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MEMORY FOR FREQUENCY OF HEARING POPULAR MUSIC : AN INVESTIGATION OF AN AUTOMATIC PROCESSING THEORY

by

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VITA

The author, James Robert Fidler, is the son of Robert C. Fidler and Barbara (Henry) Fidler-Swatzina (both to whom this work is dedicated). He was born July 16, 1960, in Chicago, Illinois.

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CHAPTER I

INTRODUCTION

A person's ability to accurately judge the frequency of occurrence of events has been cited as an example of an "automatic process" (Hasher & Zacks, 1979). As an automatic process, the estimation of event frequency is expected to be resilient to a host of experimental manipulations.

Automatic processes are carried out without an individual being aware of their operation (Posner & Snyder, 1975), without intention of doing so, and with little effort. Automatic processes are distinguished from "effortful" processes in that the former appear to be completely developed at an early age, thus showing no developmental changes (Hasher & Chromiak, 1977; Hasher & Zacks, 1979). Automatic processes are also unaffected by prior instructional set (Howell, 1973; Flexser & Bower, 1975), do not require attentional effort, and do not improve with practice (Hasher & Chromiak, 1977). In addition, recent studies suggest that there is very little variability between individuals in their automatic processing abilities (Hasher & Zacks, 1984).

Despite this evidence that processing of event frequency exhibits the above characteristics, the automatic nature of frequency encoding has recently been questioned. According to earlier work by Hasher and Zacks (1979), once stimuli were attended to, certain attributes such as frequency were encoded without additional processing. These researchers argued that frequency encoding is insensitive to strategy manipulations. However, Fisk and Schneider (1974) have provided results that tend to disconfirm this proposition. They required groups of subjects to process different attributes of the presented stimuli. For example, subjects were either directed to attend to (a) the graphic characteristics of words (does the letter "G" appear in this word?), or to (b) semantic characteristics of the words (does the word represent a vehicle?). Fisk and Schneider found differences in the accuracy of judgments between groups who processed the words under different orienting conditions. These results are similar to those found by Rowe (1974) and Rose and Rowe (1976), who showed that subjects judged frequency more accurately if they performed a semantic encoding of words rather than an orthographic encoding.

Other researchers argue that frequency information is simply not encoded automatically. For example, Greene (1984) found differences in the accuracy of judgments between groups who learned words incidentally or intentionally. Greene (1984, Exp.1) compared frequency judgments of subjects who were either not told that they would be tested on the word lists (incidental learning group), or told that they would be tested on their "memory for the words" (intentional learning group). Both groups were then tested for their memory of the frequency that the words were presented. Greene found a significant difference between the groups in the accuracy of their judgments of frequency. Greene argued that this result is inconsistent with the claim that frequency information is not affected by the intentionality of learning. Contrary to Hasher and Zack's (1979) proposition, the additional processing provided by increased attentional effort appears to enhance the accuracy of frequency judgments.

Given this conflicting evidence on the nature of the frequency encoding process, future investigation should be oriented towards revealing the circumstances and stimulus conditions under which frequency information is processed automatically. For example, under what conditions is frequency judgment accuracy affected by the intent to learn the items being judged ?

The present research is a first step towards investigating conflicting theoretical perspectives, such as those held by Hasher and Zacks and by Greene. In addition, this research incorporates popular music as a stimulus event. The use of such stimuli extends investigation beyond the typical use of words and word lists to a novel set of events.

Music is a salient part of many person's lives. People listen to the radio in their cars and hear music in stores. Some individuals pursue music more intently by buying records or playing an instrument. Musical selections are a natural set of events since music is encountered so often in daily living and under such a variety of conditions and environments. The present experiment uses music to examine the validity of automatic processing theories of frequency estimation by incorporating a new and perhaps richer set of stimulus events.

Music also represents a more complex set of stimuli than words.

In addition to possible verbal associations such as lyrics, music includes many other characteristics such as melody, rhythm, and tonality. This "package" of characteristics that makes up music is the stimulus in question. The validity of automatic processing theories may be extended by using more complex and natural stimuli such as music. Using popular music as stimuli, the present experiment was designed to assess the effects of instructional set, stimulus familiarity, and stimulus knowledge on frequency judgment accuracy.

CHAPTER II

REVIEW OF THE RELEVANT LITERATURE

Frequency Encoding: An Automatic Process

Many investigators suggest that one of the most remarkable aspects of the human memory is its ability to keep track of how often events have occurred. Research has shown that people make relatively accurate judgments as to the actual frequency of occurrence of events: as true event frequency increases, estimated event frequency also increases (Zechmeister & Nyberg, 1982).

An important distinction is made between judgments of background frequency and judgments of situational frequency. "Background" frequency refers to the accumulated frequency of a lifetime of experiences whereas "situational" frequency refers to the number of times an event has been experienced in a particular situation (Zechmeister & Nyberg, 1982). Studies have investigated memory for both background and situational frequency, and have incorporated a variety of stimulus materials. For example, Attneave (1953) found a high correlation (r =.88) between the actual frequency of occurrence of individual letters in the English language and subject's estimates of those background frequencies. Similar studies have investigated frequencies of letter combinations (Underwood, 1971) as well as whole word usage in the English language (Howes, 1954; Shapiro, 1969) and have found that as true background frequency increased, estimated frequency also increased.

Studies investigating situational frequency judgments include judging the presentation frequency of words within a list (Hintzman, 1969; Hasher & Chromiak, 1977), words within sentences (Jacoby, 1972), whole sentences and their meanings (Gude & Zechmeister, 1975), as well as pictures (Hintzman & Rogers, 1973). Subjects in these experiments are able to give accurate frequency judgments of the number of times they have experienced a particular stimulus event in a situational setting.

Investigators have placed the capacity of persons to accurately judge event frequency under the domain of what Posner and Snyder (1975) call "automatic processes." Alternatively, this process has been called "obligatory" (Hintzman, Nozawa, & Irmscher, 1982; Hintzman & Stern, 1978). Automatic processes are distinguished from "effortful" processes in that the former appear to be developed at an early age (Hasher & Chromiak, 1977; Hasher & Zacks, 1979), are not affected by prior instructional set (Howell, 1973; Flexser & Bower, 1975), do not reqiure attentional effort, and do not improve with practice (Hasher & Chromiak, 1977). While prior knowledge, educational level, intelligence, and motivation typically play substantial roles in determining learning, researchers have found that these factors do not affect the ability to judge frequency (Zacks, Hasher, & Sanft, 1982). For example, Zacks et al.(1982) compared frequency judgments of groups of students from two universities whose SAT scores differed substantially. No differences were found between the student groups' ability to judge frequency accurately. If SAT scores are accepted as a valid measure of intelligence, then frequency judgment accuracy appears to be unaffected by intelligence. Differences among individuals seem to be far less important for the processing of frequency information than for other cognitive skills (Hasher & Zacks, 1984). The results of many studies investigating frequency encoding and processing domains suggest that keeping track of event frequency is an automatic process.

Although frequency judgments appear automatic, our capacity to encode frequency information is not entirely flawless. In some situations, people make systematic errors when judging frequency of events. One bias in frequency estimation can result as a function of the nature of the stimulus material. For example, Galbraith and Underwood (1973) found that abstract words (such as "infinity" or "justice") are typically judged to have higher background frequencies than concrete words (such as "car" or "dog"), although their actual frequency of occurrence may be equivalent. Rose and Rowe (1977) and Malmi (1977) have shown how biases can arise as a result of an item's presentation context. For example, Malmi found that frequency judgments for words were different when the critical (to-be-judged) items were preceded by high-frequency versus low-frequency contexts.

A salient bias in frequency estimation results from what Tversky and Kahneman (1973) refer to as an "availability heuristic." Such a frequency estimation strategy relies on the ease with which relevant instances of an item/event come to mind. In a classic experiment, Tversky and Kahneman (1973) demonstrated the effect of an availability heuristic. Subjects were presented with either a list containing the names of 19 famous women and 20 less famous men, or a list containing the names of 19 famous men and 20 less famous women. After the lists were presented, subjects were asked to recall the personalities' names or to judge whether more male or female names had been presented. Subjects consistently recalled more famous than non-famous names, and erroneously judged the class consisting of the more famous names to be more frequent. Tversky and Kahneman suggest that because the well-known names were more "available", they led subjects to make wrong decisions about the true presentation frequency.

The availability heuristic has also been used to explain another frequency judgment bias termed "over-underestimation." For example, Lichtenstein, Slovic, Fischhoff, Layman, and Combs (1978) found that the actual frequencies of various lethal events (such as death by electrocution) were typically overestimated by subjects when the events had relatively small true frequencies, and were underestimated when the events had large actual frequencies. Such a bias is often present when judgments are required over a wide range of frequencies.

One explanation for these results is that easily recallable, widely publicized deaths (such as tornado deaths) are more available in memory and hence judged as occurring more frequently. Deaths from less publicized causes (such as asthma) are typically harder to recall and are judged to occur less frequently. Findings from studies such as these suggest that while people have a remarkable ability to keep track of event frequency, this ability is not infallible.

Studies Challenging a Theory of Automatic Processing

Despite research apparently validating the automatic nature of frequency encoding, several recent studies suggest contrary themes. One such study is that by Greene (1984) and concerns the set of criteria proposed by Hasher and Zacks (1979) for determining whether frequency information is encoded automatically. Greene's experiments are concerned with one of those criteria, namely, intentionality or instructional set. According to Hasher and Zacks, intentionality of learning, or instructional set, should have no effect on accuracy in a frequency estimation test. These researchers cite several earlier experiments supportive of this assertion.

Greene offers an alternative interpretation of previous research that has shown no effect of instructional set (Flexser & Bower, 1975; Howell, 1973; Zacks, 1982). As Greene states,

> it is possible that people do not know any effective way to keep track of the frequencies of a very large number of items. Warning them that they will be tested on frequency would therefore do them no good. It is quite possible that, if they were told an effective strategy to follow, their performance would improve (see Zacks et al., 1982, Experiment 2). Alternatively, even subjects who are expecting only an unspecified "memory test" on the items might adopt a mnemonic strategy that involves keeping track of the frequency of the items. (Greene, 1984, p.90)

Greene (1984) and other investigators (Lehman, 1982; Mander, Seegmiller, & Day, 1977) have proposed that the definitive test for determining automatic processing of an attribute of an item

> is between incidental and intentional learning of the items themselves, as opposed to varying the intent to learn that specific

> attribute. The crucial comparison is between one group of subjects who know that they will be tested on the presentation frequency of the items, and a second group who does not expect such a frequency test. (Greene, 1984, p.90)

The group not expecting a frequency test, the incidental learning group, should have no reason to encode particular attributes of the stimulus. Subjects in this group are not expected to use mnemonic strategies of any type, including strategies based on frequency information.

Experiment 1 of Greene's (1984) research compared frequency judgments of two groups. Subjects were either not told that they would be tested on word lists (incidental learning group) or that their "memory for the words" would be tested (intentional learning group). The procedure involved a modified Brown-Peterson short-term memory task. Both groups were presented with a series of 96 trials in which a microprocessor displayed a row of five digits. A word was then displayed on a subsequent screen. The subjects in the incidental learning group were told that they were participating in an experiment on short-term memory for digits, and that they would be required to repeat the words aloud as a distracting activity between presentation and recall of the digits. These subjects were not told that a test on the words would follow the trials. Subjects in the intentional learning group were told that their memory for the words would be tested following the trials. Both groups were then tested on the presentation frequency of the words. Experiment 2 was similar, but included a third group of subjects who were told that they would be tested on how often each word occurred (frequency learning group).

Regarding the accuracy of frequency judgments in Experiment 1, Greene found that subjects in the intentional learning group were significantly more accurate in their judgment of frequency than subjects in the incidental learning group. A straightforward theory of automatic processing of frequency information suggests that both groups should show comparable levels of accuracy of frequency estimation. However, in Greene's experiments, subjects who were exposed to the critical words without anticipating a frequency test apparently did not encode the words in the same manner as the intentional learning group. Greene argues that this processing difference does not support a theory of automatic frequency encoding, since accuracy was dependent upon the orienting instructions given to the subjects. Thus Greene's results seem inconsistent with the claim that frequency information is unaffected by the intentionality of learning.

