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The Effects of Word Frequency on the Recall of Information Associated with a Face

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THE EFFECTS OF WORD FREQUENCY ON THE RECALL OF INFORMATION ASSOCIATED WITH A FACE

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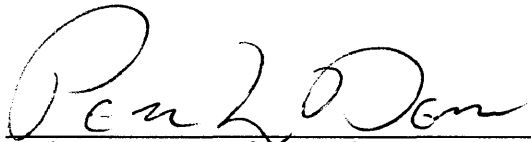

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Abstract

Bruce and Young (1986) proposed a model in which the recall of information associated with a person is a sequential process. Burton and Bruce (1992) asserts, however, that the recall of this information is positively related to the amount of mental associations between the face and this information. Different categories of information, including Occupations, Sports, Hometowns, Names and Numbers were used, and the usage frequency of the words within each category was varied. This biographical information was presented with 16 different male faces to 33 male subjects. The faces alone were presented on recall trials. As predicted, there were main effects for Frequency and Information category. There was also a significant association between the recall of Names and/or Extension Numbers with the recall of other information. These findings are not adequately explained by the Burton and Bruce (1992) model and thus modifications must be made.

The Effects of Word Frequency on the Recall of Information Associated With a Face

Introduction

During a single day, people encounter an overwhelming amount of visual information about physical objects. In fact, each object perceived by an individual is different, whether in actual appearance or in the contextual surroundings, from all other objects in the environment. If each of these entities were perceived as being unique, a person's mental capacity would be greatly overloaded. In addition, if each entity had it's own distinct name, language would be tremendously complex and virtually impossible (Smith & Medin, 1981). Fortunately, humans have the capacity to form concepts that help them make sense of the infinite amount of sensory information that they encounter.

Concept Formation

In essence a concept is a pattern-recognition device. A concept is a mental representation, or semantic code, of an entity that enables a person to recognize other objects that are similar. People recognize that an object conforms to a concept by comparing the salient attributes of the physical object

to the attributes in the semantic code of the concept. These attributes vary both in their qualitative properties (e.g. legs, wooden, can sit upon it) and in their quantitative, or dimensional, properties (e.g. size) (Mervis & Rosch, 1981). In this way, people recognize an object as a chair, and not as a novel entity, by the similarity of that object's attributes to the qualitative attributes of their mental representation of a chair. Often dimensional attributes and more detailed qualitative features are also used to recognize differences between two conceptually similar objects. For example, by attending to these detailed features, people are able to distinguish an armchair from a school desk, and by attending to dimensional attributes people are able to distinguish an adult man from an adolescent.

If, however, a novel object is encountered, the visual features of the object are processed by the person, and a new concept is developed. The semantic code of this new concept contains only the features of the object that was first encountered. This code is then shaped by subsequent encounters with conceptually

similar objects. The features of these objects are processed and the semantic code is constantly altered so that a useful concept is available. In this way, people observe and recognize stimuli that have not previously been experienced. People then acquire a label for the newly formed concept either by learning it from external sources, or by attaching their own original label to the concept.

Once recognition of an object has taken place, a person is then able to access the label associated with the object. Researchers have found that accessing the label of a familiar visual stimulus can not take place immediately upon perception, but is delayed until recognition of the stimulus takes place (Nelson, Reed & McEvoy, 1977; Kroll & Potter, 1984; Potter & Faulconer, 1975). Potter and Faulconer (1975) propose that the visual stimulus must first be processed by the semantic node of the concept before the label node can be accessed. Thus to label any physical object encountered in the environment, a person must first recognize the object.

Person Identification

As social beings, it is important for people to recognize not only objects but also people that are common to their environment. In addition to needing to recognize another person as familiar, people need to be able to recall the label, or name, of that individual. Similar to object recognition and identification, a person must first be recognized before he/she can be named. Many features are attended to when perceiving and attempting to recognize an individual. Some of these features include the height, sex and weight of the individual, and the location of the interaction. But "by far the most powerful means of recognition is by perceiving, storing and retrieving aspects of facial configuration" (Clifford and Bull, 1978, p. 71).

Most research on people's ability to remember faces has been confined to three distinct areas. The most basic form of face memory is face recognition. Face recognition is the ability of a person to "recognize a face as one that you have seen before" (Cohen, 1989, p.88). Some of this research is confined to the ability of people to recognize pictures of famous people among other non-famous distractors

(Young, Hay, McWeeny, Flude & Ellis, 1985; Malone, Morris, Kay & Levin, 1982). Other research in face recognition is often performed with brain-damaged individuals, (Flude, Ellis and Kay, 1989; DeRenzi, Bonacini and Faglioni, 1989) and the aged (Maylor, 1990; Cohen and Faulkner, 1984). Face recall, on the other hand, is the ability of people to form a mental image of the target face and describe this face verbally (Cohen, 1989). Face recall and face recognition are both important in situations involving crimes in which a victim or bystander is asked to describe or point out a suspect. Indeed, Greene and Loftus (1984) propose that, since eye-witness testimony is such an important, yet misunderstood aspect of the law, psychologists should "testify during the trial about factors of perception and memory that could affect a witnesses accuracy" (p. 395). Face identification, however, involves a slight twist of the previous two types of memory for faces. "Face identification entails being able to look at a person's face and tell who it is; being able to tell a person's name or some detail about the person..." (Cohen, 1989,

p.88).

Some of the research in the area of face identification have included diary studies of subject's everyday problems identifying people and faces (Yarmey, 1973; Young, Hay and Ellis, 1985). Yarmey investigated the "Tip of the Tongue" (TOT) phenomenon. In this study, the participants reported that they experienced this phenomenon when they were able to recognize a face, but were unable to immediately name or identify it, and felt that they were on the verge of doing so. Yarmey's participants most often experienced this state when they were trying to recall a persons name. In trying to overcome this "tip of the tongue" feeling, the participants described their attempts to recall the name by pooling all the information known about the target person. "Ss in TOT states searched for target's name by locating first his profession, where he was most often seen, and how recently" (p. 287).

This strategy of Yarmey's participants led many researchers to question what information is associated with the mental images of people and faces. Some of the first work in this area was concerned with

contextual elaboration and face recognition (Kerr & Winograd, 1982; Honeck, 1986). In one study Kerr and Winograd (1982) found that "it is easier to recognize the face of a person about whom you have been given some personal information than a face you have examined without any accompanying information" (p.607). The accompanying personal information included personality characteristics, hobbies and, again, professions.

Because of these findings, studies were performed to show how this information is associated with the mental representations of faces. In addition, the accuracy of recall of these different types of information relative to each other also became of interest. Young, Hay and Ellis (1985) noted that people can often remember a person's occupation and not that person's name, but that the converse is rarely, if ever, true. They concluded that names were much harder to recall than occupations. Indeed, much of the research in this area provided evidence that the occupation, or some other relevant information about the target person had to be accessed before the name of the person could be recalled (Young, McWeeny, Hay &

Ellis, 1986). This theory is in agreement with Yarmey's (1973) study initially discussed in which Yarmey states that "in trying to remember a person's name, or at least a famous person's name, Ss first try to locate his profession..." (p. 288).

These findings compelled researchers into developing theories concerning the type of information, and the method of its association with the concept of a person or a face. In particular, theorists tried to explain why people's occupations were more readily recalled than their names. An initial hypothesis on this phenomenon was that everyday life provides people with contextual cues about occupation. Another hypothesis was that people do not need to recall names with anything like the frequency that they must recall other semantic information, such as occupation, about people (McWeeny, Young, Hay & Ellis, 1987). In addition to these hypotheses, others produced theories based on cognitive processing.

Through their research, Morton, Hammersley and Beckerian (1985) developed the Headed Records Model. The Headed Records Model asserts that information is

held in memory units, or records, which can only be accessed by a particular key, or heading. Morton et al. proposed that any information can function as a heading, and use the name of a person as an example of a common heading. They also assert that, although this heading is used to access the record, the heading itself cannot be retrieved. The information held in the heading can only be recalled if it is also held in the records. This was the theoretical explanation of how a person can remember information about another but not that person's name. There was, however, research that contradicted this model (McWeeny, Young, Hay, & Ellis, 1987).

