Experiment 1 and situational in Experiment 2. Experiment 3 contained situational attribute contradictions to observe if they influence integration; the reason for this is that in Experiment 2, even though the attributes are situational, people may still integrate them because the studied sentences do not explicitly state that the attributes relate to different situations. In Experiment 3, contradicting attributes should make it clear that the traits relate to different situations. Experiment 4 examined whether including locations during the study phase would influence the results. That is, in Experiments 4, the fact that the contradicting attributes refer to different situations was made even clearer for participants. Finally, Experiment 5 used conflicting emotional attributes to make it more difficult for participants to visualize the attributes due to their abstractness. All five experiments followed the same basic procedure except for the different attribute types and the inclusion / exclusion of locations during study.

Additionally, a second manipulation was whether the sentences described different attributes about the same person or the same attributes about different people. More specifically, the experiments compared when different attributes are presented about the same person (e.g., “Emma has red lipstick,” “Emma has dark sunglasses,” “Emma has a green scarf”) versus when different characters have the same attribute (e.g., “Emma has red lipstick,” “Susan has red lipstick,” “Diane has red lipstick”). This manipulation is similar to the comparison of single location versus multiple locations in some of the other fan effect studies (Radvansky & Zacks, 1991; Radvansky et al., 1993). The same person / different attribute condition is similar to the single location condition with the person being the anchor for the different attributes just like how the location was the anchor for the objects. The different person / same attribute condition is similar to the multiple location condition because the same attributes are in different locations (i.e., on different people).

The third manipulation examines whether including locations during study influences the way people organize attributes. Specifically, this examined whether adding different locations to the conflicting attributes condition would motivate people to create separate mental representations. Likewise, same locations were tested to determine whether that motivates people to create one representation despite the conflicting nature of the attributes.

The other key manipulation, which is present in all fan effect studies, was the different levels of fan. There were fan levels of one and three in the current set of experiments. For example, a fan level of one would be where participants only learn one attribute about the person (e.g., “Mary has blonde hair”), whereas in a fan level of three, participants would either learn three facts relating multiple attributes to a single person (e.g., “Mary has blonde hair,” “Mary has blue eyes,” “Mary has white teeth”) or three facts relating multiple people to one attribute (e.g., “Steve has blonde hair,” “Doug has blonde hair,” “Andre has blonde hair”). Based on these manipulations, this was a 3 level within-subjects design for all of the experiments. The three levels of the independent variable were (1) one person with one attribute (fan level 1), (2) three people with one attribute (fan level 3), and (3) one person with three attributes (fan level 3). The basic experiments consisted of participants first studying a list of sentences until they were memorized, followed by a recognition test. The recognition test items consisted of sentences presented during the study phase and sentences that were similar except for the wrong pairing of people and attributes. This recognition test was used to test the predictions of ACT-R (Anderson, 1993) and situation model theory (Radvansky and Zacks, 1991; Radvansky et al., 1993).

The main hypotheses revolved around the fan effect. First, the one person with one attribute condition was used as a baseline or control condition. In this condition, because the person and the attributes do not overlap with any other facts, these relationships were classified as a fan level 1 and because of this, should be stored independently as there are no associations with other learned facts. Regardless of whether the attributes were permanent or situational, performance should be the fastest and most accurate in this condition because there should have been little to no interference.

For the one person with three attributes condition, there were multiple traits presented about the same person. Even though this was a fan level 3, situation model theory predicts that people would be able to integrate the permanent traits around the person, thus resulting in no fan effect at retrieval. This outcome would be consistent with a person-based organization (Radvansky et al., 1993) where people based their situation models around person concepts. However, for the situational attributes, there should be a fan effect because, according to situation model theory, despite the attributes being related to the same person, those attributes would be based on separate situations and should not be integrated. This would be consistent with the Radvansky and colleagues

(1998) study where participants did not integrate activities that could not be performed at the same time (i.e., based on different situations). For the conflicting situational attributes, it was predicted that there would be an even larger fan effect because not only were traits based on separate situations, but it was very unlikely for them to occur together in real life. This prediction was based on the findings that general knowledge about the world can influence whether participants integrate concepts or not (e.g., Smith et al., 1978).

The ACT-R theory predicts that there would be a fan effect for either permanent or situational attributes because multiple facts, while stored separately, would be associated with one concept. This outcome would be consistent with the Lewis and Anderson (1974) finding that the more concepts studied about people, the larger the fan effect. Based on the explanation given by Anderson and Reder (1999), as long as concepts are presented the same number of times during study and are questioned in a similar manner during the test phase (of learning), concepts of the same fan level can be assumed to have similar weightings; this was true in the current set of experiments. In addition, the recognition test procedure was the same for all items, with all items being tested in the same manner an equal number of times; thus, there were no differences at testing either, which would suggest that there should be no differences in weightings within a fan level.

For the three people with one attribute condition, this was a fan level 3 as there were multiple people that share the same attribute. For both permanent and temporary attributes, situation model theory and ACT-R would both predict a fan effect, but for different reasons. Situation model theory predicts a fan effect because recognition of the shared trait can trigger the access of three separate models (that all contain that attribute), which could lead to interference. ACT-R predicts a fan effect because there are multiple associations (i.e., the different characters) associated with one concept (i.e., the attribute).

CHAPTER 4

EXPERIMENT 1

Method

Participants

A total of 36 (20 females, 16 males) participants with a mean age of 21.7 years were recruited from the subject pool at the University of Nevada, Las Vegas. Participants were issued research credit for their psychology course. The only restrictions for participation were that one needed to be at least 18 years of age at the time of participation and able to fluently speak and understand English.

Materials and Procedure

All of the tasks were completed on a PC using the E-Prime experimental presentation software (Schneider, Eschman, & Zuccolotto, 2001). After the consent process, participants began the study phase; here they were presented with a total of 18 sentences and instructed to memorize them as efficiently as possible. The sentences were in the simple format of "*Person* is/has *attribute*," where *Person* consisted of a proper first-name and *attribute* consisted of a specific permanent attribute. The person names were two syllables and phonologically similar names (e.g., Sara and Tara) were not used. In addition, the names were rated by a separate group of people to make sure that they were all similar in terms of being common. This was done by asking people to rate a list of possible names on a scale from 1 to 7, where a 1 represented a very unique name and a 7 represented a very common name. All of the names used in Experiment 1 had a rating of 4.71 or higher. It should be pointed out that while it is typical to use occupation titles when using people / characters in fan effect studies (e.g., Radvansky et al., 1993), names were used in this thesis because with the examination of attributes, it was possible that occupation titles could activate certain schemas of people and interfere with learning the traits. For example, learning that a police officer was wearing flip-flops might create some interference because the participant could automatically represent a stereotype, such as a man in a standard police uniform, and it would be strange for a uniformed cop to wear flip-flops.

The attributes presented in Experiment 1 were permanent attributes that were stable across situations (e.g., hair color, skin color, body type, etc.). The same group of participants who rated names were also asked to rate a list of attributes in terms of being situational or permanent. For this task, they used a scale from 1 to 7 where a 1 represented an attribute that was clearly situational and a 7 represented an attribute that was clearly permanent. Attributes with scores greater than 5 were used in Experiment 1 and, as a preview, attributes with scores less than 3 were used in Experiments 2 and 3.

The sentences were created by initially using a random process to match names and attributes; however, some restrictions were necessary, as described below. The 14 names and 14 attributes were matched to create six sentences for each of the following conditions: (1) one person with one attribute, (2) one person with three attributes, and (3) three people with one attribute. In condition 1, there were six sentences that did not overlap in terms of name or attribute at all. In condition 2, there were three sentences about one person (each describing a different attribute for that person), and a second set of three sentences about a different person with three different attributes. For condition 3, there were three sentences about different people having the same attribute, and then a second set of three sentences about different people having the same attribute (but different people and a different attribute than the first set). Because the attributes used in

Experiment 1 were permanent, conflicting attributes (e.g., referring to two different eyes colors) were not included, and the combination of attributes selected for the different conditions were evaluated by the experimenter to make sure that they made sense for a person to have in real life. For example, someone having very dark skin coloring and red hair was not used because it does not occur very often in real life. To help ease any concerns of experimenter bias in terms of matching terms for the sentences, a total of four sets of the 18 sentences were created, and these sets were counter-balanced across participants. The four sets of sentences are listed in Appendix A.

For the study phase, the sentences were presented in a random order for each participant, one sentence at a time on the computer for 7 seconds each. After viewing all of the sentences, the test phase began and the participants were presented with 28 test questions in the form of “What attribute(s) does *person* have?” and “Who has *attribute*?” There was one question for each name and attribute. These questions were presented in a random order that did not correspond to the presentation order during the study phase and each question included a number that indicated how many answers there were for that question (i.e., 1 or 3). Participants typed each answer, followed by the <ENTER> key, and when all answers were entered for that question, the computer displayed the correct answer(s). At that point, they were prompted to press the space bar to advance to the next question. After they answered all of the test questions, participants began the study phase again, followed by another test phase. This study-test procedure repeated until participants answered all the questions correctly twice (i.e., two perfect test scores). This method was used in most fan effect studies to ensure that participants have committed all the facts to memory. A different random order of the sentences and test questions were used for each study and test trial.

After participants achieved two perfect test scores, they moved on to the speeded recognition test. In this test, participants were presented with one sentence at a time and the task was to indicate if the sentence was presented during study or not. Participants were instructed to respond as quickly as possible when making their judgments. All 18 of the study sentences were presented (i.e., “yes” responses) along with an equal number of sentences that were not presented (i.e., “no” responses). These non-studied sentences were created by combining names and attributes from the study phase into pairings that were different than those used in the study phase. Participants were instructed to press the left button on the computer mouse, labeled “Y”, to indicate that it was a studied sentence, and they were instructed to press the right button, labeled “N”, to indicate that it was a new sentence; response times and accuracy were measured during the recognition test. After each incorrect response, participants were given feedback with a prompt of “Error” that was presented for 1 second. To familiarize the participants with the buttons, participants first completed ten practice trials where they were presented with either the prompt “SENTENCE STUDIED” (response of “Y”) or “SENTENCE NOT STUDIED” (response of “N”). After the practice trials, participants were presented with four blocks of the 36 sentences, given a short self-paced break, and then presented with the remaining four blocks. Within each block, the sentences were presented in a random order, yielding a total of 288 trials. Upon completion of the recognition test, participants were debriefed and assigned credit.