Regarding Experiment 2, the mean accuracy of frequency judgments was equivalent in intentional-learning and frequency-learning groups, and both were more accurate than the incidental-learning group. Therefore, a significant overall effect of instructional set was found. Greene concluded that the intentionality of learning improves frequency estimation performance.

In another recent study of frequency judgments, Fisk and Schneider (1984) presented results which also disconfirm Hasher and Zacks' (1979) "automatic encoding" proposal regarding the processing of frequency information. In Experiment 1 of Fisk and Schneider's (1984) research, subjects were assigned to groups to perform tasks requiring varying levels of information processing. Subjects in five groups were presented with a series of microprocessor displays containing one word and two digits each. Each of these five groups was presented with identical display trials, but required to perform different operations on the words and digits. The tasks for each of the five groups respectively, included: a) an intentional learning task in which subjects were told about the subsequent frequency estimation task and were required to push a response button when they detected a word representing the name of a vehicle; b) a semantic orienting task in which subjects were not told about the frequency estimation task, but were simply instructed to respond whenever they detected a word representing the name of a vehicle; c) a graphic orienting task in which subjects were required to respond to any word containing the letter "G"; d) a "look" task in which subjects were required to search for one of two digits in displays containing two digits and to look at words presented in the fovea (subjects were told that the experiment was designed to "see how much could be remembered when something more important was happening", and they were informed that the most important task was the digit-detection task); and e) an "ignore" task in which subjects performed the digit-detection task and were told to ignore the words because they were inserted to distract them from the digit-detection task. Following the presentation trials, all subjects were given a frequency estimation task in which they were required to make their best estimate of the number of times they had seen each word.

Regarding frequency estimation accuracy, the results showed that subjects who intentionally processed the words (i.e., intentional, semantic, and graphic conditions) were able to estimate word frequency accurately, whereas subjects in the other conditions were not. Such "intentionality" involves the controlled processing of specific word attributes which results in a deeper elaboration of the meaning and characteristics of the word itself. Again, a straightforward theory of automatic processing of frequency information suggests that all five groups should show comparable levels of accuracy of frequency estimation. As in Greene's (1984) experiments, however, Fisk and Schnieder found that groups who intentionally processed the words apparently encoded the information differently than the other groups who processed the words "superficially." The between-group differences found by Fisk and Schneider seem contrary to Hasher and Zack's (1979) proposal regarding the automatic processing of frequency estimation. Such results are, on the other hand, consistent with the results found by Rose and Rowe (1976) and Rowe (1974). In these studies, semantic (incidental) processing tasks produced better subsequent frequency estimation than did orthographic processing tasks.

Critical Issues in the Current Controversy

The results of these studies suggest that the encoding of frequency information may not be wholly as "automatic" as prior research has suggested. A critical issue in this controversy regards the orienting instructions given to subjects. Hasher and Zack's theory of automatic processing of frequency information suggests that differential instructions should have no effect on frequency judgment accuracy. However, as is evident, results of recent studies show effects for instructional set. A theory of automatic processing suggests that if a process is indeed automatic, then it should be resilient to attempts to control that process. However, Greene (1984) and Fisk and Schneider (1984) have shown that the processing of frequency information can be inhibited or facilitated depending on the task performed on the critical stimulus. If indeed frequency encoding can be facilitated by semantic tasks, for example, would a greater degree of knowledge about the critical stimuli (thus enhancing semantic processing) further affect the processing of frequency information ?

The ability to control the processing of frequency information also raises the issue of individual differences in processing ability. A theory of automatic processing of frequency information suggests that, since an automatic cognitive operation is not readily under one's control, there should be less variability between persons in their ability to encode frequency information than there should be to encode attributes which are not processed automatically (such as reading comprehension). Studies by Zacks et al. (1982) and Goldstein, Kosteski, and Hasher (in press) appear to validite such a claim. However, if accuracy of frequency encoding can be enhanced through semantic tasks, and if some persons have a greater semantic facility (through greater knowledge of a particular event class) than others, then perhaps variability among individuals is to be expected. Moreover, this may be particularly evident for sets of stimuli with which persons are found to differ in processing competency. That is, it is likely that persons' existing level of knowledge or familiarity with a stimulus set affects their ability to judge frequency accurately.

This reasoning suggests that people who are familiar with, or expert, regarding a given class of stimuli might be better able to process information meaningfully or semantically, thus enhancing the accuracy of their frequency judgments. This idea is a logical extension of Greene's, and of Fisk and Schneider's suggestion that meaningful processing can affect the accuracy of frequency judgments. Persons who are more familiar with a class of events could perhaps perform more meaningful processing. The issue becomes one of prior stimulus knowledge. Can prior knowledge affect frequency judgment accuracy ? The present experiment involves: a) a further investigation of the automatic versus nonautomatic dilemma by examining the effects of instructional set and knowledge on the accuracy of frequency judgments, and b) the validation or invalidation of a theory of automatic processing of frequency information incorporating a currently unstudied stimulus in which familiarity is readily manipulable, viz., songs.

Musical Selections as an Event Stimulus

Research investigating memory for event frequency has generally examined retention of verbal stimuli such as words (Hintzman, 1969), parts of words (Underwood, 1971), or pictures (Hintzman & Rogers, 1973). However, Hasher and Chromiak (1977) have suggested that automatic encoding of frequency information potentially extends to all stimuli, whether the stimuli are meaningful or not. The present research tests the generality of Hasher and Chromiak's proposition by using musical stimuli.

While instrumental music (as opposed to vocal music) is clearly not a meaningless stimuli, it could be considered more abstract than verbal stimuli. Despite the abstract nature of instrumental music, compared to the more concrete class of verbal stimuli, recent research suggests that common Western (twelve-tone) musical structures reflect the general rules of cognitive organization (Deutsch & Feroe, 1981). Perhaps the critical distinction between music and words lies in their differing levels of complexity and abstractness.

The majority of research on the cognitive processing of music has been molecular in nature (i.e., musical structures are subdivided into their constituent parts, as opposed to taking a musical selection as a unified stimulus). For example, Sturges and Martin (1974) examined ease of recognition of eight-element "buzz tone" rhythms. Jeffries (1974) investigated the frequency with which musical intervals (tone separation) occurs in music, along with the relative familiarity of ascending versus descending intervals. Krumhansl (1979) studied the psychological representation of musical pitch in a tonal context with respect to a major triad (i.e., the psychological relationship of a single tone to a group of three tones, or a chord). Krumhansl and Kessler (1982) investigated perceived tonal organization in spatial representations of musical keys. This research suggests that music perception not only depends on the psychoacoustic properties of tones, but also on the processes which relate tones to other tones. In addition, these studies exhibit a primary concern for the elements of musical structure, rather than for musical structure considered as a whole.

While the majority of studies investigating the cognitive processing of music deal respectively with rhythms, pitch, intervals, and their relationships, several researchers have considered the musical piece as a unit. For example, Halpern (1984) studied differences between musicians and non-musicians in their processing of "realistic" music. Subjects in Halpern's experiment were required to listen to unfamiliar musical selections in order to study the perception of novel music structure. Results from this experiment included the finding that musicians apparently exceed non-musicians in the ability to categorize music in multiple ways. However, even non-musicians extract considerable information from newly heard music.

Other research investigating the cognitive processing of music includes a study by Stewart and Wilbanks (1982) who used musical selections to test a temporal ordering effect of recognition time (i.e., is a musical phrase better recognized if it is from the beginning, middle, or end of a musical piece ?). Stewart and Wilbank's study used unfamiliar songs by Debussy as stimuli. Their results indicated that whether a musical phrase is at the beginning, middle, or end of a composition does not in itself determine recognition time. Welker (1982) examined the abstraction of musical themes from melodic variations of songs, and found that subjects were accurate in their ability to abstract a theme (prototype) from sets of melodic variations in both false recognition task paradigms, and drawing tasks of the melodic contour.

While many aspects of the cognitive processing of music have been investigated, few have specifically dealt with memory for music. A notable exception is research conducted by Dowling (1978) who delineates two components of a theory of memory for melodies: scale and contour. In this theory, music is encoded in memory as a pattern of "ups and downs" (contour) which is applied to an overlearned structure of tones (the twelve-tone Western scale).

As suggested above, perhaps the critical distinction between music and words lies in their differing levels of complexity and abstractness. In terms of complexity, words have a graphic character, a semantic component, a grammatical component, and an auditory component, whereas music contains tonality (both absolute and relative), rhythm, tempo, melody, harmony, instrumentation, and perhaps an emotional and preference component exceeding that of individual words. In addition, many popular musical pieces contain words in their composition. While words and music are clearly not directly classifiable along similar dimensions, a fundamental difference in complexity seems evident.

In terms of abstractness, words have a generally unambiguous relationship to meaning, even though some words may have multiple meanings (such as the word "lie"). Music has a character which is less referent, in that a tone or melody does not always represent concepts, objects, or actions. If music is considered to be less strongly tied to meaning than individual words, then it seems reasonable to deem music as being more abstract than words. Again, while words and music are not directly classifiable along similar dimensions, both appear to differ in fundamental levels of abstractness. The present experiment not only investigates further the validity of frequency encoding theories, but supplements research conducted on memory for music as well.

Overview of the Present Experiment

The present experiment required subjects to estimate the frequency of occurrence of musical excerpts. The use of musical selections for investigating frequency estimation is important in that the stimuli represent a more abstract and richer set of events than those previously investigated. Moreover, this study investigates further the issue highlighted by Greene's (1984) experiments: namely, intentional and incidental learning conditions. Greene suggested that the critical test of the automaticity of frequency encoding relies on the differences found between intentional and incidental learning groups, and stated that his results showed "no strong evidence for the automatic encoding of frequency information" (p.90).

The present experiment will also provide a test of a "knowledge effect" for frequency encoding. Pilot data gathered on this issue using musical stimuli suggest that knowledge of the stimulus material may indeed affect persons' ability to accurately encode frequency information. The results of a pilot study indicated that subjects who were better able to identify the titles and performers of the songs used as stimuli (thus reflecting a greater degree of music knowledge) were more accurate in their frequency judgments than subjects who were poor at song title and artist identification.

The present experiment included six groups. The effect of knowledge on frequency judgment accuracy was measured by requiring half of the qroups to estimate the presentation frequency of popular, often-heard songs, and requiring the other half of the groups to estimate the presentation frequency of "popular sounding" but unfamiliar songs. In this experiment "knowledge" of the songs was defined as the familiarity that subjects have with these songs. The group of "low familiarity songs" contained songs for which subjects typically cannot identify the title or performer, and which subjects report having heard "rarely or never." "High familiarity songs" were readily identified in terms of title and artist, and were reported as being heard "often or very often." Norms were collected on these songs in terms of familiarity. The procedure for collecting these norms is discussed in a subsequent section.

Within the high and low familiarity conditions, subjects were separated into three subgroups. Subjects were either aware of an upcoming frequency test, aware of an unspecified memory test, or not told memory would be tested and performed a distractor task of completing a math aptitude test. The third group represents a replication of Greene's (1984, Exp.1) "incidental learning" condition. The resultant 2 X 3 design provides a test of a knowledge effect for frequency estimation, as well as a test for the effect of incidental versus intentional learning on frequency judgment accuracy. Measures of frequency judgments were based on estimates that subjects gave for the number of times each song had been presented to them on an audio tape.

While a theory of automatic processing of frequency information suggests that no differences should be found between groups, data from the pilot experiment suggest that: a) subjects in each of the three "high familiarity" groups should perform better than those in each of the three respective "low familiarity" groups, b) subjects in intentional learning groups should be more accurate in judging frequency than subjects in incidental learning groups, and c) there should be no differences in accuracy of frequency judgments between subjects who are aware of an upcoming, unspecified memory test and subjects aware of an upcoming frequency test. This final point is the only issue of agreement between an automatic processing theory of frequency information and recent data challenging that theory.

