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I am submitting herewith a thesis written by Mark Moore entitled "The Unbidden Gaze Imagery and its Relation to Hypnosis " I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Michael Nash, Major Professor

We have read this thesis

and recommend its acceptance.

Accepted for the Council

Interim Vice Provost and

Dean of the Graduate School

THE UNBIDDEN GAZE:

IMAGERY AND ITS RELATION TO

HYPNOSIS

A Thesis
Presented for the
Master of Arts
Degree
The University of Tennessee, Knoxville

Mark Moore
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DEDICATION

This thesis is dedicated to my family

Mark, Joan and Robert Moore

for their constant love and encouragement

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ABSTRACT

The purpose of this study was to assess the relationship between subjects' mental imaging ability, as assessed by self-report and computer measures, and hypnotic susceptibility 108 undergraduate students completed the Vividness of Visual Imagery Questionnaire (Marks, 1973), and a modified form of the computerized Harvard Imagery Battery (Berardi et al , 1998). A subsequent 86 of these students had their hypnotic susceptibility assessed using the Waterloo-Stanford Group C measure of hypnotizability (Bowers, 1993) A correlation matrix of subjects' Vividness of Visual Imagery Questionnaire scores, Harvard Imagery Battery error rates, response times, responses times adjusted for simple reaction times and Waterloo-Stanford Group C hypnotizability scores failed to indicate any significant relationship between mental imagery ability and hypnotizability Further analysis failed to indicate either a significant nonlinear relationship between hypnotizability and imagery ability or gender differences in the relationship.

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1. INTRODUCTION

Hypnosis can be thought of as "a social interaction in which one person (the subject) responds to suggestions given by another person (the hypnotist) for imaginative experiences involving alterations in perception, memory, and the voluntary control of action" (Kihlstrom, 1998, p 467) Despite a controversial beginning in the hands of Anton Mesmer in 1774, the practice and study of hypnotism evolved during the nineteenth century through the work of figures such as Jean Martin Charcot, James Braid, Ambrosie Auguste Liebault and Hippolyte Marie Bernheim and contributed to Sigmund Freud's early development of psychoanalytic practice and theory (Fromm & Shor, 1979) However, at the beginning of the twentieth century, hypnosis was in danger of becoming an area of merely historical interest, rather than genuine scientific inquiry, as Freud abandoned it as a therapeutic technique

It was soon salvaged by the clinical work of individuals such as Milton Erickson (1939) who used brief hypnotherapy to treat traumatized soldiers and the empirical work of Clark Hull in the 1930's (e g., Hull, 1930, 1933) However, it was not until the development of standardized scales of hypnotic susceptibility by Weitzenhoffer and Hilgard (Forms A & B, 1959, Form C, 1962) that the study of hypnosis truly came of scientific age. These scales consisted of twelve items or suggestions drawn from a pool of items that had been traditionally used in the practice of hypnotism since its inception, such as a suggested heaviness in one's arm and posthypnotic amnesia The

items were administered in a standardized format and subjects were considered to have passed an item if they met certain criteria, such as the hypnotist observing that their arm had fallen more than six inches in ten seconds. The total number of suggestions that a subject passed was taken as an index of their hypnotic susceptibility

Test-retest correlations for the various susceptibility scales ranged as high as 90 (Hilgard, 1965) and intercorrelations between various scales ranged from 58 to 82, with an average or 70 (Bowers, 1986, pp 65-66) Evidence for long-tem stability in a person's susceptibility was provided by a study of 85 subjects who were hypnotized on two occasions, ten years apart The correlation between the two scores were 60 (62 for males and 57 for females) and for most subjects their scores did not change "more than a point or two in spite of different [hypnotists] and a different testing situation" (Morgan, Johnson, & Hilgard, 1974)

The stability of individual susceptibility encouraged researchers to investigate possible correlates of hypnotic susceptibility (Bowers, 1986) Early attempts to establish a relationship between hypnotic susceptibility and certain personality traits such as acquiescence, neuroticism and hysteria did not produce expected results (Deckert & West, 1963, Barber, 1964, Dana & Cooper, 1964; Hilgard, 1965). A more promising line of research, however, seemed to be offered by the existence of individual differences in the capacity to engage in vivid mental imagery, fantasy and

daydreaming (Betts, 1909, Horowitz, 1970, Singer, 1966) In particular, Sheehan (1972, p.311) argued that, "to the extent that imagery and fantasy are different cognitive functions, hypnosis may be more related to the former than the latter " The following sections will consider arguments as to why this might be the case

Mental imagery, a form of internal visual representation, has historically been considered to be a basic form of cognition and in the British Associationist school of philosophy in the 18th century it was even considered to be the medium by which the mind represented information It also played an important role in early theories of mental events as propounded by individuals such as Wilhelm Wundt and William James (Kosslyn, 1994) The rise of behaviorism marked the seeming demise of imagery as a topic of investigation in psychology, due to difficulties in finding an objective technique by which to measure imagery.

However, the study of imagery returned to prominence with the emergence of cognitive science as a major approach within psychology. Empirical evidence for the importance of imagery in cognition soon became evident Paivio (1971) demonstrated that the ability to learn a set of words was predicted by how well subjects could visualize their referents It was also shown that, when asked to mentally rotate objects, subjects did so incrementally, requiring more time for greater rotations, indicating that subjects use imagery to transform objects (Shepard & Feng, 1972; Cooper & Shepard, 1973, Metzler & Shepard, 1974, Cooper, 1976, Shepard & Cooper, 1982).