Design and Analyses

Memory Response Times and Error Rates

For both the response time and error rate data from the speeded recognition test, the data were submitted to a one-way repeated measures Analysis of Variance (ANOVA) with three levels (one person with one attribute, one person with three attributes, three people with one attribute). According to situation model theory, relative to the one person with one attribute condition, there should be a fan effect (i.e., slowdown and more errors) for different characters sharing one attribute, but not when the one character has three attribute. According to ACT-R, relative to the one person with one attribute condition, there should be a fan effect (i.e., slowdown and more errors) for three people with one attribute and for one person with three attributes.

Results

Learning

Participants took an average of 6.39 (SE=0.42) study cycles to memorize the sentences. The mean accuracy across study cycles was computed for each condition. A one-way repeated measures ANOVA revealed that there were no differences among the means, $F(1, 35) = 1.73$, MSE = 0.005 , $p = 0.184$, $\eta_p^2 = 0.047$ (see Appendix B).

Response times

The response time data for correct responses were trimmed by removal of any response time shorter than 200 milliseconds or longer than 8,000 milliseconds. In addition, in accordance with the criteria defined by Van Selst and Jolicour (1994), a proportion of data was trimmed as a function of the sample size for a given participant. This resulted in 6.79% of the data being trimmed.

The response time data were submitted to one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attribute) and the means are presented in Figure 1. For all analyses, an alpha level of 0.05 was used to determine statistical significance; Bonferroni adjustments were used for the follow-up t-tests. The test indicated that condition type had a significant effect on response times $F(1, 35) = 5.89$, MSE = 221788.54, $p = 0.004$, $\eta_p^2 = .144$. Follow-up paired t-tests revealed that response times for the one person with one attribute condition (M = 13.74.43, $SE = 68.63$) were significantly faster than the three people with one attribute condition ($M = 1496.80$, $SE = 85.12$), $t(35) = 2.84$, $p = 0.022$. The response times for the one person with three attributes condition ($M = 1350.46$, $SE = 48.46$) were also faster than the three people with one attribute condition, $t(35) = 2.80$, $p = 0.025$. However, the one person with one attribute condition was not statistically different from the one person with three attributes condition, $t(35) = 0.58$, $p = 1.00$.

Error rates

The mean error rate in Experiment 1 was 2.9 %. Similar to the response time data, these data were analyzed with a one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attribute) and the means are presented in Figure 2. This analysis was not significant, $F(1, 35) = 1.44$, MSE = 0.001, $p = 0.245$, $\eta_p^2 = 0.039$.

Discussion

Experiment 1 investigated the possibility that when sentences were presented that were about the same person, it would produce a differential fan effect. This hypothesis was supported with a differential fan effect for response times. Specifically, there was no fan observed for the one person with three attributes condition (it was similar to the one person with one attribute condition) but there was a traditional fan effect for the three people with one attribute condition. These results are consistent with situation model theory because participants were quicker to retrieve information that could be integrated into a single situation; in this case, a situation model built around the representation of a person. This is consistent with a person based organization, which has been found in other studies (e.g., Radvansky et al., 1993).

The results are not consistent with the predictions made by the ACT-R model because according to it, the response times for the one person with three attributes condition should have been no different than the three people with one attribute condition. This is because they both contain three associations related to a single concept. However, those two conditions were statistically different.

While the response time data showed differences among the conditions, there were no differences for the accuracy data. One likely possibility for this outcome is that it was due to a ceiling effect, as the mean error rate was less than 3%. Another possibility is that it was due to a speed-accuracy trade-off, with participants emphasizing accuracy in all conditions. It is important to note that the current study is similar to past studies of the fan effect because in the latter, fan effects are more likely to be observed for response time data than accuracy data (e.g., Radvansky et al.,1998).

In Experiment 1, the attributes were permanent, and it was expected that participants would easily integrate them for a person because they should be true regardless of the situation. Experiment 2 will investigate whether people integrate situational attributes. It was predicted that situational attributes may be less likely to be integrated because they can be based on different situations, and because of this, people may create separate mental models for each attribute.

CHAPTER 5

EXPERIMENT 2

Method

Participants

A total of 36 participants (22 females, 14 males) with a mean age of 19.9 years were recruited from the subject pool at the University of Nevada, Las Vegas and participants were issued research credit for their psychology course. The only restrictions for participation were that one needed to be at least 18 years of age at the time of participation and able to fluently speak and understand English. None of these individuals participated in Experiment 1.

Materials and Procedure

The materials and procedure for Experiment 2 were identical to Experiment 1 except for one change. Instead of using sentences that described permanent attributes, situational attributes were used instead. While permanent attributes are thought to be present across all situations, the attributes used in Experiment 2 were more situation dependent (e.g., accessories, clothing items, etc.). These items were selected from the set of attributes that were rated prior to Experiment 1. As a reminder, a separate group of participants was asked to rate attributes using a scale from 1 (situational) to 7 (permanent). The attributes used in Experiment 2 were selected from those items that had a mean rating less than 3. As in Experiment 1, names and attributes were pseudo randomly combined to create four sets of 18 sentences with the only restriction being that the clothing items had to correspond to different body parts in the one person with three attributes condition to avoid potential conflicts in participants' mental representations. See Appendix A for a listing of the four sets of sentences used in Experiment 2.

Design and Analyses

Memory Response Times and Error Rates

As in Experiment 1, the response time and error rate data from the speeded recognition test were each submitted to a one-way repeated measures ANOVA with three levels (one person with one attribute, one person with three attributes, three people with one attribute). In contrast to Experiment 1, both situation model theory and ACT-R predicted the same pattern of results in Experiment 2. Specifically, there was expected to be a fan effect (i.e., slowdown and more errors) for different characters sharing one attribute and the same character with three different attributes, relative to the one person with one attribute condition, which should be the fastest and most accurate condition. However, if participants do not recognize that the situational attributes are dependent on the situation, it is possible that they may integrate them into a single representation, leading to a similar pattern that was predicted by situation model theory in Experiment 1.

Results

Learning

Participants took an average of 5.19 (SE=0.33) study cycles to memorize the sentences. As with Experiment 1, the mean accuracy across study cycles was computed for each condition. A one-way repeated measures ANOVA revealed that the means were not significantly different $F(1, 35) = 2.93$, MSE = 0.007, $p = 0.060$, $\eta_p^2 = 0.077$ (see Appendix B).

Response times

The same trimming procedure from Experiment 1 was also used for Experiment 2, resulting in 6.0 % of the response times being trimmed. The response time data were then submitted to a one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attribute) and the means are presented in Figure 3. As in Experiment 1, an alpha level of 0.05 was used and Bonferroni corrections were made for the follow-up tests. The ANOVA indicated that condition type had a significant effect on response times, $F(1, 35) = 4.68$, MSE = 69826.25, $p = 0.012$, $\eta_p^2 = 0.118$. Paired samples *t*-tests revealed that the response times for the one person with one attribute condition ($M = 1408.16$, $SE = 39.28$) were faster than in the three people with one attribute condition ($M = 1484.32$, $SE = 49.22$), $t(35) = 2.76$, $p = 0.027$. The response times for the one person with three attributes condition ($M = 1407.91$, $SE = 47.89$) was also faster than the three people with one attribute condition, $t(35) = 3.01$, $p = 0.015$. As in Experiment 1, the one person with one attribute condition was not statistically different from the one person with three attributes condition, $t(35)$ 0.008, $p = 1.00$.

Error rates

Overall, the mean error rate in Experiment 2 was 2.6 %. These data were analyzed with a one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attributes) and the means are presented in Figure 4. The result was not significant, $F(1, 35) = 0.35$, MSE = 0.00, $p = 0.704$, $\eta_p^2 = 0.010$.

Discussion

The results of Experiment 2 were very similar with what was observed in Experiment 1, which showed that people were able to integrate permanent attributes about characters. In Experiment 2, situational attributes were used, but the results still demonstrated a differential fan effect for the response times with integration occurring for the one person with three attributes condition. The general finding is consistent with situation model theory, because participants were quicker to retrieve information about one person (even when there were three attributes related to that person) than when information was presented about three different people.

In Experiment 2, it is possible that people were able to integrate situational attributes because, while they were technically situational, they were not tied to different specific situations. Because of this, people may have easily integrated the attributes about a single person in a representation such as, "Gabby is wearing a blue beanie, tight yoga pants, and sunglasses." Even though these attributes are situational, the example situation could be a plausible integration of traits in real life. Therefore, to emphasize the situational aspect of the attributes, Experiment 3 investigated situational attributes that were conflicting. That is, all of the attributes related to a single person occurred on the same body part and would be a very unlikely combination to occur simultaneously in real life. Unlike what was observed in Experiments 1 and 2, it was predicted that there would be a fan effect for the one person with three attributes condition, because unlike the previous experiments, it would be harder to create an integrated situation model based on plausible real life scenarios.

CHAPTER 6

EXPERIMENT 3

Method

Participants

A total of 36 participants (24 female, 12 male) with a mean age of 19.5 years were recruited from the subject pool at the University of Nevada, Las Vegas and participants were issued research credit for their psychology course. The only restrictions for participation were that one needed to be at least 18 years of age at the time of participation and able to fluently speak and understand English. None of these individuals participated in Experiments 1 or 2.

Materials and Procedure

The materials and procedure for Experiment 3 were identical to Experiment 2 except for one change. To encourage participants to identify that the attributes were situational, the situational attributes used in Experiment 3 were attributes that conflicted; that is, these were three attributes that a person should not be able to have at the same time (e.g., “Frank is wearing a bike helmet,” “Frank is wearing a baseball cap,” “Frank is wearing a cowboy hat”). The situational attributes were selected from the set of attributes that were rated prior to Experiment 1, and only those items with a score less than 3 (using the scale from 1, situational, to 7, permanent) were used. Conflict was determined by selecting attributes that corresponded to the same body part (e.g., face), thus, it was unlikely that the attributes would occur simultaneously together in real life. The four sets of 18 sentences are listed in Appendix A.

Design and Analyses

Memory Response Times and Error Rates

As in Experiments 1 and 2, the response time and error rate data from the speeded recognition test were each submitted to a one-way repeated measures ANOVA with three levels (one person with one attribute, one person with three attributes, three people with one attribute). Both situation model theory and ACT-R predicted the same pattern. Specifically, there was expected to be a fan effect (i.e., slowdown and more errors) for different characters sharing one attribute and the same character with three different attributes, relative to the one person with one attribute condition, which should be the fastest and most accurate condition.

Results

Learning

Participants took an average of 5.25 (SE = 0.23) study cycles to memorize the sentences. Just like with Experiment 1 and 2, the mean accuracy across study cycles was computed for each condition. A one-way repeated measures ANOVA revealed that the means were not significantly different $F(1, 35) = 0.77$, MSE = 0.299, $p = 0.468$, $\eta_p^2 = 0.021$ (see Appendix B).