To counter the Headed Records Model of Morton et al., Young, McWeeny, Ellis and Hay conducted a series of experiments on "Naming and Categorizing Faces and Written Names" (1986). In these studies, Young et al. had participants first categorize a set of famous faces, among distractor non-famous faces, as either familiar or not familiar. Next the participants were to say whether they recognized a set of famous names from among non-famous names. Participants were then

asked to identify (name) another set of famous faces from amongst distractors. And finally, the participants were asked to read aloud a set of written names. Young et al. found that overall "subjects were able to name aloud written names faster than photographs of faces, but were able to classify faces on familiarity or occupation faster than written names. Faces were categorized faster than they were named, but written names were spoken faster than they could be categorized" (p.297). From these results, Young et al. concluded that "name codes can only be accessed from familiar faces via an intervening identity-semantic code, whereas names can access identity specific semantic codes and name codes in parallel" (p.316). That is, Young et al. felt that people can recognize or recall a name for a face only after retrieving some relevant information, or the name itself, of the target person. They also felt that these results help explain "everyday errors in which people often find that they can recall a seen person's occupation but not her or his name, yet never find that they can recall a person's name but not her or his occupation" (p. 316).

Human Face Processing System

Supported by these findings, Bruce and Young (1986) developed their own theory of face recognition. In Bruce and Young's theory, called the Human Face Processing System, recognition and recall of a person is a graded cognitive process with levels, or units, of recognition (Cohen, 1989). This recognition can occur through any number of modalities, including speech and smell, but was most easily achieved through face recognition.

The first unit of recognition is the Face Recognition Unit. In this cognitive processing unit, the mental representation, or concept, of a person's face is stored. It is this level that is activated when a previously seen face is encountered again. This activation occurs through the matching of the target facial features with the face recognition units contained within the node. When a successful match has been made, the observer feels that the target face is familiar.

The second level of the model is the Person Identity Node. In this level, certain relevant

information pertaining to the target person are stored. Some of the person's identity specific information could be describing his or her occupation, who the person's friends are, what the persons hobbies are, where he or she is usually encountered, and so on. This level of recall, however, cannot be accessed until the first level of processing, the Face Recognition Unit, is activated. That is, an observer cannot recall information relevant to a person that he or she has seen until the appearance of the target person is recognized.

The third level of this model is the unit that contains additional information about the target person, in particular, his or her name. Bruce and Young call this level the Name Generation Node. Again, however, the information in this node cannot be accessed until the preceding level of processing, the Person Identity Node, is activated. That is, an observer cannot name a person that he or she has seen until some kind of relevant personal information of the target person is recalled. The process of activating the Person Identity Node does not have to be

intentionally undertaken by the individual seeking the name (although it is often done intentionally; Yarmey, 1973).

To counter this model, Cohen and Faulkner (1986), hypothesized that names of people were more difficult to recall than occupations because a person's name is more arbitrary. Cohen and Faulkner define arbitrariness as being equivalent to Katz's (1972) definition of token reference. Katz asserts that a noun has token reference to an concept when the same noun can be used to refer to many different concepts. That is, while the word doctor conjures the same concept in most people, the word John means something different to each person. Thus, while there may be contextual and appearance cues that aid recall of occupations, names are only arbitrarily related to their referents.

McWeeny, Young, Hay and Ellis (1987) performed an experiment attempting to test these contrasting predictions. To accomplish this, McWeeny et al. attempted to control any and all artifacts that might contribute to subjects recalling occupations more

efficiently than names. First, McWeeny et al. asserted that one possibility as to why this occurs in everyday life was that people are provided with a variety of non-facial contextual cues as to occupation, but not to name. McWeeny et al. tried to control for this artifact by presenting photographs of faces surrounded by a closely fitting circular template to remove as many non-facial cues as possible. McWeeny et al. also suggested that names could be harder to recall because they are not retrieved, heard, and spoken with anything like the frequency that other information, like occupations. And finally, McWeeny et al. cite Cohen and Faulkner's (1986) argument that names are more difficult to recall because they are words with low meaningfulness and imageability. McWeeny et al. attempted to control for these artifacts by using a set of names and occupations that were identical words. That is, they employed such words as Baker and Cook that are commonly used as both names and occupations. Thus, as they argued, these words, whether used as names or occupations, have the same frequency of usage and same meaningfulness, because they are the same

words.

McWeeny et al. used this set of ambiguous words (e.g. Baker, Cook) as half of the stimuli used, while the other half consisted of unambiguous names (e.g. Knowles, Rothwell) and unambiguous occupations (e.g. grocer, architect). The results of this experiment showed that the occupations associated with the faces were recalled without names more frequently than names were recalled without occupations. (It is important to remember that there were, however, a few occasions when this outcome did occur.) The results also showed that ambiguous occupations were recalled far more frequently than ambiguous names. (This phenomenon was subsequently termed the "Baker-baker paradox"). McWeeny et al. asserted that "surnames are harder to recall than occupations regardless of the order that the items are learnt and regardless of their ambiguity or lack of ambiguity" (p.146). They also concluded that these results provided convincing evidence for the Human Face Processing System.

Other studies have also provided support for the Bruce and Young model (Hanley and Cowell, 1988; Flude,

Ellis and Kay, 1989; Brenner, Baguley, Bright and Bruce, 1990). In a series of experiments performed by Hanley and Cowell (1988), the effectiveness of different cues on the recall of the names of famous people was tested. Some of these cues were additional photographs of the celebrity, biographical information about the celebrity, or the celebrity's initials. The effectiveness of showing a second photograph and the effectiveness of just repeating the same photo were also compared. The results showed that the initials were effective only if the subject knew the occupation of the celebrity "because it helped them bridge the gap between the contextual information in the person-specific semantic system and the name in the lexical output system" (p.548). The biographical information was helpful only if the subjects had found the face familiar, and not if they already knew some biographical information about the celebrity. And finally, the additional viewing of the celebrity was helpful only if the subject had originally not found the face familiar. In this study, however, participants found the face to be familiar and gave the

right name but could not initially recall the occupation on 20 occasions. Hanley and Cowell concluded that these results "generally support the view that successive, but distinct stages are involved in face recognition, consistent with the model put forward by Bruce and Young (1986)" (p.545).

Flude, Ellis and Kay (1989) described a case study and a set of experiments performed with an individual who suffered aphasic brain damage resulting in anomia, or the clinical difficulty in naming objects and ideas. Flude et al. presented this individual with the faces of 60 persons of varying familiarity. The anomic aphasic was able to name only 3 of the 40 familiar faces. He was, however able to recognize 34 of them and provide semantic descriptions of 30. Flude et al. asserted that this pattern of response is explained in "terms of either impairment to name generation itself or the partial disconnection of that component from the person identity nodes" (p.70) as a result of his tumor and subsequent operation. Flude et al. conclude that these findings "challenge models which propose that names are stored alongside semantic information in a

general-purpose long-term store" (p. 60).

In a series of studies, Cohen (1986) again proposed a theory countering the Human Face Processing System. Cohen acknowledged McWeeny, Young, Hay and Ellis' (1987) attempt to control some of the variables that might contribute to making occupations easier to recall, but asserted that other characteristics of names, aside from those addressed by McWeeny et al. could be the cause of their recall difficulty. Referring to Katz (1972), Cohen argues that names are more difficult to recall because "proper names have only token reference and not type reference. Other biographical information...is rich in connotative meaning, and is linked to an elaborate semantic network of interconnected items so that multiple routes to retrieval are available" (p.289).

In the first experiment, Cohen tested this hypothesis by presenting faces along with names, occupations and possessions, to subjects. Half of the possessions were actually non-words created by the experimenter, and half of the possessions were actual objects that could be owned by an individual. The

results for the non-word condition showed that names and non-words were equivalent in terms of recall. The results also revealed that occupations and real-word possessions were recalled about equally, and that both were recalled better than names. Cohen did note, however, that remembering occupation was a virtual precondition of recalling either names or real-word possessions.

In the second study, Cohen attempted to test the effect of meaningfulness of both names and occupations on their subsequent recall. In this study, she refers to McWeeny et al. (1987) study, but argues that the study does not convincingly show that the meaningfulness of the words has no effect. Cohen asserts that Baker-baker paradox can be explained by the encoding strategies of the participants. Using as an example the hypothetical "Mr. Baker, who is a lawyer," Cohen argues that "if the name...is encoded meaningfully, this produces a conflicting representation of an individual who is both a baker and a lawyer" (p.293). Cohen argues that participants might be avoiding this conflict by not encoding the

name as a meaningful word. Cohen also suggest that the use of both ambiguous (e.g. Baker) and non-ambiguous (e.g. Higgins) could also have discouraged the participants from encoding the former as meaningful. In the experiment itself, subjects again viewed faces accompanied by both names and occupations. Half of the names were ambiguous and meaningful (e.g. Baker), and half were ambiguous and meaningless (e.g. Ryman). A third of the occupations were ambiguous and meaningful (e.g. baker), a third were unambiguous and meaningful (e.g. lawyer), and a third were ambiguous and meaningless (e.g. ryman). The results of this experiment revealed that ambiguous-meaningful names (e.g. Baker) were recalled more than meaningless-ambiguous occupations (e.g. ryman). Meaningless names and meaningless occupations were recalled about equally. But again a meaningful occupation was recalled more when it was paired with meaningless or a meaningful name. Cohen concluded that "it is the meaningfulness of an item, rather than the slot that it occupies, that determines how easy it is to recall" (p. 294). Cohen also declares that "in everyday life it is

clear that names are always treated as meaningless. People habitually ignore whatever meanings names do have..." (p.295). Cohen proposes a new, modified version of the Bruce and Young model, suggesting that it is possible that "meaningful information is stored at the person identity node and is accessed first; meaningless information is stored at outlying nodes and can only be accessed from the person identity node" (p.295).