One conclusion that can be drawn from this research is that mental images are internal representations that parallel external objects Within the literature on imagery, a central debate has been over the nature of this representation – namely, whether it is propositional or depictive (Kosslyn, 1994) *Propositional* representations (e g., "book on table") contain a predicate ("on") that ties together one or more arguments ("book" and "table") while *depictions* can be thought of as a type of picture

Research has indicated that mental images are mainly depictions but that they also involve some propositional representation (Kosslyn, 1980, 1994). Thus, as depictive representations, images imply that "each part of an object is represented by a pattern of points, and the spatial relations among these patterns in the functional space correspond to the spatial relations among the parts themselves" (Kosslyn, 1994, p 5) The major critique of images as depictions rested on the assumption that mental depictions would require infinitely regressed depictions This critique was rebuked, however, when it was demonstrated that computers could use depictions to represent images (Kosslyn & Schwartz, 1977, 1978)

Research has also indicated that the areas of the brain that are used in visual perception are also involved in mental imagery Patients with perceptual brain damage have been found to have parallel deficits in mental imagery (Farah, 1988), and in non-brain damaged subjects the areas of the brain used in visual perception are also active in mental imagery (Farah, Peronnet, Gonon, & Girard, 1988)

Feedback is an important part of the visual system and, thus also an important part of mental imagery As Kosslyn states in his book, Image and Brain, (1994, p. 15)

> Almost every visual area that sends fibers to another visual area also receives fibers from that area And the fibers running upstream and downstream are of comparable size Although the precise function of these backward (efferent) pathways is not known, it seems clear that these fibers modulate processing of lower-level areas

Such a feedback system is likely to have implications for how mental imagery may influence our perception of the external world as well as motoric behavior Imagined objects are inspected and transformed using the same mechanisms that are used during actual visual perception and the presence of a feedback systems may allow for a situation whereby what is imagined may be experienced as real, e g , hypnosis.

Furthermore, the motor cortex and motor programming subsystems have been shown to be involved in mental transformations whereby an image is made to move in a novel way (Logie & Marichetti, 1991, Georgopoulos et al , 1989), and there is suggestive evidence that this connection between imagery and motoric processing works both ways Finke (1979) found that imagery can substitute for visual feedback in biasing the motor system (as, for example, when subjects wear prisms that displace the world to one side) A similar effect was observed when they merely imagined the displacement It has also been found that practicing something through imagery can

improve performance (Goss et al , 1986) Such evidence suggests that imagery may augment the effect of a hypnotic suggestion on motoric behavior

Sheehan (1972) also presents several reasons why a relationship between imagery and hypnotic susceptibility should be expected Hypnosis has been conceived of as a change in consciousness (Tart, 1972) and it has been found that imagery is common in altered states of consciousness (e.g , Moss, 1967, J R Hilgard, 1970) Furthermore, Shor (1959) described hypnosis as a loss of generalized reality-orientation, where one's generalized reality-orientation (GRO) can be defined as the frame of reference by which we interpret ongoing experience GRO is thought to facilitate secondary process thinking which is characterized as occurring "in language rather than imagery, pictures, and symbols. is reality oriented. goal directed, verbal thinking and operates by logically ordered, practical, or abstract concepts" (Fromm & Nash, 1997, p 33)

A reduction in GRO produces a greater amount of primary process thinking in which "the form of thinking is that of preverbal imagery [and] is nonsequential and does not follow the rules of logic" (Fromm & Nash, 1997, p. 33) With the loss of GRO in hypnosis the distinction between reality and imagination is lessened, thus leading to the expectation that more vivid imagery, dreamlike phenomena & hallucinations would occur (Gill, 1972) Sheehan argues that "the occurrence of primary process mentation in trance, combined with the assumption that not everyone is susceptible to

hypnosis, suggests that certain cognitive abilities must exist for a person in order that he may function as a good hypnotic subject" (Sheehan, 1972, p 389) One such cognitive ability that Sheehan argues for is the ability to create vivid mental imagery

The basis for Sheehan's argument stems from clinical observations and empirical research Both Hilgard (1965) and Connors and Sheehan (1976) observed how hypnosis may be inadvertently induced when patients were given imagination suggestions Arnold (1946) found that the amount of sway a person produced upon suggestion was proportional to the reported vividness of the image a person had of swaying – although not a perfect measure of susceptibility, suggestive swaying has been used as a preliminary measure of hypnotic susceptibility (see also Richardson, 1969, 1972).

A more direct study of the relationship between hypnotic susceptibility and imagery was conducted by Sutcliffe, Perry, and Sheehan (1970) using Betts' Questionnaire upon Mental Imagery (Betts' QMI, 1909) and a standardized measure of hypnotic susceptibility They found a correlation of 0.58 for men and 0 20 for women between vividness of mental imagery and hypnotic susceptibility As well as finding an unexpected effect for gender, their results also indicated a missing quadrant effect – they found that "poor" imagers were typically "low" susceptible hypnotic subjects (i e , passing few suggestions) while vivid imagers could be either *low* or *high* susceptible hypnotic subjects

Of course, Sheehan's argument that certain cognitive processes are required in order to be susceptible to hypnosis does not necessitate that imagery is one of those processes Furthermore, the observed increase in primary process mentation, and specifically imagery, in the trance state does not directly imply that imagery is a prerequisite for hypnotic susceptibility Imagery may be an epiphenomenon of hypnosis and not a causal aspect of one's ability to be hypnotized Other researchers using the QMI have failed to find any significant relationship between reported vividness of imagery and hypnotic susceptibility Morgan & Lam (1969) failed to find a relationship, as did Lehman (1973) who administered the QMI at a different time than the measure of susceptibility. Perry (1973) failed to fully replicate Sutcliffe et al. (1970), but he found that a reported lack of vividness continued to be almost invariably related to insusceptibility Spanos et al (1973), using the QMI, found that the relationship between imagery vividness and hypnotizability was stronger for subjective hypnotic scores rather than objective scores

The matter has been further complicated by findings that there may be an effect for gender on the relationship between hypnotizability and imagery vividness. J R Hilgard (1970) found a small but significant correlation between the Stanford Hypnotic Scale of Susceptibility, Form C (SHSS C) but when she analyzed the relationship for gender effects, the relationship was significant for females only Although there is a lack of empirical evidence for gender differences in hypnotic susceptibility (Bowers, 1986), Michael (1967) found gender differences in imaging

ability, which may account for Hilgard's finding. However, work by Fromm, Oberlander, and Gruenewald (1970) suggests that the relationship between imagery and hypnotizability should be stronger for males They found that males rather than females, increase primary process mentation in trance compared to the waking state

