HYPNOTIC SUSCEPTIBILITY AS A FUNCTION OF INFORMATION PROCESSING

DISSERTATION

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By

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Hypnotic susceptibility, often regarded as a relatively stable individual characteristic, has been found to be related to the personality dimension of absorption. To test the hypothesis that this relationship is a function of the nature of the sensory response to stimulus events and the development of cognitive models pursuant to the processing of that information, a group of hospitalized, chronic pain patients were assessed on the following dimensions: absorption, clinical hypnotic responsiveness, cognitive resistance to interference, and visual automatization.

Results suggest that hypnotic susceptibility is primarily a sensory process. Clinical hypnotizability, represented by a factorial dimension comprised of absorption and clinical hypnotic responsiveness, was predictive of clinical pain relief, through a brief hypnotic treatment intervention.

Findings are considered to provide theoretical support for the clinical techniques of hypnotic induction advocated by Milton Erickson and Ernest Rossi and William Kroger.
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HYPNOTIC SUSCEPTIBILITY AS A FUNCTION
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Susceptibility to hypnosis has been shown to vary among individuals (E. R. Hilgard, 1965, 1975; J. R. Hilgard, 1970) and to be a relatively stable characteristic (Morgan, Johnson, & Hilgard, 1974; Perry, Gelfund, & Morcovitch, 1979). Basing their findings on nearly 20,000 cases, nineteenth-century investigators of hypnotic responsiveness reported that 30% of subjects reach a "deep state" of hypnosis, 30% reach a "moderate state," 30% reach a "drowsy-like state," and 10% appear to be refractory to hypnosis (Hilgard & Hilgard, 1975). More recent studies of hypnotic susceptibility have found nearly 90% of those tested to be responsive to hypnotic induction (Hilgard, 1965; Weitzenhoffer & Hilgard, 1959, 1962). Stability coefficients of hypnotic susceptibility, obtained with such instruments as the Stanford scales of hypnotic susceptibility (Weitzenhoffer & Hilgard, 1959, 1962), are generally found to be in the .80's and .90's for periods of days or weeks and at .60 after 10 years (Hilgard & Hilgard, 1975; E. R. Hilgard, 1977).

Morgan et al. (1974) retested 85 former Stanford University students, using the Stanford Hypnotic Susceptibility Scale, Form A, after an interval of 8 to 12 years. Their results obtained a correlation of .60, despite the fact that
they used different hypnotists and that "major life changes" generally occur between the ages of 20 and 30. Attempts to increase hypnotic susceptibility have met with mixed results. As, Hilgard, and Weitzenhoffer (1963); Cooper, Banford, Shubot, and Tart (1967); and Shor, Orne, and O'Connell (1962) all reported little success in enhancing susceptibility through training and practice; other researchers reported some gains using role modeling (Diamond, 1972) and operant conditioning (Sachs & Anderson, 1967; Kenney & Sachs, 1974).

E. R. Hilgard (1977) points out that while subjects often show slight gains in hypnotic susceptibility following training, there is a positive correlation between posttraining scores and initial scores; individuals who are more susceptible prior to training show greater gains in susceptibility than those who are initially less susceptible. Therefore, any gains are proportional to initial susceptibility and probably reflect preexisting hypnotic ability. Moreover, training (in the form of practice) may increase responsiveness to a particular type of scale item, thus giving the false impression of enhancement of overall hypnotic susceptibility (Hilgard & Hilgard, 1975). According to E. R. Hilgard (1977), there is little evidence that a fully cooperative, but minimally susceptible, individual can profit from present techniques designed to increase hypnotizability. Diamond (1974) concludes that successful
modification of hypnotic susceptibility does not challenge the notion of hypnotic stability that is well-documented (Morgan et al., 1974; Hilgard & Hilgard, 1977) but rather, increases understanding of behavior change in a clinical setting.

Historically, the study of hypnotic susceptibility has focused on the exploration for evidence of individual characteristics which might correlate with it. While attempts to find such relationships have been legion, results have been inconsistent and often negative, until recently.

In the 1930's, personality traits or types, such as introversion and extraversion (White, 1930; Wells, 1931; Friedlander & Sarbin, 1938) and neuroticism (Bartlett, 1936; Messer, Hinckley, & Mosier, 1938), were the primary focus of investigation. During the 1940's, there were several attempts to correlate Rorschach psychograms with hypnotic susceptibility (Sarbin & Madow, 1942, Brenman & Reichard, 1943). In the 1950's and on into the 1960's, the emphasis of research was on personality inventories, such as the Minnesota Multiphasic Personality Inventory (MMPI) (Sarbin, 1950; Paw & Wilcox, 1958); the California Personality Inventory (CPI) (Hilgard & Lauer, 1952); and the Maudsley Personality Inventory (MPI) (Cooper, 1964).

In recent years, research has centered on cognitive processes associated with hypnotic susceptibility. Based on
such concepts as J. R. Hilgard's (1970) "imaginative involvements," Shor's (1960) naturally-occurring "hypnotic-like" experiences, Ås' (1963) "nonhypnotic" subjective experiences of "mental absorption," and Lee-Teng's (1965) "concentration absorption," Tellegen and Atkinson (1974) developed a scale which was found to correlate significantly with measures of hypnotic susceptibility and which seemed to identify a new personality dimension, "absorption" (Finke & MacDonald, 1978; O'Grady, 1980).

The present study attempts to demonstrate a relationship between absorption (as defined and measured by Tellegen and Atkinson [1974] and Tellegen [1978]) and the manner in which stimuli are processed. A theory of information processing is proffered as a possible explanation of the process of absorption and, hence, of hypnotic susceptibility.

Origin and Evolution of the Concept of Absorption

The term "absorption" (or "absorbed," or "absorbing") arose during the search for personality characteristics associated with hypnotic susceptibility, and was originally one of several terms used to describe aspects of nonhypnotic subjective experiences of everyday life which resemble hypnosis. In her description of the "hypnotizable" individual, J. R. Hilgard (1970) mentions "absorbing adventures" as a component of "deep involvement in one or more imaginative-feeling areas of experience" (p. 4-5). Van Nuys (1973) believes that "absorption" is a component of
cognitive "attentional processes" which are pivotal in hypnotic susceptibility. As and Lauer (1962) define, in part, Eysenck and Furneaux's (1945) "primary suggestibility" factor of hypnosis as the ability to become so "absorbed" in an activity as to selectively suspend objective reality (i.e., responsiveness to ideo-motor suggestions, such as arm levitation). "Absorption" as a kind of intense concentration related to hypnotic susceptibility is reported by other researchers (Barber & Glass, 1962; Shor et al., 1962; Sarbin & Lim, 1963).

Absorption and Hypnotic Susceptibility

Parallels between absorption and hypnotic responsiveness are evident in the writings of various theorists. In 1941, White suggested that hypnotic responsiveness involves a shifting from an alert, critical reality orientation to an uncritical acceptance of reality from a different frame of reference. White's ideas are similar to those of Kubie and Margolin (1944) who consider hypnotic responsiveness to involve a constriction of the field of awareness and an acceptance of suggestions as "veridical" descriptions of reality, while, at the same time, holding a usual reality orientation in abeyance. In Shor's view (1960, 1962, 1970), hypnotic responsiveness is largely a process of "selective attention" in which (a) the distinction between reality and imagination becomes less important to the individual's subjective experience; (b) hypnotic imaginings become the
sole reality of the moment; and (c) usual reality orientation is suspended. For Barber (1960) and Leuba (1960), hypnotic responsiveness involves "selectively attending to" suggested stimuli while ignoring other stimuli; for Ås (1962), it involves becoming "absorbed" in stimuli that are the focus of attention while becoming oblivious to other stimuli.

Perhaps the most extensive work linking absorption to hypnotic susceptibility and to the subjective experience of hypnosis is that of J. R. Hilgard. According to Hilgard (1970, 1974), the hypnotically susceptible individual tends to have "hypnotic-like" experiences or "imaginative involvements" in daily life. These experiences consist of total "immersion" or "absorption" in some activity (e.g., reading) wherein "ordinary" reality is temporarily set aside and replaced by the imaginative experience. In reading involvement, "the very 'being' of the person is swept emotionally into the experiences described by the author . . ." (J. R. Hilgard, 1970, p. 23). The reader may suspend reality testing and allow the author to guide his experience; he may merge with the life of a character; and he may experience sensory changes, including vivid imagery of a hallucinatory quality (J. R. Hilgard, 1970, 1974). Subjects report similar involvement in the dramatic arts and in the aesthetic appreciation of nature. In the former, active participation as an actor can result in the assumption of an "as if" reality of the character portrayed with such intense
absorption that there is a temporary departure from a usual reality orientation. Aesthetic involvement in nature, through affective arousal by sensory stimulation, can result in "drifting" and a merging of the individual with his or her surroundings (J. R. Hilgard, 1970). For the hypnotic experience, J. R. Hilgard's (1970) subjects reported involvements in suggested-related imaginings and the loss of awareness of their surroundings.

In addition to self-report data, J. R. Hilgard (1970) found an empirical relationship between hypnotic susceptibility and imaginative involvement in reading, dramatic arts, and nature. Subjects who scored high in imaginative involvement tended to score significantly higher than subjects who rated low in imaginative involvement, on measures of hypnotic susceptibility.

Definition and Dimensions of Absorption as a Personality Characteristic

Until 1974, the term "absorption" was used in a general way to describe the intensity of quality of subjective experiences that also appeared to characterize hypnotic susceptibility (e.g., "nonhypnotic mental absorption," Ås, 1963; "intense concentration," Lee-Teng, 1965; cognitive "attentional processes," Van Nuys, 1973; and "imaginative involvements," Hilgard, 1970, 1974).