Response times

The same trimming procedure was used for Experiment 3, resulting in 5.9 % of the response times being trimmed. The response time data was then submitted to a one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attribute) and the means are presented in Figure 5. As in Experiments 1 and 2, an alpha of 0.05 was used and Bonferroni corrections were made for follow-up tests. The ANOVA indicated that condition type had a significant effect on response times, $F(1, 35) = 8.56$, MSE = 150241.74, $p = 0.000$, $\eta_p^2 = 0.197$. Paired t-tests revealed that the one person with one attribute condition ($M = 1426.01$, $SE = 45.07$) had significantly faster response times than the three people with one attribute condition ($M = 1546.78$, $SE = 54.97$), $t(35) = 3.41$, $p = 0.005$. The response times for the one person with three attributes condition ($M = 1446.63$, $SE = 46.78$) were also significantly faster than the three people with one attribute condition, $t(35) = 3.03$, $p = 0.014$. In addition, as in Experiments 1 and 2, the one person with one attribute condition was not statistically different from the one person with three attributes condition, $t(35) = 0.855$, $p = 1.00$.

Error rates

The overall mean error rate in Experiment 3 was 2.7 %. These data were analyzed with a one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attribute) and the means are presented in Figure 6. There was not a significant effect, $F(1,35) = 0.32$, MSE = 0.00, $p = 0.725$, $\eta_p^2 = 0.009$.

Discussion

The results of Experiment 3 showed the same pattern as Experiments 1 and 2. However, in this case, the results were not consistent with the predictions made by the situation model view nor the ACT-R model. There was an integration effect for the one person with three attributes condition despite the attributes being of a conflicting nature; the fact that they conflicted should have clearly indicated that they were referring to separate situations and should not have been integrated. This finding was also inconsistent with previous research because Radvansky et al. (1997) found that people did not integrate information from sentences in which people were buying objects that were likely bought in different locations.

There are a couple of explanations that could explain the outcome of Experiment 3. First, it is possible that people were employing themes to help them group the attributes. For instance, Jones and Anderson (1987) found that words that were related to each other produced smaller fan effects than unrelated words. In regards to Experiment 3, the conflicting attributes were all on the same body part so they could have used the body part as a cue to help them retrieve the respective attributes. For example, if participants were presented with a set of sentences such as, "Holly is wearing a gas mask," "Holly is wearing a hockey mask," and "Holly is wearing sunglasses," then they could use the theme that all three attributes were related to the face. A second possibility deals with the usage of the verb phrase "*is wearing;"* because all of the verbs were in the same present tense, it is possible that participants were interpreting that the attributes were all related on a common spatial-temporal framework (Radvansky, Wyer, Curiel, & Lutz, 1997). Even though the attributes appeared to conflict, people may have remembered them easily by relying on a von Restorff effect (1933) due to the unusualness of integrating those items.

Experiment 4 took another step toward emphasizing the situational nature of the attributes. Specifically, in Experiment 4, I examined whether adding locations to the sentences during study would push participants to create separate situation models when there was one person with three attributes in three locations, but they should create one situation model when the locations are the same. The procedure for this experiment was slightly different from the previous experiments in that I used location (different versus same) as a between-subjects factor. Because the goal was only to emphasize the situational nature of the attributes, and not to change the basic task, locations were only used during study (i.e., not during study testing nor during the recognition test). The predictions for Experiment 4 were the same as the original predictions for Experiment 3 with regards to the different locations. That is, adding a different spatial location to each study sentence, in addition to the fact that the attributes conflict, should really emphasize that the attributes are situational. As a reminder, both situation model theory and the ACT-R model would predict a similar fan effect for the three people with one attribute condition as well as for the one person with three attributes condition. However, the predictions are different for the same location condition. If people process location information, then the location can be used as a spatial-temporal framework into which all three sentences can be integrated into a single situation model. Thus, according to situation model theory, because people can integrate around the location in both conditions, there should be no fan effect (or at least a smaller fan effect) for either of those conditions. Therefore, there should be an interaction with location for the person with three attributes condition, in that people will integrate attributes in the same location but will not integrate attributes in the different location condition. According to the ACT-R model, because there are multiple associations related to a single concept, both conditions should lead to a fan effect.

CHAPTER 7

EXPERIMENT 4

Method

Participants

A total of 72 participants (53 females, 19 males) with a mean age of 19.9 years were recruited from the subject pool at the University of Nevada, Las Vegas and participants were issued research credit for their psychology course. The only restrictions for participation were that one needed to be at least 18 years of age at the time of participation and able to fluently speak and understand English. Participants were assigned to either the same location group or different location group using a counterbalancing procedure. None of these individuals participated in the previous three experiments.

Materials and Procedure

The materials and procedure for Experiment 4 were identical to Experiment 3 except for one change. A spatial location was added to end of the study sentences for all of the conditions. For example, if in Experiment 3 people were presented with a study sentence such as, “Austin is wearing a cowboy hat,” the sentence used in Experiment 4 would also include a location, such as, “Austin is wearing a cowboy hat at the airport”. The same location group had the same location for the one person with three attributes condition and the three people with one attribute condition. For example, “Austin is wearing a cowboy hat at the airport,” “Austin is wearing a beanie at the airport,” and “Austin is wearing a baseball cap at the airport”. However, in the different location group, there was a different location for every sentence. For example, “Austin is wearing a cowboy hat at the bank," "Austin is wearing a beanie at the hotel," and "Austin is wearing a baseball cap at the office." Large locations where multiple people could be present were used and pairings of an attribute and location that could be semantically related were avoided (e.g., "Sally is wearing a lab coat in the laboratory"). It is important to note that the locations were only presented during the study phase and there were no questions regarding locations during the study testing procedure or during the recognition test. This allowed for an emphasis of the situational aspect of the attributes during study, but by keeping the locations out of the study testing and the recognition test, it did not change the basic task. The sets of sentences used in Experiment 4 are listed in Appendix A.

Design and Analyses

Memory Response Times and Error Rates

The response time and error rate data from the speeded recognition test were each submitted to a 3 x 2 mixed design repeated measures ANOVA with the three fan levels (one person with one attribute, one person with three attributes, three people with one attribute) as the within-subjects variable and location (same or different) as the between-subjects variable. Both situation model theory and ACT-R predicted the same pattern of results in the different location group. Specifically, there was expected to be a fan effect (i.e., slowdown and more errors) for different characters sharing one attribute and the same character with three different attributes, relative to the one person with one attribute condition, which should be the fastest and most accurate condition. Situation model theory predicts a differential fan effect because people can organize around locations. However, it is possible that just presenting locations during study may not be a strong enough manipulation to produce a different pattern of results from Experiment 3. The ACT-R model would predict that presenting the locations during study would not have an effect on the results compared to the other experiments because according to ACT-R theory, the fan effect is based primarily on the number of associations and on the retrieval process.

Results

Learning

Participants took an average of 5.33 (SE = 0.18) study cycles to memorize the sentences. (see Appendix B) As with the other experiments, the mean accuracy across study cycles was computed for each condition. The mean accuracy data were then submitted to a 3 x 2 mixed factorial ANOVA, with fan condition (one person with one attribute, one person with three attributes, three people with one attribute) as the within-subjects factor and with location (same or different) as the between-subjects factor. The ANOVA did not reveal a mean effect of fan for accuracy during the study phase, $F(1, 71) = 2.96$, MSE = 0.012, $p = 0.055$, $\eta_p^2 = 0.041$. There also was not a main effect of location, $F(1, 71) = 0.36$, MSE = 0.008, $p = 0.553$, $\eta_p^2 = 0.005$. Finally, the interaction of attribute condition and location was also not significant, $F(1, 71) = 0.03$, MSE = 0.000, $p = 0.971$, $\eta_p^2 = 0.000$.

Response times

The same trimming procedure was also used for Experiment 4, resulting in 5.41 % of the response times being trimmed. The response time data were then submitted to a 3 x 2 mixed factorial ANOVA, with the within-subjects as the fan condition (one person with one attribute, one person with three attributes, three people with one attribute) and with location (same or different) as the between-subjects factor. The means for both groups are presented in Figure 7. As in the previous experiments, an alpha level of 0.05 was used and Bonferroni corrections were made for follow-up tests. The ANOVA revealed a significant main effect of fan on response times, $F(1, 71) = 8.67$, MSE = 168464.661, $p = 0.000$, $\eta_p^2 = 0.110$. Paired t-tests revealed that the one person with one attribute condition ($M = 1425.73$, $SE = 46.09$) had significantly faster response times than the three people with one attribute condition ($M = 1519.71$, $SE = 47.71$), $t(71) = 3.43$, $p = 0.003$. The response times for the one person with three attributes condition ($M = 1452.82$, $SE = 43.10$) were also significantly faster than the three people with one attribute condition, $t(71) = 2.92$, $p = 0.014$. In addition, as in Experiments 1, 2, and 3, the one person with one trait condition was not statistically different from the one person with three attributes condition, $t(71) = 1.42$, $p = 0.478$. There was not a significant main effect of location, $F(1, 71) = 2.76$, MSE = 1122992.112, $p = 0.101$, $\eta_p^2 = 0.942$. Finally, the interaction of attribute condition and location was also not significant, $F(1, 71) = 1.80$, MSE = 34864.737, $p = 0.170$, $\eta_p^2 = 0.25$.

Error rates

Overall, the mean error rate in Experiment 4 was 2.1 %. The data were analyzed with a 3 x 2 mixed factorial ANOVA, with the within-subjects factor as the fan condition (one person with one attribute, one person with three attributes, three people with one attribute) and with location (same or different) as the between-subjects factor. The means for both location groups are presented in Figure 8. There was no main effect of fan condition, $F(1, 72) = 0.71$, MSE = 0.000, $p = 0.495$, $\eta_p^2 = 0.010$ or location, $F(1, 72) = 1.36$, MSE = 0.001, $p = 0.248$, $\eta_p^2 = 0.019$. Also, the interaction was not significant, $F(1, 72) = 1.02$, MSE = 0.001, $p = 0.364$, $\eta_p^2 = 0.014$.

Discussion

Experiment 4 produced a similar pattern to the other experiments with there being a differential fan effect. Specifically, there was a fan effect observed for the three people with one attribute condition, but not for the one person with three attributes condition. The addition of locations during the study phase, in addition to the attributes conflicting, was not enough to push participants in the different location group to maintain separate situation model representations for the different attributes in the one person with three attributes condition.