Pilot Experiments

A series of three pilot experiments were conducted in which a total of 121 subjects participated. Two pilot experiments (including 26 and 32 subjects, respectively) compared frequency judgments of groups who were aware of an unspecified, upcoming memory test, and groups who were aware of an upcoming frequency test. A third pilot experiment (involving 63 subjects) included the same groups as above, in addition to a third "distractor" group who performed a reading comprehension test and were told to ignore the tapes being played in the background. Because the procedures and results were similar in each of the three pilot trials, these experiments will be discussed concurrently. Differences between experiments will be noted where relevant.

In all pilot experiments, subjects were presented with an audio tape containing 10-second excerpts from 21 popular songs. Of these songs, four were presented once, four were presented twice, four were presented three times, and four were presented four times. Five songs were used as "buffers" and were not judged. All songs and their positions in the tape sequence were block-randomized so that no song was repeated within three positions.

After this tape was played a "test tape" was presented to the subjects in which each of the 16 critical items was played once, along with four songs that were not presented in the first tape (zero-presented items). Subjects were then asked to provide frequency judgments for each of the 20 songs in the test tape.

Two groups of subjects heard both tapes. One group was told that frequency judgments would be required following the tape presentation, but the other group was unaware that frequency judgments would follow. The results of the pilot studies correspond with prior research in that there were no significant differences between the group's ability to judge frequency. Knowledge of a forthcoming frequency judgment task did not improve a person's ability to estimate frequency accurately. However, subjects in the third experiment's "distractor" condition were significantly less accurate in their frequency estimation than were the other two groups (frequency test and memory test groups).

In addition to providing frequency estimates of the critical songs, subjects were also required to identify the song's title and performer (group or artist), if they could do so. For each subject, the number of correct title identifications and correct performer identifications correlated highly (r =.89), so that only one measure, title, was used in the analysis.

The results showed that subjects who knew the titles of more songs were more accurate in their frequency judgments. These results appear to contradict the automatic processing theory of frequency judgment accuracy on two counts: a) knowledge of the stimulus material apparently influenced frequency judgment accuracy, and b) subjects were apparently less accurate in frequency estimation when required to perform other "distractor" tasks. Considering these results along with those of Greene (1984) and Fisk and Schneider (1984), an experiment was designed to assess both a "knowledge effect" as well as a "condition effect" (intentional versus incidental instructional set) for frequency estimation.

CHAPTER III

METHOD

Materials

In order to investigate the effect of high versus low knowledge of stimulus material on the accuracy of frequency judgments, it was necessary to construct tapes for groups reflecting this knowledge difference. The tape edited for the high knowledge conditions consisted of well-known, familiar music (such as Michael Jackson's "Thriller"), and the tape edited for the low knowledge conditions consisted of familiar sounding, but unknown music (such as Aldo Nova's "Under the Gun"). Before constructing the above tapes, norms were gathered on the true popularity of each critical song used. Such a strategy is analogous to the use of background word frequency lists compiled by Thorndike and Lorge (1944).

In this experiment, knowledge of popular musical selections was defined as the frequency with which such selections have been heard, as well as the number of correct song title and performer identifications for each selection. A 14-minute tape recording was edited for the purpose of gathering norms on the familiarity of the chosen songs. The tape consisted of 44, 10-second excerpts from the beginnings of musical pieces. The experimenter chose 22 popular songs from recent radio and music industry surveys. Therefore, "well-known" songs were in the "top

40" at some point in their history. Such songs typically receive wide exposure on contemporary radio stations. The experimenter also chose 22 rarely heard songs to be included in the tape. Such songs sounded similar to the "well-known" songs, as they evidenced similar rhythm structure, tonality, instrumentation, and musical style. Song excerpts from both familiarity categories were randomized and recorded with 5- to 7-second silent intervals between selections.

The tape was played to 46 students at Loyola University of Chicago who were enrolled in undergraduate psychology courses. Subjects were asked to provide song titles, song performer, and a rating from 1 to 7 (7 being most familiar) of the familiarity of each song that was played.

The results from the pilot survey verified the experimenter's judgments of the familiarity and unfamiliarity of the chosen songs, respectively. The mean familiarity rating of the "well-known" songs (on a 1 to 7 scale) was 5.18, compared to a familiarity rating of 1.53 for "unknown" songs, t (38)=18.44, p <.001. In addition, the well-known songs were identified correctly about half the time, on the average. Only two correct identifications (less than 1 percent) were made of the unfamiliar songs, χ^2(1)=1159.02, p <.0001. From the 22 songs in each familiarity category, two were eliminated since only 20 critical items would be used for the final tapes. The 20 songs used in each familiarity condition, their mean familiarity ratings and total identification scores are presented in Appendix A.

Having identified the songs to be used in the high familiarity and low familiarity conditions, tapes were edited using a procedure identical to that of the pilot experiment. That is, a "presentation tape" containing the randomly selected critical items plus buffer items was followed by a "test tape", in which the critical items were played once, along with four new items never before presented. Each song excerpt was about 10-seconds in length, with about 7-second silent intervals between selections.

Four final tapes were edited; two alternate forms of the familiar, high-knowledge song tape, and two alternate forms of the unfamiliar, low-knowledge song tape. Song tapes constructed for each familiarity condition consisted of two blocks each. Overall, each tape consisted of 16 critical, or to-be-judged items. Eight of these items were presented in block A, and eight were presented in block B. The two forms of the familiar song tape consisted of block A followed by block B, and block B followed by block A, respectively. The two forms of the unfamiliar song tape followed a similar format. The alternate forms of each tape were used to control for any order effect that might possibly be present in terms of song sequence.

Equipment

Audio tapes were edited using an Onkyo 2070 stereo cassette deck, and a Philips AF 777 turntable. Tapes were presented to subjects using a portable Panasonic cassette player.

Design

This experiment included six experimental conditions. The effect of knowledge on the accuracy of frequency judgments was measured by requiring subjects in the three high-familiarity conditions to estimate the presentation frequency of popular, often heard songs, and requiring subjects in the three low-familiarity conditions to estimate the presentation frequency of "popular sounding" but unfamiliar songs. Within the above high and low familiarity conditions, subjects were divided into three sub-groups. Subjects were either aware of an upcoming frequency test ("frequency" condition), aware of an upcoming unspecified memory test ("memory test" condition), or not told memory would be tested and required to perform a distractor task involving a math skills test ("distractor" condition). The resultant 2 X 3 design provides a test of a familiarity effect for frequency judgments as well as a test for an effect of incidental versus intentional learning on frequency judgment accuracy.

Procedure

Subjects were first given instructions about the task, then presented with a 23-minute tape recording containing 52, 10-second musical excerpts. After this "presentation tape" was played, subjects listened to a 13-minute "test tape" which contained each of the critical items played once, plus four items not included in the "presentation tape" (zero-presented items). After hearing each musical selection in the test tape, subjects estimated the number of times that selection was heard in the presentation tape. Subjects had approximately 10-seconds between each selection in which to estimate frequency for each song. After the test tape was played and frequency estimations were completed, the experimenter played an 11-minute "expertise tape" in which subjects were required to identify the titles and artists of the critical (judged) items which were used in the high knowledge, familiar song tape. All songs were ordered randomly in this tape. The "musical expertise " tape was used as a measure of each individual's familiarity and knowledge of popular music in general. After this tape was played, subjects were debriefed and dismissed.

Subjects in both high and low familiarity "frequency" conditions were instructed to listen to the musical selections in order to prepare for a test of estimating the frequency with which each song would be played. Subjects in both "memory test" conditions were told to listen to the musical selections in preparation for a following "test of memory" for the musical selections. Subjects in both "distractor" conditions were presented with a 40-question math aptitude test, and were told to ignore the audio tape being played in the background. More specifically, they were told that the math test was a primary task in the experiment.

After the presentation tape was played under each of the above conditions, all groups were then required to estimate frequency and to attempt to identify the title and artist of the critical familiar items.

Musical Excerpts

The "presentation tapes" consisted of 52, 10-second musical excerpts, with 7-to 10-second silent intervals between each excerpt. These tapes were based on 16 critical selections. That is, of 16 critical selections, items were presented with varying frequencies. Specifically, four items were played once, four items were played twice, four items were played three times, and four items were played four times (4+8+12+16=40). In addition to these 40 items, one song was played six times throughout the tape, but was not to be judged. Similarly, four songs were played at the beginning of the tape and two were played at the end of the tape which were not to be judged (thus equalling 52 excerpts). These additional items were included in the tape so that not every song would be a critical item. More specifically, the non-critical songs at the beginning of the tape were to control for any possible primacy effects of the list, and the non-critical songs at the end of the tape were to control for any possible recency effects of the list. Assignment of songs to frequency level was random. In addition, the sequence of songs in the tape was randomized with the restriction that no song would be played within three positions of a previous presentation of that song (i.e., a minimum of three different songs between each repetition).

The "test tape" consisted of 20, 10-second musical excerpts, with 7- to 10-second silent intervals between each excerpt. Sixteen of these excerpts were the critical (to-be-judged) items heard in the "presentation tape", whereas four of these songs were not played in that tape.

All songs were randomly ordered.

Subjects

Participants in this experiment were 180 students from the introductory psychology subject pool at Loyola University of Chicago. Thirty subjects participated in each experimental condition, and assignment to conditions was random. Subjects within each condition were tested in small groups, ranging from three to twelve subjects per group.

CHAPTER IV

RESULTS

Overview

The key issues that were investigated in this experiment were; (a) the effect of stimulus familiarity on frequency judgment accuracy, (b) the effect of instructional set on frequency judgment accuracy, and (c) the effect of stimulus knowledge on frequency judgment accuracy. If the cognitive processing of frequency information is wholly automatic, then there should be no differences in frequency judgment accuracy among persons who process familiar or unfamiliar music, respectively. Similarly, if frequency information processing is wholly automatic, then instructions orienting the subjects to perform different tasks with the information should not affect frequency judgment accuracy.

For the purpose of the present experiment, it is now necessary to distinguish between absolute accuracy and relative accuracy. "Absolute accuracy" refers to when persons assign correct estimates when judging frequency. In this case, persons are accurate only if their frequency estimates are the same as the true presentation frequencies (for example, persons are absolutely correct if they estimate that an item was presented 12 times, when in fact it was presented 12 times). In contrast, "relative accuracy" refers to subjects' frequency discrimination ability for items presented at varying frequency levels. For example, a subject exhibits relative accuracy if he estimates that an item presented four times was in fact heard more then an item presented three times. Similarly, once-presented items should be judged as occurring less frequently then twice-presented items. A subject who is able to discriminate the frequency with which items of varying frequency levels are presented, is said to exhibit relative accuracy.

Three measures of frequency judgment accuracy were employed: "hits", "relative accuracy scores", and mean estimates. "Hits" represented correct absolute frequency judgments. For example, if a song was presented three times on the tape, and a person estimated that the song was presented three times, that subject scored a hit. The second measure of "relative accuracy" was represented by two statistics: (1) a transformed- r score for each subject, and (2) an overall correlation score for each subject. For the transformed- r measure, correlations were calculated between mean presentation (actual) frequencies of songs and their mean estimated frequencies for each subject. More specifically, four songs were presented in each of the four frequency levels (four songs were presented once, twice, etc.). The means for each frequency level (based on four observations per level) were calculated for each subject's estimates and correlated with the "true" frequencies. This correlation was then taken to a tabled set of values to obtain a standardized score for each correlation. An additional measure of relative accuracy was not based on means (as above), but on individual item estimates. For this measure, estimates for every item presented once through four times was correlated with each item's true presentation frequency for each subject. Therefore, this correlation was based on 16 items per subject. Although these two measures of relative accuracy correlated satisfactorily (r =.75), results for each will be presented. The final measure consisted of the mean estimates given for each frequency level. For example, if for the once-presented items, a subject estimated that each had been played 1,1,2, and 2 times respectively, that subject would have a mean estimate score for that frequency level of 1.5. Each subject therefore had an overall hit score, two overall relative accuracy scores, and mean estimate scores.