In 1974, Tellegen and Atkinson attempted to quantify the concept of absorption and, in so doing, identified what
seemed to be a new personality dimension. They named this characteristic *absorption* and defined it as the disposition for having episodes of "total" attention... involving a full commitment of available perceptual, motoric, imaginative, and ideational resources to a unified representation of the attentional object (p. 275, 274).

The cognitive component of absorption includes the "ability to operate diverse representational modalities synergistically so that full but unified experience is realized" (Telegen & Atkinson, 1974, p. 275). During the absorbing experience, the attentional process is so complete that it permits a suspension of critical analysis of the focal object as represented by the representational system. Thus, such thoughts as "this is not really happening" or "this is only my imagination" do not occur. Another characteristic of the attentional process during engagement of the representational system is that usually-distracting external stimuli are ignored and no longer incorporated into subjective reality. Simultaneously, the subjective reality, upon which attention is focused, is amplified to such a degree that, when the experience is viewed retrospectively from a nonabsorbed condition, its vividness may seem unreal or imaginary.
Development of the Absorption Scale

According to Tellegen and Atkinson (1974), an initial pool of 71 items was administered to 481 student subjects at the University of Minnesota, in order to explore for tendencies to become involved or absorbed in reading, daydreaming, dramatic acting or drama watching, and other hypnotic-like activities or imaginative involvements. Factor analysis yielded 11 primary factors, accounting for 99% of the common variance. To obtain higher order factors, the 11 primary factors were combined with items from the Stability-Neuroticism Scale developed by Tellegen and Atkinson (1974) as an intermediary step in the construction of the Absorption Scale. Items for the Stability-Neuroticism Scale were borrowed from Block's (1965) measures of stability and introversion, which he respectively renamed Ego Resiliency and Ego Control. Through factor analysis of the combined 11 primary factors and the Ego Resiliency and Ego Control factors, three higher-order factors were identified, accounting for 100% of the common variance. Two of these factors represented stability and introversion or extroversion dimensions. The third (and largest) factor consisted of scales with the highest loadings; these clusters were identified as Reality Absorption, Fantasy Absorption, Dissociation, and Openness to Experience. Tellegen and

1The Absorption Scale is now included as a subscale of the Tellegen Differential Personality Questionnaire, University of Minnesota, 1978.
Atkinson labeled this factor as "Openness to Absorbing and Self-Altering Experiences" or "Absorption." Of the three higher-order factors, only Absorption showed a consistently significant positive relationship to the group form of the Harvard Scale of Hypnotic Susceptibility and the Field Scale of Hypnotic Depth (Field, 1965). Absorption was found to be independent of Stability/Neuroticism (Ego Resiliency) and Introversion/Extraversion (Ego Control).

Roberts, Schuler, Bacon, Zimmerman, and Patterson (1975) obtained a significant positive relationship between the Absorption Scale and hypnotizability. Spanos and McPeake (1975) found that subjects who scored high in absorption also tended to have favorable attitudes toward hypnosis, whereas those who scored low in absorption tended to have less favorable attitudes toward hypnosis. However, they also found that, even when the attitudinal variable was statistically eliminated, absorption continued to predict hypnotic susceptibility, with the absorption variable accounting for 75% of the predicted variance.

Tellegen and Atkinson (1974) concluded that absorption, as "self-altering attention," is essential to hypnotic susceptibility and that hypnotic performance reflects the "trait" of absorption. They state:

To some extent, then, it is possible to view hypnotic phenomena as experiential and behavioral manifestations of a certain kind of thought process, namely,
the imaginative, inactive, and self-altering representation of an attentional object (p. 276).

The discriminant validity of the Absorption Scale was investigated by O'Grady (1980) who compared it to a variety of personality measures: Authoritarian Scale (Adorno, Frendel-Brunswick, Levinson, & Sanford, 1950); Repression-Sensitization Scale (Byrne, Barry, & Nelson, 1963); Locus of Control Scale (Norwicki & Duke, 1974); State-Trait Anxiety Inventory (Speilberger, Gorsuch, & Lushene, 1970); and Social Desirability Scale (Crowne & Marlow, 1964). Only the Repression-Sensitization Scale showed significant common variance with the Absorption Scale ($r = .247$, $p < .002$), suggesting that individuals high in absorption tend to be sensitive to the environment. Factor analysis revealed that 61.9% of the total variance was accounted for entirely by the Absorption Scale. O'Grady (1980) concluded that the variance defined by the Absorption Scale represented a new personality dimension—absorption.

Cognitive Variables of Absorption and Hypnotic Susceptibility

Given the empirical relationship between absorption and hypnotic susceptibility (Tellegen & Atkinson, 1974; Roberts et al., 1975; Finke & MacDonald, 1978), individuals who rate high on both measures might be expected to show some similar characteristics. Absorption and hypnotic susceptibility appear to involve a narrowing and focusing of attention and a related involvement in some subjective experience.

The absorptive process associated with hypnotic susceptibility may be viewed as a progression from a cognitively-mediated selective attention to environmental stimuli to a subjective, or internalized, cognitive frame of reference. Therefore, if absorption is a relatively stable personality characteristic, differences in hypnotic susceptibility may largely be a function of the manner in which stimuli (information) are processed. Perhaps, then, the absorptive process may be conceptualized in terms of information-processing theory.

A Theory of Information Processing

Information processing is generally conceptualized as the active cognitive mediation of environmental stimuli (Mahoney, 1974). A limited-channel capacity for sensory input limits the amount of information the brain can process
in a given period of time (Miller, 1956; Broadbent, 1965). To overcome such limitations, Furst (1971) proposed that information processing become automatized. Automatization is hypothesized to reflect a shift from a sensory-perceptual to a cognitive-ideational mode of information processing (de la Peña, 1978).

According to de la Peña (1978), the brain processes information along quantitative and qualitative dimensions. The amount of information processed varies over time (e.g., bits per second) and is a function of stimulus complexity and processing limitations of the brain. Qualitatively, information may be

- garnered from the sensory components of stimulus configurations (e.g., intensity, magnitude, color)
- and/or from the cognitive-ideational attributes of the "same" stimulus configuration (e.g., configuration, quality, quantity) (p. 110).

Upon presentation of a novel stimulus, the organism attends relatively more to the sensory information in the stimulus configuration than to the cognitive-ideational information. Repeated exposure to the stimulus results in habituation to the sensory component, and the cognitive-ideational component gains in saliency. The stimulus is then perceived as a global entity on a cognitive or ideational level, with little or no attention to sensory attributes.

Furst (1971) helps clarify this process with the example of a newly purchased camera. Upon first examining
the camera, the new owner attends primarily to sensorial physical characteristics (e.g., color, texture, size). With repeated inspection of the camera, although still cognizant of the physical (sensory) attributes, the owner no longer "notices" them, and the camera is perceived relatively more ideationally than before. The cognitive-ideational mode now dominates, and attention to the stimulus is said to be "automatized."

During habituation to the sensory attributes of a stimulus, the individual is hypothesized to form a cognitive, or neuronal, model of "external objects acting on the sense organs" (Sokolov, 1963b, p. 286). Over time, the brain builds cognitive structures which represent cumulative past experiences. With this store of stimulus events and contingency memories, the brain can more accurately predict a larger number of stimulus configurations or event contingencies, with less sensory information (de la Peña, 1978).

The "information" processed by the brain from stimulus configurations and stimulus event contingencies is information in the mathematical sense of the term, and refers to degrees of freedom (i.e., lack of constraint) that exist in a given situation to choose among signals, symbols, messages or patterns to be transmitted (de la Peña, 1978, p. 110).

Essential here, is the notion that of the information potentially available in a stimulus event or stimulus event
contingency, only a small portion is chosen for processing. Therefore, a degree of uncertainty exists as to what will be attended to, processed, and become "known." Shannon (1948) devised a method for determining how much information is processed. By quantifying the uncertainty or randomness in the selection process, he determined that the amount of information gained (or processed) is equal to the amount of uncertainty that has been reduced in the system.

Higher Nervous System Functions and Information Processing

Support for the foregoing theory of information processing may be gleaned from the work of Sokolov (1963a, 1963b), in his extensive research into the orienting reflex as it relates to higher nervous-system functions. According to Sokolov (1963a), the orienting reflex is an integral component of complex exploratory behavior of man and lower animals. Pavlov (1947), who was first to physiologically study the orienting reflex, defined it as follows:

It is the reflex which brings about the immediate response in man and animals to the slightest changes in the world around them, so that they immediately orientate their appropriate receptio-organ in accordance with the perceptible quality in the agent bringing about the change, making full investigation of it. . . . In man this reflex has been greatly developed in its highest form by inquisitiveness—the parent of that scientific method through which
we hope to come to a true orientation in knowledge of the world around us. (p. 27)

Major characteristics of the orienting reflex include nonspecificity of the response with respect to the nature or intensity of the eliciting stimulus (Sokolov, 1963a). The orienting reflex is the "tendency to orient toward (or pay attention to) any novel stimulus, without regard to its significance," and therefore, it may be regarded as the Pavlovian equivalent of "attention" (Hilgard & Bower, 1974, p. 81). As an attentional response, the orienting reflex is associated with cognitive, somatic, visceral, and neural reactions; dilation of cerebral blood vessels and constriction of peripheral vessels; pupillary dilation; galvanic skin response; eye movement toward a stimulus; and EEG desynchronization (which is believed to be indicative of an alert state in which the organism is more receptive to environmental stimuli) (Sokolov, 1963a; Razran, 1971; de la Peña, 1978). Thus, the orienting reflex is a centrally-organized complex response involving multiple organ systems (Razran, 1971).