Interactive-Activation Model

Burton and Bruce (1992) have since attempted to produce a revised version of the Human Face Processing System. Burton and Bruce base this account upon the Interactive Activation and Competition model of McClelland, Rumelhart and others (cited in Burton & Bruce, 1992). These models are comprised of a number of units organized into pools. The units within these pools are connected by bi-directional inhibitory links, while the pools are connected by bi-directional excitatory links. In the models, activation, either internal or external, is passed along between the pools by the excitatory links, while decay is caused by the

inhibitory links. Burton and Bruce have combined the Interactive Activation and Competition model with the Human Face Processing System. They suggest that the Face Recognition Unit activates the Person Identity Node through its excitatory links with the Person Identity Node. Burton and Bruce contend that it is within the Person Identity Node that recognition occurs. Burton and Bruce propose that when a Person Identity Node is activated, it activates a Semantic Information Unit. This Semantic Information Unit will then in turn activate any other Semantic Information Unit and Person Identity Node with which it is linked. This continues until the decay caused by the inhibitory links weakens the excitation level below that of threshold.

Burton and Bruce (1992) also propose that names and biographical information are both contained in the Semantic Information Unit pools. Burton and Bruce contend that if each Person Identity Node is attached to all its associated Semantic Information Units, some units will have more connections to Person Identity Nodes than others. In particular, most name units will

have only one connection, as a result of their uniqueness. Burton and Bruce then "propose that it is precisely because of the shared nature of much semantic information, and the isolation of names, that the difficulty in naming arises. Many SIUs will have more than one unit to bolster their activation, whereas names (in most cases) have a single connected unit" (p. 49).

Burton and Bruce (1992) assert that this model predicts the results that have been obtained in previous research not only more accurately but also more parsimoniously then the Human Face Processing System. They support this assertion by pointing to the instances in the previous studies in which names were recalled prior to occupations. Unlike the Human Face Processing System, the Interactive Activation and Competition model not only allows such results, but actually predicts their occurrence. Burton and Bruce also discuss the case study of the anomic-aphasic (Flude, Kay and Ellis, 1989). They argue that the responses of this individual can not be evidence for the Human Face Processing System because if the Name

Generation Node had been damaged or disconnected, the individual would have recalled no names.

Burton and Bruce (1992) also discuss the parallels between this model and that of Cohen's, stating that "the uniqueness of a semantic unit will often be associated with its meaningfulness" (p. 57). Burton and Bruce assert, however, that their Interactive Activation and Competition model should be preferred because it not only "provides a much more detailed account of the phenomenon than the Cohen model." And, unlike the Bruce and Young model, they argue that it does so "from relatively simple assumptions", and is "couched in terms of a model which has already been shown to explain many phenomenon of face recognition" (p. 57).

In a study that supported the Burton and Bruce model, Vittoria (1992) varied the meaningfulness and arbitrariness of the information that was associated with a face. In this study slides of faces were presented accompanied by biographical information. The participants were asked to recall as much of this accompanying information on subsequent viewing as

possible. The information used, which included occupations, sports, hometowns, names, and numbers, varied in its meaningfulness and arbitrariness relative to person identification. Occupation was judged to have the highest amount of meaning and was least arbitrary, and was thus expected to be recalled most frequently. Names were considered less meaningful and were expected to be recalled less frequently than occupations. Hometowns and sports were judged to have levels of meaningfulness between those of occupations and names and somewhat equal to each other. Thus these two types of categories were expected to be recalled more than names but less than occupations. Numbers were argued to have the least meaning and to be most arbitrary, and were thus predicted to be recalled least of all. In addition, the author made the prediction, stemming from the modified Human Face Processing System of Cohen (1990), that no name or number would be recalled on a trial without some more meaningful piece of information.

The results of this study confirmed most of these hypotheses. Occupations were recalled most frequently,

followed by hometowns and sports (in a virtual tie). Names were recalled less than sports and hometowns while numbers were remembered least of all, and provided a convenient baseline for the study. Names and numbers were rarely recalled without more meaningful information on most trials, with the exception of trial 2, in which this ratio did not reach statistical significance.

There were, however, certain limitations to this study. One consideration was that the level of meaningfulness of the information stimuli was not exactly known. Judgements were made using opinion and inference alone. A second limitation was that there was an eventual ceiling effect on the learning of the biographical information. This ceiling effect caused the typical recall pattern to be distorted in the later trials.

Overall, however, this study provided support for the Interactive Activation and Competition model of Burton and Bruce (1992). As discussed, the recall of the different types of information seemed to be on a continuum, being highest with occupation and declining

steadily to a minimum with numbers. This pattern of recall was much different than the one that would have been predicted by the Human Face Processing System. The Human Face Processing System would have predicted that all semantic information would have been recalled at a high rate with a severe drop-off in the rate of recall for names and numbers. Additionally, there were instances in which names and numbers were recalled without other semantic information, although less than expected by chance. Again this result was consistent with the predictions that would have been made from the Interactive Activation and Competition model and not from the Human Face Processing System.

In an attempt to explain the results more accurately, Vittoria preceded to propose a theory of face recognition in which the information is arranged categorically. Although this theory differs slightly from the Burton and Bruce model, it is indeed very similar. Vittoria states that "categories based on commonly shared attributes, such as an occupation, would be larger, while a category based on less commonly shared attributes, such as a particular name,

are smaller. The larger the category, the more easily the label is accessed" (p.36) Indeed, if category is translated as a Semantic Information Unit pool, and the size of the category as the number of excitatory links, these theories are virtually identical.

Present Study

The study reported here was performed in order to provide conclusive evidence that would distinguish the more appropriate model of face identification. This study was based on a proposal made by Burton and Bruce (1992) that the frequency of exposure to a word could be used as an indirect measure of the strength of the associational links. Similar to the previous study, this study varied the meaningfulness of the categories of information used. Additionally, however, the information within each category varied as to its frequency of usage, as reported by Kucera and Francis (1967) and Battig and Montague (1969).

In general, it was expected that the higher the frequency of exposure to a word, the better the recall. This hypothesis is made based on not only the Interactive Activation and Competition model of Burton

and Bruce (1992), but also on converging evidence, stemming from general verbal learning studies (Underwood & Schulz, 1960), and other studies with anomic aphasics (Goodglass, 1980; Wepman, Bock, Jones & Van Pelt, 1973). In their description of the Spew Hypothesis, Underwood and Schulz (1960) stated that "the more frequent a verbal unit has been experienced, the more quickly will this become a response in a new associative connection" (p.86).

Similar to the previous study performed by Vittoria (1992), it is hypothesized that the more meaningful categories (occupations, sports and hometowns) will be recalled more accurately. Thus it is predicted that the high-frequency words in each category will be recalled more than the low-frequency words within that category. Because of the advantage in recall of the meaningful words, it is predicted that the high-frequency names will be recalled less than the high-frequency words in the meaningful categories, but more than the low frequency words of those categories (i.e. John will be recalled more often than welder, but not than doctor or farmer). Thus high frequency

Occupations are expected to be recalled most accurately, followed by high frequency Sports and Hometowns, and then high frequency Names. Low frequency Occupations are expected to be recalled less than high frequency Names but more than low frequency Sports which are expected to be recalled more than Hometowns and then Names. Extension Numbers are predicted to be recalled the least accurately.

Unlike the previous experiment, however, it is hypothesized that the recall of names and numbers will not be dependent upon the recall of the more meaningful information. It is argued that, in the previous study, there was an artifact in that the retrieval of the more meaningful information provided cues that allowed for the subsequent recall of Names. In this study, however, since high frequency Names will be recalled more accurately than the other Types of Information of low frequency, it is asserted that there will be no inadvertent cues provided for the recall of Names. Thus, it is predicted the number of Name and/or Extension Number only responses will be no different than would be expected by chance.