Items heard 1,2,3, or 4 times on the "presentation tape" were analyzed separately from items not presented on that tape (zero-items). This was done since it was assumed that different processes were involved in these two frequency categories. When a zero-item is heard on the test tape (a song that was not heard on the presentation tape) a simple "yes or no" recognition decision is called for. This type of decision is fundamentally different from estimating "how many" times a song was previously heard. For this reason all items never heard before were analyzed separately from items heard either once, twice, three times, or four times.

While overall knowledge differences were represented by the between-group variable of song familiarity, a within-group measure of music knowledge was employed by calculating each subject's total number of song and artist identifications from the "musical expertise" tape. Therefore, a single score represented a musical knowledge rating for each subject.

The main analysis strategy consisted of a series of between and within subject analyses of variance. These analyses will be discussed as they apply to each of the key areas investigated.

Frequency Judgment Accuracy as Measured by Hits

The hit frequency judgment scores for items heard once through four times were analyzed via a 2(familiarity) X 3(instruction) analysis of variance. Mean hits for each of the six groups are presented in Table 1.

Regarding instructional set, the results revealed a highly significant difference in hits among groups who either (1) were told that they would have to judge frequency, (2) were told to expect an unspecified memory test, or (3) performed a distractor task and were told to ignore the material, F (2,174)=19.60, p <.01. These results suggest that orienting subjects to perform different tasks with the stimulus information affects the accuracy of absolute frequency judgments. More specifically, a planned comparisons analysis compared both frequency and memory test groups (weighted together) to the distractor group. The results from this analysis showed that frequency and memory test groups differed substantially from the third (distractor) group as predicted by Greene (1984), F (1,174)=35.38, p <.01.

Regarding familiarity, the ANOVA revealed a highly significant difference in accuracy of absolute frequency judgments between groups who estimated familiar versus unfamiliar songs, F (1,174)=67.19, p <.01. These results suggest that knowledge of stimulus material, as

TABLE 1

Hit Accuracy, Instructional Set, and Familiarity

Mean Hit Frequency Judgments for Six Groups as
a Function of Instructional Set and Familiarity

	Instructions			
Group	Frequency	Memory Test	Distractor	Overall
Familiar Music	7.83	7.20	4.47	6.50
Unfamiliar Music	4.63	3.77	3.17	3.86
Overall	6.23	5.48	3.82	

Note: Higher scores represent greater frequency judgment accuracy.

represented by familiarity, affects the ability to judge the absolute number of times an item was presented. Subjects judging familiar songs were far more accurate in their absolute frequency judgments than subjects judging unfamiliar songs.

This analysis also revealed an interaction between familiarity and instructions, F (2,174)=4.39, p <.05. This interaction was due to the fact that subjects' estimates in the familiar and unfamiliar conditions were more similar in the distractor group then they were for the frequency and memory test groups. That is, while the accuracy performance of subjects judging familiar music was clearly superior to that of subjects judging unfamiliar music in the frequency and memory test groups, this difference was not as great for the distractor groups.

An additional 2(familiarity) X 3(instruction) X 4(frequency level) ANOVA performed on subject's hits (for items presented once through four times) confirmed a main effect for familiarity, F (1,174)=66.43, p <.01, a main effect for instructions, F (2,174)=18.43, p <.01, and an interaction between familiarity and instructions, F (2,174)=5.60, p <.01. In addition, interactions between familiarity and frequency level, F (3,522)=8.47, p <.01, and instructions and frequency level, F (6,522)=5.22, p <.01 were obtained. These interactions will be discussed in the context of similar results from other analyses, below.

Frequency Judgment Accuracy as Measured by Relative Scores

The relative accuracy scores or transformed- *r* scores (1-4 items) were analyzed using a 2(familiarity) X 3(instruction) analysis of variance. Mean relative accuracy scores for each of the six groups are presented in Table 2. The results regarding instructional set revealed a significant difference between groups in the accuracy of their relative frequency judgments, $F\ (2,174)=3.98$, $p <.05$. As above, planned comparisons revealed that the distractor group was poorer in frequency judgment accuracy compared to the other two groups, $F\ (1,174)=7.63$, $p <.01$.

While both measures of hits and relative accuracy scores did show significant differences in accuracy between groups who were given different instructions, hits (absolute judgments) in contrast to relative judgments, seemed to be more strongly affected by instructional set.

Results from the ANOVA regarding familiarity revealed a significant difference in the relative accuracy of frequency judgments between groups who estimated familiar versus unfamiliar songs, $F\ (1,174)=6.12$, $p <.05$. Similarly, these results suggest that although familiarity affects the accuracy of relative frequency judgments to some degree, relative judgments are less affected by familiarity than are absolute judgments. This issue is clarified by examining mean frequency judgments as a function of presentation frequency and familiarity condition. No interactions were present in this analysis.

A second measure of relative accuracy consisted of correlations between each item's presentation frequency and its estimated frequency

TABLE 2

Relative Accuracy, Instructional Set, and Familiarity

Mean Relative Accuracy Scores for Six Groups as a Function of Instructional Set and Familiarity

	Instructions			
Group	Frequency	Memory Test	Distractor	Overall
Familiar Music	1.77	1.71	1.29	1.59
Unfamiliar Music	1.32	1.47	1.24	1.34
Overall	1.54	1.59	1.27	

Note: Higher scores represent greater frequency judgment accuracy.

for each subject. Using a 2(familiarity) X 3(instruction) ANOVA as above, the results yield similar conclusions. Mean correlations for each of the six groups are presented in Table 3.

Results from this analysis revealed a main effect for familiarity, *F* (1,174)=17.11, *p* <.01 and a main effect for instructions, *F* (2,174)=16.55, *p* <.01. In addition, an interaction between familiarity and instructional set was obtained, *F* (2,174)=3.71, *p* <.05. This interaction was due to the following facts: for frequency and memory test conditions, subjects judging familiar music were more accurate than subjects judging unfamiliar music, but familiarity did not differentially affect performance in the distractor group. Therefore, in the distractor group, familiarity did not affect frequency judgment accuracy as it did in the other two instructional conditions. This result concurs with the familiarity by instructions interaction obtained using the hits measure.

Frequency Judgment Accuracy as Measured by Mean Estimates

A 2(familiarity) X 3(instruction) X 4(frequency level) ANOVA performed on subject's mean frequency estimates revealed significant effects for instructional set, *F* (2,174)=3.15, *p* <.05, and familiarity, *F* (1,174)=26.72, *p* <.01. Overall means for this analysis are presented in Table 4.

Regarding instructional set, converging results from analyses of hits, relative accuracy scores, and mean estimates suggest that there may indeed be an effect of instructional set on frequency judgment

TABLE 3

Mean Correlations, Instructional Set, and Familiarity

Mean Correlations Between Estimated and Actual Frequency for Six Groups as a Function of Instructional Set and Familiarity

	Instructions			
Group	Frequency	Memory Test	Distractor	Overall
Familiar Music	.70	.67	.44	.61
Unfamiliar Music	.52	.53	.43	.49
Overall	.61	.60	.44	

Note: Higher correlations represent greater frequency judgment accuracy.

TABLE 4

Mean Estimates, Actual Frequency, and Instructional Set

Mean Frequency Judgments Overall as a Function
of Presentation Frequency and Instructional Set

	Presentation Frequency				
Group	1	2	3	4	Overall
Frequency	1.34	2.65	3.40	3.75	2.79
Memory Test	1.49	2.93	3.63	3.91	2.99
Distractor	1.41	2.58	3.19	3.23	2.60
Overall	1.41	2.72	3.41	3.63	

Note: Mean scores closer to the presentation frequencies represent greater frequency judgment accuracy.

accuracy. Furthermore, this effect seems to manifest itself by causing an accuracy decrement in distractor conditions. There appears to be no differential effect for instructional set between subjects in frequency and memory test conditions.

In addition, the results from the above ANOVA revealed a highly significant effect for familiarity. Converging results from analyses of hits, relative accuracy scores, and mean estimates suggest that there may be an effect of stimulus familiarity on frequency judgment accuracy. Groups judging unfamiliar music are less accurate than groups judging familiar music in terms of both absolute frequency judgments, and relative frequency judgments.

An examination of subjects' mean estimates reveals why the effects of instructional set and familiarity are stronger for the "hit" measure (absolute correct judgments) in contrast to the relative accuracy score (relative correct judgments) measure. Means for each frequency level are presented in Table 5. As can be seen, subjects judging unfamiliar songs appear to be overestimating the true presentation frequencies. This effect is apparent by considering the consistently higher mean estimates of the unfamiliar music conditions compared to the familiar music conditions, regardless of presentation frequency level. Persons judging unfamiliar music are inflating their estimates compared to persons judging familiar music.

The above analysis also revealed an interaction between familiarity and frequency level, $F\ (3,522)=4.27$, $p<.01$, as well as an interaction between instructions and frequency level, $F\ (6,522)=2.79$, $p<.05$.

TABLE 5

Mean Estimates, Actual Frequency, and Familiarity

Mean Frequency Judgments Overall as a Function of Presentation Frequency and Familiarity Condition

	Presentation Frequency				
Group	1	2	3	4	Overall
Familiar Music	1.09	2.49	2.93	3.35	2.47
Unfamiliar Music	1.73	2.95	3.88	3.92	3.12
Overall	1.41	2.72	3.41	3.63	

The familiarity by frequency level interaction was due to a "ceiling effect" exhibited by persons judging unfamiliar music. While the unfamiliar groups consistently overestimated the true frequencies of the presented items relative to the familiar groups, less overestimation occured for items presented four times. The instruction by frequency level interaction was due to the overall poor accuracy of the distractor groups. Relative to the other two groups (frequency and memory test), the distractor groups' estimates were higher at the low presentation frequency range, and lower near the high presentation frequency range.

Accuracy as a Function of Individual Knowledge Differences

Each subject in the experiment heard a "musical expertise" tape in which he/she was required to identify the names and performers of various contemporary rock songs. The identification (ID) score for each subject represented the number of times that that subject provided the correct title of a song, or the correct performer of a song. These correct identifications were summed for each subject. Since there were 15 songs on this tape, a possible ID score range for each subject included 0 to 30 correct identifications. Subjects within each of the six groups were rank ordered according to their ID scores. The middle two ranks in each group were dropped in order to prevent ties. Subjects above the median in each group represented "high knowledge" persons, and subjects below the median represented "low knowledge" persons.

The hit scores for each subject were then analyzed using a 2(familiarity) X 3(instruction) X 2(music knowledge) analysis of variance. The results from this analysis confirmed a main effect for instructional set, F (2,156)=22.98, p <.01, a main effect for familiarity, F (1,156)=68.39, p <.01, in addition to a main effect for music knowledge, F (1,156)=8.88, p <.01. This analysis revealed no interactions. Means for twelve groups are presented in Table 6.

Therefore subjects with high music knowledge, as operationalized by their ability to identify the titles and performers of popular songs, were more accurate in their judgments of absolute frequency than subjects low in music knowledge.

A similar analysis was performed on subject's relative accuracy scores (represented by transformed- r scores). The results again showed significant effects for music knowledge, F (1,156)=7.02, p <.05, familiarity, F (1,156)=5.31, p <.05, and instructional set, F (2,156)=3.72, p <.05. No interactions were obtained. Means for 12 groups are presented in Table 7.

As with the instruction and familiarity variables, relative accuracy scores exhibited a weaker effect than hits, for the music knowledge variable. Therefore, music knowledge seems to affect absolute frequency judgment accuracy more than relative frequency judgment accuracy. Results from these analyses suggests that the individual difference variable of stimulus knowledge affects frequency judgment accuracy.

As above, a 2(familiarity) X 3(instruction) X 2(music knowledge) ANOVA was performed on correlations between each item's true and estimated frequency for each subject. Mean correlations for the twelve groups are presented in Table 8.