At this point, it appears that participants are inclined to organize around person concepts. Across all four experiments, which all showed similar patterns, participants were integrating information around a person, regardless of whether the attributes were permanent (Experiment 1), situational but with the possibility of a plausible integration (Experiment 2), or situational with no plausible integration (Experiments 3 and 4 (with different location group)). It is possible that people will create a mental representation centered around a person even if it violates their world knowledge of how attributes are typically grouped.

The goal for Experiment 5 was to determine whether participants would organize their mental representations around people when the attributes are abstract, internal, and conflicting. To examine this, Experiment 5 used emotional states that are unlikely to be experienced at one time. For example, "Patrick is repulsed," "Patrick is happy," and "Patrick is upset" This experiment differed from the first four because it should be a lot more difficult to create a mental representation of more than one emotional attributes, thus, less likely that the attributes would be integrated. According to situation model theory, there should also be a fan effect for the one person with three attributes condition because the attributes are difficult to integrate into one representation. According to the ACT-R model, there should also be a fan effect for this condition because there are three associated presented about one person. As in the earlier experiments, both situation model theory and the ACT-R model would predict a fan effect for the three people with one attribute condition.

CHAPTER 8

EXPERIMENT 5

Method

Participants

A total of 36 participants (27 females, 9 males) with a mean age of 20.6 years were recruited from the subject pool at the University of Nevada, Las Vegas and participants were issued research credit for their psychology course. The only restrictions for participation were that one needed to be at least 18 years of age at the time of participation and able to fluently speak and understand English. None of these individuals participated in the previous four experiments.

Materials and Procedure

The materials and procedure for Experiment 5 were similar to Experiments 1-3 except for one change. Here, the attributes referred to emotional states. The emotions used for the one person with three attribute condition were derived from the six universal emotions so that they clearly referred to different states. For example, “Laura is happy,” “Laura is angry,” and “Laura is fearful.” The emotions for the remaining conditions were synonyms or closely related to the six universal emotions, with half being positive and half being negative.

Design and Analyses

Memory Response Times and Error Rates

As in the first three experiments, the response time and error rate data from the speeded recognition test were each submitted to a one-way repeated measures ANOVA with three levels (one person with one attribute, one person with three attributes, three people with one attribute).

Situation model theory predicted a fan effect for both fan 3 conditions because neither condition corresponds to a situation where people can form an integrated situation model. The ACT-R model predicts a fan effect for both conditions because there are multiple associations related to a single concept. The sets of sentences used in Experiment 5 are listed in Appendix A.

Results

Learning

Participants took an average of 5.72 (SE=0.27) study cycles to memorize the sentences. As with the other experiments, the mean accuracy across study cycles was computed for each condition. A one-way repeated measures ANOVA revealed that the means were significantly different $F(1, 35) = 3.42$, MSE = 0.012, $p = 0.038$, $\eta_p^2 = 0.089$ (see Appendix B). Paired t-tests revealed that the one person with one attribute condition was learned with more accuracy than the one person with three attributes condition, $t(35) = 2.67$, $p = 0.034$. The accuracy for learning the sentences for the three people with one attribute condition was not significantly different from the one person with three attributes condition, $t(35) = 1.06$, $p = 0.885$, or the one person with one attribute condition, $t(35) = 1.67$, $p = 0.312$.

Response times

The same trimming procedure that was used in the previous experiments was also used in Experiment 5, resulting in 8.14 % of the response times being trimmed. The response time data was then submitted to a one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attribute) and the means are presented in Figure 9. As in the other experiments, an alpha of 0.05 was used and Bonferroni corrections were made for follow-up tests. The ANOVA indicated that condition type had a significant effect on response times, $F(1, 35) = 4.38$, MSE = 123692.378, $p = 0.016$, $\eta_p^2 = 0.111$. Unlike the previous experiments, paired t-tests revealed that the one person with one attribute condition ($M = 1260.67$, $SE = 57.33$) had significantly faster response times than the one person with three attributes condition ($M = 1305.55$, $SE = 57.46$), $t(35) = 2.80$, $p = 0.025$. The response times for the three people with one attribute did not differ from the one person with three attributes condition ($M = 1322.19$, $SE = 55.57$), $t(35) = 0.74$, $p = 1.000$, or the one person with one attribute condition, $t(35) = 1.98$, $p = 0.168$.

Error rates

Overall, the mean error rate in Experiment 5 was 3.76 %. These data were analyzed with a one-way repeated measures ANOVA (one person with one attribute, one person with three attributes, three people with one attributes) and the means are presented in Figure 10. The result was not significant, $F(1, 35) = 0.43$, MSE = 0.001, $p = 0.653$, $\eta_p^2 = 0.012$.

Discussion

Experiment 5 investigated whether participants would form mental representations when the attributes were conflicting emotions and a different pattern of results was observed. Specifically, the response times for the one person with three attributes condition were significantly slower than the one person with one attribute condition. The fan effect for the one person with three attribute condition was a result that both situation model theory and the ACT-R model predicted. Situation model theory predicted this effect because it is based on the idea that people form mental representations of the described state of affairs and it is difficult to visualize abstract attributes that contradict. ACT-R model would predict this finding because multiple associations are associated with one attribute. However, the lack of a fan effect for the three people with one attribute condition was rather surprising. Based on the state of affairs explanation for situation model theory, a fan effect was expected for this condition because, as in Experiments 1 through 4, people were not expected to integrate three people into one representation. However, to date, fan effects have not been studied with abstract entities. Although, ACT-R model would predict a fan effect, Anderson and Reder might say that participants were attending more to the names because they are more concrete (see Anderson & Reder, 1999).

CHAPTER 9

GENERAL DISCUSSION

Five experiments were conducted to investigate whether fan effects would be observed for attributes that could potentially be organized around people. Previous research has shown that people can organize around person concepts, but that it does not always occur. For instance, a person-based organization was observed when the material included small spaces, but not large (Radvansky et al., 1993). A person-based organization was also observed in situations where people were buying objects that could be purchased in one location, but not when the objects either could not be purchased in the same location or when the sentences described situations where people already owned the objects (Radvansky et al., 1997). Given the results of previous studies, I predicted that people would organize the attributes around the person, thus producing a differential fan in cases where the traits were permanent, but not when they were situational, especially when the attributes were conflicting.

The first three experiments tested the organization of three different attributes: permanent, situational, and situational attributes that were conflicting. According to situation model theory, when a set of sentences refer to a static event, integration of the facts should be observed. This was observed with permanent attributes (Experiment 1) and situational attributes that could plausibly refer to a single, static event (Experiment 2). While I did not originally predict this outcome for situational attributes, in retrospect, this pattern can be consistent with the Radvansky et al. (1997) findings because participants may have interpreted the sentences as referring to a common situation. However, the same pattern of integration was also observed with conflicting situational attributes (Experiment 3), which does not support that explanation for situation model theory.

Because Radvansky et al. (1993) showed that participants can use both people and locations as the focus of integration, Experiment 4 tested the inclusion of locations with conflicting traits. Different locations were used to encourage participants to interpret the information as referring to separate situations by giving participants different spatial-temporal frameworks in which to organize their mental representations. Regardless of whether different or same locations were used, Experiment 4 produced the same pattern of results as the first three experiments, and locations did not appear to influence situation model organization. It is important to note, though, that people may not have attended to locations because they were not asked questions about locations during the study phase. Sohn et al. (2004) found that attention can influence the fan effect, however those results were in the opposite direction, with the greater amount of attention producing a larger fan effect.

So, if that explanation of situation model theory cannot account for the results, is it still possible for the theory to explain these outcomes? One difference between this thesis and other studies is that I used attributes which could possibly be more inherently related to person concepts. Other studies have not exclusively included objects that can be worn or can be a part of someone. Therefore, the integration of attributes can fit in with the Gestalt laws of grouping (Köhler, 1920). In particular the results fit in with the law of proximity when an individual perceives objects that are close together as forming a group. This law refers to items that are presented visually, but in this thesis, the participants could have mentally represented the objects as being close together because they were associated with the same body part.

Similar to this idea, it might be tempting to conclude that participants misinterpreted the sentences used in the current experiments. That is, rather than interpreting the sentences as they were written (i.e., "is wearing an attribute"), it is possible that participants interpreted them to mean "owns an attribute." In the latter scenario, it is intuitive to imagine that participants could integrate the "owned attributes" into a single representation; however, Radvansky et al. (1997) showed that participants do not integrate information when ownership is described because it does not refer to a specific situation. Alternatively, future research could examine the "owns an attribute" phrasing with conflicting attributes such as, "Robin owns flippers," "Robin owns ice skates," and "Robin owns high heels." Owning these objects that are all associated with the same body part could possibly lead to integration.

Another explanation for the pattern of results is that, despite the attributes conflicting, people continued to integrate them into a single, bizarre, representation. In this case, there may have been a contribution of the von Restorff effect (1933), which predicts that distinct items are remembered better than other items. It is possible that the unusualness of a situation where one person is wearing items of clothes that do not usually occur together boosted the integration of those items. This is related to a study conducted by McDaniel and Einstein (1986) where bizarreness was manipulated by the relations of word triplets such as, "The dog rode the bicycle down the street." This was compared to common images such as, "The dog chased the bicycle down the street."

Participants were slower to form bizarre images compared to common images, but recall was higher for bizarre images.

Another possibility is the explanation that was offered by Radvansky et al. (1993) to account for the integration of information around people when using small locations (e.g., phone booth, witness stand, etc.). Here, Radvansky et al. described the integration as occurring around a course of events that were linked through a common person (Barwise & Perry, 1983). A course of events is thought to be a situation type that can include a series of events, with a common thread, that do not need to occur in the same location. Thus, integration happens because the events are so highly related despite the non-static nature of those events. However, this idea does not seem to be consistent with some other findings related to the fan effect. For example, Radvansky et al. (1998) showed that participants did not integrate actions performed by the same person unless those actions could occur simultaneously. Also, it is not clear how an integrated course of events could be perceptually represented as a single situation. Granted, situation models do not have to be linked to perceptual representations (e.g., Zwaan & Radvansky, 1998), but they often are linked to them (e.g., Zwaan, Stanfield, & Yaxley, 2002).

One intriguing finding from the current set of experiments was that in Experiment 5, when conflicting emotional states were used, the results showed a different pattern; specifically, the results did not show evidence of integration in the one person with three attributes condition. Interestingly, participants organized around the emotional attributes. A fan effect was not expected for this condition, considering it was not found in the previous four experiments, but this finding shows how inclined people are to integrate information in long-term memory. It also demonstrates that the concept that integration is centered around does not have to be a dimension of the situation model that is found in research with narrative comprehension. That is, unlike character / entity and spatial location, emotion is not classified as a unique situation model dimension. Future research could examine whether emotion should be classified as a situation dimension and whether there is a hierarchy of situation dimensions that people use to determine what should be the focus of their organization.