Method

Pilot Study

Prior to the face identification study, a pilot study was conducted for the purpose of selecting the stimuli for use in the main study. Ten male subjects were asked to perform two tasks. They were first asked to separate 64 photographs of men into sixteen different groups depending upon the similarity of their appearance. These photographs were black and white, and were of unfamiliar men. Each slide shows the whole head in a full-face pose, with no accompanying background. The second task involved the subjects rating their familiarity with twenty words in each of the four information categories used: Occupations, Sports, Cities and men's first Names. These words were of equal length and number of syllables. This task was designed as a check upon the frequency ratings as provided by Battig and Montague (1969).

Analysis of the patterns of groupings was performed and the 16 most dissimilar faces were chosen for use in the main study (Appendix A). Additionally, the eight words from each category rated as most

familiar were used as the High Frequency words of the category, while the eight words rated as least familiar were used as the Low Frequency words (Appendix B).

Main Study

Subjects

The participants consisted of 33 male individuals who were enlisted from the Introductory Psychology subject pool. These participants received course credit in return for their participation.

Materials

The 16 faces selected by means of the pilot study were used as the visual stimuli in the study while the words that were rated as most and least representative of their category was used as the biographical information. Additionally, 16 two digit numbers were chosen to be used as the Extension Number stimuli. Extension Numbers, however, were not varied in regard to frequency.

Procedure

Experimental sessions were conducted for groups of participants. These groups consisted of no more than ten participants. The participants were seated facing

a screen onto which the slides of faces were projected.

Each face was be shown for 30 seconds, while the accompanying biographical information was presented. This information was read to the subjects in the following manner: "This is Richard from Boston. He is a teacher who likes football. His extension number is 63." The different aspects of the biographical information were presented in a varied and balanced order (e.g. another slide was accompanied with "This man likes croquet and is a lawyer. His name is Alvard and his extension number is 27. He is from Polton.")

The participants were instructed to memorize each face and the accompanying facts. They were told that all facts were equally important.

Following this "introduction" to the stimuli, only the faces were presented to the participants. The participants were asked to recall all of the biographical information that originally accompanied each face. Guessing was encouraged. The subjects were asked to write the recalled information, in the order that it was recalled, on an answer sheet provided for this purpose. All sixteen faces were shown, and were

presented in random order. Following each recall trial, the faces and facts were re-presented. Four more re-introduction and recall trials followed for a total of five trials.

Results

The design of the study required that the first hypothesis be tested using two separate repeated-measures MANOVAs. The two MANOVAs were performed because the Extension Number category was not divided by frequency. Thus the first MANOVA analyzed the data with regard to two independent variables: Information Type, which had five levels, and Trial, which also had five levels. The second MANOVA analyzed the data with regard to three independent variables: Information Type, which for this analysis only had four levels, Trial, and Frequency, which had two levels. The dependent variable for both MANOVAs was the number of correct responses. Additionally, planned orthogonal contrasts and post-hoc T-Tests using the Bonferroni adjustment were calculated to determine the relative rank of the nine different Information Type/Frequency combinations, also determined by the number of correct

responses.

To test the significance of the second hypothesis, the frequency of Name and/or Extension Number only responses expected by chance were calculated for each of the 16 slides. These expected frequencies were compared to the actual observed frequency of this type of response on the appropriate slide to determine if this response occurred more or less than expected for the slide. A sign test was performed to test the significance of these results. This test was performed only upon the first and second trials because of the very few times in which only one type of information was recalled for a slide on the subsequent trials. Additionally, a Chi-Square was calculated using the frequency expected by chance and the observed frequencies of Name and/or Extension Number only response over all sixteen slides on both the first and second trials.

Hypothesis 1:

The first hypothesis was concerned with the overall accuracy of recall for the five different information types and the two frequency levels. It was

hypothesized that high frequency words would be recalled more accurately than low frequency words within each information category. It was also predicted that there would be a specific rank ordering of the different information types in terms of the amount correctly recalled.

The first two-way MANOVA, which did not include the Frequency variable, revealed main effects for Information Type ($F(4,29)=200.98$, $p<.001$), and Trial ($F(4,29)=201.22$, $p<.001$). The interaction between the two variables was also significant ($F(16,17)=14.90$, $p<.001$). It was expected that the amount of correctly recalled information would increase over the trials because of practice with the stimuli.

An interaction, however, was not predicted but can easily be understood by an examination of Figure 1. As

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Insert Figure 1 about here

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can be seen in Figure 1, the interaction is caused by the different rate at which the Extension Number information is learned, as well as some minor overlaps

between the other types of information. Extension Number information was predicted to be the least meaningful information that could be associated with a face. Thus it is easy to understand why the rate at which the subjects acquired this information was much slower then for the other information types. There was a trend for the four other information types to have a high rate of learning within the first three trials, while the rate of recall for Extension Numbers appears to only be increasing during the third or fourth trial.

The means of the number of correct responses of the five information types, over all five trials, indicated that the predictions concerning the rank order of the information types overall were not completely correct. As can be seen in Figure 2, the recall of Occupations ($\underline{M}$=9.22) was no better than the

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Insert Figure 2 about here

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recall of Sports ($\underline{M}$=9.23). However, the recall of both of these types of information was better then for Cities ($\underline{M}$=7.12), which was slightly better than the

recall for Names (M=6.83). Extension Numbers were recalled most poorly (M=2.14). The planned contrasts tested the significance of these differences. The first contrast, Occupations against Sports, was not significant ($t(32)=0.02$, $p>.05$). The second contrast, between the mean of the recall of Occupations and Sports against the recall of Cities, was significant, as predicted ($t(32)=-7.13$, $p<.001$). The third contrast, between the mean of recall of Occupations, Sports and Cities against the recall of Names, was also significant as predicted ($t(32)=-5.01$, $p>.001$). And finally, the contrast between the recall Extension Numbers and the recall of all else was also highly significant, as predicted ($t(32)=-26.43$, $p<.001$).

The other MANOVA, which excluded Extension Numbers, was performed basically to determine the significance of the Frequency variable, and whether it interacted with the either Trial and/or Information Type. This MANOVA also revealed a main effect for Information Type ($F(3,30)=27.37$, $p<.001$) and for Trial ($F(4,29)=266.85$, $p<.001$), as well as a significant interaction between Information Type and Trial

($F(12,21)=3.31$, $p<.01$). (As can be seen in these results, however, the removal of Extension Numbers from the analysis decreased the F value in both the main effect of type of information as well as in the interaction.) As predicted, this MANOVA also revealed a significant main effect of Frequency ($F(1,32)=87.11$, $p<.001$), and a nonsignificant interaction between Frequency and Information Type ($F(3,30)=1.01$, $p>.05$). The analysis, however, also revealed a significant interaction between Frequency and Trial ($F(4,128)=12.56$, $p<.001$) as well as a three-way interaction between Information Type, Frequency and Trial ($F(12,21)=5.57$, $p<.001$). These interactions can be understood by an examination of Figure 3.

As seen in Figure 3 there was a slight increase

Insert Figure 3 about here

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in the difference between the recall of the low frequency words of each category, and overall as well, as the trials increase. (The high power inherent in this repeated measures design allowed this small

difference to reach significance.) High frequency words were always recalled more accurately than low frequency words on all trials, however. Thus, it appears that people continue to learn and recall high frequency words better than low frequency words as exposure increases. Since there was no overlap between the recall accuracy of high and low frequency words, however, these interactions do not weaken the main effects that are of interest to the study.

The means of the number of correct responses to the nine groups of combinations of frequency and information type (including Extension Number) indicate that the second part of this hypothesis was also not altogether accurate. As can be seen in Figure 4, the

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Insert Figure 4 about here

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recall of high frequency occupations ($\underline{M}$=5.00) was not much different then the recall of high frequency Sports ($\underline{M}$=5.08). These two groups were recalled better than low frequency Occupations ($\underline{M}$=4.22) and low frequency Sports ($\underline{M}$=4.15) as predicted. However, the recall of

high frequency Cities (M=4.08) was less then these low frequency groups, as was the recall of high frequency Names (M=3.75). High frequency Names were recalled better than low frequency Names (M=3.08) low frequency Cities (M=3.03) and Extension Numbers (M=1.07) as predicted. The planned contrast tested the significance of the original hypothesized rankings. These contrast revealed that high frequency Occupations and Sports were not significantly different ($t(32)=.46$, $p=.649$), while Extension Numbers were recalled significantly lower than everything else ($t(32)=-24.35$, $p<.001$). The contrast between the high frequency words of all categories against the low frequency words of all categories was not significant ($t(32)=-1.60$, $p=.12$), showing that the predicted arrangement was not correct. Post-hoc T-Tests using a Bonferroni adjustment (with a stringent probability level of .0125 for significance) were performed to determine the relative ranking positions of the rest of the groups. There was no significant difference between the recall of low frequency Cities and low frequency Names ($t(32)=-.22$, $p=.825$), while the recall of low frequency

Cities was significantly lower than the recall of high frequency Names ($t(32)=3.19$, $p<.0125$). The recall of high frequency Names was not significantly different than the recall of high frequency Occupations ($t(32)=-2.07$, $p=.047$), which was greater than the recall for both high frequency Cities and low frequency Sports. There was also a significant difference between the recall of low frequency Occupations and high frequency Occupations ($t(32)=-6.01$, $p<.001$).