TABLE 6

Hit Accuracy and Music Knowledge

Mean Hits as a Function of Music Knowledge, Familiarity, and Instructional Set

	High Knowledge		Low Knowledge	
Group	Familiar	Unfamiliar	Familiar	Unfamiliar
Frequency	8.71	5.21	6.71	4.43
Memory Test	7.71	4.07	6.50	3.28
Distractor	5.07	2.71	3.86	3.00
Overall	5.58		4.63	

TABLE 7

Relative Accuracy and Music Knowledge

Mean Relative Accuracy Scores as a Function of Music Knowledge, Familiarity, and Instructional Set

	High Knowledge		Low Knowledge	
Group	Familiar	Unfamiliar	Familiar	Unfamiliar
Frequency	1.83	1.48	1.62	1.15
Memory Test	1.85	1.34	1.41	1.62
Distractor	1.49	1.46	1.14	.90
Overall	1.57		1.31	

TABLE 8

Mean Correlations and Music Knowledge

Mean Correlations Between Estimated and Actual Frequency for Twelve Groups as a Function of Instructional Set, Familiarity, and Music Knowledge

	High Knowledge		Low Knowledge	
Group	Familiar	Unfamiliar	Familiar	Unfamiliar
Frequency	.75	.57	.65	.46
Memory Test	.74	.51	.59	.52
Distractor	.45	.51	.42	.32
Overall	.59		.49	

Results from this analysis revealed a main effect for familiarity, *F* (1,156)=18.53, *p* <.01, a main effect for instructional set, *F* (2,156)=18.25, *p* <.01, as well as a main effect for music knowledge, *F* (1,156)=12.58, *p* <.01. Again, subjects high in music knowledge were more accurate in their estimates of frequency than subjects low in music knowledge. This analysis also revealed an interaction between instructional set and familiarity, *F* (2,156)=3.22, *p* <.05, as did earlier analyses.

In addition to the above analyses, within group correlations were obtained between subjects' identification scores, and the accuracy measures of hits, transformed- *r* and item correlation scores, respectively. These correlations are presented in Table 9.

In agreement with results from previous analyses, correlations between accuracy and identifications tended to be greater for the intentional processing (frequency and memory test) groups then for the distractor groups. Similarly, these correlations tended to be greater for the familiar groups then for the unfamiliar groups. Although these results were not uniform across all measures, the hit measure revealed these trends most strongly. This fact agrees with the results of prior analyses which showed the superiority of the hit measure in reflecting accuracy differences.

TABLE 9

Correlations Between Accuracy Measures and ID Scores

	Hits		Transformed-r		Item Corr.	
Group	Fam.	Unfam.	Fam.	Unfam.	Fam.	Unfam
Frequency	.42	.14	.14	.33	.35	.29
Memory Test	.37	.18	.45	-.28	.64	-.01
Distractor	.22	.05	.13	.28	.08	.38

Note: Higher correlations represent greater a relationship between accuracy and identification.

Music Knowledge Differences Between Groups

It was important to establish that subjects in each of the six experimental conditions did not differ in their average music knowledge. For example, consider a case where one group is outstanding in terms of of music knowledge, compared to the other five groups. This fact alone could account for frequency judgment accuracy differences which might otherwise be attributed to instructional set or familiarity.

The ID sum scores for all subjects were analyzed via a 2(familiarity) X 3(instruction) analysis of variance. The absence of any significant relationships in this data suggests that each group was equivalent in terms of its overall music knowledge. Other relationships obtained are thus not attributable to knowledge differences between groups.

Analysis of Zero-Presented Items

Since it is suggested that the judgment decisions involved in judging zero-items and once through four times-presented items are fundamentally different, the data for each of these were analyzed separately. Hits on zero-items for the six groups were analyzed using a 2(familiarity) X 3(instruction) analysis of variance. The results showed no differences between the groups in their ability to judge whether or not a song was previously presented.

Each subject's mean frequency estimate for the zero-items was then analyzed using a similar ANOVA. Again, no significant differences were obtained. Regardless of stimulus familiarity or orienting instructions, subjects appear to be equally accurate in terms of judging whether or not a song was presented earlier.

Regarding the effect of music knowledge on estimates for zero-items, a 2(familiarity) X 3(instruction) X 2(music knowledge) analysis of variance was performed on each subject's mean estimate for the zero-items. The results from this analysis showed that persons high in music knowledge were better able to judge whether or not a song was previously presented, than persons low in music knowledge, F (1,156)=4.31, p <.05. Results from this analysis also revealed a main effect for instructional set, F (2,156)=3.43, p <.05. The main effect obtained for instructional set appears to contradict results from the above analysis. However, in the present analysis, 12 subjects (two from each group) were dropped, thus reducing the variability of the groups. This caused the otherwise non-significant result to barely reach significance. Subjects were dropped in order to prevent ties in the median-split for high versus low music knowledge. The effect obtained in this analysis was due to the distractor groups' overestimation of the zero-items. For the distractor conditions, the average estimate for zero-items was .54, compared to average estimates of .33 and .21 for memory test and frequency groups, respectively. Subjects low in music knowledge tended to inflate zero-item estimates, thus paralleling results from the unfamiliar stimulus condition.

A similar ANOVA performed on hits for zero-items provided confirming results regarding the superiority of high music knowledge persons. Subjects high in music knowledge were more accurate in terms of recognizing a song that was not previously presented , compared to subjects low in music knowledge, $F\ (1,156)=26.47$, $p<.01$.

Effect of Song Presentation Order on Frequency Judgments

A sample of songs used in the present experiment was selected and tested for any effects of song presentation order on frequency estimation. For each frequency level, frequency judgments of songs in the first half of the audio presentation (block A) were compared to frequency judgments of songs in the second half of the audio presentation (block B). Within each experimental condition, half of the subjects heard block A followed by block B, and the other half of the subjects heard block B followed by block A. A series of t -tests on mean estimates for each frequency level for both blocks revealed no significant differences. For example, "Jump" was a twice-presented item. Mean frequency estimates of this song when it was presented in block A were compared to mean frequency estimates when it was presented in block B. Therefore, mean frequency estimates were compared within songs, or across blocks. These estimates did not differ significantly. Songs in one block were not over- or under-estimated compared to songs in the other block. This finding suggests that the effects on frequency judgment accuracy are not due to the order of presentation of the songs or to peculilarities within the particular list of songs.

Cover Task Effectiveness

To verify the effectiveness of the distractor manipulation, the mathematical aptitude tests (used as a cover task) were scored for percentage of items completed, as well as percentage of items correct. Sixty subjects (thirty in the familiar-distractor group and thirty in the unfamiliar-distractor group) attempted the math test. The average completion rate for subjects, out of 53 possible problems, was 42 problems attempted, with a range of 29 to 53 (four persons attempted every problem). This result suggests that the test was challenging enough to occupy the subjects for at least the 18-minutes required to hear the "presentation " tape. The scoring of a random sample of the math skills tests revealed an average correct answer score of greater than 89 percent. Although there is no base to use as a comparison, this result clearly suggests that subjects were attending to the cover task, and performing it at a satisfactory level. The cover task appeared to be effective, as evidenced by the performance attempts exhibited by the subjects thus verifying the incidental nature of the distractor condition.

CHAPTER V

CONCLUSIONS AND DISCUSSION

Instructional Set

The importance of carefully examining and defining task instructions is highlighted by Kausler, Lichty, and Hakami (1984). For example, these authors state that evidence for support of an automatic processing of frequency information hypothesis derives mostly from studies indicating equivalent performance levels on frequency judgment tasks in which subjects are told of an upcoming frequency estimation test, or told of an upcoming unspecified memory test. However, these authors criticize this methodology because subjects in both groups are informed in advance of item presentations that they will receive a subsequent memory test. Furthermore, these authors state that such conditions differ only in that the group informed of an upcoming frequency estimation task knows precisely what item attribute will eventually be tested, while the group informed of a "memory test" knows only that some unspecified item attribute will eventually be tested. "In either case, instructing subjects as to a future memory test is likely to activate a rehearsal strategy for processing items during the course of their presentations. That strategy may, in fact, be quite similar for the two instructional conditions, thus conceivably accounting for their comparable performance levels on the frequency judgment task "(p.660).

Rather, these authors are concerned with frequency estimation performance of groups who do not have any intent to memorize item information. Such groups would not experience any activation of a rehearsal strategy. Therefore, the orientation of Kausler, Lichty, and Hakami (1984) is similar to that of Greene (1984) in that a critical test of the automaticity of frequency information lies in a comparison between groups who are activating, or likely to activate, a rehearsal strategy, and groups not adopting a rehearsal strategy. Regarding the present experiment, the "distractor" condition represents what Greene (1984) calls "incidental", and what Kausler, Lichty, and Hakami (1984) call "truly incidental." While the terminology may differ, these labels all apply to the same experimental situation.

It is interesting to note a more historical point which is also highlighted by Kausler, et al.(1984), although they do not cite it as such. Essentially, they suggest that what was once evidence for the automatic processing of frequency information, may no longer be valid. Research examining differences between "frequency" and "memory test" conditions may merely be investigating similar processes delineated by different labels. Therefore, what was once evidence for automatic processing may now become an expected outcome. By expanding the nomological net of constructs (via inclusion of distractor, or no-rehearsal paradigms), the true conduct of automatic processes are more closely approximated.

Perhaps most importantly, the above authors show why it is crucial to thoroughly examine task instructions. The investigators must be sure that their experimental manipulations in fact reflect different cognitive operations. They must be sure that null effects obtained are not merely due to assessment of identical processes.

Results from the present experiment resemble those found by Greene (1984). Intentional learning groups are more accurate in their frequency judgments than incidental learning groups. While Greene interprets these findings as support for the claim that "there is no strong evidence for the automatic encoding of frequency information" (p.90), the issue may not be that simple.

While it is true that intentional groups perform better than incidental groups, it is useful to consider the groups' absolute performance. Although the distractor (incidental learning) group did not perform as well as the other groups, their performance was still rather good, especially when the nature of the task is taken into consideration. Recall that subjects in the distractor condition were performing a math test, told to ignore the music, and in one group, exposed to music they had never before heard. Despite the adversity of these conditions, subjects' mean estimates generally increased as true presentation frequencies increased. In addition, subjects' estimates in these groups were generally close to the true frequencies. Given this fact, it is difficult to entirely dismiss the claim that frequency information is processed automatically. Perhaps it is more appropriate to suggest that automatic cognitive processing, like any processing, may have its limits. However in the present experiment, while the limits surely were tested, some degree of automatic processing is still apparent.

A related issue concerns the differential reception of stimulus material between intentional and incidental learning groups. An argument could be made that persons in the distractor group are simply not receiving all of the stimulus information, and hence are not as accurate as other groups in judging frequency because they never get the information. However, such a claim seems invalid. Examination of analyses performed on the zero-items shows only a small difference between groups in their ability to judge these items. Incidental, as well as intentional learning groups appear equally able to recognize a song that they did or did not hear in a previous tape. Results from one analysis did reveal an effect for instructional set (however, the dropping of subjects in this analysis was responsible for a reduction in the groups' variability, causing the effect to barely reach significance). Except for this last finding, overall, the results suggest that the distractor groups are receiving and processing the information despite experimental instructions directed towards the inhibition of this process. Subjects appear to be processing some information despite their conscious effort to ignore the information.

Fisk and Schneider also found differences in frequency judgment accuracy between groups who processed information under different orienting conditions. These authors interpret the lack of differences observed by Hasher and Zacks (1979) as due to frequency encoding showing an early asymptote and little benefit from extended periods of controlled processing. "Hence, we suggest that what Hasher and Zacks refer to as 'automatic encoding' be interpreted as early asymptotic controlled process encoding of event frequency" (p.189).

The point to be taken from such an exchange, as well as from the results of the present study, is that at what point do we consider a process automatic or controlled (non-automatic)? Hasher and Zacks, Greene, and Fisk and Schneider appear to interpret the facts by adopting different criteria for automaticity. Similarly, do the results from the present study tend to support or disconfirm an automatic processing theory of frequency information ? According to Hasher and Zacks (1979), automatic processes should be unaffected by other controlled processes operating concurrently. Yet in the present study, the distractor group did experience a processing decrement as a function of other controlled (math test performance) processing. Should this result cause one to dismiss an automatic processing theory of frequency information despite the fact that persons in the distractor group were obviously still processing frequency information automatically to some extent ?