According to the ACT-R model, the more facts associated with a concept, the weaker the strength of associations which results in less activation of items with more fans. Across all of the experiments, the predictions of the ACT-R model were not consistently supported because a differential fan effect was always observed. Specifically, because the focus of attention and frequency of materials was consistent across conditions at encoding and retrieval, there was no a priori reason to expect different weights for different concepts. Thus, the model would have not predicted the differential fan effects.

The only reasonable way to fit the current results into the ACT-R model would be to assume, post-hoc, that some concepts were weighted higher than others. Anderson and Reder (1999) claimed that concrete items could receive more weight than items that are not concrete. However, first names are more arbitrary and abstract than the attributes used in Experiments 1-4, but a differential fan effect was still observed. In Experiment 5, the first names were probably more concrete than emotional states but a differential fan effect was observed for emotions. Anderson and Reder (1999) also argued that concepts that have multiple words could result in more weighting because there are more cues at retrieval. There were incidents where multiple words were used in the current set of experiments (e.g., emerald green eyes) but participants still organized around the person-concept. Finally, it is also possible that participants were biased to organize around people because people always came first in the sentences; however, this does not seem to be a likely explanation because in Radvansky et al.'s (1993) experiments, locations appeared last in the sentences, yet people organized their representations around those.

One thing that is clear is that neither the ACT-R model nor situation model theory can adequately explain all the findings from this set of experiments. The ACT-R model could possibly be used to explain the results if fan effects were consistently observed for each condition, but it does not do a good job at supporting the differential fan effects. Situation model theory can explain the differential fan effects in Experiments 1 and 2, but cannot easily explain the findings in Experiments 3-5 because, in those cases, there were conditions in which an integrated situation model would be implausible and separate situation models should have been constructed. It is possible that the fan effect paradigm itself needs to be investigated more deeply. The majority of studies have focused on changing the materials to get different effects, but only a small number of studies have manipulated the procedure. Perhaps, the procedure itself is not indicative of how memory is really organized. For example, the study phase involves asking questions that group the items related to the same concept together (e.g., "What emotions are Mary feeling?"). It is possible that this forces people to think about the items as a group too much, which in turn can cause interference or integration. The testing procedure was manipulated in one prior study by having people verify whether the sentence was plausible and reversed fan effects were found (Reder & Ross, 1983). Therefore, the fan effect paradigm itself might cause artificial representations in memory and should be investigated in future studies.

CHAPTER 10

LIMITATIONS AND FUTURE DIRECTIONS

One of the limitations of this thesis may lie in pre-experimental associations with grouping of the attributes. Due to the nature of the attributes, and the fact that some attributes were specifically matched together because they contradicted, the material was not as random as in other fan effect studies where almost every participant would get a different set of materials (e.g., Radvansky & Zacks, 1991). In contrast, this thesis only had four different versions of the sentences that were counterbalanced across participants. However, this could only be a limitation in Experiments 1 and 2, because the materials in the other experiments, while still not being as random as other studies, were combinations that are highly unlikely to occur together in real life.

Another potential limitation was the use of real names instead of occupation titles. Previous fan effect studies investigating people have used occupation titles, however, because I was looking at physical attributes in most of the experiments, I did not want the occupation titles to elicit schemas of physical descriptions. It is possible that I could have observed less integration if I used occupation titles because people would not need the physical attribute descriptions to create a mental representation of the person, thus they may have been less likely to integrate more information. Related to this idea, the use of first names could have cued participants to think about individuals whom they know and then they could have integrated the extra attributes. This would be consistent with studies that found that memorizing false facts about familiar people increases memory recall (e.g., Kole & Healy, 2010).

Future experiments should continue to investigate why people will form an integrated situation model with conflicting materials. This could be investigated in a few ways. First, the bizarreness effect could be examined by including combinations that are bizarre in the one person with three attribute conditions along with combinations that are more likely to occur in everyday life, such as the ones that were presented in Experiment 2. If people form integrated models for the bizarre pairings, but not the normal pairings, then it would show that the integration only occurs because of the bizarreness enhancing the items. Also, if the bizarre items referred to attributes that correspond to different body parts and they still elicit a differential fan than this could rule out the possibility of the results being due to a Gestalt effect (Köhler, 1920). Another route to examine the bizarreness effect would be to include conflicting permanent traits in the material set which are even less likely to occur in real life (blue eyes, green eyes, brown eyes), rather than conflicting situational traits.

Future experiments could also continue to study attribute pairings with people in conjunction with other situational dimensions (e.g., location, goals, time, etc.). For example, the possibility of locations being ignored during Experiment 4 could be examined further by including questions during the study phase about locations. However, this could potentially be too difficult for participants to have to answer questions about locations, people, and attributes (i.e., this would noticeably increase the duration of the experiment, which could lead to fatigue). For the time dimension, performance could be examined by including attributes that occur through different phases in the life cycle (e.g., “Scott has oily pimples,” “Scott has a receding hair line,” and “Scott has aging wrinkles.”). If these types of materials produced a fan effect, then it would indicate that the inclusion of time shifts can stop integration from occurring around the person, and it would also be consistent with the Radvansky et al. (1997) studies. However, this could be taken a step farther by also including the possibility of a course of events spread across time shifts by focusing on differences within a single attribute (e.g., “Scott has thick hair,” “Scott has receding hair,” and “Scott is bald.”). If materials that describe a course of events can produce integration then it would prove that course of events integration can happen in the fan effect paradigm.

As stated earlier, the patterns observed across five experiments did not fit perfectly with the predictions of the ACT-R model or situation model theory. Any, or all, of the possibilities described above could be explored to gain a better understanding of how participants are organizing information about people and attributes. These possibilities should be explored so that the fan effect can be more fully understood.

CHAPTER 11

CONCLUSION

In summary, this thesis demonstrated further support that the integration of information occurs differentially in the fan effect paradigm. The integration occurred when attributes were permanent, situational, and even when they conflicted or involved different locations. However, when the attributes were internal (i.e., emotions), integration occurred around the attribute rather than the person. The basic integration patterns for permanent and plausible situational traits fit into predictions made by situation model theory, but the other findings do not easily fit into the explanations made by that theory. The findings observed in this thesis suggest that people will find a way to integrate information, despite how implausible the situation may be, but the concept chosen to integrate around can differ depending on the materials used.

APPENDIX A

Complete sets of sentences for Experiments 1, 2, 3, 4, and 5

Experiment 1: Permanent Attributes

Version 1

One Person with One Attribute

Carrie has two deep dimples
Austin has a broad forehead
Gabby has big floppy ears
Bradley has a tribal tattoo
Holly has a crooked nose
George has two hairy moles

One Person with Three Attributes

Jenna has rosy red cheeks
Jenna has shiny brown hair
Jenna has emerald green eyes
Kevin has a defined cleft chin
Kevin has a jagged scar
Kevin has pasty pale skin

Three People with One Attribute

Patrick has deep line wrinkles
Randy has deep line wrinkles
Thomas has deep line wrinkles
Laura has very tan skin
Marie has very tan skin
Nancy has very tan skin

Version 2

One Person with One Attribute

Laura has two hairy moles
Marie has a defined cleft chin
Nancy has shiny brown hair
Randy has pasty pale skin
Thomas has a jagged scar
Bradley has deep line wrinkles

One Person with Three Attributes

Gabby has a broad forehead
Gabby has big floppy ears
Gabby has two deep dimples
Austin has very tan skin
Austin has a tribal tattoo
Austin has a crooked nose

Three People with One Attribute

George has rosy red cheeks
Kevin has rosy red cheeks
Patrick has rosy red cheeks
Carrie has emerald green eyes
Holly has emerald green eyes
Jenna has emerald green eyes

Version 3

One Person with One Attribute

Nancy has emerald green eyes
Laura has a tribal tattoo
Jenna has very tan skin
Randy has shiny brown hair
Austin has a jagged scar
Kevin has a broad forehead

One Person with Three Attributes

Holly has two hairy moles
Holly has deep line wrinkles
Holly has pasty pale skin
Patrick has two deep dimples
Patrick has big floppy ears
Patrick has rosy red cheeks

Three People with One Attribute

George has a defined cleft chin
Thomas has a defined cleft chin
Bradley has a defined cleft chin
Gabby has a crooked nose
Carrie has a crooked nose
Marie has a crooked nose

Version 4

One Person with One Attribute

Jenna has very tan skin
Nancy has two deep dimples
Carrie has a broad forehead
Kevin has deep line wrinkles
Patrick has a jagged scar
Randy a defined cleft chin

One Person with Three Attributes

Laura has pasty pale skin
Laura has a crooked nose
Laura has shiny brown hair
George has rosy red cheeks
George has emerald green eyes
George has two hairy moles

Three People with One Attribute

Bradley has a tribal tattoo
Thomas has a tribal tattoo
Austin has a tribal tattoo
Marie has big floppy ears
Holly has big floppy ears
Gabby has big floppy ears

Experiment 2 –Situational Attributes (Non-conflicting)

Version 1

One Person with One Attribute

Laura is wearing orange rain boots
Marie is wearing combat boots
Nancy is wearing cowboy boots
Randy is wearing khaki pants
Thomas is wearing a thick vest
Bradley is wearing a polo shirt

One Person with Three Attributes

Jenna is wearing a blue beanie
Jenna is wearing sunglasses
Jenna is wearing tight yoga pants
Kevin is wearing a beer helmet
Kevin is wearing a red hoodie
Kevin is wearing a stopwatch

Three People with One Attribute

Patrick is wearing safety goggles
Randy is wearing safety goggles
Thomas is wearing safety goggles
Laura is wearing a sweater
Marie is wearing a sweater
Nancy is wearing a sweater

Version 2

One Person with One Attribute

Laura is wearing a beer helmet
Marie is wearing orange rain boots
Nancy is wearing tight yoga pants
Randy is wearing a sweater
Thomas is wearing a red hoodie
Bradley is wearing a blue beanie

One Person with Three Attributes

Gabby is wearing safety goggles
Gabby is wearing khaki pants

Gabby is wearing a thick vest
Austin is wearing a polo shirt
Austin is wearing sunglasses
Austin is wearing cowboy boots

Three People with One Attribute

George is wearing combat boots
Kevin is wearing combat boots
Patrick is wearing combat boots
Carrie is wearing a stopwatch
Holly is wearing a stopwatch
Jenna is wearing a stopwatch