The hypothesized formation of cognitive models or structures which predict stimulus configurations and stimulus event contingencies is extrapolated from results of investigations into the habituation of the orienting reflex.

After repeated exposure to an unchanging stimulus, the orienting reflex extinguishes (or habituates). Accompanying
extinction is a decrease in CNS activity to a preorienting baseline level. EEG patterns show neural synchrony (i.e., bundles of nerve fibers firing with a similar temporal pattern and at a similar rate), a condition associated with a resting state during which there is minimal information processing (de la Peña, 1978). However, any alteration of the stimulus elicits the orienting reflex and its associated physiological activity (Sokolov, 1963a). Sokolov (1963a) holds that only the concept of a "nervous" or "neuronal" model of the stimulus can adequately explain how, after habituation, a minimal change in a given parameter of the stimulus can evoke the orienting reflex.

The habituation effect is hypothesized by Sokolov (1963b) to be a function of a filtering mechanism inherent in the model, which selectively prevents repetitive afferent impulses from communicating with the motor system, thereby inhibiting an orientation reflex. Any alteration in the pattern or rate of afferent impulses which define a stimulus alerts the model to a change in one or more stimulus parameters, resulting in the release of the orienting reflex through activation of the motor system.

In summary, the orienting reflex arises in response to novelty and includes the integrative activities of various areas of the brain. After repeated presentations of a novel stimulus, a representation (i.e., a neuronal, nervous, or cognitive model) of all essential parameters of the
stimulus is formed in the brain. Thereafter, if successive presentations of the stimulus match the model, the orienting reflex is inhibited; habituation to the stimulus has occurred. However, any discrepancy between any stimulus parameter and the neuronal model is a mismatch, and the orienting reflex is again evoked. Thus, the orienting reflex depends upon elaboration of a nervous model of stimulus and the mismatch between the model and a new stimulus. The elaboration of the neuronal model consists of fixation by the nervous system of stimulus traces. The origin of the orienting reflex apparently lies in a mismatch of extrapolatory impulses and afferent signals reaching common efferent neurons."

(Sokolov, 1963a, p. 576)

Automatization of Information Processing via the Visual Modality

According to Furst (1971), automatization of visual attention increases the efficiency of information processing through a "stereotyping in the sampling of sensory information together with an attendant decrease in the rate of sampling of that information" (p. 64). Empirical evidence for automatization in the sensory-perceptual system upon repeated exposure to a stimulus was reported by Furst (1971), who monitored perceptual processing during physiological habituation to a simple stimulus. To obtain evidence of hypothesized stereotypy of sensory-perceptual processing,
rate of eye movement was chosen as the dependent variable, because of the "intimate involvement" of "fixation eye movements" in visual processes (Hebb, 1949; Festinger, Ono, Burnham, & Bamber, 1977), and because of the correspondence of fixation eye movements with visual perception (Furst, 1971).

Furst's (1971) actual procedure was to present subjects with several trials of stimulus pictures and to make film recordings of eye fixations over stimuli. He observed a significant decrease in eye movement frequency over trials, which was accompanied by an increase in average fixation time. These findings were suggestive of a decrease in the rate of visual information processing (i.e., habituation). Support for visual automatization was found in the increasing predictability over trials of where subjects focused their attention; that is, predictability of eye fixations was interpreted by Furst to be an index of stereotypy of information processing in the visual modality.

Toward an Information Processing Model of Hypnotic Susceptibility

Recalling that major characteristics associated with absorption include sensory and more internal or subjective cognitive processes, similarities between the absorption theory and the theory that information processing proceeds from a sensory-perceptual to a cognitive-ideational mode of activity (de la Peña, 1978) begin to emerge. More
specifically, with regard to absorption, initial focusing of attention to a stimulus is followed by the formation of a "unified representation of the attentional object" (Tellegen & Atkinson, 1974, p. 274). In information processing, the orienting reflex (attentional) is followed by the development of cognitive structures (de la Peña, 1978) or neuronal models (Sokolov, 1963b), to accomodate the stimulus-event configurations. Similarly, during hypnosis, a diffuse thalamic-system mediation of neural conduction from sensory projection areas to the limbic cortex and hippocampus facilitates the exclusion of sensory impressions and the activation of suggested memory images (Arnold, 1959).

The general hypothesis of this study is that during the process of absorption, a shift occurs from a sensory-perceptual to a cognitive-ideational (subjective) mode of stimulus processing. Individuals who rate high in the personality characteristic of absorption are expected to be more efficient in the processing of information (i.e., they develop or modify cognitive or neuronal models to accomodate stimulus event configurations and shift modes of stimulus processing more quickly) than do individuals who rate low in absorption. Therefore, since automatization in the visual modality is hypothesized to reflect a shift from a sensory-perceptual to a cognitive-ideational mode of information processing (Furst, 1971), persons rating high
in absorption are also expected to show more visual automation (as defined and measured by Furst, [1971]) in the processing of information.

Empirical support for an information processing model of hypnotic susceptibility (as proffered in this study) would be suggestive of psychophysiological correlates of hypnotic susceptibility, which may, in part, account for the varying degrees of effectiveness of hypnosis in the clinical context (e.g., treatment of chronic pain syndromes). A thorough review of the literature on hypnosis has revealed no attempt to conceptualize hypnotic susceptibility in terms of information processing or to advance the relationships proposed in this study.

Purpose of This Study

The major purpose of this study is to demonstrate that the relationship between absorption and hypnotic susceptibility is a function of (a) the nature of the sensory response to stimulus events and (b) the development of cognitive models pursuant to the processing of that information. This study will also serve to further confirm the positive relationship between absorption and hypnotic susceptibility (Tellegen & Atkinson, 1974; Roberts et al., 1975; Finke & MacDonald, 1978), as well as, demonstrate a positive relationship between absorption and hypnotic pain relief. Given the positive relationship between hypnotic susceptibility and hypnotic pain relief (Hilgard & Hilgard, 1975), and that relationship's relationship with absorption,
a similar relationship between absorption and hypnotic pain relief is expected. Finally, this study is expected to demonstrate that the positive relationship between hypnotic susceptibility and the relief of laboratory pain (Hilgard & Hilgard, 1975) apply equally as well to clinical pain.

**Hypothesis 1.** A single underlying factorial dimension will account for the pattern of intercorrelations among the following variables: hypnotic susceptibility, absorption, visual automatization, and cognitive resistance to interference from irrelevant or extraneous stimuli.

**Hypothesis 2.** A positive relationship exists between the multifactorial measure of hypnotic susceptibility of Hypothesis 1 and clinical pain relief.

**Method**

**Subjects**

Participants were 32 patients in a pain management program for the treatment of chronic pain at the Audie Murphy Veterans' Administration Hospital, San Antonio, Texas. There were 30 male and 2 female patients who ranged in age from 25 to 68 years, with an average age of 49. Ethnic origin of the patients was 72% Caucasian, 22% black, and 6% Hispanic. Twenty-four patients were married, four were divorced or separated, and one was widowed. The average number of years of formal education was 12, with a range of 6 to 19 years. Included in the 50% who had some college education, two persons held bachelor's degrees, and two held advanced degrees—one master's and one doctorate.
Only 3 of the 32 patients were employed; 84% were receiving social security benefits or Veterans' Administration disability compensation, or both. When they entered the pain management program, 84% were taking one or more prescription pain medications, and 65% had undergone from 1 to 6 surgical procedures for pain relief.

The pain management program is a 6-week, hospital, inpatient, multimodal approach to the treatment of chronic pain. Individual initiative, responsibility, and active participation are emphasized. Street clothes are mandatory. Each 6-week cycle typically includes from four to a maximum of eight patients, depending upon the number of applicants available for a given cycle.

Hypnosis, biofeedback, cognitive control seminars on the psychology and management of pain, educational seminars on the physiology of pain, physical therapy, corrective therapy, and occupational therapy are all combined in a comprehensive program designed to alleviate pain, alter the perception (and hence the experience) of pain, and effect a change in lifestyle wherein the reinforcement of "well" behavior supplants a focus on pain and its operants. During the course of treatment, patients are prescribed a "pain cocktail," consisting of pain medication dissolved in a pleasant-tasting liquid which masks the flavor of the medication. This is administered on a regular basis and is designed to wean the patient from medication, by gradually
reducing the amount of medication until only the flavored liquid remains. Patient reliance on pain medication is thereby reduced, as pain management skills are developed.

Requirements for admission to the program include a medical diagnosis of chronic pain syndrome for which all medical treatment has been exhausted, an identifiable organic origin of pain, and a history of pain complaints for at least 6 months. Applicants are screened through interviews by the program director, a doctoral level psychologist, who shares responsibility for programming and treatment with the Chief of Psychiatry Service and two staff psychiatrists, who oversee the hospital unit on which patients are housed. Interviews are supplemented by results of the Minnesota Multiphasic Personality Inventory (MMPI). Prospective patients who manifest dementia, organic brain syndrome, or psychosis are not admitted to the program.

Patients who participated in this study had consecutive admissions to successive 6-week cycles of the pain management program. Since no patient refused to participate, the study sample was considered to be representative of the population of patients generally admitted to the program.