Regardless of the criteria which an investigator adopts for considering information processing automatic, the problem of explaining the decrement in distractor (incidental learning) groups' frequency judgment accuracy still remains. Why did subjects in the distractor groups perform more poorly than the subjects in the other groups in terms of frequency judgment accuracy ?

The possibility that these groups are not receiving information has already been ruled out, via analysis of the zero-presented items. Similarly, analyses of music knowledge scores suggest that this variable can not be causing the differences obtained between groups. The only other two viable factors possibly affecting frequency judgment accuracy in distractor conditions are the "ignore" instructions or the distractor task itself.

It is doubtful that the mathematical skills test in and of itself could be responsible for the distractor groups' decrement. It is argued that listening to music and solving math problems are tasks that are extremely different, and hence unlikely to interfere with one another (compare the above tasks to learning word lists while performing reading comprehension tests, or other high-interference paradigms).

The last viable alternative is to consider the fact that telling subjects to ignore the material somehow affects the processing of frequency information. In such a case, subjects are presumably making a conscious attempt to avoid the musical stimuli. This controlled, conscious processing does seem to affect the automatic processing of frequency information, albiet to a small degree. Again the issue becomes one of criteria. It is necessary to examine what implications that the above results have for an automatic processing theory of frequency information. Perhaps the most reasonable implication involves pointing out that an automatic process is not simply "unaffected" by orienting instructions. Alternatively, it is suggested that automatic processes represent a generally robust phenomena, even though under some circumstances, this capacity can be diminished. An automatic processing theory of frequency information is not to be discarded, but revised. Such a revision would include delineating the conduct of automatic processes when pressed to their limits.

Stimulus Familiarity

A similar argument can be made for the effects of stimulus familiarity on frequency judgment accuracy. The key analyses relating to a "familiarity effect" involve the absolute (hit) and relative accuracy scores. Groups judging familiar music are more accurate than groups judging unfamiliar music in terms of both absolute frequency judgments, and relative frequency judgments.

The differences obtained are accountable for by a tendency for the groups judging unfamiliar music to overestimate item's presentation frequencies. The explanation for such a result involves what will be called a "pooling of frequency information." It is suggested that subjects hearing unfamiliar music are less able to discriminate between different songs than subjects hearing familiar music. Familiar songs are more distinct than unfamiliar songs. Familiar songs have been cognitively elaborated upon with repeated exposure over time. Unfamiliar songs have not had such elaboration or establishment in memory, and hence may "sound alike". Since such songs are "similar sounding", subjects tend to think that they heard a song more than they actually did. As such, presentations of similar sounding songs, generally lacking a discrimative element at that point, are pooled with the to-be-judged (critical) item. As a result, while the relative frequencies remain unaffected (for, example, items presented three times are judged as occurring more than items presented two times) the absolute frequencies are inflated due to a "pooling effect."

A re-examination of Table 5 highlights this issue. The grand mean for actual presentation frequencies is 2.5. The marginal mean for estimated frequency for familiarity conditions is 2.47 which is very close to the expected or actual mean. In contrast, the marginal mean for estimated frequency for unfamiliar conditions is 3.12. Such a difference between groups judging familiar versus unfamiliar music suggests that the latter subjects "heard" more songs than were actually presented. It is suggested that these results occurred because subjects were hearing more new information in the unfamiliar conditions. This new information, not yet discriminable, caused subjects to perceive some different songs as sounding alike. Therefore over many such judgments, a single presentation of a song will be counted, or estimated more than once. For example, consider a subject who perceives songs A and G as sounding alike. When song A is to be judged, presentations of songs A and G are combined when judgments are made. Similarly, when song G is to be judged, presentations of songs G and A are combined when judgments are made.

While such estimate inflation may not be grand in scale, the above results clearly show that overestimation is occurring and, hence, has implications for automatic processing theories. Again, does the fact that familiarity of stimulus material affects frequency judgment accuracy necessarily suggest that frequency information is not processed automatically ?

As with a discussion of the effects of instructional set on frequency judgment accuracy, it is suggested that an automatic processing theory be revised to include the qualification that although generally a robust phenomenon, automatic processing may be impaired under conditions in which a great deal of new information is presented. Again, the conduct of automatic processes are further delineated when pressed to their limits.

The importance of meaning, or semantic value of a stimulus in mediating frequency information processing is highlighted by Rao (1983), who examined the "word frequency effect" in situational frequency estimation. Rao's investigation deals with linguistic frequency, which refers to the frequency with which words are encountered in everyday life. A general finding is that linguistic high-frequency (HLF) words are better recalled than are linguistic low-frequency (LLF) words. "But in recognition memory, LLF words are better recognized than are HLF words. The finding that LLF words are better recalled whereas HLF words are better recognized is commonly refered to as the word frequency effect"(p. 73). It is argued that there is a great deal of similarity in the processing of recognition and frequency information, in addition to the similarity of their respective testing procedures. Rao suggests that if this unitary processing view is correct, manipulation of intrinsic characteristics of the item used such as concreteness of meaning and linguistic frequency would be expected to produce the same kind of effects in situational frequency judgment as it would in item recognition.

In a series of experiments designed to examine the relationship of nonwords (items of the lowest possible frequency of occurrence) to the word frequency effect, Rao (Exp. 2) discovered an overall greater estimation of nonwords. Results included the finding that at high situational frequencies, nonwords were given higher frequency estimates than LLF words.

One hypothesis offered as an explanation for these results is that the intrinsic item characteristics of richness and meaning, and pronounceability could affect frequency estimation. Rao cites Ghatala, et al. (1975) who demonstrated that when linguistic frequency is held constant, the more meaningful items are given more accurate estimates. It is suggested that there are at least three item factors that could favor accurate situational frequency estimation: low linguistic frequency, high pronounceability, and high semantic content.

Another experiment was conducted to test the prediction that pronounceable nonwords should be given more accurate and discriminal frequency estimates than should unpronounceable nonwords (Rao, Exp. 3). Results from this investigation revealed greater frequency estimate accuracy for pronounceable nonwords than for unpronounceable nonwords, in addition to overall superior discriminability of pronounceable nonwords. Rao concludes, in agreement with the theoretical inferences drawn by other investigators, that meaning is an important modifier of the word frequency effect. He suggests that if this were not the case, pronounceable nonwords would have been given more accurate and discriminal frequency estimates than those given to LLF words.

The results from Rao's experiment concurs with those of the present study on two counts: (1) items lacking in meaningfulness tend to be overestimated, and (2) these meaningfulness effects may be related to the discriminability of the critical items used in the estimation task. It is argued that although familiar music in the present esperiment is analogous to Rao's HLF words, unfamiliar music is analogous to his nonwords. This is the case because background frequency, in and of itself, is not the only mediator of frequency estimation accuracy: the meaningfulness dimension must also be taken into consideration as an intrinsic item characteristic mediating the accuracy of frequency judgments. In the present study, highly unfamiliar music is "nonmusic" (to integrate Rao's terminology) since it has little meaning and hence lacks discriminability.

Instructional Set and Familiarity Interaction

ANOVA's performed on the correlations between true frequency and estimated frequency for each subject, and for hits for once through four times-presented items yielded an interaction between instructional set and familiarity. This effect was due to the fact that subjects judging familiar music were more accurate than subjects judging unfamiliar music in the frequency and memory test groups, but were not more accurate in the distractor group. Stimulus familiarity therefore had its greatest effect for frequency and memory test groups. Subjects in the distractor (incidental) conditions did more poorly than the other conditions, regardless of stimulus familiarity.

Two alternative hypothesis can be offered to account for the above interaction: (1) the incidental nature of the distractor condition was salient such that the processing of frequency information was inhibited regardless of stimulus familiarity, or (2) a "basement effect" was present in the distractor conditions judging unfamiliar music. The first of these hypotheses would suggest that because of the nature of the incidental task (i.e., the controlled processing of another concurrent stimulus), one should not expect to find great differences between groups in this condition because any processing of frequency information is likely to be inhibited. Stimulus familiarity would therefore not differentially affect groups because of the a priori strength of the incidental task itself.

The second of these hypotheses, the basement effect, would argue that subjects in the unfamiliar music-distractor condition simply could not perform more poorly on this task. In such a case, the task itself puts a lower limit on subject's accuracy performance. Recall that the present experiment had only four frequency levels: items were presented once, twice, three times, and four times.

The utility of these competing hypotheses could be assessed through an experiment similar to the present one. Such an experiment would simply raise and expand the range of frequency levels thus allowing the unfamiliar music-distractor group to estimate frequency without a lower limit imposed by the task (for example, frequency levels might be 5, 10, 15, and 20 times presented, respectively). If no difference is found for familiarity within the distractor condition, then the basement effect could be given less credence.

In summary, it is argued that the math test present in the distractor condition restricts the meaningful processing of the music information, overall. Although this information is processed to some degree, the math test prevents full semantic elaboration of the music, regardless of its familiarity.

Other Interactions

One set of interactions was obtained between familiarity and frequency level. This result was due to a "ceiling effect" exhibited by persons judging unfamiliar music. While the unfamiliar group had a tendency to overestimate the true presentation frequencies of items relative to the familiar group, less overestimation occured for items presented four times. That is, subjects judging unfamiliar music exhibited less overestimation at the high presentation frequency level. While subjects in the unfamiliar groups were generally less accurate than subjects in the familiar groups, they nevertheless developed a sense of the range of frequencies with which items were presented. Given this knowledge about the presentation frequency range, they were reluctant to make estimates that went beyond that range. This effect could be expected to occur regardless of the true range of presentation frequencies. For example, if items were presented once through thirty times, less overestimation would probably occur at the high end (25 to 30 times-presented) of the range, for subjects judging unfamiliar music.

A second set of interactions was obtained between instructions and frequency level. This result was due to the poor discrimination performance of the distractor conditions. Examination of the distractor groups' performance relative to the other two groups (frequency and memory test) reveal the former to exhibit less discriminability. For the low presentation frequencies, the distractor groups' estimates were higher than for the other two groups. Similarly, for the high presentation frequencies, the distractor groups' estimates were considerably lower than the other two groups. The relative lack of discriminability present in the distractor groups was responsible for the above interaction.

Music Knowledge as an Individual Difference

Results from the present experiment suggests that persons who "know more" about popular music are more accurate in their frequency judgments of musical stimuli than persons who know less about popular music. While the measure of music knowledge only involved identifying the titles and artists of popular songs, it is argued that persons able to make such identifications are "well versed" in popular music. It is remarkable that these "high knowledge" persons were often able to to give the name and performer of songs after hearing only about 7-seconds of an instrumental beginning, and then having only about 5-seconds to decide on and write down their identifications. Persons able to perform this task must surely be knowledgable of popular music.

Music knowledge as operationalized in this experiment also includes a familiarity component. In this sense, results from the music knowledge analyses reinforce that of the stimulus familiarity results. However this measure surely includes more than just a familiarity component. Available memory reserves of sounds, performer names, group names, song titles, and song lyrics are required to perform the identification tasks.

Subjects with knowledge of these components are better able to judge frequency than those without such knowledge. It is argued that songs for the high knowledge group are distinctive, salient, familiar, and have an affective component which enables persons to readily differentiate between songs. In a sense, persons low in music knowledge are similar to subjects in the unfamiliar song conditions. In both cases, songs simply lack distinctiveness and hence remain undiscriminated. If such songs are not discriminable, frequency judgments will experience an accuracy decrement.

While persons high in music knowledge have cognitive musical structures which enable them to assimilate and recognize a good deal of new, incoming information, persons low in music knowledge are overwhelmed by the same information. Much in the same way that a chess expert can recognize and remember piece positioning on a chess board better than non-chess players, musical "experts" possess a facility superior to that of non-musical experts for processing musical information. It is argued that this facility enables more knowledgable persons to articulate differences, and thus discriminate between similar instances or elements of a given event class.