Hypothesis 2:

The second hypothesis stated that the recall of Names and Extension Numbers would be independent of the recall of the other types of information. This was tested by observing the number of Name and/or Extension Number alone response and comparing this total to the number of these responses that was expected to occur by chance. This analysis was performed only on the first two trials because of the few times in which only one type of information was recalled in later trials.

For the first trial, on slides in which at least one type of information was recalled (149 out of 528 times), Name, Extension Numbers and the combination of

Name and Extension Number were recalled with no other information only a few times (N=22). Significance tests were performed to judge whether they occurred as frequently as would be expected by chance if the recall of the different types of information was independent. To avoid making the assumption of independence between the responses for each slide in trial one, the frequency of Name and/or Extension Number only responses, expected by chance for each individual slide, was calculated. These expected results were compared to the actual observed results for the respective slide. A Sign Test was performed to determine the probability that the resulting discrepancies between the observed and expected frequencies of this type of response were due to chance. For the slides of trial 1, the observed frequency of Name and/or Extension Number only responses was less then the chance expectancy on 11 out of the 16 slides, with one being equal. This outcome was marginally significant (p=.058).

In addition, a planned Chi-Square, assuming independence between the individual slides, was

performed to determine if these outcomes occurred significantly less than expected by chance overall for trial 1. Under this assumption of independence, Name and/or Extension Number only responses were significantly lower than the chance expectancy ($X^2(1, N=33)=38.23$, $p<.001$). Table 1 displays the frequency expected by chance and observed frequencies for trial 1 overall, as well as for the ten slides individually. Thus in both assuming independence between the slides,

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Insert Table 1 about here

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and in avoiding this assumption, the occurrence of Name and/or Extension Number only responses was less than expected by chance.

The same analysis was performed for the second trial. Out of the 355 slides for which some information was correctly recalled, Name and/or Extension Number only responses occurred only 15 times. The frequency expected by chance of these responses for each slide were calculated for this trial as well. In this trial, however, the chance expectancy was greater

than the observed frequency for 15 out of the 16 slides ($p<.001$). Likewise, a Chi-Square was performed for the frequency of this response pattern for trial two overall. Again the observed frequency of Name and/or Number only responses was significantly less than expected ($X^2(1, N=33)=47.47, p<.001$). Table 2 displays the chance expectancy and observed frequency of responses for the individual slides, as well as for overall, for Trial 2.

Insert Table 2 about here

A final note should be made about the pattern of recall exhibited by the different types of information. Since the answer sheets upon which the subjects wrote their responses simply had five blank spaces on which to write the recalled information, a measure of the order of recall, or at least of report, of the information was obtained. For those slides (N=225) in which all five types of information was recalled, Names were overwhelming reported in the first blank (N=181). All other types of information were recalled, on

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Insert Figure 5 about here

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average, in the third to fourth space. Figure 5 shows the mean recall position of the five different groups.

Discussion

As hypothesized, the meaningfulness of the category had an effect on the recall of the information. The information from the more meaningful categories was recalled more accurately than the information from the less meaningful categories. Thus, as suggested by Cohen (1990), the strength of the association between a unit of information and a Person Identity Node is strengthened by increased meaningfulness, thereby facilitating the recall of this information.

The effects of the level of meaningfulness on the accuracy of recall are very similar to those found in the previous study (Vittoria, 1992). In the earlier study, however, the overall difference in recall for Names and Occupations was not great. In this earlier study, only monosyllabic names were used, while the

other words used in the study were two syllables long. This difference may have provided a slight advantage for the recall of Names. In the present study, however, the words in all categories were two syllables long, and, as a result, the difference in the recall between Names and Occupations was much larger. In fact, the difference in the accuracy in recall between the two categories was similar to the findings of other studies in the field (McWeeny, Young, Hay & Ellis, 1987; Cohen, 1990). In the previous study by Vittoria (1992), a ceiling effect occurred in the later trials that caused a distortion of the overall difference between the recall of the different types of information. In the present study, however, additionally slides were included to increase the amount of information to be learned and thus increase the difficulty in the acquisition and retrieval of a specific unit of information. This increased difficulty eliminated the ceiling effect.

As predicted, the usage frequency of the stimulus words also had an effect on their recall in this study. Those words that were of high frequency within a

category were recalled more accurately than those words of low frequency within the same category. Additionally, there was some overlap between the High frequency words of a low meaningful category and the low frequency words of a higher meaningful category. Thus as suggested by Burton and Bruce (1992), the frequency of a word is an indirect measure of the strength and number of associations between the word and its associated Person Identity Node. However, this manipulation was not powerful enough to overcome the effect of category meaningfulness on the recall of the information. That is, the recall of most information from higher meaningful categories was higher, regardless of frequency, than the recall of information from lower meaningful categories.

Contrary to predictions made at the outset of this study, however, was the finding that Name and/or Number alone responses occurred less than expected by chance. This result was also similar to that found in the previous study (Vittoria, 1992). The reoccurrence of this phenomenon provides converging evidence of the association between the recall of Names and Numbers

with the prior recall of some more meaningful information.

There were, however, occasions in which there was a recall of a Name and/or a Number without the recall of other information. This result is also similar to that found in the first study. In the first study, however, there was a methodological artifact that put that finding into question. In the initial study, the answer sheets upon which each subject wrote their responses had blanks that were designated specifically for each type of information. These spaces were always listed in the same order with the blank for Names being first. This arrangement led to the question of whether the few Name only responses occurred because of the subjects attempt to fill in this first space to the detriment of the other spaces. In this follow-up study, however, the five spaces were not designated for any particular Information Type, and the subjects were asked to write down the information in the order in which they were recalled. The presence of the Name and/or Number only responses in this study provides convincing evidence for the possibility of recall of

Names without recall of other types of information.

This answer sheet arrangement also enabled a measure of the recall order for the different Information types to be obtained. As discussed, on those trials in which all five Information Types were recalled, Names were reported in the first space overwhelmingly. This finding seems to contradict the finding of the lack of Name only responses just discussed. What this might indicate is a change in the connections between the Person Identity Node and individual Information Units from the time in which the different types of information are being learned to the time in which all has been successfully encoded. Personal experience suggests, for an individual who is well known, that the occupation of a person is not always recalled first. A possible explanation of both this personal experience as well as these empirical findings could be that the association between the Name and the Person Identity Node is not strong enough for activation when the Name is first being learned. Thus to access this word, a secondary route must be used. This route seems to be through the connection with

other information that has a stronger association with the Person Identity Node. After successive retrievals of the Name through this secondary route, the direct connection between the word and the Person Identity Node is strengthened to such an extent that a activation of the word can occur directly from the Person Identity Node. Because of the social practice to acknowledge others primarily by their names, the subjects report Names first, when they are able to directly retrieve these words.

Overall, these results provide conflicting evidence for both the Bruce and Young (1986) and Burton and Bruce (1992) models. The evidence for the effect of frequency and meaningfulness on the accuracy of recall provides evidence for the Interactive Activation and Competition Model of Burton and Bruce. However, this model doesn't provide a sufficient explanation of the repeated shortage of Name and/or Number only responses. The Bruce and Young model provides an explanation for a complete absence of these responses, but does not provide a reasonable explanation for the occurrence, albeit infrequent occurrence, of these

responses.

Thus alterations to both of these models are required in order for either to provide an adequate explanation of the observed results. The Human Face Processing System must include some secondary route to name retrieval which bypasses its "Person Identity Node" (which contains occupational information). This alteration, however, would alter the Human Face Processing System in such a way that would cause it to be very similar to the Interactive Activation and Competition Model as proposed by Burton and Bruce.

Burton and Bruce assert that, in their model, there are no excitatory interconnections between different units within the Semantic Information Pool. "In contrast, the account presented here requires that all semantic information units are mutually inhibitory within pool. Although this seems rather odd, we should note that associated semantic information units are linked by excitatory routes, but these are via PINs" (p.56). Thus Burton and Bruce provide a secondary route for the activation of semantic information, but do so almost as an afterthought. This method of

retrieval, however, seems to be very important in the early stages of name learning and recall and thus needs to be more fully explained.