The clinical population of the pain management program was ideally suited to this study. Although successful treatment of chronic pain through hypnosis (i.e., pain reduction) is well documented (Hilgard & Hilgard, 1975), the relationship of hypnotic susceptibility to pain reduction
has been systematically investigated only with laboratory-induced pain (e.g., ischemic or cold pressor pain) (Hilgard & Hilgard, 1975). General findings have indicated that persons who are highly responsive to hypnosis are more likely to achieve pain reduction than are persons low in hypnotic responsiveness (Hilgard & Hilgard, 1975). However, since laboratory studies are generally performed with select, relatively homogeneous populations (e.g., college undergraduates) under controlled conditions (e.g., calibrated pain-intensity induction and limitations on any substance that might contaminate results), the generalizability of results tends to be limited. Thus, the very purity or elegance of experimental design may impose limitations on the applicability of findings to clinical populations.

On the other hand, a clinical-pain population is considered to manifest ongoing behavior in a complex environment which is more likely to approximate the experiences of other persons with chronic pain (or those in general) than the behavior and life styles of select laboratory subjects. Moreover, a clinical population will provide the opportunity to (a) measure hypothesized correlates of hypnotic susceptibility under actual treatment conditions and (b) evaluate the relative effectiveness of hypnosis in the treatment of chronic pain syndromes.

**Instrumentation**

**Hypnotic susceptibility:** Stanford Hypnotic Clinical Scale (SHCS). The SHCS is a cognitively-weighted,
standardized measure of hypnotic susceptibility designed for clinical application (Hilgard & Hilgard, 1975). The SHCS consists of five items of suggestion, four of which (moving hands, dream, age regression, and amnesia) were culled from the Stanford Hypnotic Susceptibility Scales (SHSS), Forms A, B, and C (Weitzenhoffer & Hilgard, 1959, 1962) and were modified for the clinically-oriented SHCS. The fifth item, posthypnotic suggestion, is patterned after a similar item found in the Harvard Group Scale of Hypnotic Susceptibility (HGSHS) (Shor & Orne, 1962). The total score, which can range from 0 to 5, is the number of items passed, as determined by behavioral response to criteria for each of the five suggested experiences.

The SHCS was chosen for its applicability to a clinical population, such as the chronic pain patients used in this study. Moreover, it can be administered in approximately 20 minutes, as opposed to the 45 to 90 minutes required to administer the SHSS.

Hilgard and Hilgard (1975) demonstrated that the SHCS is a suitable research instrument; they report a significant relationship between the SHCS and Form C of the SHSS. For a sample of 111 university students, the correlation between these two scales was .72, whereas the correlation between the two groups on four items common to both scales was .81.

**Absorption: Absorption Scale (ABS).** The Absorption Scale (Tellegen & Atkinson, 1974) is a 34-item, true-false
inventory that identifies and measures the personality dimension of absorption (O'Grady, 1980), which may be defined as the "disposition for having episodes of 'total' attention that fully engage one's representational (i.e., perceptual, enactive, imaginative) and ideational resources" (p. 268).

**Visual automatization: Mackworth camera apparatus.** The Mackworth camera was developed by Norman Mackworth in 1967, to measure and record line-of-sight eye movements. The rationale for tracking eye movements in research on visual perception is based on the premise that visual perceptual processing begins with the extraction of information from the environment (Pribram, 1960; Mackworth & Bruner, 1966; Posner, 1966; Staniland, 1966; Hilgard & Bower, 1975). Through the analysis of eye tracks in stimulus picture identification, it is possible to identify strategies of selective visual attention which may be used to extract information from the stimulus, in order to increase efficiency recognition (Mackworth & Bruner, 1966; Mackworth & Morandi, 1966). Using the frequency and rate of eye fixations, McCormick and Halfrecht (1965) found a positive relationship between efficiency of visual processing and hypothesized internal schemata, presumably formed during prior experience with certain stimuli.

Other areas of study in which eye movements have been explored extensively include cognitive research on reading

Operationally, a subject's line of sight is determined, and eye movements and eye fixations over a visual stimulus are recorded on film (Figure 1, Appendix A). To find the line of sight, a narrow beam of light is reflected off of the cornea. The spot of light produced by the reflected beam is then optically superimposed upon a projected stimulus picture. Line of sight can then be observed through movement of the eye spot. Measurement of eye movement through corneal reflection is accurate to within $\pm 1^\circ$ of arc for stimuli occupying approximately $20^\circ$ of arc. An 8" x 8" visual stimulus at a distance of 22" from the subject's eye subtends the necessary $20^\circ \times 20^\circ$ of visual field arc. Line-of-sight eye movement is mapped over an 8" x 8" grid (64 1-inch squares) superimposed upon the project stimulus picture.

Measurement error due to possible head movement is minimized by a padded brace that encircles the subject's forehead and extends from ear to ear. A dental-wax bite
plate, mounted on a biting bar attached to the same support used for the head brace, further restricts possible head movement. The biting bar and head brace are adjustable and are locked into position.

The film is projected frame by frame over the grid. Rows and columns are numbered 1 through 8. Grid sections are identified by a 2-digit number (e.g., 1-1, 4-4, 8-8, etc.). Thus, line of sight is coded by 2-digit numbers that identify each sector upon which the person's gaze is fixated.

Visual automatization: Stimulus pictures.

1. Country landscape with information diffusely represented.

2. Country landscape with information discretely represented.


4. Talland's Hidden Words Test, sample from page D (Talland, 1965).

Pictures were selected for neutrality of content, in order to minimize affective arousal which could affect visual-perceptual processing (e.g., perceptual defense, Luborsky, 1963; Luborsky et al., 1965) or cue previously formulated cognitive models only tangentially related to the stimulus pictures (de la Peña, 1978). The diffuse and discrete informational content of stimulus pictures 1 and 2 is designed to control for spatial bias in subject selection.
of visual information from the overall stimulus pattern. The demand characteristics of task requirements of pictures 3 and 4 (i.e., determination of embedded figure and hidden word, respectively) are expected to highlight observable concomitants (i.e., eye movements) associated with visual automatization.

**Visual automatization: Habituation and stereotypy of visual fixation.** Habituation is assessed through measurement of visual fixation rates by determining the number of eye fixations for each of the four stimulus pictures. A decrease in eye-fixation rate over trials indicates habituation to the stimulus (Furst, 1971).

An index of stereotypy is obtained through determination of the distributions of eye fixations per section of stimulus picture defined by each of the 1-inch squares of the 8" x 8" grid upon which the stimulus pictures are superimposed. The number of fixations per 1-inch square and the time spent fixating within a section constitute this measure. Decreases in the uncertainty of eye fixation frequency and eye fixation time distributions indicate an increase in the predictability of fixations (Furst, 1971).

A single numerical value (H value), representing relative degree of visual automatization, is obtained by applying Shannon's (1948) entropy function (see Appendix B) to the mean ocular fixation time per sector and to the specific sector fixated, in order to determine the spatial
distribution of ocular fixations per stimulus, presented as an index of the amount of average uncertainty generated by the spatial distribution of fixations. The entropy function is based on the concept that the amount of information gained from a system is equal to the amount of uncertainty reduced in that system. Thus, the amount of information processed through the visual modality is a function of the amount of average uncertainty generated by the distribution of eye fixations. The lower the $H$ value, the greater the visual automatization.

Efficacy of hypnosis in the treatment of chronic pain: Pain/Discomfort Rating Scale (PDRS). Recognizing that the experience of physical pain encompasses a sensory component and an evaluative or "suffering" component, Hilgard and Hilgard (1975) constructed an oral analogue, dual rating scale to assess degree of sensory pain and level of discomfort, which is used to measure these two parameters of the pain experience.

Pain and discomfort are rated separately, each on a scale of 0 to 10, with 0 indicating no pain or discomfort and 10 indicating maximum pain or discomfort. Hilgard and Hilgard (1975) found the scale to be stable over successive administrations over time, under laboratory conditions.

This program contains a built-in small sample statistic correction factor (Miller & Meadow, 1954) designed to generate an unbiased estimate of the population uncertainty of spatial distributions.
In order to simplify data analysis, pain and discomfort ratings are represented by a single measure. A pretreatment PDRS was administered twice, 30 minutes apart, first, as a baseline measure and, then, as a preinduction measure, just prior to treatment intervention with hypnosis. Pearson product-moment correlations were then performed on the two sets of pain ratings and on the two sets of discomfort ratings. The correlation between pain ratings was .97 ($p < .001$); the correlation between discomfort ratings was .98 ($p < .001$). The correlations suggest stability of the pain and discomfort measures.

The preinduction pain and discomfort ratings were then correlated ($r = .77$, $p < .001$). In view of the correlation between the preinduction pain and preinduction discomfort ratings and their apparent stability, the preinduction pain rating (PreIn) was chosen as a unitary measure of pain and discomfort.

To maintain consistency of assessment methodology, the postinduction pain rating (PostIn) was chosen as a unitary criterion measure of pain and discomfort. The correlation between the preinduction and postinduction pain ratings was .82 ($p < .001$), suggesting that the relative ranking of patients on these two pain measures is preserved.

A second criterion measure of pain and discomfort consists of a residualized pain change score (RChng), derived as follows:
RChng = (ZPostIn) - (.82) \times (zPreIn),

where, ZPostIn = postinduction pain rating standard score; .82 = correlation between the preinduction and postinduction pain ratings; and zPreIn = preinduction pain rating standard score.

A postinduction minus preinduction rating index results in negative values representing pain reduction or relief (postinduction pain rating being a lower value than preinduction rating). The higher the negative value, the greater the pain relief.