In a more recent attempt by Glisky, Tataryn, & Kihlstrom (1995) to explicate the nature of the relationship between vividness of mental imagery and susceptibility, Marks' Vividness of Visual Imagery Questionnaire (VVIQ - Marks, 1973) was used to assess imagery vividness, and the data was analyzed for a nonlinear relationship between imagery and hypnotizability. Based on Sutcliffe et al (1970) finding a missing quadrant effect and similar findings by J R Hilgard (1970) and deGroh (1989), Glisky expected the nonlinear relationship to be stronger than the linear relationship. The research was conducted on two groups of 782 and 750 undergraduate students and the correlation between scores on the VVIQ and the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS.A) for the two group was 0 08 and 0 07 respectively However, they failed to find a significant nonlinear relationship that was consistent across both groups

In attempting to explain the missing quadrant effect, Glisky et al. (1995) noted that high scores were easily obtainable on self-report measures of imagery, thus resulting in a skewed distribution of imagery vividness scores. Kihlstrom, Glisky, Peterson, Harvey & Rose (1991) found that only 10% of subjects reported vague images

Comparing such a skewed distribution with the typically normal distribution of hypnotizability scores may account for the missing quadrant effect. In reference to this point, Glisky et al (1995, p 36) stated:

> In other words, it is possible that both the low correlation between imagery and hypnotizability, and the nonlinear nature of the imagery-hypnotizability relationship, are psychometric artifacts Although a rather different scatterplot might emerge if the scales in question had similar psychometric properties, no such instruments are available in the domain of mental imagery to test this hypothesis

In response to this possibility, Kogon et al. (1998) used a computer-based imagery vividness measure in an attempt to avoid a skewed distribution of vividness scores The computer measure that they used was the Harvard Imagery Battery (HIB) which was devised by Berardi et al to "assess the ability to generate, maintain, and transform images" (p 364) This imagery measure has potentially distinct advantages over traditional self-report measures of imagery such as the VVIQ It is a more objective measure and less likely than self-report measures to produce a skewed distribution Indeed, Kogon et al hypothesized that these measures would correlate more strongly with the Hypnotic Induction Profile (HIP – Spiegel & Spiegel, 1978) and the SHSS C (Weitzenhoffer & Hilgard, 1962) than the VVIQ (Marks, 1973) because they were "more objective, repeatable, and less prone to interpretation than self-report measures" (p 364) Also the HIB not only attempts to measure differences in the vividness of mental imagery but also differences in the controllability of an image, both of which

researchers consider to be fundamental characteristics of mental imagery (Denis, 1989, Kosslyn, 1985)

The HIB consisted of four tasks that each consisted of four sample items and sixteen test items The first task, the Word Imagery Task, involved subjects hearing a four-letter word as played by the computer and they had to decide whether the first letter was taller, shorter or equal in length to the last letter in the word In the second task, the Image Rotation Task, subjects were present with two 2-dimensional cube figures on either side of a central fixation point The image on the right was rotated either 90 or 135 and subjects had to decide if the image on the right was an exact replica of the one on the left.

For the third task, the Image Maintenance Task, subjects were presented with 2 or 4 gray squares located in a 4x5 grid and they had to memorize the locations of the gray squares After memorizing the squares the image disappeared and a new grid appeared after 3 seconds and it contained a single "X" Subjects had to decide if this "X" matched the location of any of the gray squares that they had memorized In the final task, the Face Imagery Task, subjects heard the names of two famous people and they were asked to decide, using a mental image, whose face was rounder. Table 1 on the following page presents the correlations between response times and hypnotizability that Kogon et al (1998) obtained, while table 2 presents similar results for error rates (significant correlations in bold face, N=43)

Table 1: Correlation Matrix for Median Reaction Times and Hypnotizability

	Word	Rotation	Maintenance	Face	HIP	SHSS:C
Word	1.0					
Rotation	.21	1.0				
Maintenance	**.39**	**.60**	1.0			
Face	**.44**	.31	**.44**	1 0		
HIP	-.01	.03	.04	-.05	1.0	
SHSS.C	- 05	.12	04	.04	**.60**	1 0

Significant correlations in bold face (p<0 05)

Source Kogon, M M , Jasiukaitis, P , Berardi, A , Gupta, M , Kosslyn, S M , Spiegel, D (1998) Imagery and hypnotizability revisited *The International Journal of Clinical and Experimental Hypnosis, 46 (4),* 363-370

Table 2: Correlation Matrix for Error Rates and Hypnotizability

	Word	Rotation	Maintenance	Face	HIP	SHSS:C
Word	1.0					
Rotation	- 02	1.0				
Maintenance	- 04	.29	1.0			
Face	.24	.13	-.08	1.0		
HIP	.18	-.32	-.09	-.05	1.0	
SHSS:C	- 01	-.22	.04	-.3	**.60**	1.0

Significant correlations in bold face (p<0 05)

Source Kogon, M M , Jasiukaitis, P., Berardi, A , Gupta, M , Kosslyn, S. M , Spiegel, D. (1998) Imagery and hypnotizability revisited. *The International Journal of Clinical and Experimental Hypnosis, 46 (4),* 363-370

In addition to failing to find a significant correlation, Kogon et al. also failed to find significant differences when the hypnotizability scores and imagery scores were dichotomized into highs and lows. In explaining the lack of a significant relationship between their imagery vividness measure and the hypnotizability scales, Kogon et al. referred to Kearns and Zamansky (1984) who found that the ease of learning pairs of nouns containing low- and high-imagery words was significantly correlated with hypnotizability, but that the "task involving spatial imagery did not" (p.368).

However, it is also possible that measurement error accounted for their inability to find a relationship between imagery vividness and hypnotizability. They did not account for simple reaction times and this may have served as a confound in their experiment, given that reaction times have been found to be related to hypnotizability (Braffman & Kirsch, 1999). As response times in the Kogon et al. (1998) study are the sum of simple reaction times and time required to process the mental imagery task it is impossible to partial out the degree to which the time required to process mental imagery is associated with hypnotizability. Furthermore, they also failed to analyze their data for possible gender effects.

The aim of this thesis is to better test the relationship between imaging ability and hypnotizability by improving upon the HIB as a measure of imagery by accounting for simple reaction times, changing the words used in the Word Task as subjects had

difficulty deciding if the letter "t" constituted a low or high word (Kogon, personal communication), and creating a more user-friendly format for the measure.