Additionally, this model mentions an explanation for the subsequent retrieval, or at least, report of Names prior to the report of other information. Burton and Bruce state that "we have said nothing about the output processes by which one may articulate names or words. Articulatory processes must follow activation elsewhere in the system" (p.58). Again however, Burton and Bruce have failed to provide an adequate explanation of a process that seems to be important for recall after learning has been complete. An explanation of this sort could include a socialization process that actually strengthens the connection between the Person Identity Node and the Name word to a level greater than that between the Person Identity Node and the occupation.

Future research that could help develop these theories should include a direct control of the amount and strength of each and every association made between a unit of information and a face. This could be

achieved by creating non-word stimuli and presenting them to the subject in text as Occupations, Hobbies and Names. In this way, the experimenter could directly control the frequency of the occurrence of a word, as well as the temporal and semantic associations between different words. Following this controlled exposure, these non-words could be used as the biographical stimuli in a study with exactly the same design as the study reported here. The results of this study would provide evidence of whether there is a direct link between association strength and recall accuracy. Such findings would go a long way in developing an appropriate theoretical explanation of the empirical findings.

Future research could also empirically test the preliminary finding that Names are reported earlier after more extensive learning. This research could be accomplished by measuring the latency of name recognition as compared to occupation recognition following different levels of exposure to the stimuli. A decrease in latency would provide evidence that the actual association strength between the face and the

Name has increased. A steady recognition latency would indicate simply a change in reporting strategy in which the person just feels compelled to report the Name first, although they have recalled some other information first.

The results of this study, in conjunction with the previous one (Vittoria, 1992), have demonstrated the robustness of the association between the recall of Names and the recall of other information. This finding has provided important insight into the process of face identification. For this reason, it is imperative that elaborations and modifications be made to the existing model if it is to provide an adequate theoretical explanation for these findings.

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Table 1: Observed and Expected Frequencies of Name and/or Extension Number Only Responses on Trial 1.

	Expected	Observed	Difference
Slide 1	0.80	1.00	+0.20
Slide 2	3.64	3.00	-0.64
Slide 3	6.55	4.00	-2.55
Slide 4	1.30	0	-1.30
Slide 5	0.88	1.00	+0.12
Slide 6	2.55	2.00	-0.55
Slide 7	2.80	0	-2.80
Slide 8	2.45	3.00	+0.55
Slide 9	0	0	0
Slide 10	0.88	0	-0.88
Slide 11	1.52	0	-1.52
Slide 12	1.70	2.00	+0.30
Slide 13	2.55	2.00	-0.55
Slide 14	4.00	2.00	-2.00
Slide 15	2.10	1.00	-1.10
Slide 16	2.64	1.00	-1.64
Overall	40.25	22.00	-18.25

Sign Test, $p=.058$

$X^2(1, N=33)=38.23, p<.01$

Table 2: Observed and expected Frequencies of Name and/or Extension Number Only Responses on Trial 2.

	Expected	Observed	Difference
Slide 1	2.55	2.00	-0.55
Slide 2	3.55	1.00	-2.55
Slide 3	3.64	1.00	-2.64
Slide 4	2.18	0	-2.18
Slide 5	3.27	1.00	-2.27
Slide 6	1.82	0	-1.82
Slide 7	1.82	0	-1.82
Slide 8	3.64	2.00	-1.64
Slide 9	2.67	2.00	-0.67
Slide 10	2.42	2.00	-0.42
Slide 11	3.03	1.00	-2.03
Slide 12	2.12	0	-2.12
Slide 13	2.18	0	-2.18
Slide 14	3.64	1.00	-2.64
Slide 15	1.91	2.00	+0.09
Slide 16	2.42	0	-2.42
Overall	48.07	15.00	-33.07

Sign Test, $p<.001$

$X^2(1, N=33)=47.47, p<.01$

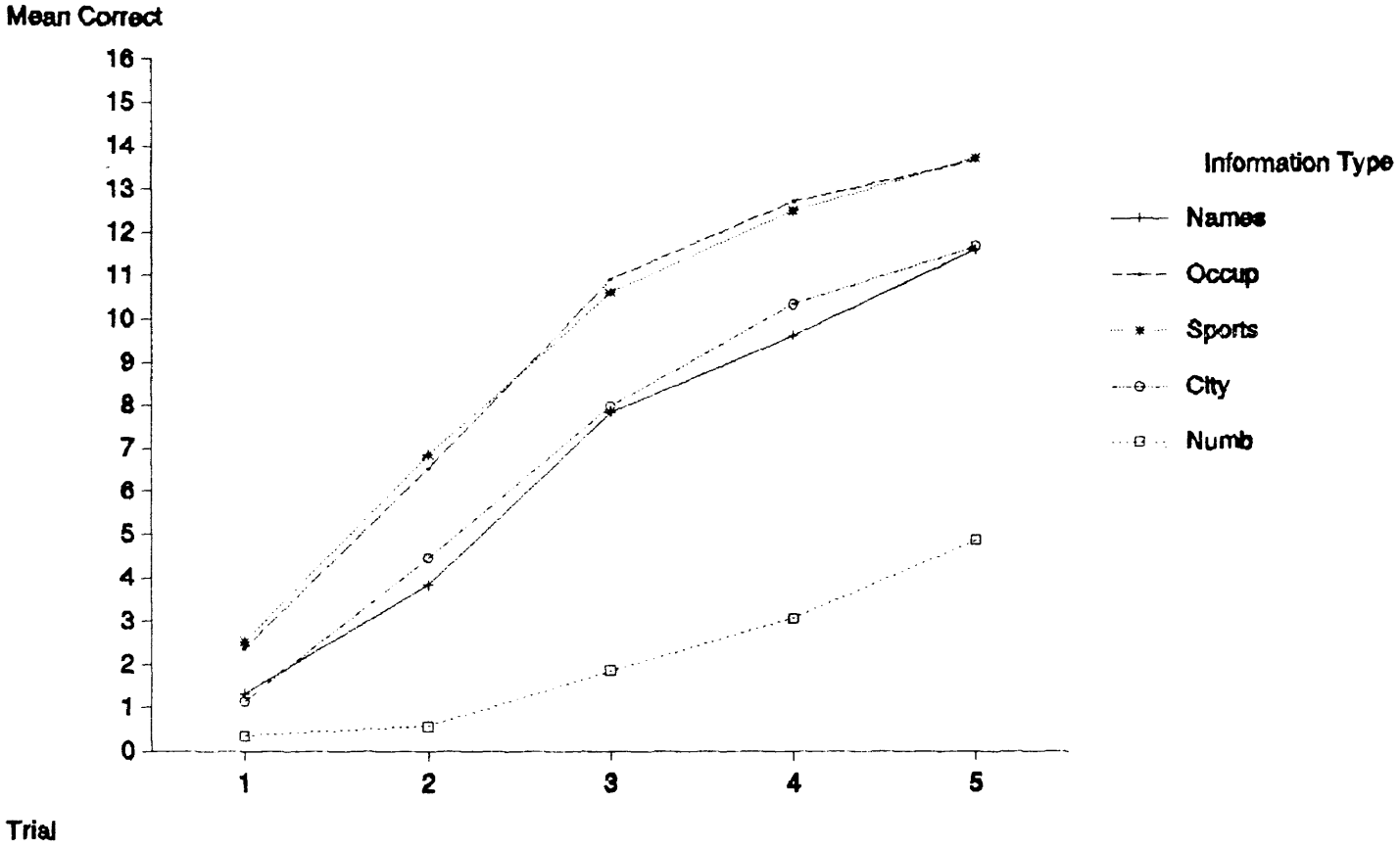

Figure 1: Average correct for each Information Type on each Trial.