Version 3

One Person with One Attribute

Nancy is wearing a blue beanie
Laura is wearing tight yoga pants
Jenna is wearing cowboy boots
Randy is wearing a polo shirt
Austin is wearing sunglasses
Kevin is wearing safety goggles

One Person with Three Attributes

Holly is wearing a sweater
Holly is wearing combat boots
Holly is wearing a stopwatch
Patrick is wearing a thick vest
Patrick is wearing a beer helmet
Patrick is wearing orange rain boots

Three People with One Attribute

George is wearing khaki pants
Thomas is wearing khaki pants
Bradley is wearing khaki pants
Gabby is wearing a red hoodie
Carrie is wearing a red hoodie
Marie is wearing a red hoodie

Version 4

One Person with One Attribute

Jenna is wearing safety goggles
Nancy is wearing cowboy boots
Carrie is wearing a tight yoga pants
Kevin is wearing orange rainboots
Patrick is wearing a thick vest
Randy is wearing a stopwatch

One Person with Three Attributes

Laura is wearing khaki pants
Laura is wearing a red hoodie
Laura is wearing sunglasses
George is wearing a blue beanie
George is wearing a sweater
George is wearing combat boots

Three People with One Attribute

Bradley is wearing a polo shirt
Thomas is wearing a polo shirt
Austin is wearing a polo shirt
Marie is wearing a beer helmet
Holly is wearing a beer helmet
Gabby is wearing a beer helmet

Experiment 3 – Situational Attributes (Conflicting)

Version 1

One Person with One Attribute

Carrie is wearing cowboy boots
Austin is wearing a striped tie
Gabby is wearing combat boots
Bradley is wearing orange rain boots
Holly is wearing a lab coat
George is wearing a trench coat

One Person with Three Attributes

Jenna is wearing a gas mask
Jenna is wearing a hockey mask
Jenna is wearing sunglasses
Kevin is wearing a beer helmet
Kevin is wearing a silk top hat
Kevin is wearing a cowboy hat

Three People with One Attribute

Patrick is wearing a neck brace
Randy is wearing a neck brace
Thomas is wearing a neck brace
Laura is wearing a varsity jacket
Marie is wearing a varsity jacket
Nancy is wearing a varsity jacket

Version 2

One Person with One Attribute

Laura is wearing a beer helmet
Marie is wearing a silk top hat
Nancy is wearing a cowboy hat
Randy is wearing a hockey mask
Thomas is wearing a gas mask
Bradley is wearing a neck brace

One Person with Three Attributes

Gabby is wearing orange rain boots
Gabby is wearing cowboy boots

Gabby is wearing combat boots
Austin is wearing a trench coat
Austin is wearing a lab coat
Austin is wearing a varsity jacket

Three People with One Attribute

George is wearing a striped tie
Kevin is wearing a striped tie
Patrick is wearing a striped tie
Carrie is wearing sunglasses
Holly is wearing sunglasses
Jenna is wearing sunglasses

Version 3

One Person with One Attribute

Nancy is wearing a neck brace
Laura is wearing a trench coat
Jenna is wearing cowboy boots
Randy is wearing a varsity jacket
Austin is wearing a striped tie
Kevin is wearing orange rain boots

One Person with Three Attributes

Holly is wearing a beer helmet
Holly is wearing a silk top hat
Holly is wearing a cowboy hat
Patrick is wearing a gas mask
Patrick is wearing a hockey mask
Patrick is wearing sunglasses

Three People with One Attribute

George is wearing combat boots
Thomas is wearing combat boots
Bradley is wearing combat boots
Gabby is wearing a lab coat
Carrie is wearing a lab coat
Marie is wearing a lab coat

Version 4

One Person with One Attribute

Jenna is wearing a gas mask
Nancy is wearing sunglasses
Carrie is wearing a beer helmet
Kevin is wearing a striped tie
Patrick is wearing a neck brace
Randy is wearing a silk top hat

One Person with Three Attributes

Laura is wearing a trench coat
Laura is wearing a lab coat
Laura is wearing a varsity jacket
George is wearing orange rainboots
George is wearing cowboy boots
George is wearing combat boots

Three People with One Attribute

Bradley is wearing a hockey mask
Thomas is wearing a hockey mask
Austin is wearing a hockey mask
Marie is wearing a cowboy hat
Holly is wearing a cowboy hat
Gabby is wearing a cowboy hat

Experiment 4 – Conflicting Attributes with Locations

Different Locations

Version 1

One Person with One Attribute

Carrie is wearing cowboy boots at the laboratory
Austin is wearing a striped tie at the office
Gabby is wearing combat boots at the theater
Bradley is wearing orange rain boots at the bakery
Holly is wearing a lab coat at the school
George is wearing a trench coat at the city hall

One Person with Three Attributes

Jenna is wearing an eye patch at the factory
Jenna is wearing a hockey mask at the bar
Jenna is wearing sunglasses at the park
Kevin is wearing a beer helmet at the garage
Kevin is wearing a silk top hat at the hotel
Kevin is wearing a cowboy hat at the bank

Three People with One Attribute

Patrick is wearing a neck brace at the museum
Randy is wearing a neck brace at the airport
Thomas is wearing a neck brace at the diner
Laura is wearing a mink fur coat at the library
Marie is wearing a mink fur coat at the café
Nancy is wearing a mink fur coat at the mall

Version 2

One Person with One Attribute

Laura is wearing a beer helmet at the laboratory
Marie is wearing a silk top hat at the library
Nancy is wearing a cowboy hat at the bakery
Randy is wearing a hockey mask at the café
Thomas is wearing an eye patch at the airport
Bradley is wearing a neck brace at the office

One Person with Three Attributes

Gabby is wearing orange rain boots at the mall
Gabby is wearing cowboy boots at the diner
Gabby is wearing combat boots at the garage
Austin is wearing a trench coat at the park
Austin is wearing a lab coat at the factory
Austin is wearing a mink fur coat at the museum

Three People with One Attribute

George is wearing a striped tie at the city hall
Kevin is wearing a striped tie at the bank
Patrick is wearing a striped tie at the theater
Carrie is wearing sunglasses at the hotel
Holly is wearing sunglasses at the bar
Jenna is wearing sunglasses at the school

Version 3

One Person with One Attribute

Nancy is wearing a neck brace at the bakery
Laura is wearing a trench coat at the theater
Jenna is wearing cowboy boots at the airport
Randy is wearing a mink fur coat at the diner
Austin is wearing a striped tie at the museum
Kevin is wearing orange rain boots at the bank

One Person with Three Attributes

Holly is wearing a beer helmet at the hotel
Holly is wearing a silk top hat at the bar
Holly is wearing a cowboy hat at the mall
Patrick is wearing an eye patch at the laboratory
Patrick is wearing a hockey mask at the garage
Patrick is wearing sunglasses at the factory

Three People with One Attribute

George is wearing combat boots at the café
Thomas is wearing combat boots at the city hall
Bradley is wearing combat boots at the park
Gabby is wearing a lab coat the school
Carrie is wearing a lab coat at the office
Marie is wearing a lab coat at the library

Version 4

One Person with One Attribute

Jenna is wearing an eye patch at the museum
Nancy is wearing sunglasses at the bakery
Carrie is wearing a beer helmet at the hotel
Kevin is wearing a striped tie at the laboratory
Patrick is wearing a neck brace at the office
Randy is wearing a silk top hat at the theater

One Person with Three Attributes

Laura is wearing a trench coat at the café
Laura is wearing a lab coat at the factory
Laura is wearing a mink fur coat at the city hall
George is wearing orange rain boots at the park
George is wearing cowboy boots at the bank
George is wearing combat boots at the library

Three People with One Attribute

Bradley is wearing a hockey mask at the school
Thomas is wearing a hockey mask at the mall
Austin is wearing a hockey mask at the bar
Marie is wearing a cowboy hat at the garage
Holly is wearing a cowboy hat at the airport
Gabby is wearing a cowboy hat at the diner

Same Locations

Version 1

One Person with One Attribute
Carrie is wearing cowboy boots at the laboratory
Austin is wearing a striped tie at the office
Gabby is wearing combat boots at the theater
Bradley is wearing orange rain boots at the bakery
Holly is wearing a lab coat at the school
George is wearing a trench coat at the city hall

One Person with Three Attributes

Jenna is wearing an eye patch at the factory
Jenna is wearing a hockey mask at the factory

Jenna is wearing sunglasses at the factory
Kevin is wearing a beer helmet at the hotel
Kevin is wearing a silk top hat at the hotel
Kevin is wearing a cowboy hat at the hotel

Three People with One Attribute

Patrick is wearing a neck brace at the museum
Randy is wearing a neck brace at the museum
Thomas is wearing a neck brace at the museum
Laura is wearing a mink fur coat at the mall
Marie is wearing a mink fur coat at the mall
Nancy is wearing a mink fur coat at the mall

Version 2

One Person with One Attribute

Laura is wearing a beer helmet at the laboratory
Marie is wearing a silk top hat at the library
Nancy is wearing a cowboy hat at the park
Randy is wearing a hockey mask at the café
Thomas is wearing an eye patch at the airport
Bradley is wearing a neck brace at the office

One Person with Three Attributes

Gabby is wearing orange rain boots at the diner
Gabby is wearing cowboy boots at the diner
Gabby is wearing combat boots at the diner
Austin is wearing a trench coat at the bakery
Austin is wearing a lab coat at the bakery
Austin is wearing a mink fur coat at the bakery

Three People with One Attribute

George is wearing a striped tie at the bank
Kevin is wearing a striped tie at the bank
Patrick is wearing a striped tie at the bank
Carrie is wearing sunglasses at the bar
Holly is wearing sunglasses at the bar
Jenna is wearing sunglasses at the bar

Version 3

One Person with One Attribute

Nancy is wearing a neck brace at the bakery
Laura is wearing a trench coat at the theater
Jenna is wearing cowboy boots at the airport
Randy is wearing a mink fur coat at the diner
Austin is wearing a striped tie at the museum
Kevin is wearing orange rain boots at the bank

One Person with Three Attributes

Holly is wearing a beer helmet at the garage
Holly is wearing a silk top hat at the garage
Holly is wearing a cowboy hat at the garage
Patrick is wearing an eye patch at the laboratory
Patrick is wearing a hockey mask at the laboratory
Patrick is wearing sunglasses at the laboratory

Three People with One Attribute

George is wearing combat boots at the café
Thomas is wearing combat boots at the café
Bradley is wearing combat boots at the café
Gabby is wearing a lab coat the school
Carrie is wearing a lab coat at the school
Marie is wearing a lab coat at the school