Specifically, it is hypothesized that the correlation found between error rates on the imagery tasks and hypnotizability will not significantly differ from those found by Kogon et al. (1998). However, it is also hypothesized that response times with simple reaction times factored out will be both significant and significantly more correlated with hypnotizability than were the response times measured by Kogon et al. Furthermore, it is hypothesized that the nature of this relationship between imagery response times and hypnotizability will be nonlinear. Finally, it is hypothesized that the nature of the relationship between imagery vividness and hypnotizability will be different for males and females, with females displaying better imaging ability (as measured by the VVIQ and the altered HIB), and there being an interaction effect between gender and imaging ability for hypnotizability scores.

2. METHOD

Subjects

The subjects were drawn from a class of 212 Introductory Psychology students 193 students completed the Vividness of Visual Imagery Questionnaire (VVIQ), while 189 students took part in the group hypnosis session in which their Waterloo-Stanford Group C (WSGC) hypnotizability scores were obtained, and 102 students completed the computerized imagery tasks (the modified Harvard Imagery Battery or the HIB) for extra credit Information on age and GPA scores is given below in Tables 3 and 4 for those subjects for whom hypnotizability scores were available and who completed the VVIQ and/or the modified HIB.

Table 3: Mean Age of Subjects

	NUMBER	MEAN	S D
HYPNOSIS Males	36	18.93	4.67
HYPNOSIS Females	50	18 42	3 24
VVIQ Males	39	18.94	4 13
VVIQ Females	48	18.06	3.74
COMPUTER TASK Males	37	19.07	4 12
COMPUTER TASK Males	52	17 73	3 76

Table 4: Mean GPA of Subjects

	NUMBER	MEAN	S D.
HYPNOSIS Males	36	2.96	.55
HYPNOSIS Females	50	3 22	70
VVIQ Males	39	2 98	60
VVIQ Females	48	3.12	76
COMPUTER TASK Males	37	3 02	57
COMPUTER TASK Males	52	3 05	77

Materials

Hypnotizability Measure

The Waterloo-Stanford Group C (WSGC) Scale of Hypnotic Susceptibility was used to assess subjects' hypnotic susceptibility. This is a 12-item hypnosis scale, developed by Kenneth Bowers (1993), that can be administered in large group settings The twelve suggestions are listed in Table 5 in their correct order of administration. Protocols are completed by subjects at the end of a hypnosis session in which they are presented with a hypnotic induction followed by the twelve suggestions (the last two of which are posthypnotic suggestions). After the last suggestion, subjects are taken out of the hypnotic state and given an opportunity to respond to the two post-hypnotic

Table 5: WSGC Items in Order of Appearance

Items
1 Hand Lowering
2 Moving Hands Together
3 Mosquito Hallucination
4 Taste Hallucination
5 Arm Rigidity
6 Dream about Hypnosis
7 Arm Immobilization
8 Age Regression
9 Music Hallucination (hear Jingle Bells)
10 Negative Visual Hallucination
11 Posthypnotic Suggestion (draw a tree on response booklet)
12 Posthypnotic Amnesia

suggestions on their response booklet (drawing a tree on the top of page two and failing to recall suggestions until a post-hypnotic suggestion for amnesia is lifted) Subjects then indicate the degree to which they believe an objective observer would have seen them respond to each suggestion and/or the degree to which they felt themselves respond A subject's score is arrived by totaling the number of items that they record as ones they responded to Thus scores can range from 0 to 12.

Bowers (1933) reported an internal consistency of 0.80 for the WSGC when given to a sample of 259 students. The mean and standard deviation were 5.71 and 3 07 respectively, which is comparable to the mean of 5 19 and standard deviation of 3 09 for the commonly-used individual Stanford Hypnotic Susceptibility Scale, Form C

Bowers found it comparable in most important respects to the norms of the SHSS C and that the two scales were significantly correlated at 0 85

For the purposes of this study, an altered 11-item form of the WSGC was used that was identical to the original in all aspects, expect that item 8, age regression, was omitted The purpose of the omission was to avoid the possibility of traumatic regression and decompensation, whereby subjects vividly recall a traumatic childhood event despite instructions to recall a pleasant school day This altered form has been typically used in hypnosis research in this university and reliability coefficients remain in the 0 80 – 0 99 range (in this study Cronbach's Alpha was 0 99).

Self-Report Measure of Vividness of Mental Imagery

The Vividness of Visual Imagery Questionnaire (VVIQ) is a 16 item questionnaire developed by David Marks (1973) in which subjects are asked to close their eyes and visualize four distinct elements of four different scenes (a relative or friend, a rising sun, the front of a familiar shop, and a country scene) and rate each of the 16 elements on the basis of how vividly they can be imagined Support for the validity of the VVIQ can be found in research that shows how it predicts various types of visual memory performance (McKelvie & Demmers, 1977) For example, Marks (1973) reported that subjects classified as highly vivid visual imagers on the basis of this scale were more accurate in recall of visual stimuli than subjects classified as less vivid visual imagers. Estimates of its test-retest reliability range from 0 67 to 0 87 (McKelvie & Demmers,

1977) Inter-item reliability, as measured by Cronbach's Alpha, in this current sample was 0 94

In Marks' original scale (1973) the ratings were made on a scale of 1 to 5, with 1 labeled as 'Perfectly clear and as vivid as normal vision,' 2 labeled as 'Clear and reasonably vivid,' 3 labeled as 'Moderately clear and vivid,' 4 labeled 'Vague and dim,' and 5 labeled as 'No image at all, you only "know" that you are thinking of the object ' In this study we reversed scoring and altered the scale so that it read from 0 to 4 with zero labeled 'No image at all, you only "know" that you are thinking of the object' up to 4 which was labeled as 'Perfectly clear and as vivid as normal vision ' This was done in order to ease interpretation of scores so that high scores represented greater vividness Furthermore, Moran (1992) in reference to self-report vividness measures, noted that there "appears to be no good reason for the counter-intuitive practice of assigning lower scores to higher vividness" (p 158)

Computer Measure of Mental Imagery

Three of Anna Berardi's (Berardi et al , 1998) four original computer-based imagery tasks were adapted for use in this current research – the Word Task, the Rotation Task and the Maintenance Task (see Kogon et al , 1998). The basic format of these tasks remained the same – (1) in the Word Task subjects hear a four-letter word and they have to decide if the first letter is taller or shorter or equal in height to the last letter; (2) in the Rotation Task subjects have to mentally rotate a stimulus image and decide,

when rotated, if it matches a second stimulus image on the screen, and (3) in the Maintenance Task subjects have to memorize the location of two or four gray squares in a 4x5 grid and then decide, from memory, if they match the location of a newly presented "X" in the same grid These tasks have been described in greater detail in the Introduction (pp. 10-11).