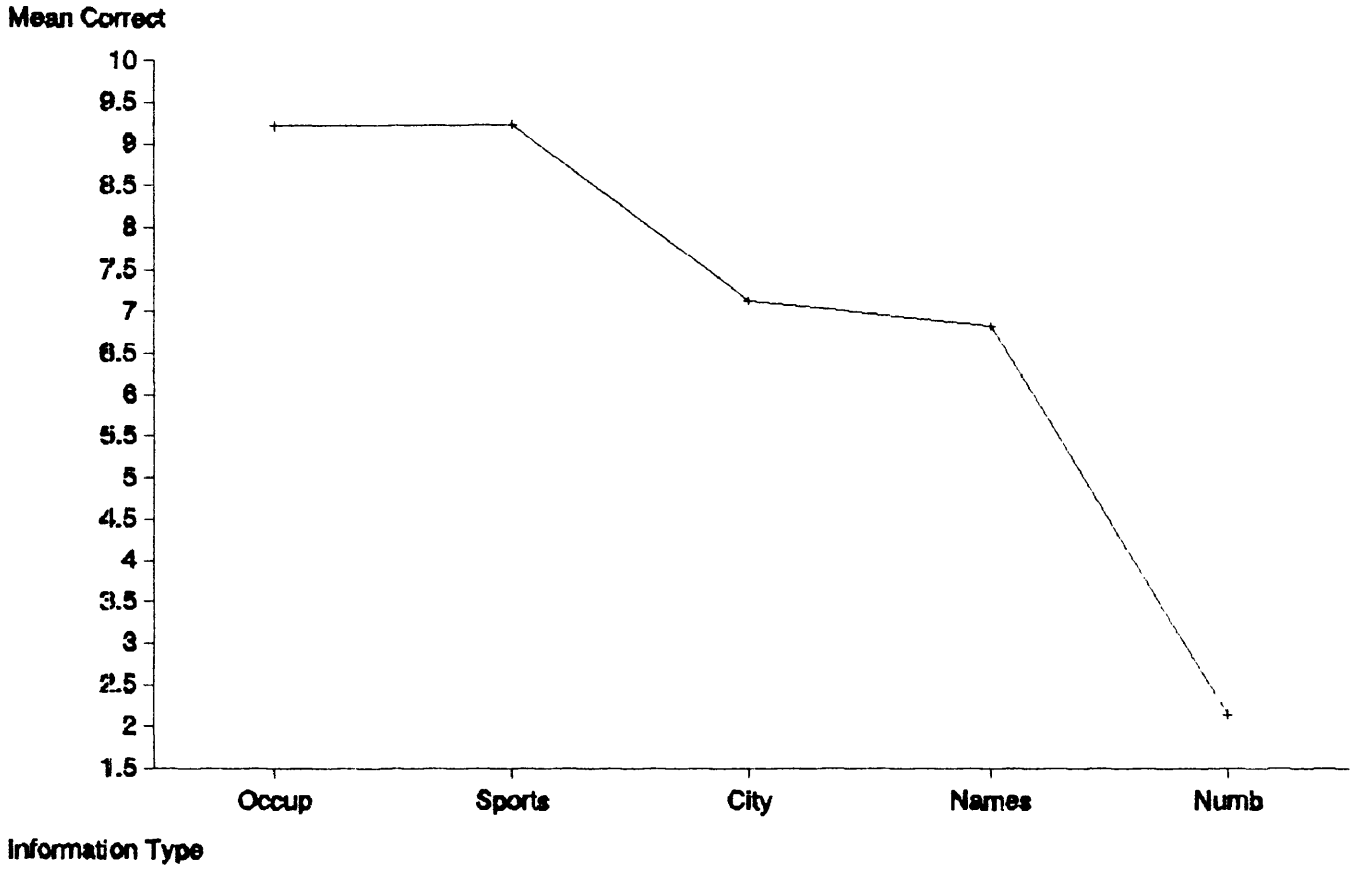

Figure 2: Average correct for Each Information Type over all trials.

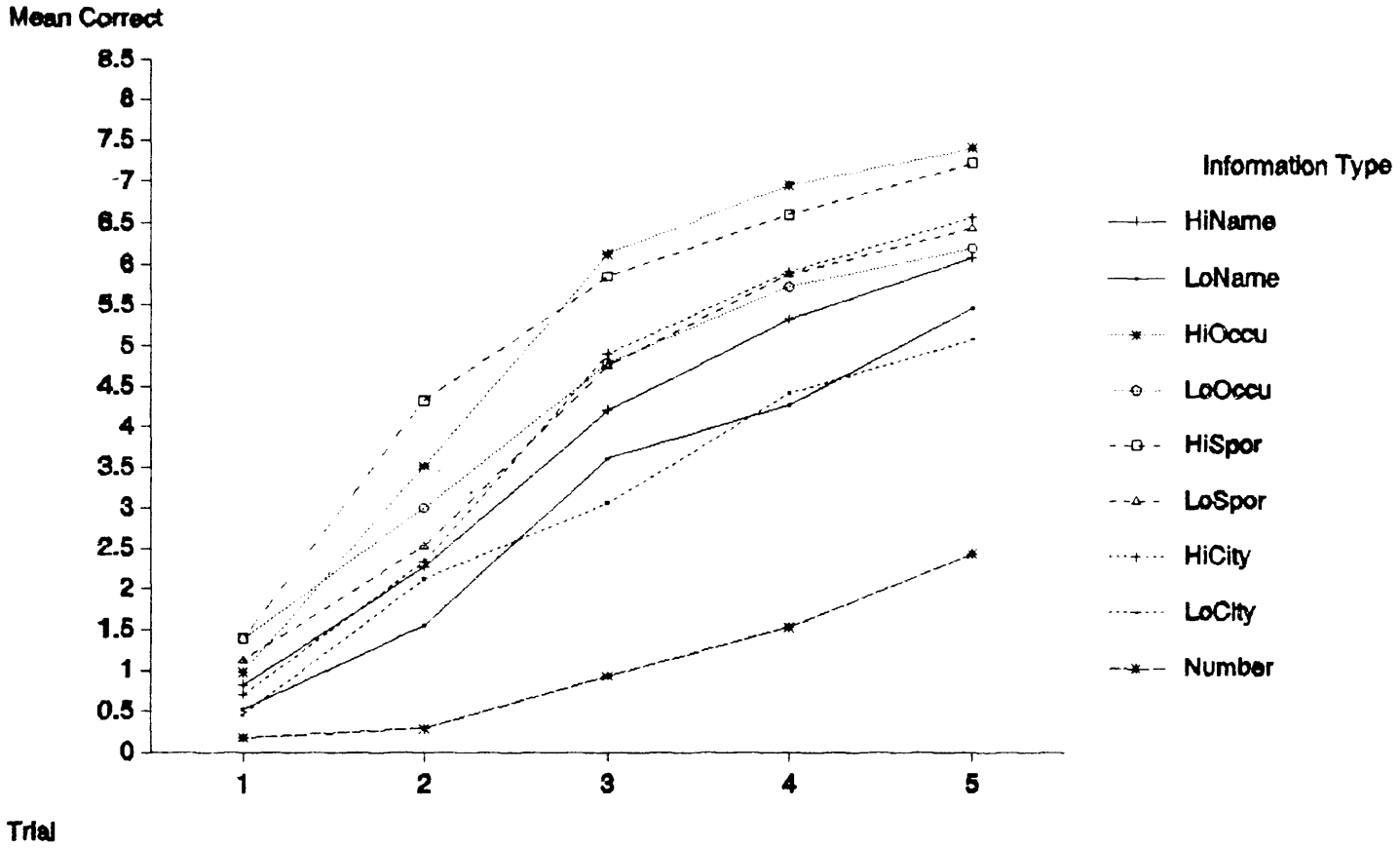

Figure 3: Average correct for each Information Type and Frequency combination on each Trial.