Selective attention: Stroop Color and Word Test (SCWT). The SCWT is a measure of cognitive resistance to interference, which may be defined as the ability to screen sensory stimuli, select only those stimuli which are relevant to determine behavior, and resist distraction by irrelevant information (Golden, Marsella, & Golden, 1975). Individuals may be classified as relatively high in resistance to interference (HR) or relatively low in resistance to interference (LR), on the basis of their performance on the SCWT. Callaway and Stone (1960) found a positive relationship between resistance to interference and ability to focus attention on environmental stimuli relevant to a task at hand. This finding supports an earlier notion advanced by Gardner, Holzman, Klein, Linton, and Spence (1959) that resistance to interference is primarily related to the ability to select parameters of environmental events while ignoring other cues.
Resistance to interference is associated with an attentional process which appears similar to that found in absorption. Implied in the hypothesized shift from a sensory-perceptual to a cognitive-ideational mode of information processing is a resistance to distracting stimuli, a characteristic of both absorption and hypnotic responsiveness (Arnold, 1946, 1959; Barber, 1960; Leuba, 1960; Ås, 1962; Lee-Teng, 1965; J. R. Hilgard, 1960, 1974; Van Nuys, 1973; Tellegen & Atkinson, 1974). This resistance presumably facilitates the focus of attention which is believed to be a requisite to the formation of a cognitive configuration (de la Peña, 1978) or neuronal model (Sokolov, 1963a, 1963b) of the stimulus event, or a "unified representation of the attentional object" (Tellegen & Atkinson, 1974, p. 274). The neuronal model itself is hypothesized to possess filtering properties for the screening of sensory stimuli (Sokolov, 1963b).

High resistance to interference is expected to show a positive relationship to absorption, hypnotic susceptibility, and visual automatization.

Procedure

A procedural summary is presented in Table 1. The PDRS, ABS, SHCS, SCWT, and line-of-sight recordings were included in the routine admission battery of the pain management program. Pain management program patients were routinely apprised of the purposes and results of all evaluation techniques, prior to discharge.
Table 1

Procedural Summary of the Pain Management Program

<table>
<thead>
<tr>
<th>Subject Population</th>
<th>Pretreatment Procedures</th>
<th>Treatment Procedure</th>
<th>Posttreatment Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain management program chronic pain patients</td>
<td>1. Pain/Discomfort Rating Scale</td>
<td>1. Hypnosis Dissociative imagery</td>
<td>Feedback on pain management program evaluation techniques and results</td>
</tr>
<tr>
<td></td>
<td>2. Absorption Scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Stanford Hypnotic Clinical Scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Stroop Color and Word Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Line-of-sight recordings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Mackworth camera apparatus)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. presentation of stimulus pictures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. patient self-report</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of subjective experience while performing tasks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Hilgard and Hilgard (1975) PDRS, the first instrument of the battery, was administered on three occasions: twice preceding and once following treatment intervention with hypnosis. The first, or baseline, administration took place after completion of patient informed consent forms; the second, or preinduction, administration took place following the ABS and an informal discussion, both of which served as interpolated tasks. Elapsed time between these two administrations of the PDRS was approximately half an hour. Hypnosis was then induced, as per instructions in the SHCS. Dissociative imagery, a generally accepted experimental and clinical method of effective pain relief through hypnosis (Hilgard & Hilgard, 1975) and a strategy used for the treatment of chronic pain in the pain management program, was selected as the treatment intervention for this study. Imagery was decided upon in advance and was chosen by the patients for its pleasing relaxing content. The duration of the intervention with dissociative imagery was approximately 5 minutes. The SHCS was then administered, after which the patient was brought out of hypnosis, and the third, or postinduction, PDRS was completed. After an interlude of approximately 10 minutes, for a debriefing of the patient on the hypnotic experience, the SCWT was administered. Under the direction of Dr. Augustin de la Peña, director of the psychophysiology laboratory at the Audie Murphy Veterans' Administration Hospital, the following
procedural sequence was employed in obtaining line-of-sight recordings with the Mackworth camera apparatus.

1. A dental-wax bite impression of the patient's mouth was made and secured to the bite bar.

2. The patient was seated before the apparatus, while facing a blank 8" x 8" screen, with his or her head held in place by the headrest and bite bar.

3. A calibration slide was projected onto the screen, and the patient was instructed to fixate on the center of the slide. Calibration consisted of reflecting a beam of light off of the cornea of the left eye. The reflected light served as the eyespot for determination of line-of-sight during eye movement.

4. A series of 16 stimulus pictures (four 5-second trials of four slides) was presented in random order, except that there were no successive presentations of the same picture. Sequencing of slides was counterbalanced over subjects, using a Latin Squares Design. The patient was asked to view the stimulus pictures in any manner desired. In order to avoid influencing the patient to develop cognitive models, no further instructions were provided.

To insure precision of exposure time, visual stimulus presentation was computerized. Stimulus pictures were automatically presented for 5 seconds. Length of time for initial calibration was approximately 90 seconds; thereafter, presentation of calibration slides was manually controlled,
with time for each recalibration averaging approximately 3 to 5 seconds. The entire procedure (80 seconds for stimulus slide presentation, approximately 80 seconds for calibration slides, and approximately 90 seconds for initial calibration time) required that the patient be apparatus bound for 4 to 4½ minutes.

Filming was done with a 16mm Bolex Motion Picture Camera programmed to film each 5-second exposure of each stimulus picture. With a film speed of 14 frames per second, every 5-second picture exposure was recorded over 70 frames.

After completion of the Mackworth camera operations, the patient was disengaged from the apparatus and presented with reproductions of the stimulus pictures on 8½x11 paper. The patient was then asked for a retrospective recounting of cognitions (e.g., thoughts, foci of attention, distractions, etc.) during the viewing of the slides. The purpose of this inquiry was to obtain support for the theory that automatization of information processing reflects the development of a cognitive configuration or neuronal model of the stimulus, as information processing shifts from a sensory-perceptual to a cognitive-ideational mode. The relative amount of visual automatization, as measured through increased predictability of eye movements over successive presentations of visual stimuli, was expected to parallel reporting by patients of a progression from a generalized scanning to a more detailed and focused description of each
stimulus picture, particularly the country scenes. The discovery of the hidden word and figure would be highly suggestive of the development of cognitive models.

Reliance on subjective self-report data has recently gained in acceptance (Hase & Goldberg, 1967; Payne & Williams, 1972; Spanos & Barber, 1974; Hilgard & Hilgard, 1975; Spanos & McPeake, 1975; E. R. Hilgard, 1977). J. R. Hilgard (1970) relied almost exclusively on phenomenological data in relating imaginative involvements to hypnotizability. E. R. Hilgard (1977) maintains that behaviorism's rejection of subjective experience neglects a major source of information about psychological reality. He also points out that combining phenomenological and objectively reported behavioral data does not compromise the integrity of the scientific method.

**Results**

Table 2 shows the mean, range, and standard deviation of all pretreatment and posttreatment measures.

Analysis of treatment effects (i.e., pain reduction through hypnosis) was accomplished through a t test of the difference between means of the preinduction (PreIn) and postinduction (PostIn) pain rating scales. Results were

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3Factor analytic solutions reported in this study were derived using raw scale data. Factor analytic solutions were also performed on scale data transformed into a 6-point metric. Since both sets of solutions were comparable, results of this study were not considered to have been contaminated by method variance.
significant, indicating that a treatment effect had occurred \( t = 5.38, p < .01 \).

Table 2

Summary of Pre- and Posttreatment Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean</th>
<th>Range</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
</tr>
<tr>
<td>Absorption Scale (ABS)</td>
<td>16.96</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>Stanford Hypnotic Clinical Scale (SHCS)</td>
<td>2.87</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Stroop Color and Word Test (SCWT)</td>
<td>-0.81</td>
<td>-28</td>
<td>+28</td>
</tr>
<tr>
<td>H Value</td>
<td>3.53</td>
<td>2.27</td>
<td>4.70</td>
</tr>
<tr>
<td>Preinduction pain rating (PreIn)</td>
<td>5.93</td>
<td>1.00</td>
<td>9.00</td>
</tr>
<tr>
<td>Postinduction pain rating (PostIn)</td>
<td>4.50</td>
<td>0.00</td>
<td>9.00</td>
</tr>
<tr>
<td>Residualized pain rating change score (RChng)</td>
<td>-1.43</td>
<td>-4.00</td>
<td>+4.00</td>
</tr>
</tbody>
</table>

To test Hypothesis 1, individual scores on the Absorption Scale, Stanford Hypnotic Clinical Scale, Visual Automatization, and Stroop Color and Word Test were first intercorrelated, using the Pearson product-moment method. Minnesota Multiphasic Personality Inventory Scales of Hypochondriasis, Depression, and Hysteric were included as marker variables in the correlation procedure. As seen in Table 3, the resultant interitem correlation matrix shows a
significant positive relationship between the ABS and SHCS ($r = .62, p < .05$) and a significant inverse relationship between the ABS and $H$ Value ($r = -.45, p < .05$). The SCWT did not correlate significantly with any pretreatment variable. The MMPI Scales (Hypochondriasis, Depression, and Hysteria) showed significant positive intercorrelations among themselves but no significant correlations with any pretreatment variables.

The interitem correlation matrix was then factored (utilizing the PA 1 principal factors analysis), and four of the emerging factors, accounting for approximately 88% of the variance, were rotated to a varimax orthogonal solution (Table 4) (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975).