Berardi's original Face Task was omitted as it was decided that it would be impossible to control for the variable ways in which subjects could visualize famous people (e g , face-on, from an angle, when younger, when aged, etc) Also a measure of simple reaction time was included at the beginning of Imagery Battery that involved subjects pressing the space bar as quickly as they could when they heard the computer make a "ping" sound Subjects practiced this twenty times, took a 15-second break and then repeated the test for another 20 presentations of the sound. Their mean reaction time on the second set of auditory stimuli was used as the measure of their simple reaction time

Each task contained 4 sample items and 16 test items and subjects' output contained the answers to individual items and the overall mean response time for each task Kogon (personal communication) indicated that there had been difficulty with some of the words used in the original Word Task as subjects had difficulty deciding if the letter "t" was a tall or short letter As a result, we created a new list of 20 four-letter words to be used in this research, assigning them in random order with four words

used for the sample portion and the remaining 16 being used as test items The original stimuli as used by Berardi (1998) were retained in the Rotation Task and the Maintenance Task However, in all the tasks the instructions were rewritten so as to be clearer and the answer buttons on the computer screen were also reformatted so as to make them less confusing.

No statistic for inter-item reliability is available for Berardi's HIB Kogon et al (1998) performed a factor analysis of the tasks using item response times and error rates They found a single factor emerging for response times and two distinct factors emerging for errors – rotation/maintenance and word/face. However, given the low number of subjects in Kogon et al.'s study (N=43) the results of this factor analysis must be interpreted cautiously A similar factor analysis, using 108 subjects for the analysis of response times and 72 subjects for error rates, was conducted in this current study but only single factors were found for both response times and error rates A reliability analysis of the error rates in each task produced Cronbach's Alpha values of 0 48, 0 76, and 0 57 for the Word Task, Rotation Task, and Maintenance Task respectively Similar statistics for the response times could not be calculated, as only mean scores were available from the computer No evidence is available regarding the validity of the HIB, although it does appear to have face validity

Design

A correlational design was used Hypnotic susceptibility as measured by the WSGC was considered the dependent variable of interest, with imagery vividness as measured by error rates, response times and adjusted response times on the altered HIB and imagery vividness as reported on the VVIQ as predictor variables for the purpose of regression analyses To avoid inflated correlations due to a possible context effect, subjects participated in three sessions on three separate days which, respectively, assessed performance on (1) the VVIQ; (2) the WSGC, and (3) a computer measure of simple reaction time and imagery vividness.

Procedure

Subjects were given the opportunity during class time to complete a questionnaire battery, which included the VVIQ, for class credit Completion of the entire battery took approximately forty minutes. Students who did not wish to do so were permitted to attend a concurrent study group in an adjacent building Subjects' age, gender, GPA and social security number were also collected Subjects' scores on the VVIQ, along with demographic information, were scored and recorded by the primary researcher To maintain anonymity, only the last digits of their social security were recorded to allow for matching with later data

The same procedure was followed with the administration of the WSGC, as subjects were given the opportunity to either partake in a 50 minute hypnosis session for class

credit or to attend a study group The same demographic information as above was collected from all students who completed the hypnosis session. All scoring of the hypnosis protocols were completed by the primary investigator and individual scores as well as total scores were recorded

Subjects who had completed both sessions were then informed that they could sign up for extra credit for the last phase of the experiment Subjects were able to chose from a variety of one-and-a-half hour timeslots for this portion of the experiment The actual testing for this part of the experiment took place in a sound-proof hypnosis laboratory in the Psychology Department During this part of the experiment, subjects were first asked to complete the simple reaction times measures and, once finished, to complete the three imagery tasks

3. RESULTS

The mean WSGC score obtained by subjects was 4.37 (S.D.=2.51), with a range from 0 to 10. No subject obtained the maximum possible score of 11. The mean VVIQ score was 2.70 (S.D.=0.84), with scores ranging from 0 to 4. For the 16 items on each of the imagery tasks, the mean number of items incorrectly answered was 1.56 (S.D.=1.47), 1.52 (S.D.=1.67), and 1.67 (S.D.=1.75) for the Word Task, the Rotation Task and the Maintenance Task respectively. The respective range of errors was 0 to 7, 0 to 8 and 0 to 8. The degree of skewness for VVIQ scores, WSGC hypnotizability scores, Word Task Errors, Rotation Task Errors, and Maintenance Task Errors were – 0.687, 0.342, 1.484, 1.559, 1.628 respectively. Figures 1, 2, 3, 4 and 5 display the distribution for each of these variables.