Version 4

One Person with One Attribute

Jenna is wearing an eye patch at the museum
Nancy is wearing sunglasses at the bakery
Carrie is wearing a beer helmet at the hotel
Kevin is wearing a striped tie at the laboratory
Patrick is wearing a neck brace at the office
Randy is wearing a silk top hat at the theater

One Person with Three Attributes

Laura is wearing a trench coat at the city hall
Laura is wearing a lab coat at the city hall
Laura is wearing a mink fur coat at the city hall
George is wearing orange rain boots at the library

George is wearing cowboy boots at the library
George is wearing combat boots at the library

Three People with One Attribute

Bradley is wearing a hockey mask at the park
Thomas is wearing a hockey mask at the park
Austin is wearing a hockey mask at the park
Marie is wearing a cowboy hat at the airport
Holly is wearing a cowboy hat at the airport
Gabby is wearing a cowboy hat at the airport

Experiment 5- Emotional Attributes

Version 1

One Person with One Attribute

Carrie is anxious
Austin is eager
Gabby is confused
Bradley is content
Holly is aroused
George is annoyed

One Person with Three Attributes

Jenna is angry
Jenna is surprised
Jenna is fearful
Kevin is upset
Kevin is happy
Kevin is repulsed

Three People with One Attribute

Patrick is nervous
Randy is nervous
Thomas is nervous
Laura is relaxed
Marie is relaxed
Nancy is relaxed

Version 2

One Person with One Attribute

Laura is confused
Marie is content
Nancy is annoyed
Randy is relaxed
Thomas is nervous
Bradley is aroused

One Person with Three Attributes

Gabby is upset
Gabby is happy

Gabby is fearful
Austin is angry
Austin is repulsed
Austin is surprised

Three People with One Attribute

George is eager
Kevin is eager
Patrick is eager
Carrie is anxious
Holly is anxious
Jenna is anxious

Version 3

One Person with One Attribute

Nancy is nervous
Laura is eager
Jenna is relaxed
Randy is annoyed
Austin is aroused
Kevin is anxious

One Person with Three Attributes

Holly is surprised
Holly is happy
Holly is repulsed
Patrick is upset
Patrick is fearful
Patrick is angry

Three People with One Attribute

George is confused
Thomas is confused
Bradley is confused
Gabby is content
Carrie is content
Marie is content

Version 4

One Person with One Attribute
Jenna is relaxed
Nancy is eager
Carrie is confused
Kevin is content
Patrick is anxious
Randy is nervous

One Person with Three Attributes

Laura is happy
Laura is angry
Laura is fearful
George is surprised
George is upset
George is repulsed

Three People with One Attribute

Bradley is aroused
Thomas is aroused
Austin is aroused
Marie is annoyed
Holly is annoyed
Gabby is annoyed

APPENDIX B

Table 1

Mean scores from study cycles for Experiments 1-5

Condition	One person with 1 attribute	One person with 3 attributes	Three people With 1 attribute
	M	*M*	*M*
Exp. 1: Permanent Attributes	75.5%	76.3%	77.8%
Exp. 2: Temporary Attributes	74.7%	77.1%	77.3%
Exp 3: Conflicting Attributes	92.1%	76.7%	76.0%
Exp. 4: Locations – Same	74.5%	76.9%	75.7%
Exp. 4: Locations – Different	73.0%	75.7%	79.7%
Exp. 5: Emotions	77.8%	74.1%	75.9%

APPENDIX C: FIGURES

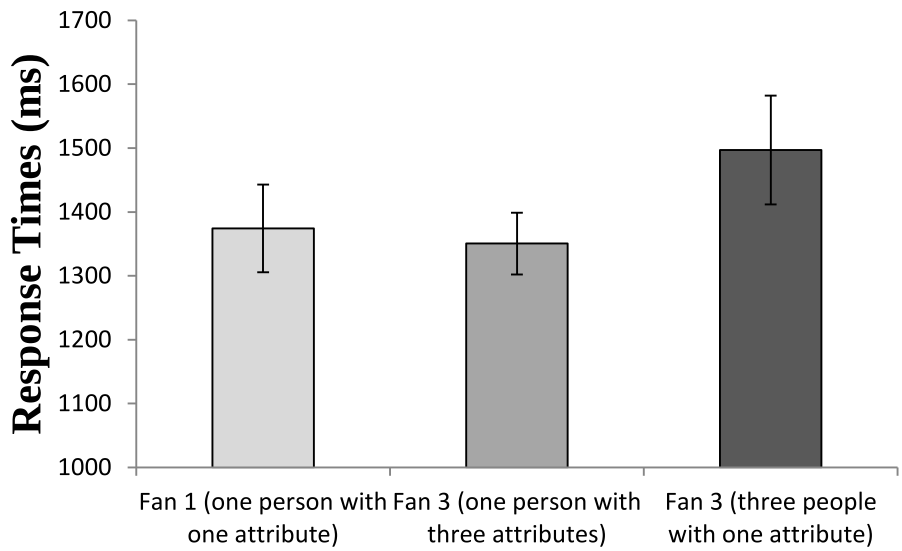

Figure 1. Mean response times (ms) for the one person with one trait, one person with three traits, and three people with one trait conditions in Experiment 1. The error bars reflect standard error.

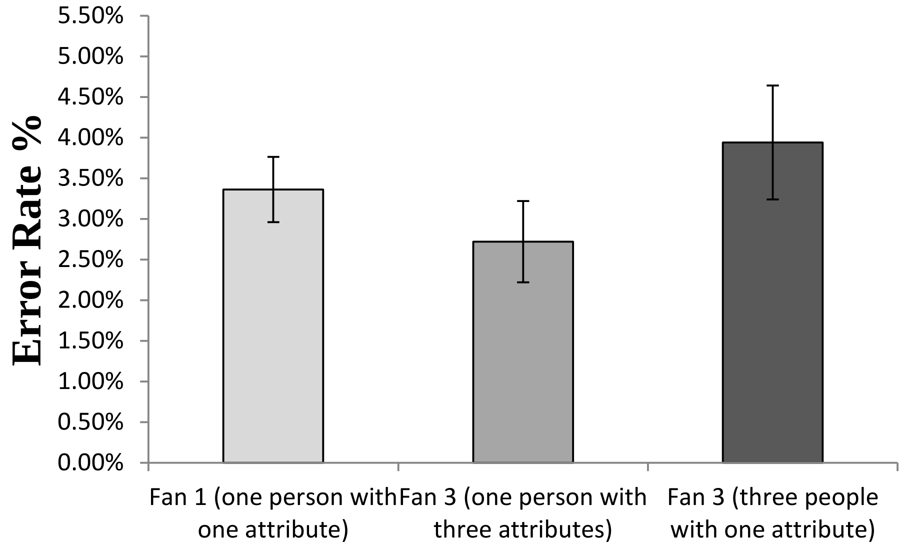

Figure 2. Mean error rates for the one person with one attribute, one person with three attributes, and three people with one attribute conditions in Experiment 1. The error bars reflect standard error.

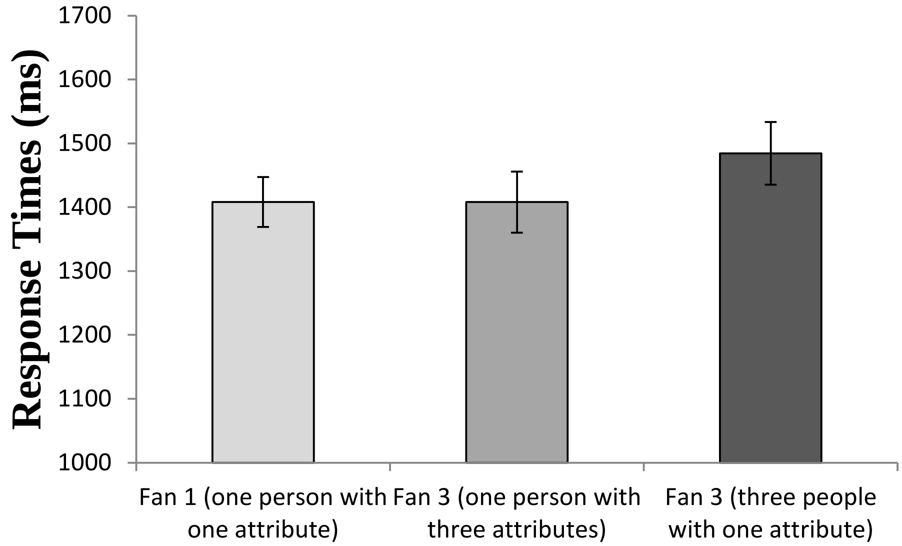

Figure 3. Mean response times (ms) for the one person with one trait, one person with three traits, and three people with one trait conditions in Experiment 2. The error bars reflect standard error

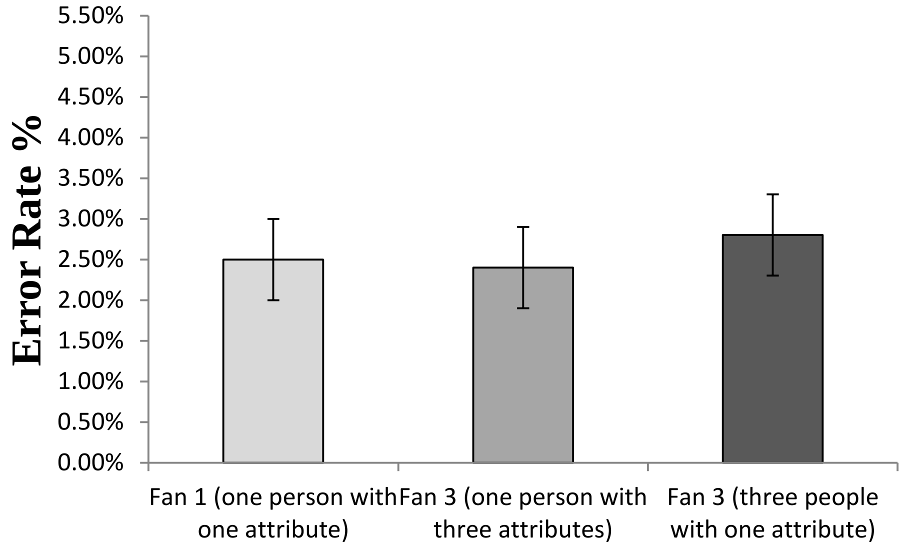

Figure 4. Mean error rates for the one person with one attribute, one person with three attributes, and three people with one attribute conditions in Experiment 2. The error bars reflect standard error.