As seen in Table 5, prior to rotation, seven factors accounted for 100% of the matrix variance. Four factors accounted for 88.5% of the matrix variance: 35.4%, 28.8%, 14.9%, and 9.3%. Although three factors, accounting for 79.1% of the matrix variance, achieved an eigen value of 1.0 or greater, a scree test (Cattell, 1952; Gorsuch, 1974) suggested that four factors should be extracted and rotated (Figure 2, Appendix C).

Factor analytic results were generated using a relatively small $N$ of 32. The author recognizes that more confidence would be placed on factor analytic results based on a larger $N$. 
Table 3
Interitem Correlation Matrix of Pretreatment Measures and MMPI Scales

<table>
<thead>
<tr>
<th></th>
<th>Absorption Scale</th>
<th>Stanford Clinical Hypnotic Scale</th>
<th>Stroop Color and Word Test</th>
<th>H Value</th>
<th>Hypochondriasis</th>
<th>Depression</th>
<th>Hysteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption Scale</td>
<td>---</td>
<td>.62*</td>
<td>-.21</td>
<td>-.45*</td>
<td>.01</td>
<td>.22</td>
<td>-.05</td>
</tr>
<tr>
<td>Stanford Hypnotic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroop Color and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H Value</td>
<td></td>
<td></td>
<td></td>
<td>.04</td>
<td>.08</td>
<td>.00</td>
<td>-.02</td>
</tr>
<tr>
<td>Hypochondriasis</td>
<td></td>
<td></td>
<td></td>
<td>-.16</td>
<td>.02</td>
<td>-.24</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td></td>
<td></td>
<td></td>
<td>.62*</td>
<td></td>
<td>.86*</td>
<td></td>
</tr>
<tr>
<td>Hysteria</td>
<td></td>
<td></td>
<td></td>
<td>.63*</td>
<td></td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>

Note: *p < .05. N = 32, df = 30. Critical value of t = 2.04.
Table 4

Varimax Rotated Factor Solution

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption Scale</td>
<td>.05</td>
<td>.78</td>
<td>.40</td>
<td>-.14</td>
</tr>
<tr>
<td>Stanford Hypnotic Clinical Scale</td>
<td>.04</td>
<td>.94</td>
<td>.01</td>
<td>-.06</td>
</tr>
<tr>
<td>Stroop Color and Word Test</td>
<td>-.01</td>
<td>-.13</td>
<td>.02</td>
<td>.98</td>
</tr>
<tr>
<td>H Value</td>
<td>-.10</td>
<td>.18</td>
<td>.95</td>
<td>.04</td>
</tr>
<tr>
<td>Hypochondriasis</td>
<td>.92</td>
<td>.02</td>
<td>-.07</td>
<td>-.09</td>
</tr>
<tr>
<td>Depression</td>
<td>.82</td>
<td>.25</td>
<td>.07</td>
<td>.10</td>
</tr>
<tr>
<td>Hysteria</td>
<td>.93</td>
<td>-.09</td>
<td>-.14</td>
<td>-.03</td>
</tr>
</tbody>
</table>

Table 5

Factor Variances

<table>
<thead>
<tr>
<th>Factor</th>
<th>Eigen Value</th>
<th>Total Variance</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.479</td>
<td>35.4</td>
<td>35.4</td>
</tr>
<tr>
<td>2</td>
<td>2.017</td>
<td>28.8</td>
<td>64.3</td>
</tr>
<tr>
<td>3</td>
<td>1.039</td>
<td>14.9</td>
<td>79.1</td>
</tr>
<tr>
<td>4</td>
<td>0.654</td>
<td>9.3</td>
<td>88.5</td>
</tr>
<tr>
<td>5</td>
<td>0.366</td>
<td>5.2</td>
<td>93.7</td>
</tr>
<tr>
<td>6</td>
<td>0.321</td>
<td>4.6</td>
<td>98.3</td>
</tr>
<tr>
<td>7</td>
<td>0.120</td>
<td>1.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Factor loadings greater than .40 were considered sufficient for inclusion of the variable in factor description. The interpretations of the factors were made from those variables with the highest loadings (Table 6).

Table 6
Varimax Factors and Identifying Names

<table>
<thead>
<tr>
<th>Variable</th>
<th>Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1</td>
<td></td>
</tr>
<tr>
<td>Minnesota Multiphasic Personality Inventory Cluster</td>
<td></td>
</tr>
<tr>
<td>Hypochondriasis</td>
<td>0.92</td>
</tr>
<tr>
<td>Depression</td>
<td>0.82</td>
</tr>
<tr>
<td>Hysteria</td>
<td>0.93</td>
</tr>
<tr>
<td>Factor 2</td>
<td></td>
</tr>
<tr>
<td>Clinical Hypnotizability</td>
<td></td>
</tr>
<tr>
<td>Absorption Scale</td>
<td>0.78</td>
</tr>
<tr>
<td>Stanford Hypnotic Clinical Scale</td>
<td>0.94</td>
</tr>
<tr>
<td>Factor 3</td>
<td></td>
</tr>
<tr>
<td>Visual Automatization</td>
<td></td>
</tr>
<tr>
<td>H Value</td>
<td>0.95</td>
</tr>
<tr>
<td>Factor 4</td>
<td></td>
</tr>
<tr>
<td>Cognitive Resistance to Interference</td>
<td></td>
</tr>
<tr>
<td>Stroop Color and Word Test</td>
<td>0.98</td>
</tr>
</tbody>
</table>

MMPI Scales (Hypochondriasis, Depression, and Hysteria) comprised the first factor which was identifiable as the
MMPI cluster. The ABS and SHCS comprised the second factor. Since these two scales are considered to be cognitive parameters associated with hypnotic responsiveness, and since the SHCS is also a clinical measure of hypnotic responsiveness, Factor 2 was designated as clinical hypnotizability. Factor 3, comprised of the $H$ Value (visual automatization), was designated as the visual automatization factor; and Factor 4, comprised of the SCWT, a measure of cognitive resistance to interference, was identified as the cognitive resistance to interference factor.

Hypothesis 1 was not supported. The principal factors analysis with varimax orthogonal rotation resulted in a multidimensional factor structure. Absorption, hypnotic responsiveness (as measured by the SHCS), visual automatization, and cognitive resistance to interference did not conform to a simple dimension of hypnotic susceptibility.

To test Hypothesis 2, four predictors were used to develop predictive equations. Predictors were generated by computing factor scores on every subject for each factor, using the complete estimation method of Nie et al. (1975). Predictors consisted of the following factors: Factor 1 (MMPI); Factor 2 (clinical hypnotizability); Factor 3 (visual automatization); and Factor 4 (cognitive resistance to interference) (Table 7).
Table 7

Factor Score Coefficients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factors 1</th>
<th>Factors 2</th>
<th>Factors 3</th>
<th>Factors 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption Scale</td>
<td>0.00</td>
<td>0.42</td>
<td>0.15</td>
<td>-0.03</td>
</tr>
<tr>
<td>Stanford Hypnotic Clinical Scale</td>
<td>-0.06</td>
<td>0.72</td>
<td>-0.35</td>
<td>0.13</td>
</tr>
<tr>
<td>Stroop Color and Word Test</td>
<td>0.00</td>
<td>0.09</td>
<td>-0.04</td>
<td>0.99</td>
</tr>
<tr>
<td>H Value</td>
<td>0.06</td>
<td>-0.22</td>
<td>0.98</td>
<td>-0.03</td>
</tr>
<tr>
<td>Hypochondriasis</td>
<td>0.39</td>
<td>-0.08</td>
<td>0.05</td>
<td>-0.09</td>
</tr>
<tr>
<td>Depression</td>
<td>0.34</td>
<td>-0.12</td>
<td>0.07</td>
<td>0.15</td>
</tr>
<tr>
<td>Hysteria</td>
<td>0.39</td>
<td>-0.09</td>
<td>-0.00</td>
<td>-0.03</td>
</tr>
</tbody>
</table>

Two criterion measures of treatment effects (i.e., pain relief through hypnosis) were used: raw score postinduction pain ratings (PostIn) and the residualized postinduction minus preinduction pain rating change score (RChng).

A full correlational model with four predictors was nonsignificant in predicting pain reduction using the postinduction pain rating (PostIn) as the criterion measure of hypnotic pain relief ($r = 0.424, p < 0.05$). A full correlational model using four predictors was also nonsignificant in predicting pain reduction using the residualized change score (RChng) as the criterion measure of hypnotic pain relief ($r = 0.330, p < 0.05$). A reduced correlational model
which examined the relationship of each factor individually with each criterion measure of pain reduction showed a significant inverse relationship between Factor 2 (clinical hypnotizability) and the postinduction pain rating (postinduction pain relief is indicated by a negative value) ($r = -0.374, p < .05$).

Table 8 summarizes results of full multiple and reduced correlational models for prediction of pain relief through hypnosis.

**Table 8**

<table>
<thead>
<tr>
<th>Predictors/ Factor</th>
<th>Criteria</th>
<th>Postinduction</th>
<th>Residualized Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMPI/1</td>
<td></td>
<td>.106 ($F = 0.36$)</td>
<td>-.033 ($F = 0.03$)</td>
</tr>
<tr>
<td>Clinical Hypnotizability/2</td>
<td></td>
<td>-.374* ($F = 4.61$)</td>
<td>-.285 ($F = 2.48$)</td>
</tr>
<tr>
<td>Visual Automatization/3</td>
<td></td>
<td>-.122 ($F = 0.49$)</td>
<td>.163 ($F = 0.81$)</td>
</tr>
<tr>
<td>Cognitive Resistance to Interference/4</td>
<td></td>
<td>-.118 ($F = 0.46$)</td>
<td>.003 ($F = 0.00$)</td>
</tr>
<tr>
<td>Full Model</td>
<td></td>
<td>.424 ($F = 1.48$)</td>
<td>.330 ($F = 0.83$)</td>
</tr>
</tbody>
</table>

Note: Critical value of $r$ with 31 df = .296, with $\alpha = .05$. Critical $F$ value for $r$ with 4 and 27 df = 2.73.