It is interesting to note that regardless of instructional set or familiarity condition, subjects were equally able to tell whether or not they had heard a song previously, but subjects high in music knowledge showed increased discrimination ability on this task (as evidenced by zero-item analyses). This fact could also be used to argue for an "expertise" effect. While all subjects are generally good regarding the discrimination task of song recognition, persons high in music knowledge, the "experts", exhibited discrimination ability for music beyond that of non-experts. In fact, examination of the grand mean for zero-item hits, for high-knowledge subjects revealed that they rarely made an error (a grand mean of 3.65 hits, compared to a perfect mean of 4.00, for 84 subjects). This statistic is based on the number of zero-items estimated by each subject. That is, four new songs were heard in the test tape that were not heard in the presentation tape (representing the zero-items). For this "zero" frequency level, a perfect score would be represented by a hit on each of the four songs within that frequency level. Similarly, overall means are also based on this four-item statistic. It is clear that persons high in music knowledge possess a discrimination ability for music which is above and beyond that of persons without such knowledge.

Musical Selections as Event Stimuli

The use of musical selections as stimulus events has expanded upon the body of knowledge relating to automatic processing. Incorporating musical stimuli into the present experiment has proven to be fruitful for two reasons; (1) the automatic processing of frequency information has been shown to be apparent for a set of events other than verbal and pictoral stimuli, and (2) even though automatic processing is apparent, the limits of such processing have begun to be delineated.

On the one hand, it is remarkable that persons judging unfamiliar music while taking a math test and told to ignore the music, are still fairily accurate in frequency estimation tasks. In this sense, the automatic processing of frequency information is a robust phenomenon. On the other hand, circumstances have been investigated which suggest that the automatic processing of frequency information may be vulnerable to other, non-automatic processing factors thus challenging Hasher and Zacks (1979) proposition in its current form.

The results from this experiment, like that of Rose and Rowe (1976), Greene (1984), and Fisk and Schneider (1984) show that instructional set can influence frequency estimation accuracy. In addition, it has been shown that persons judging familiar music are more accurate in frequency estimation tasks than persons judging unfamiliar music. Finally, persons with greater music knowledge are also more accurate in frequency estimation tasks than persons lower in music knowledge. The results from the present experiment suggest that while a straightforward theory of automatic processing of frequency information may be appropriate for verbal learning, this theory could be revised to include limitations when other event classes are considered. The use of musical stimuli in this experiment is a further step towards expanding the generalizability of automatic processing theories.

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APPENDIX A

MEAN FAMILIARITY RATINGS AND SUM ID SCORES FOR SONGS

Musical Selection	Mean Familiarity Rating	Total ID Score
One Thing Leads To Another	6.37	36
Let's Hear it for the Boy	6.19	57
Jump	6.09	79
I Want a New Drug	6.00	62
Against All Odds	5.95	47
Thriller	5.93	87
Maniac	5.80	38
Owner of a Lonely Heart	5.63	41
Footloose	5.58	58
Centerfold	5.28	41
Too Much Time On My Hands	5.17	37
Urgent	5.06	32
Heat of the Moment	5.04	16
Start Me Up	4.87	51
Born to Run	4.37	40
Curly Shuffle	4.28	39
Shake It Up	4.13	42
Don't Tell Me You Love Me	4.13	13
Modern Love	3.89	33
In a Big Country	3.78	38
Gettin' Ready	2.17	1
Makin' Magic	1.87	0
Keep On Playin' That Funky Music	1.80	0
Our Song	1.80	0
Let Me Love You Once Before You Go	1.78	0
Caroline	1.74	0
Young Man	1.69	0
Such a Woman	1.61	0
Surf's Up	1.58	0
Black Cat Shuffle	1.56	0
Tip of My Tongue	1.54	0
Give Me Your Money, Honey	1.50	0
What's He Got	1.37	1
Your Back Yard	1.37	0
Hard Luck	1.28	0
What You Gonna' Do	1.28	0
Under the Gun	1.26	0
Open Up the Door	1.26	0
Rocket Roll	1.08	0
Recycled	1.02	0

APPENDIX B

DATA USED IN ANALYSES

Subject	Presentation Frequency					ID
	0	1	2	3	4	
			I. Familiar-Frequency			
1	1 1 0 0	1 0 0 1	1 0 0 0	3 0 5 3	3 3 1 2	12
2	0 0 0 0	0 1 1 1	2 3 0 2	3 3 4 3	5 3 2 4	10
3	1 0 2 0	5 1 0 1	2 4 3 2	3 4 3 1	6 2 2 2	7
4	0 0 1 0	1 1 1 1	2 3 2 2	4 3 3 2	4 3 3 3	29
5	0 0 0 0	1 1 1 1	2 4 1 2	2 3 3 2	3 2 4 4	20
6	0 0 0 0	1 2 1 1	4 5 2 3	3 4 4 5	4 5 3 4	10
7	0 0 0 0	1 1 1 1	2 2 1 1	3 3 3 3	4 4 5 2	25
8	0 0 0 0	2 1 1 1	4 3 4 3	3 3 2 3	4 3 2 4	26
9	0 0 0 0	1 1 1 1	2 3 1 2	2 3 2 3	4 4 2 3	28
10	0 0 0 0	1 1 1 1	3 1 2 2	2 2 3 3	5 3 3 5	27
11	0 0 0 0	1 1 1 1	2 2 2 3	3 2 3 2	3 3 1 4	23
12	3 1 3 1	2 1 2 1	4 3 2 3	3 4 3 2	4 3 2 4	12
13	0 0 0 0	1 1 2 1	2 3 3 0	2 2 4 3	4 4 4 4	19
14	0 0 0 0	1 1 2 1	4 4 2 2	4 2 4 3	3 3 3 6	11
15	0 0 0 0	1 1 1 3	3 4 2 2	2 3 1 4	3 4 3 4	22
16	0 0 0 0	1 1 1 0	4 4 5 4	3 5 1 2	7 5 7 8	28
17	0 0 0 0	0 2 0 1	3 5 3 2	3 4 4 3	4 3 4 5	19
18	0 0 1 0	0 1 1 1	3 2 3 1	2 4 4 2	2 3 3 4	2
19	2 0 0 1	0 1 0 3	4 2 2 0	3 2 5 5	5 3 4 6	7
20	0 1 0 0	0 1 0 1	2 3 2 0	2 1 3 2	4 3 2 2	12
21	2 0 0 0	0 1 1 1	2 3 3 3	3 3 2 3	7 2 4 3	6
22	0 0 0 0	1 1 2 1	3 1 2 1	3 2 3 2	4 4 3 5	27
23	0 0 0 0	1 1 1 1	3 2 2 2	3 3 3 2	3 4 4 3	26
24	0 0 0 0	1 1 1 1	2 3 2 1	3 2 3 2	3 2 1 3	10
25	0 0 0 0	1 1 1 1	3 2 2 2	3 4 4 5	3 2 5 2	18
26	0 0 0 0	1 1 1 1	2 2 1 1	3 4 2 2	3 5 5 4	21
27	0 0 0 0	0 1 1 1	2 4 1 1	3 3 3 1	3 4 2 4	13
28	0 0 0 0	1 1 1 1	5 3 3 2	4 4 3 4	5 4 5 5	30
29	0 0 0 0	1 1 0 1	4 4 2 2	4 3 4 3	4 4 4 4	22
30	0 0 0 0	1 1 3 1	2 5 1 1	2 3 3 2	2 2 2 3	26

II. Familiar-Memory Test

1	0 0 0 0	1 1 1 1	3 4 2 2	2 4 4 3	3 3 3 5	23
2	1 0 0 0	1 1 3 1	3 2 3 3	2 3 3 2	5 4 3 5	16
3	0 0 2 0	1 1 1 2	3 2 3 2	3 2 1 1	5 2 0 4	12
4	0 0 0 0	1 1 1 2	2 4 3 2	3 3 4 4	5 6 2 5	25
5	1 0 1 1	3 1 0 1	6 4 6 3	3 4 3 3	5 1 4 4	0
6	0 0 0 0	0 1 1 1	2 3 3 1	2 3 2 2	5 3 2 4	13
7	0 0 0 0	0 1 0 0	3 3 1 1	3 3 3 1	5 4 3 4	20
8	0 0 0 0	0 1 1 1	3 3 3 2	3 2 2 4	4 4 4 5	22
9	2 0 1 0	2 1 2 3	5 4 2 2	5 4 6 5	6 3 5 5	9
10	0 0 0 0	1 1 1 1	2 2 1 2	2 2 3 3	5 3 2 4	23
11	0 0 1 0	1 1 2 1	2 2 2 2	4 3 2 1	4 3 2 4	18
12	0 0 0 0	1 1 0 1	4 3 2 2	3 3 4 1	4 2 2 4	16
13	0 0 0 0	1 1 1 1	5 2 2 2	3 4 2 6	4 4 3 4	20
14	0 0 0 0	0 2 0 1	4 3 2 3	3 1 5 1	6 1 1 6	4
15	0 0 0 0	1 1 0 0	3 2 2 0	4 2 3 2	4 3 3 4	19
16	2 0 2 3	1 3 0 3	7 5 8 4	3 5 6 4	4 4 7 4	1
17	0 0 1 0	1 1 2 1	2 3 2 1	3 2 3 1	3 4 3 3	18
18	0 0 0 0	1 1 1 2	3 3 3 2	4 3 4 2	5 4 4 3	27
19	0 0 0 0	1 1 2 1	4 7 3 2	5 4 6 5	3 4 5 3	24
20	0 0 0 0	1 1 0 1	4 3 4 6	6 4 1 3	5 7 1 7	25
21	1 0 0 2	1 0 0 2	2 3 1 2	2 3 2 2	1 2 3 5	6
22	0 0 0 0	1 1 1 1	2 4 3 1	5 3 5 3	3 4 6 3	29
23	0 0 0 0	1 1 0 1	2 3 2 1	3 1 3 3	1 2 2 3	10
24	0 0 0 0	1 1 1 1	2 4 3 3	3 3 3 2	3 4 4 4	23
25	2 0 0 0	0 1 3 2	3 4 2 2	3 3 3 4	4 2 3 3	3
26	1 0 0 0	1 1 2 1	2 3 2 2	3 4 2 3	4 3 3 3	13
27	0 0 0 0	1 3 1 1	2 3 2 4	4 3 4 4	4 4 3 5	27
28	0 0 0 0	1 1 2 1	3 5 2 2	3 3 3 2	4 3 3 3	27
29	0 0 0 0	1 1 1 1	3 4 2 2	5 3 7 2	5 7 6 3	26
30	2 0 0 0	1 1 3 0	3 3 2 2	4 3 2 3	3 4 3 4	10