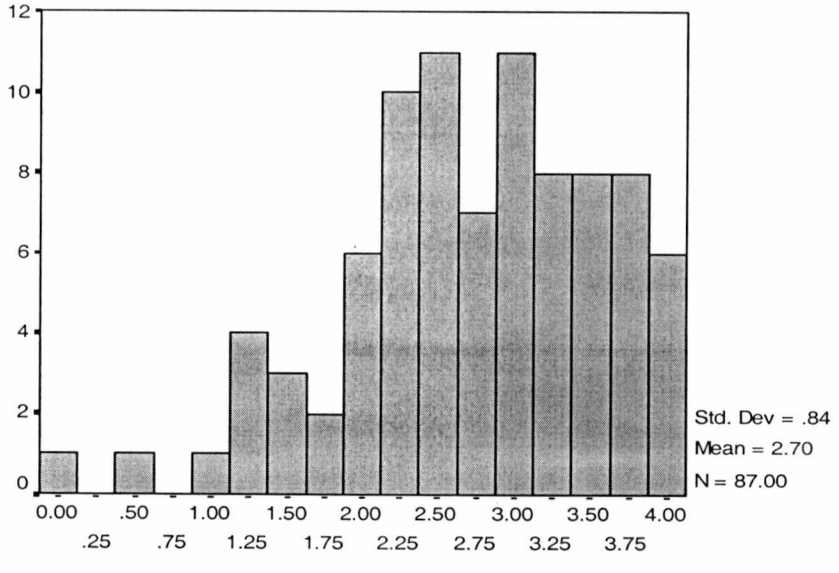


Figure 1: Distribution of VVIQ Scores

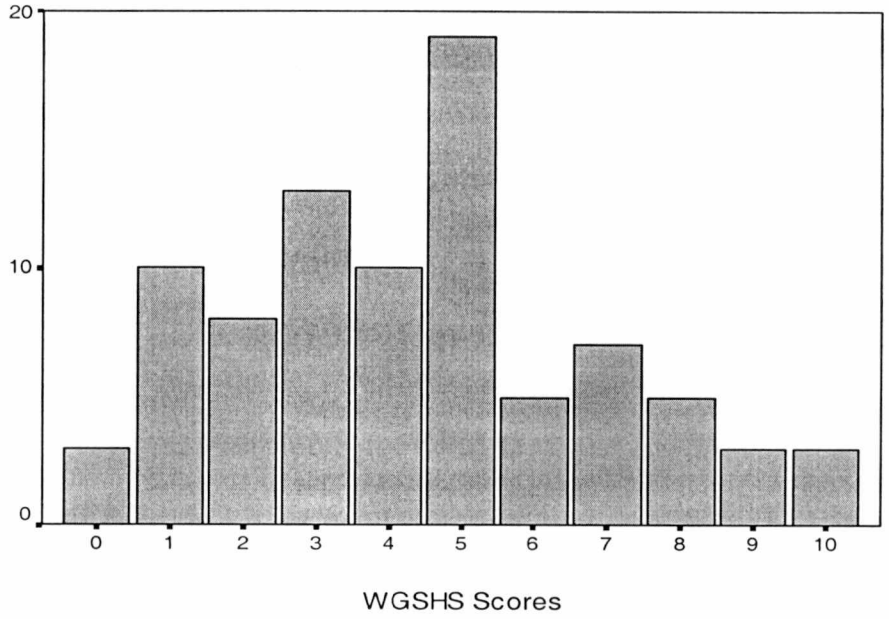


Figure 2: Distribution of WSGC Hypnotizability Scores

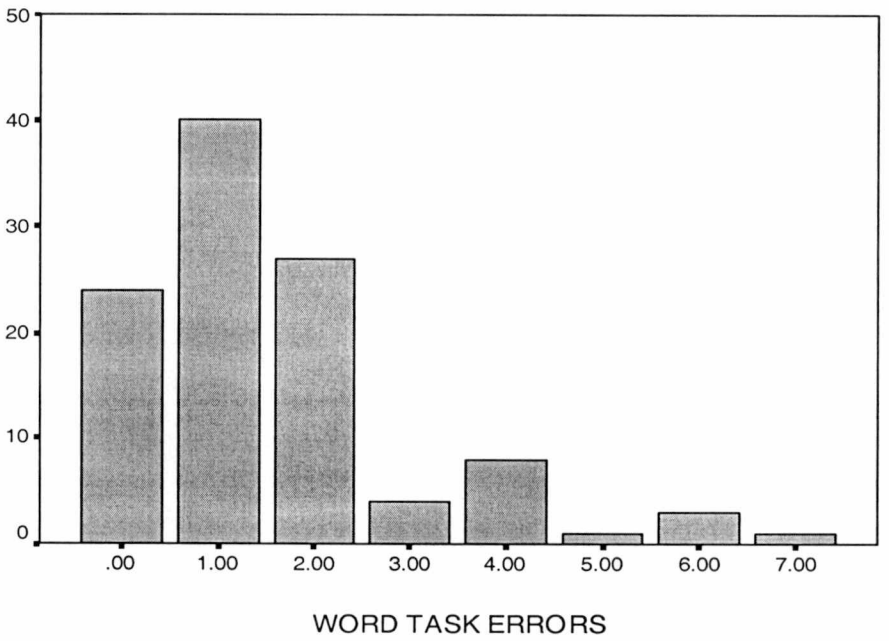


Figure 3: Distribution of Errors made on the Word Imagery Task

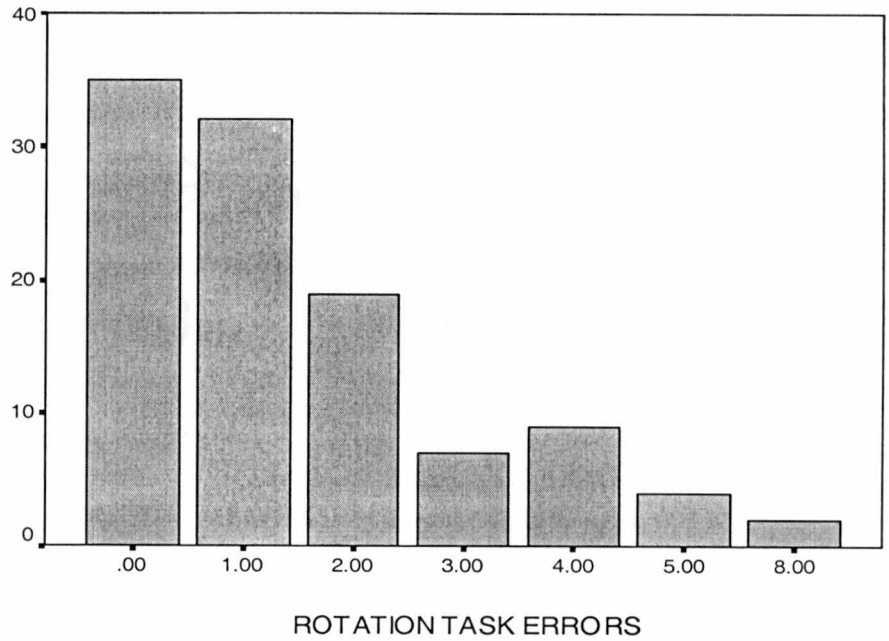


Figure 4: Distribution of Errors made on the Rotation Imagery Task

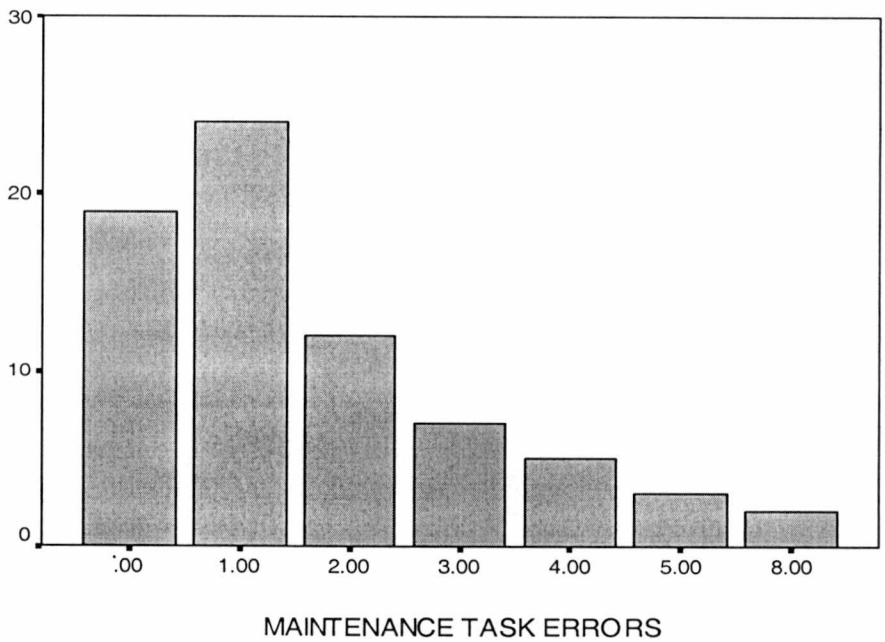


Figure 5: Distribution of Errors made on the Maintenance Imagery Task

The mean response times (in seconds), with standard deviations, minimum and maximum values and degree of skewness for the three computerized imagery tasks are given in Table 6 Table 7 presents the same statistics for the simple reaction time task and the imagery task response times corrected for simple reaction times (calculated by subtracting a subject's mean simple reaction time from their mean imagery response times)

Table 6: Response Times for the Imagery Tasks

	MEAN	S D	MINIMUM	MAXIMUM	SKEWNESS
Word	4 28	0 61	3 10	6 27	0 373
Rotation	5 25	1 63	1 11	10 46	0 712
Maintenance	8 87	0.34	8 32	9 78	0 629

Table 7: Simple Reaction Times and Corrected Imagery Task Response Times

	MEAN	S D	MINIMUM	MAXIMUM	SKEWNESS
Simple RT	0 27	0 06	.153	396	323
Word	4.05	0 63	2 82	5.25	0 032
Rotation	4 97	1 50	2 27	8 37	0 469
Maintenance	8 60	0 33	8.11	9 35	0 333

Kolmogrov-Smirnov tests of normality were performed on the distributions of the WSGC hypnosis scores, the VVIQ mean scores, and the error rates, simple response times and adjusted response times for the computerized imagery tasks A cut-off point of 0 10 was used as the upper bound for rejection of the null hypothesis that the various distributions differ from a normal distribution Thus, any statistic with an associated p-value greater than 0 10 was considered to indicate a normal distribution A Lilliefors significance correction was used for all the tests of normality The results for the tests of normality are given in Table 8