*$_*p < .05.$
Hypothesis 2 was not supported. A multifactorial measure of hypnotic susceptibility predictive of clinical pain relief was not found. However, Factor 2, clinical hypnotizability, was found to be predictive of clinical pain relief through hypnosis.

Discussion

The major finding of this study is a significant inverse relationship between absorption and visual automatization. Other significant findings are a significant positive relationship between hypnotic susceptibility and hypnotic pain relief in a hospitalized clinical pain patient population; support for the previously reported relationship between absorption and hypnotic susceptibility (Tellegen & Atkinson, 1974; Roberts et al., 1975; Finke & MacDonald, 1978); and the efficacy of hypnosis as a treatment for chronic pain. While a multifactorial measure of hypnotic susceptibility was not found, one factor, representing the dimension of clinical hypnotizability, was predictive of hypnotic pain relief.

Hypnosis, Pain Relief, and Hypnotic Susceptibility

Seventy-five per cent of the patients participating in this study achieved some degree of pain relief with hypnotic treatment intervention of approximately 5 minutes. Twenty-five per cent of the patients reported no change or an increase in pain level, following treatment intervention with hypnosis.
The effectiveness of hypnosis in the alleviation of chronic pain is indicated by the decrease in level of reported pain. A comparison of preinduction and postinduction pain measures showed a significant reduction in overall pain level ($t = 5.38, p < .01$). Additional evidence that the decrease in level of pain is attributable to a treatment effect is the finding of no change in the level of pain as function of time; the means of pain ratings taken twice during pretreatment procedures (once as a baseline and a second time, 30 minutes later, just preceding hypnotic induction) were identical ($\bar{X} = 5.93$).

That the response to treatment with hypnosis is in some measure attributable to hypnotic susceptibility is supported by the finding that Factor 2 (representing the dimension of clinical hypnotizability) was predictive of the postinduction pain rating (PostIn) criterion measure of pain relief ($r = -.374, p < .05$). Factor 2 was not predictive of the residualized pain rating change score (RChng) ($r = -.285, p > .05$). However, the RChng accounted for only 57% of the variance associated with predicted pain relief (the correlation between the pre- and postinduction pain ratings was .76), whereas the postinduction pain rating accounted for 100% of the variance associated with predicted pain relief. A larger criterion target (i.e., more variance as a function of a higher correlation between pre- and postinduction pain ratings) would have increased the probability of reaching a
critical value required for predictive significance. Therefore, the RChng should not be discounted as a potentially suitable criterion measure of pain relief.

The use of chronic pain patients to demonstrate a relationship between hypnotic susceptibility and pain relief was a departure from the usual practice of using volunteer subjects and laboratory-induced pain (e.g., ischemic or cold pressor) to obtain a correlation between pain reduction and hypnotic susceptibility (Evans & Paul, 1970; E. R. Hilgard, Ruch, Lange, Lenox, Morgan, & Sachs, 1974; Hilgard & Hilgard, 1975). In contrast to the findings of E. R. Hilgard (1969) and Evans and Paul (1970) that, for hypnosis to be effective in reducing laboratory pain, suggestions for analgesia must be included as a treatment strategy, the present study employed only relaxing dissociative imagery in successfully reducing chronic pain with hypnosis.

A Reexamination of Visual Automatization, Absorption, and Hypnotic Susceptibility as a Function of Information Processing

The relationship of absorption to hypnotic susceptibility has been generally described in terms of parallels between everyday hypnotic-like experiences, or "imaginative involvements," and the subjective experience of hypnosis (Shor, 1960; Ås, 1963, J. R. Hilgard, 1970). Ås (1962), Lee-Teng (1965), J. R. Hilgard (1970), and Van Nuys (1973) have suggested that common to absorption and hypnosis is a
temporary suspension of a generalized reality orientation which is replaced by a subjective reality characterized by an intense concentration on internal experience. These approaches tend to blur the distinction between hypnotic susceptibility and the hypnotic experience and, in effect, almost equate absorption with hypnosis. Absorption may be more accurately defined as a personality characteristic associated with, or predictive of, hypnotic susceptibility. As will be shown shortly, the relationship of absorption to hypnotic susceptibility can best be understood in terms of the two-process theory of information processing described earlier (de la Peña, 1978).

This study found a high positive correlation between the Absorption Scale and the Stanford Hypnotic Clinical Scale ($r = .62, p < .05$), supporting previous findings of a consistently significant positive correlation between absorption and hypnotic susceptibility (e.g., Roberts et al., 1975); a significant negative correlation between visual automatization and absorption ($r = -.45, p < .05$), suggesting that low visual automatization is associated with high absorption; and a nonsignificant, yet negative, correlation between visual automatization and hypnotic susceptibility as measured by the Stanford Hypnotic Clinical Scale ($r = -.24, p > .05$).

Low visual automatization during the processing of information (as in the viewing of stimulus slides used in this study) is reflective of little cognitive-ideational
activity and is suggestive of the processing of that information in the sensory-perceptual mode. Therefore, an inverse relationship between visual automatization and absorption is highly suggestive of absorption as a sensory process. That absorption is primarily a measure of sensory experience and sensitivity to the environment is indicated by the results of a study by O'Grady (1980) that found a significant positive correlation between the Absorption Scale and the Repression-Sensitization Scale ($r = .25, p < .002$); high scores on the latter are believed to reflect sensitivity to the environment.

The Stanford Hypnotic Clinical Scale (SHCS), which did not show a significant negative relationship to visual automatization ($H$ Value), is an abbreviated, cognitively weighted version of the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C). Conceivably, the longer and more heterogeneous SHSS:C (i.e., mixture of sensory and cognitive items) would show a significant inverse relationship to $H$ Value.

The implication of these findings is that hypnotic susceptibility is inversely related to visual automatization (i.e., the greater the hypnotic susceptibility, the less the stereotypy in the processing of information from the environment). Since high visual automatization reflects information processing in the cognitive-ideational mode, hypnotic susceptibility may reflect information processing in the sensory-perceptual mode.
Hypnotic Susceptibility as a Sensory Function

Clinical support for the position that hypnotic susceptibility is primarily a sensory process is found in the Erickson and Rossi (1979) concept of the "depotentiating" of habitual mental sets as a facilitator of hypnotic induction. The rationale for fixating attention during hypnotic induction is that it briefly interrupts or suspends the reliance upon belief systems and frames of reference which ordinarily serve as the basis for reality perception. According to Erickson and Rossi (1979),

during that momentary suspension [of belief systems] latent patterns of association and sensory-perceptual experience have an opportunity to assert themselves in a manner that can initiate the altered state of consciousness that has been described as trance or hypnosis. (p. 5)

These belief systems and associated frames of reference bear a striking similarity to the cognitive-ideational mode of information processing. Operating from the cognitive-ideational mode implies perceiving or interpreting the environment through a system of cognitive configurations which are gradually acquired over time and which provide the structure for a generalized reality orientation. The notion of depotentiating belief systems for heightening the sensory-perceptual experience parallels the triggering of the Orienting Reflex associated with a shift from a cognitive-ideational to a sensory-perceptual mode of information
processing, resulting in increased sensitivity to the environment. The methods suggested by Erickson and Rossi (1979) for effecting depotentiation include "confusion" and "disequilibrium" which allow the individual to overcome "learned limitations" and "become open and available to new means of experiencing and learning" (p. 6). Similarly, the Orienting Response is aroused through the surprise of any mismatch between sensory stimuli and existing cognitive structures, preparing the way for the acquisition or incorporation of new information via the sensory-perceptual mode of information processing (Sokolov, 1963a, 1963b; Pavlov, 1946; de la Peña, 1978).

Given that hypnotic susceptibility may be a sensory-perceptual function, preference for this mode of information processing should be related to susceptibility to hypnotic induction. Evidence for such a relationship may be derived from the common clinical findings that focusing on sensory experiences facilitates hypnotic induction (Kroger, 1977) and that age is a factor in hypnotic susceptibility (Hilgard & Hilgard, 1975).

To enhance hypnotic susceptibility, Kroger (1977) encourages a continued state of awareness of bodily sensations and attention to ideosensory or ideomotor responses, or both. From an information processing perspective, such focusing would encourage information processing in the sensory-perceptual mode.
As far as age is concerned, children tend to be good hypnotic subjects and, once having achieved necessary language skills, show a steady rise in hypnotic susceptibility from approximately 4 to 5 years of age, reaching a peak between ages 8 and 12 and showing a gradual decline thereafter (Hilgard & Hilgard, 1975). That younger children also operate primarily from a sensory-perceptual mode of information processing is supported by studies which have found chronological age to correlate with sensitivity to stimulation of major sensory modalities (Hinchcliffe, 1958; Collins & Stone, 1966; Haslam, 1969; Molinari & Foulkes, 1969; Pare, 1969). The less developed the organism, the more sensitivity shown to sensory stimulation. Younger organisms also show higher general levels of activation in the cerebral cortex and autonomic nervous system, which are associated with the processing of sensory information (Steinschneider, Lipton, & Richmond, 1966; de la Peña, 1978) and relative to older, more cognitively developed organisms, exhibit a longer habituation period of the Orienting Reflex to environmental stimuli (Lynn, 1966). With increasing age, a gradual decrease in central nervous system and autonomic nervous system activity is presumably a function of more reliance upon established cognitive configurations of the cognitive-ideational mode of information processing in responding to the environment.
Thus, children may be relatively high in hypnotic susceptibility by virtue of their tendency to operate from a sensory-perceptual mode of information processing, whereas older adults may be relatively less hypnotically susceptible as a function of operating increasingly from a cognitive-ideational mode of information processing. By encouraging a shift from the cognitive-ideational to the sensory-perceptual mode, through a focus on sensory experience (e.g., Kroger, 1977; Erickson & Rossi, 1979), hypnotic susceptibility may be enhanced and hypnotic induction facilitated.