III. Familiar-Distractor

1	0 0 0 0	2 3 1 2	2 3 1 3	5 5 6 3	6 4 0 6	27
2	0 0 0 0	0 1 0 0	3 4 2 3	5 4 3 4	3 2 0 3	14
3	0 0 0 0	2 1 0 0	3 2 1 1	3 1 4 2	2 5 0 4	18
4	0 0 0 0	1 1 1 1	1 2 1 1	4 2 2 1	3 2 2 1	28
5	0 1 2 2	2 1 2 0	1 6 3 1	2 3 2 1	3 4 4 3	21
6	0 0 2 3	2 1 2 0	4 2 4 0	3 3 2 1	3 1 3 0	4
7	1 0 1 0	0 0 0 1	3 0 1 3	2 3 3 3	3 1 2 3	0
8	1 0 0 0	0 2 1 2	5 4 3 3	2 4 2 4	6 5 3 1	12
9	0 0 0 2	1 2 1 3	2 3 3 0	2 4 3 1	1 4 2 1	28
10	0 0 0 0	2 1 0 4	3 4 3 4	3 5 5 6	6 4 6 5	22
11	0 0 0 1	0 0 1 1	2 2 1 0	3 3 1 1	1 1 2 2	17
12	0 0 0 0	1 1 1 1	3 4 2 2	3 5 5 3	5 4 2 5	28
13	0 0 0 0	1 1 1 2	3 4 2 1	2 1 4 1	3 3 1 3	30
14	0 1 0 2	1 1 0 2	1 2 0 1	2 1 2 2	2 0 1 3	6
15	2 1 2 1	1 3 3 2	2 2 3 2	1 3 3 2	2 4 4 3	3
16	0 0 0 0	1 1 0 0	1 2 2 1	2 2 1 2	2 0 1 1	7
17	3 0 0 0	2 2 1 1	2 4 3 2	3 1 1 3	4 1 1 3	18
18	0 0 0 1	0 1 0 0	2 3 2 0	5 1 2 3	1 4 3 2	3
19	0 0 0 0	1 1 2 1	3 5 0 0	5 2 2 2	4 3 4 2	20
20	0 0 0 2	1 1 0 1	2 2 1 2	1 2 1 2	2 3 2 3	14
21	0 0 0 0	1 1 2 1	3 6 1 0	5 2 2 2	4 6 3 3	20
22	0 0 0 0	0 3 1 2	2 3 3 0	3 2 2 2	2 1 3 3	17
23	1 0 0 1	0 1 0 1	2 2 1 0	1 1 2 1	3 1 1 1	7
24	0 0 1 2	0 3 0 2	0 3 2 3	2 2 3 3	2 3 3 3	5
25	1 0 0 3	0 5 0 2	4 1 2 2	6 1 6 4	5 2 4 3	11
26	2 0 0 0	0 1 1 1	0 3 2 2	3 4 2 2	3 1 3 1	13
27	0 0 0 0	0 1 0 1	0 3 1 1	1 2 4 4	3 2 2 2	11
28	0 0 0 0	1 1 2 2	3 0 2 2	2 3 3 0	1 4 4 2	20
29	0 0 0 2	0 3 2 2	0 5 2 4	2 5 3 3	4 3 4 3	8
30	0 0 3 0	3 5 0 2	10 8 8 4	6 4 10 3	8 5 4 5	11

IV. Unfamiliar-Frequency

1	0 0 0 0	1 4 1 1	5 2 311	810 7 2	413 510	14
2	0 0 0 1	2 3 1 0	1 3 3 3	5 4 3 1	4 6 2 3	28
3	0 0 0 1	2 2 2 2	3 4 4 4	4 4 3 3	5 5 3 3	14
4	1 0 0 0	1 4 1 1	2 3 1 4	3 4 4 2	5 4 5 6	24
5	0 0 0 0	1 2 0 1	2 1 2 2	4 4 5 1	3 3 3 5	21
6	0 0 0 0	3 2 1 1	1 3 3 1	4 3 3 3	5 4 2 2	21
7	0 0 0 0	1 3 1 1	1 2 3 1	4 4 6 3	4 5 3 5	29
8	0 0 0 0	2 2 1 2	4 3 3 5	5 2 4 2	6 5 2 6	12
9	0 0 0 0	1 1 1 0	3 3 2 2	2 2 3 3	3 4 3 4	16
10	0 0 0 0	1 1 1 1	2 3 2 2	5 3 4 4	4 5 2 3	26
11	1 2 2 0	4 1 0 1	1 1 3 2	2 0 2 2	1 1 0 2	6
12	1 0 1 0	3 1 1 2	1 0 1 1	2 3 2 1	2 1 0 3	5
13	0 0 0 0	3 2 2 0	2 3 3 2	4 3 4 2	5 3 2 2	17
14	0 0 0 0	3 1 1 2	4 5 3 4	6 3 8 1	5 5 7 5	15
15	0 0 0 1	3 3 2 2	3 4 5 2	1 3 4 2	5 3 4 3	22
16	0 0 0 0	2 1 0 5	6 5 7 0	6 4 5 8	4 4 7 2	26
17	0 0 0 0	4 5 1 0	2 7 5 3	10 9 4 6	6 8 3 3	14
18	0 0 0 0	3 6 0 0	4 8 6 3	610 5 4	4 9 5 7	20
19	0 0 1 2	2 3 1 1	4 210 0	610 6 9	12 5 8 1	20
20	0 1 0 0	3 3 1 0	5 4 5 3	4 6 5 3	6 4 6 4	28
21	0 0 0 0	2 3 1 1	2 2 2 0	4 3 3 3	4 3 2 2	9
22	3 0 0 0	2 2 1 2	4 2 3 1	5 3 1 3	3 2 4 1	18
23	3 0 0 0	2 3 1 1	4 3 2 1	4 4 2 4	2 2 1 2	18
24	1 0 0 1	1 4 1 0	1 1 4 1	4 4 4 4	4 4 4 4	0
25	0 0 0 0	0 2 1 1	4 3 5 2	2 3 3 2	3 3 4 2	26
26	1 0 1 0	1 1 1 0	3 2 2 1	2 3 2 2	4 3 4 3	18
27	0 0 1 0	0 2 2 1	2 3 5 2	3 3 2 3	5 4 3 3	30
28	1 0 0 3	2 2 2 5	5 1 7 2	10 5 6 5	3 4 6 5	29
29	0 0 0 0	0 2 1 4	5 3 4 0	6 3 2 4	4 6 4 1	28
30	0 0 0 0	1 1 1 1	3 2 2 0	2 3 1 3	5 4 3 2	29

V. Unfamiliar-Memory Test

1	2 0 2 1	3 3 1 1	3 2 3 2	4 3 2 3	3 3 0 3	14
2	0 0 0 0	3 3 1 3	2 4 2 2	5 3 4 2	6 4 1 5	20
3	0 0 0 2	4 1 1 3	6 3 4 1	7 4 5 2	5 7 2 6	15
4	2 0 0 0	3 3 1 2	1 4 3 2	6 3 4 2	4 7 3 4	14
5	0 0 0 0	3 5 1 2	5 4 5 3	7 4 4 3	5 6 5 5	15
6	2 0 0 0	4 3 1 2	3 4 3 4	3 4 4 2	2 5 4 5	11
7	0 0 0 0	2 3 2 3	3 4 2 4	7 4 5 4	3 3 4 3	29
8	0 0 0 0	1 1 1 1	2 2 2 2	3 4 2 3	4 3 2 4	30
9	0 0 0 0	4 3 2 0	0 5 6 3	6 4 4 4	3 6 5 6	11
10	2 0 0 1	1 3 0 3	4 5 2 3	5 4 4 4	5 3 1 5	27
11	1 0 0 0	2 3 1 1	4 4 5 4	6 6 4 2	4 6 5 6	19
12	1 1 0 1	2 2 1 1	1 2 4 2	2 4 3 2	3 2 2 3	5
13	1 0 0 0	3 2 2 1	1 3 4 4	4 4 4 4	5 3 2 3	27
14	6 0 4 0	1 2 3 1	5 4 3 2	6 4 4 6	7 5 6 6	13
15	1 1 2 3	1 2 2 3	2 6 7 2	5 7 4 4	8 6 5 4	17
16	0 0 0 1	1 1 1 0	4 3 4 2	5 2 5 3	4 2 4 3	19
17	0 0 0 0	1 1 1 0	3 3 4 1	4 5 1 6	6 4 4 2	20
18	0 0 0 1	1 2 1 0	4 3 4 2	6 5 4 4	8 3 2 0	19
19	2 0 0 0	1 2 1 5	3 1 4 2	5 5 3 5	7 3 3 5	29
20	0 0 0 0	2 0 1 5	1 3 4 3	6 5 4 3	8 6 7 5	0
21	1 0 0 0	2 3 1 0	0 4 4 2	6 5 3 4	8 3 4 3	22
22	0 0 0 0	3 2 1 2	4 3 3 1	8 5 3 4	6 5 4 3	30
23	0 0 0 0	1 0 1 6	6 6 4 4	4 5 3 3	7 5 6 3	14
24	0 0 0 0	3 3 1 2	2 3 4 1	6 7 2 4	6 4 3 2	30
25	0 0 0 0	1 1 0 3	1 0 1 0	4 2 1 2	3 2 1 1	23
26	0 0 0 0	3 1 1 3	3 3 6 2	7 5 4 4	3 4 4 3	27
27	0 0 0 0	0 3 1 1	4 2 3 3	4 5 4 5	5 4 3 2	15
28	0 0 0 1	5 3 1 0	5 3 5 3	8 4 5 3	5 6 4 4	27
29	0 0 0 5	0 1 1 3	0 4 3 1	3 5 1 3	5 3 3 2	26
30	0 1 0 2	3 4 0 7	2 5 5 1	6 4 2 6	8 3 4 4	4

VI. Unfamiliar-Distractor

1	0 0 0 0	0 0 1 0	3 3 2 0	4 2 3 3	4 3 1 4	9
2	3 0 0 0	0 5 1 3	4 4 5 2	5 3 4 3	6 5 3 6	23
3	0 0 0 0	0 0 0 0	3 3 3 0	3 3 3 3	3 3 3 0	12
4	0 0 0 0	2 1 0 2	1 3 2 0	3 3 3 1	5 4 3 4	17
5	0 0 0 0	6 5 0 1	4 5 2 3	5 6 3 5	8 4 6 5	8
6	0 1 0 0	0 2 2 2	3 1 2 2	3 2 2 1	3 1 3 3	25
7	0 0 0 0	4 4 6 4	5 6 8 5	8 3 5 5	10 7 6 3	9
8	0 0 0 0	1 4 3 0	5 3 4 1	4 1 1 5	6 5 2 3	3
9	0 0 0 0	0 4 0 2	5 6 4 0	6 7 3 6	5 7 4 5	27
10	0 0 0 0	5 0 1 2	5 7 3 0	6 6 5 4	10 9 5 2	30
11	0 0 0 0	1 0 0 0	2 5 4 0	4 5 4 2	3 2 0 3	24
12	1 0 0 0	1 2 0 1	0 2 3 2	3 3 3 2	3 4 2 3	21
13	2 0 1 4	0 2 0 0	2 3 6 2	4 6 0 2	2 4 2 1	11
14	3 1 2 2	4 3 2 3	4 2 3 2	3 3 2 3	3 3 3 2	15
15	0 0 0 0	0 0 1 0	2 0 2 0	6 2 0 3	3 3 2 4	30
16	5 0 010	6 6 6 0	8 5 8 4	1010 610	10 5 6 6	27
17	5 0 4 2	3 1 2 4	4 3 5 4	8 7 5 3	5 6 4 3	26
18	0 0 1 4	2 0 2 2	0 3 6 3	5 2 3 6	2 3 2 4	11
19	0 0 0 0	2 4 2 2	1 5 1 1	3 3 3 4	3 5 4 5	12
20	0 0 0 0	1 2 1 0	3 2 2 1	4 2 1 4	4 1 2 0	15
21	0 0 1 3	4 2 2 2	4 4 4 4	4 3 4 4	4 3 4 3	11
22	0 0 0 0	3 2 0 0	1 2 3 0	4 2 3 0	3 2 1 2	9
23	0 0 0 0	3 3 0 0	0 3 0 2	3 3 3 1	3 0 0 0	11
24	0 0 0 0	0 0 2 3	0 3 0 3	4 4 2 4	5 5 0 5	21
25	0 0 1 0	3 4 0 1	4 2 3 3	2 3 4 2	5 2 2 2	16
26	0 0 0 3	0 3 3 0	310 6 3	6 0 6 3	1010 310	21
27	0 0 0 0	0 0 1 0	4 3 2 0	4 2 2 3	3 0 3 5	23
28	0 0 0 0	2 1 3 0	2 0 2 2	3 3 1 3	2 2 2 1	21
29	0 0 0 0	0 5 0 0	1 2 3 0	5 5 0 5	5 5 3 3	21
30	0 0 0 0	0 1 1 3	2 2 4 2	4 4 2 4	3 4 4 2	28

APPROVAL SHEET

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The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fufillment of the requirements for the degree of *Master of Arts*.

4/9/85
Date

Director's Signature