Table 8: Tests of Normality for the VVIQ and the Computerized Imagery Tests

	STATISTIC	DF	SIGNIFICANCE
WSGC Hypnotizability Scores	0.134	86	0 001
Mean VVIQ Scores	0 078	87	0 200*
Word Errors	0 239	108	0 000
Rotation Errors	0 142	108	0 000
Maintenance Errors	0 245	108	0 000
Word RT	0 061	108	0 200*
Rotation RT	0 090	108	0 031
Maintenance RT	0 106	108	0 005
Adjusted Word RT	0 072	71	0 200*
Adjusted Rotation RT	0 092	71	0 200*
Adjusted Maintenance RT	0 092	71	0 200*

*Lower bound of true significance

To examine the relationship between hypnotizability, self-reported imagery vividness, and computer measured imagery ability three correlation matrices were calculated Table 9 presents the correlation matrix for WSGC hypnotizability scores, VVIQ mean scores, and error rates for each of the computer tasks The correlation matrix for

Table 9: Correlation Matrix for WSGC, VVIQ, & Computer Task Error Rates

		WSGC	VVIQ	WERRORS	RERRORS	MERRORS
WSGC	R	1 000	0 015	0 090	0 045	-0 002
Hypnotizability	Sign	.	0.907	0 450	0 707	0 991
Scores	N	86	67	73	73	49
VVIQ	R	0 015	1 000	0 183	-0.014	-0 021
Mean Scores	Sign	0 907	.	0.129	0 911	0.890
	N	67	87	70	70	46
Word Task Errors	R	0 090	0 183	1 000	0 126	0.119
(WERRORS)	Sign	0 450	0 129		0 194	0 321
	N	73	70	108	108	72
Rotation Task	R	0 045	-0 014	0.126	1 000	**0.293***
Errors	Sign	0 707	0 911	0 194	.	0 013
(RERRORS)	N	73	70	108	108	72
Maintenance Task	R	-0 002	-0 021	0 119	0 126	1 000
Errors	Sign	0 991	0 890	0 321	0 194	
(MERRORS)	N	49	46	72	108	72

*Correlation is significant at the 0 05 level (2-tailed)

WSGC scores, VVIQ mean scores, and the three computer task response times is given in table 10 Table 11 contains a similar correlation matrix for adjusted computer task response times (mean response times minus simple reaction times), WSGC scores and VVIQ scores.