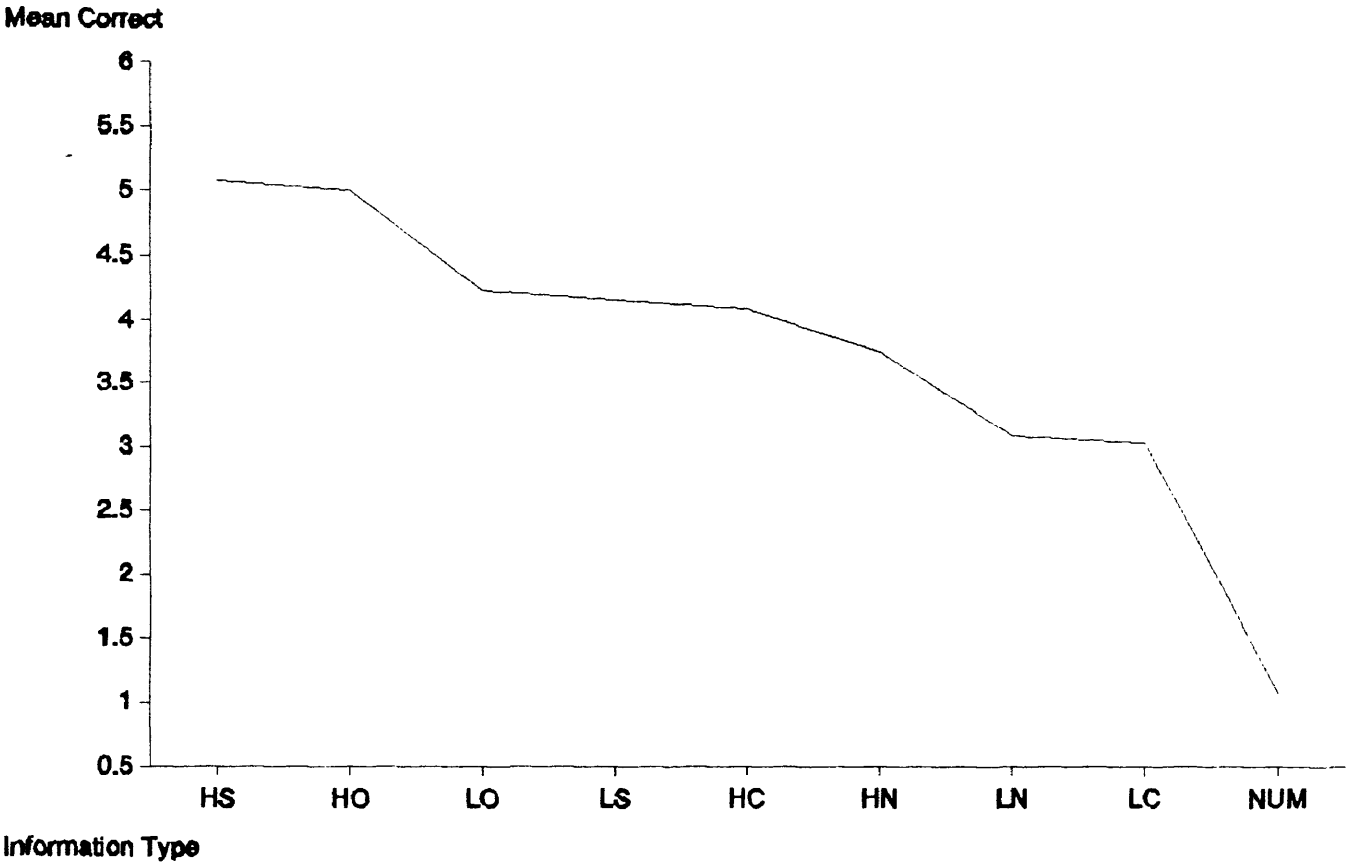

Figure 4: Average correct for each Information Type and Frequency combination over all Trails.

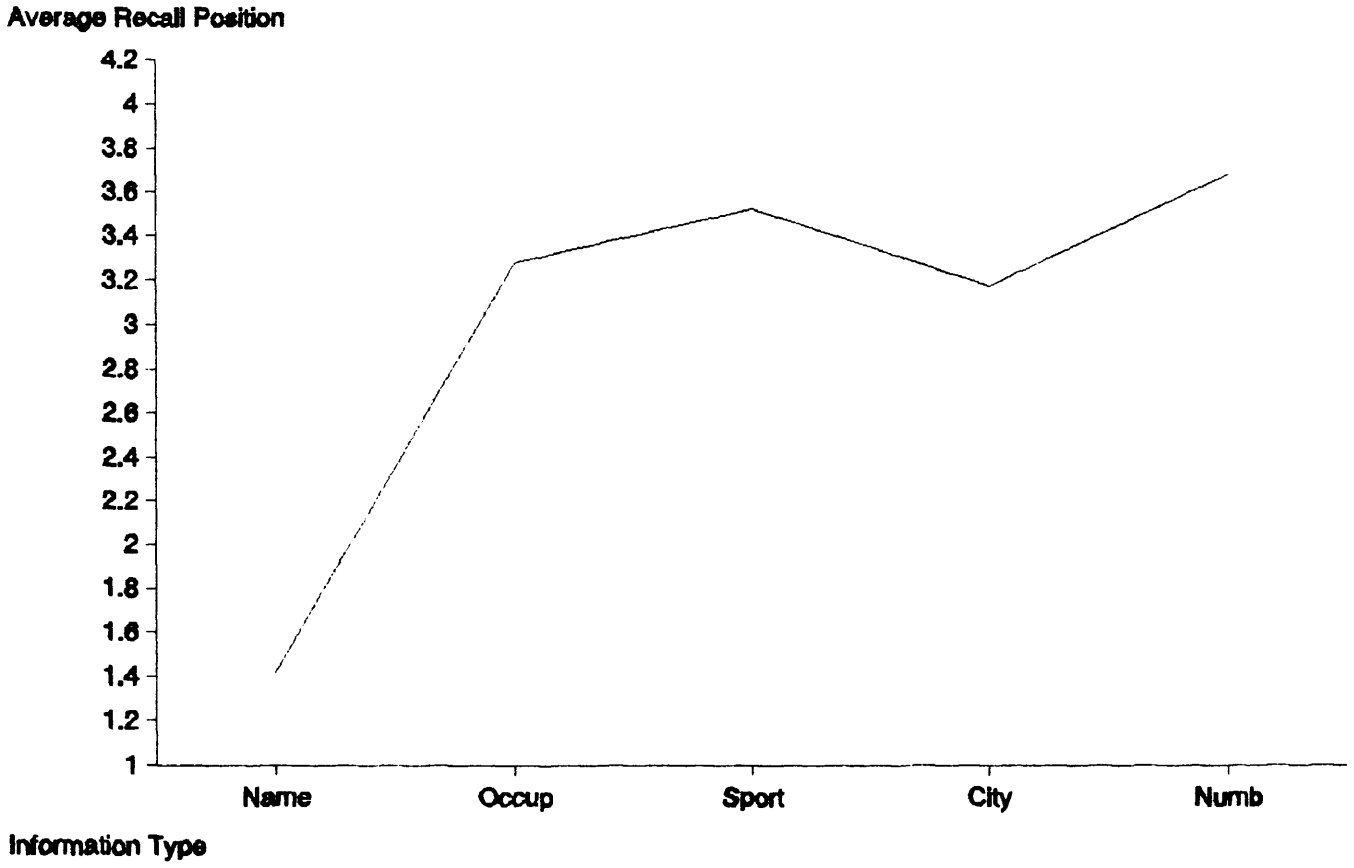

Figure 5: Average recall location of each Information Type on those Trials in which all information was recalled correctly.

Appendix A

Appendix B

	Occupation	Names	Hometowns
High Frequency	Lawyer(269)	Harry(91)	Boston(74)
	Teacher(155)	Richard(64)	Detroit(52)
	Dentist(112)	Eddie(49)	Dallas(50)
	Salesman(60)	Robert(48)	Cleveland(31)
	Plumber(41)	David(43)	Pittsburg(30)
	Farmer(25)	Henry(38)	Denver(28)
	Chemist(23)	Michael(30)	Tampa(18)
	Banker(21)	Peter(25)	Richmond(11)
Low Frequency	Teller(1)	Gilbert(1)	Fresno(1)
	Miner(1)	Bradley(1)	Scarsdale(1)
	Busboy(1)	Duncan(1)	Duluth(1)
	Butler(1)	Felix(1)	Polton(1)
	Turner(1)	Clayton(1)	Monroe(1)
	Miller(1)	Robin(1)	Bellaire(1)
	Pressman(1)	Alvard(1)	Fairfield(1)
	Joiner(1)	Jody(1)	Lemont(1)

	Sport	Numbers
High Frequency	Baseball(360)	79
	Tennis(329)	28
	Soccer(160)	46
	Hockey(130)	57
	Lacrosse(107)	73
	Wrestling(87)	35
	Softball(31)	86
	Boxing(23)	53
Low Frequency	Climbing(1)	43
	Riding(1)	92
	Croquet(1)	57
	Tumbling(1)	19
	Curling(1)	67
	Cricket(1)	94
	Fencing(1)	83
	Hunting(1)	32

Note: Number in parenthesis is the frequency of report of the word by subjects (N=442) in Battig and Montague (1969).

VITA

Anthony F. Vittoria

The author was born on July 5, 1969 in Fredericksburg, Virginia. He graduated with Honors from Stafford Senior High School in 1987, and enrolled in the University of Virginia that same year. The author received his B.A. in Psychology, graduating with High Distinction from the University in May of 1991. His thesis was entitled "Critical periods in music acquisition," completed under the advisement of Jacqueline S. Johnson Ph.D. The author entered the Master of Arts program in psychology at the College of William and Mary in August of 1991. His first year project, "The effects of meaningfulness and arbitrariness on the recall of information associated with a face," was presented at the annual convention of the Eastern Psychological Association in April, 1993. An avid rugby player and proud dog owner, the author was eternally searching for truth and knowledge...or at least something fun to do on Friday night.