An Information Processing Model of Cognitive Resistance to Interference

Based on the results of this study, hypnotic susceptibility, in large measure, would appear to be a function of information processing in the sensory-perceptual mode. Absorption, clinical hypnotic responsiveness, and low visual automatization are all suggestive of sensitivity to sensory experience. Only cognitive resistance to interference, as measured by the Stroop Color and Word Test, failed to correlate with other variables associated with sensory processes.

A possible explanation for this latter finding rests with both the premise of the SCWT and supporting research. According to Golden, Marsella, and Golden (1975), resistance to interference involves the screening of sensory stimuli
and the selective attending only to stimuli relevant to the determination of appropriate behavior. Jenson and Rohwer (1966) conclude that while resistance to interference is a cognitive skill, the nature of the cognitive process is unknown.

In a major study by Golden, Marsella, and Golden (1975), designed to clarify the mechanism underlying cognitive resistance to interference, subjects were divided into high and low resistance to interference on the basis of their performance on the SCWT. They were then administered a battery of 20 cognitive tests, 12 of which assessed the ability to screen and process material while avoiding distraction. On 9 of 12 screening tests, the high resistance to interference group performed significantly better than did the low resistance to interference group. The groups did not differ in performance on eight tests unrelated to the screening of stimuli.

While the Golden, Marsella, and Golden (1975) study supported the theory that high resistance to interference is related to the ability to screen and select sensory stimuli relevant to a given situation, no light was shed on the mediating cognitive processes. Other studies on the SCWT have focused on the ability to perform tasks or carry on operations requiring sustained attention to detail, despite outside distraction (Hardison & Purcell, 1959) or ambiguity in the stimulus material itself (Loomis & Moskowitz, 1959).
In all of these studies, high resistance to interference was attributed to the ability to resist interference by competing stimuli in the performance of a task (Callaway & Stone, 1960), whereas, low resistance to interference was considered to reflect difficulty in maintaining a satisfactory level of performance in the presence of distracting stimuli (Klein, 1954).

The concept of cognitive resistance to interference is compatible with the two-process theory of information processing. Resistance to distraction, through the filtering of sensory stimuli, implies functioning from a primarily cognitive-ideational mode. With the development of cognitive configurations or neuronal models of stimulus events, information processing becomes more efficient in the selection of the minimum amount of stimuli that provides maximum information for optimal performance. Less stimuli is required to process relevant information, resulting in a decrease in sensory information processing (de la Peña, 1978). Operating from a cognitive-ideational mode may be likened to functioning from a well-established cognitive map or blueprint of the environment, which would then encourage the most efficient task accomplishment behavior with high resistance to interference from stimuli not essential to the given task. Sensory-perceptual activity would be significantly decreased.

The cognitive resistance to interference is unrelated to hypnotic susceptibility, at least in terms of
sensory-perceptual processes, is strongly indicated by the results of this study.

In retrospect, perhaps the most significant accomplishment of this study was to present evidence that hypnotic susceptibility is probably a function of sensory processes that can be conceptualized in terms of an empirically testable, physiologically based theory of information processing. This finding also provides a theoretical framework for the clinical methods of inducing hypnosis advocated by Milton Erickson and William Kroger, both of whom emphasize some form of reorienting response to the immediate environment, which has the effect of increasing sensory awareness. In terms of the information processing model presented in this study, these procedures shift information processing from a cognitive-ideational to a sensory-perceptual mode. Presumably, then, persons who are high in hypnotic susceptibility are amenable to change through the hypnotic experience. The effectiveness of hypnosis as a treatment procedure may be viewed as an openness to the altering of perceptions, or cognitive configurations, through reinterpretation of sensory input. In the experience of this researcher, patients often apparently perceive bodily sensations (e.g., pain) through cognitive models formed in the past in response to existing conditions. With the passage of time, these models are not modified to conform to changing circumstances, and the interpretation of past
bodily sensations persists into the present. In effect, the cognitive model is faulty. A strategy for altering such perceptions is to help the patient shift to the sensory-perceptual mode of information processing and modify faulty cognitive models to more accurately reflect present conditions.

With regard to age and hypnotic susceptibility, the often reported decline in hypnotic susceptibility with increasing age is readily interpretable from an information processing model. Cognitive structures represent the world and, as such, are the primary means of interacting with the environment. They are modifiable through an orienting response to environmental change. Since these structures increase in number and complexity as a function of development and provide an increasingly comprehensive generalized perception of reality, sensory orientation to the environment decreases in frequency. With increasing age, relatively more reliance is placed upon cognitive structures relative to orienting sensory-perceptual experiences in interacting with the environment. To the extent that the latter form of information processing also plays a significant role in hypnotic susceptibility, a decrease in hypnotic responsiveness with increasing ages is understandable.

The results of this study are also suggestive of a relationship between information processing and cognitive resistance to interference. Reliance upon cognitive models
in the performance of a task would limit attentiveness to other unrelated environmental events. Cognitive resistance to interference would then be a function of operating from a cognitive-ideational mode of information processing and not orienting to a relatively unchanging environment. From a biological standpoint, there is adaptive value in not responding to insignificant environmental events. However, overreliance upon cognitive structures at the expense of sensory processing may also be considered a sign of cognitive inflexibility. Perhaps, then, an optimal balance of operation between cognitive-ideational and sensory-perceptual modes of information processing would be maximally adaptive.

Finally, this study extends laboratory findings of the relationship between hypnotic susceptibility and pain relief to chronic clinical pain in a hospitalized population. Pain reduction through hypnosis was found to be significantly related to clinical hypnotizability.
Appendix A

Figure 1. Schematic view of Mackworth camera apparatus (Mackworth, 1967).

Eye light source (X) projects a light beam which is reflected off of subject's cornea into eye lens (Y). Eye spot travels through the periscope (Z) to beam-splitting cube (D) which splits the beam into two paths, one terminating at the experimenter (F) and the other at the recording camera (E). Simultaneously, visual stimulus scene (A) is reflected by the mirror (B) to the scene lens (C). The image is then split into two paths by the beam-splitting cube (D), one terminating at the experimenter (F) and the other at the recording camera (E). Thus, the experimenter and the recording camera receive a composite image of the stimulus scene and the eye spot superimposed over the visual stimulus (Mackworth, 1967).
Appendix B

Shannon's Entropy Function

Shannon's Entropy Function measures predictability in a system, through measurement of the reduction of uncertainty in that system. As applied to information processing by Furst (1971), it is used to quantify the amount of information processed, by measuring the reduction of uncertainty of the spatial distributions of eye fixation-frequency and eye fixation-time, over a stimulus picture. Information is defined as anything which reduces uncertainty; thus, the amount of information gained is equal to the amount of uncertainty removed from a system.

Conceptually, information is gained through "bits." Each bit of information reduces the amount of uncertainty in the system by one half. This process can be compared to a systematic procedure for identifying which of the 64 squares of a checkerboard has been selected by a friend. By asking dichotomous questions, which can be answered "yes" or "no," (e.g., "Is the square in the right side of the board?") bits of information are obtained. One bit of information is gained by determining that the designated square is on the right side of the board; this bit of information also reduces the uncertainty by one half (from 64 to 32 squares). Since each succeeding bit of information will continue to reduce the uncertainty by one half, five additional bits of information (or six in all) will be
necessary to identify the square. Thus, by continuing to halve the uncertainty, through dichotomous questioning, the number of bits required to gain the desired information can be defined as the power to which 2 must be raised to equal the original number of alternatives. In this case, 2 raised to the power of 6 equals 64 ($2^6 = 64$), the original number of squares (or alternatives).

Shannon's formula is as follows:

$$H = -\sum p(i) \log_2 p(i)$$

where $H$ = the amount of uncertainty and $p$ = the probability of a particular alternative $i$, with $\sum p(i) \log_2 p(i)$ a weighted average of the probability of each alternative, which takes into account the varying information value of alternatives and the varying probability of alternative selections. Logarithms are used in place of exponential functions because of their ease of mathematical manipulability and their compatibility with a binary system (log to base 2 reflects the binary nature of a bit of information.)
Appendix C

Figure 2. Scree representation.
References


Cooper, G. W., Jr., & Dana, R. Hypnotizability and the Maudsley Personality Inventory. International Journal of Clinical and Experimental Hypnosis, 1964, 12, 28-33.


Miller, G. A. The magical number seven, plus or minus two. *Psychological Review*, 1956, 63, 81-97.


Pare, W. R. Age, sex, and strain difference in the aversive threshold to grid shock in the rat. Journal of


Sokolov, E. N. Higher nervous system functions: The orienting reflex. Annual Review of Physiology, 1963, 25, 545-580. (a)

Sokolov, E. N. Perception and the conditioned reflex. New York: MacMillan, 1963. (b)


Steinschneider, A., Lipton, E. L., & Richmond, J. B. Auditory sensitivity in the infant: Effect of intensity