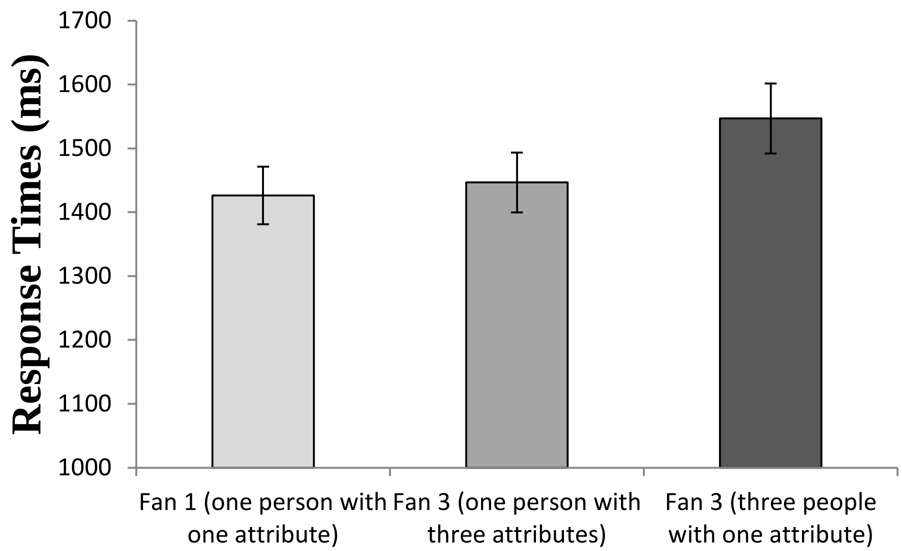

Figure 5. Mean response times (ms) for the one person with one trait, one person with three traits, and three people with one trait conditions in Experiment 3. The error bars reflect standard error.

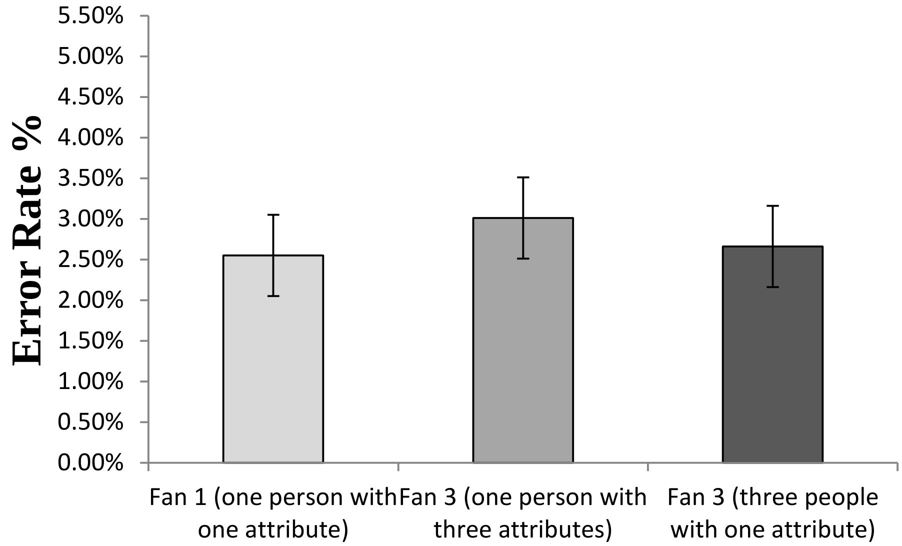

Figure 6. Mean error rates for the one person with one attribute, one person with three attributes, and three people with one attribute conditions in Experiment 3. The error bars reflect standard error.

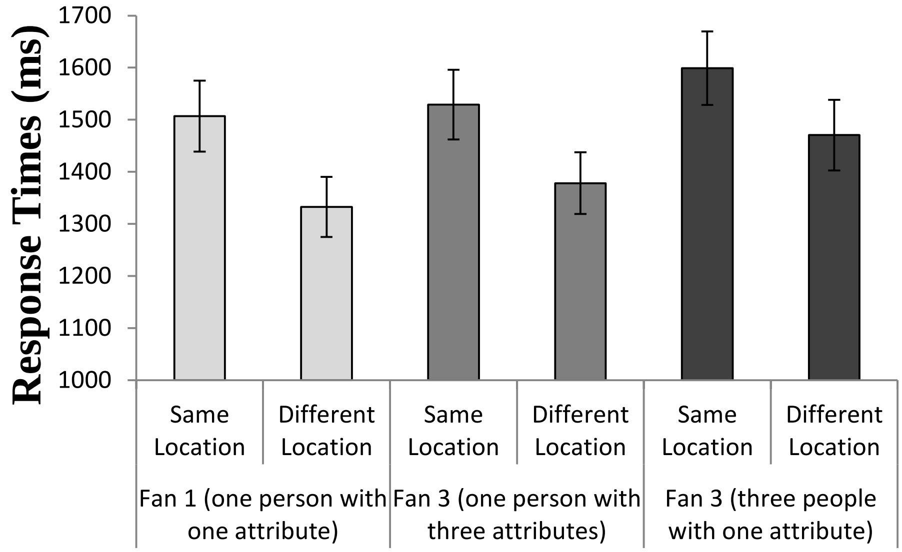

Figure 7. Mean response times (ms) for the one person with one trait, one person with three traits, and three people with one trait conditions in Experiment 4. The error bars reflect standard error.

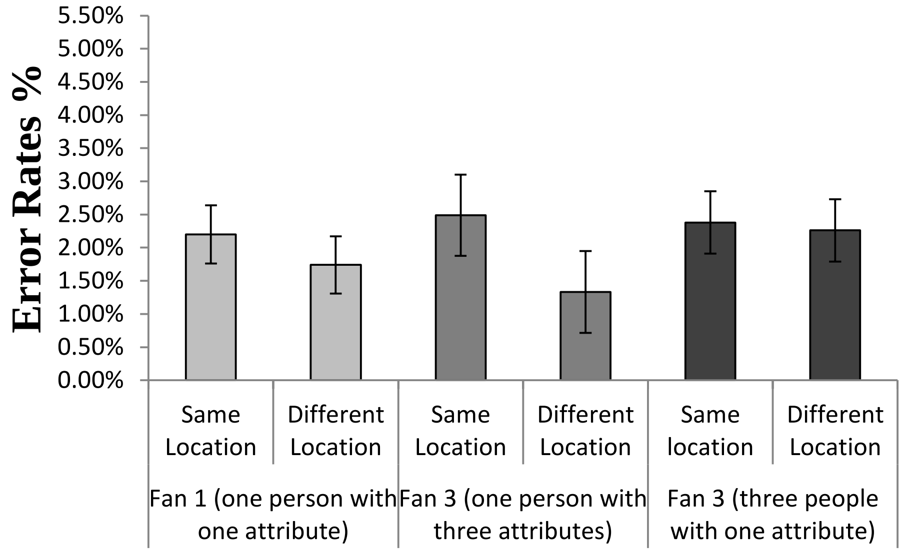

Figure 8. Mean error rates for the one person with one attribute, one person with three attributes, and three people with one attribute conditions in Experiment 4. The error bars reflect standard error.

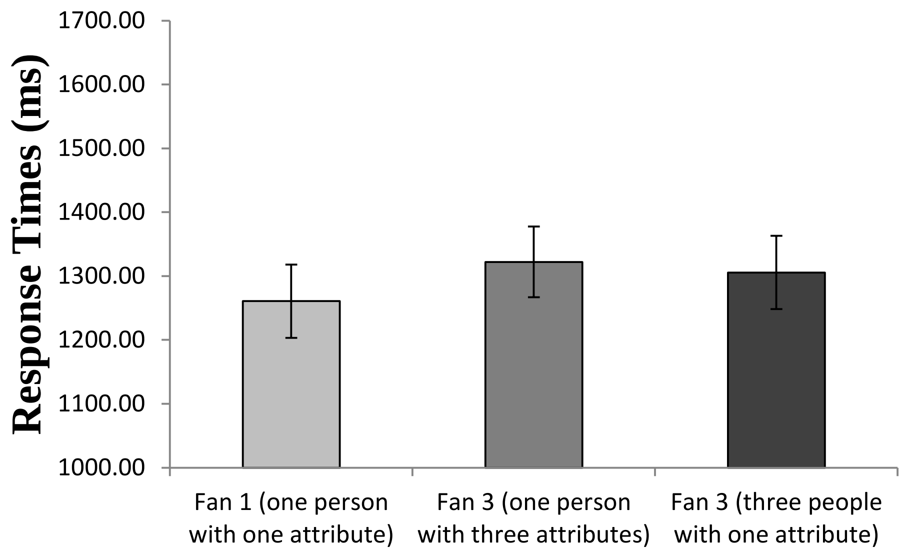

Figure 9. Mean response times (ms) for the one person with one trait, one person with three traits, and three people with one trait conditions in Experiment 5. The error bars reflect standard error.

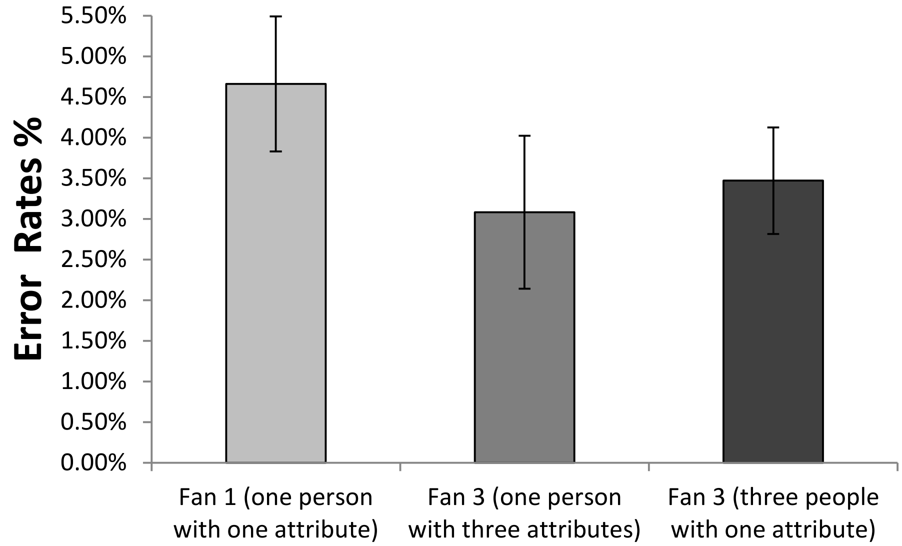

Figure 10 . Mean error rates for the one person with one attribute, one person with three attributes, and three people with one attribute conditions in Experiment 5. The error bars reflect standard error.

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