Table 10: Correlation Matrix for WSGC, VVIQ, & Computer Task Response Times

		WSGC	VVIQ	WRT	RRT	MRT
WSGC Hypnotizability Scores	R	1 000	0 008	0 140	0 112	0 194
	Sign.	.	0 947	0 239	0 346	0 100
	N	86	66	73	73	73
VVIQ Mean Scores	R	0 008	1 000	-0.062	-0 019	0 129
	Sign	0.947		0 612	0 874	0 291
	N	66	87	69	69	69
Word Task RT (WRT)	R	0 140	-0 062	1 000	**0.449****	**0.345****
	Sign	0 239	0.612	.	0 000	0 000
	N	73	69	108	108	108
Rotation Task RT (RRT)	R	0 112	-0 019	**0.449****	1 000	**0.223***
	Sign	0 346	0 874	0.000		0 020
	N	73	69	108	108	71
Maintenance Task RT (MRT)	R	0.194	0.129	**0.345****	**0.223***	1 000
	Sign	0 100	0 291	0 000	0 020	
	N	73	69	108	71	108

**Correlation is significant at the 0 01 level (2-tailed)
*Correlation is significant at the 0 05 level (2-tailed)

Table 11: Correlation Matrix for WSGC, VVIQ, & Adjusted Computer Task Response Times

		WSGC	VVIQ	AWRT	ARRT	AMRT
WSGC Hypnotizability Scores	R	1 000	0 008	-0 049	-0 104	0 118
	Sign	.	0 947	0.734	0 473	0 413
	N	86	66	50	50	50
VVIQ Mean Scores	R	0 008	1.000	-0 213	-0 152	-0 022
	Sign	0.947		0 160	0 318	0 887
	N	66	87	45	45	45
Adjusted Word Task RT (AWRT)	R	-0 049	-0 213	1 000	**0.364****	**0.425****
	Sign.	0 734	0 160	.	0.002	0 000
	N	50	45	71	71	71
Adjusted Rotation Task RT (ARRT)	R	-0.104	-0 152	**0.364****	1 000	0 193
	Sign	0.473	0 318	0 002	.	0 106
	N	50	45	71	71	71
Adjusted Maintenance Task RT (AMRT)	R	0 118	-0 022	**0.425****	0 193	1 000
	Sign	0 413	0 887	0.000	0 106	
	N	50	45	71	71	71

**Correlation is significant at the 0 01 level (2-tailed)

In order to detect a possible nonlinear trend, subjects' VVIQ scores, computer imagery task error rates and adjusted computer imagery task response times were dichotomized into two groups, low and high hypnotizables, using the median WSGC score (the median was 4). Table 12 presents these results Compared to the low hypnotizable group, the high hypnotizable group made more errors on all the computer tasks, displayed slower adjusted response times on the rotation and maintenance computer tasks and a faster adjusted response time on the word computer task However, t-tests indicated that none of these differences were significant (all p-values >0 10) There was no difference between the groups in mean VVIQ scores.

Table 12: Mean VVIQ Scores, Computer Task Error Rates and Adjusted Computer Response Times Dichotomized by Hypnotizability

	WSGC < 5 (LOWS)	WSGC > 4 (HIGHS)
VVIQ Mean Score	2 68	2 68
S D	0 69	0.95
N	33	34
Word Task Errors	1 29	1 49
S D	0 98	1 52
N	38	35
Adjusted Word Task RT	4 05	3 93
S D	0 49	0 69
N	26	24
Rotation Task Errors	2 89	3 00
S D.	2 40	2 54
N	38	35
Adjusted Rotation Task RT	4.93	5 02
S D	1 63	1 28
N	26	24
Maintenance Task Errors	1.68	1 83
S D	1 82	1.66
N	25	24
Adjusted Maintenance Task RT	8 56	8.59
S D	0 32	0 35
N	26	24

A multiple regression with WSGC hypnotizability scores as the dependent variable and VVIQ score, and number of errors on the Word Task, the Rotation Task and the Maintenance Task as independent variables failed to reveal a significant relationship ($R^2 = 0.076$, $p = 0.641$). A similar multiple regression with WSGC hypnotizability scores as the dependent variable and VVIQ score, and adjusted response times on the Word Task, the Rotation Task and the Maintenance Task as independent variables also failed to reveal a significant relationship ($R^2 = 0.016$, $p = 0.972$).

Tests for a possible non-linear trend between both VVIQ scores and computer imagery task error rates and hypnotizability were performed by four separate multiple regressions with WSGC scores as the dependent variable and either VVIQ scores or adjusted imagery task response times entered as independent variables followed by their squares in the regression equation. All four regression analyses were non-significant with R^2 values ranging from 0 009 to 0.025. Figures 6, 7, 8 and 9, which display VVIQ scores and computer imagery task error rates with subjects classified by WSGC scores, also fail to indicate any clear trend.

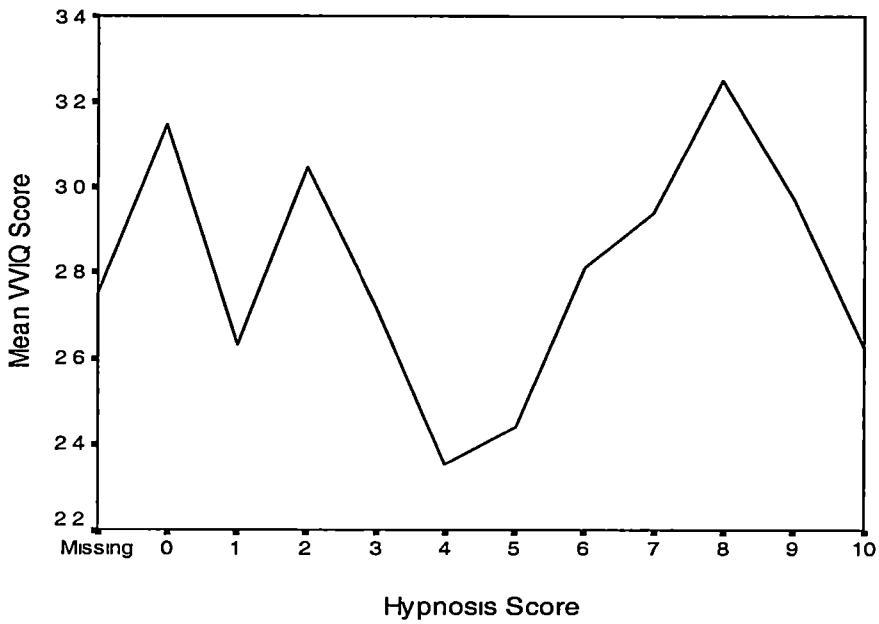


Figure 6: Mean VVIQ Scores with Subjects Classified by WSGC Scores

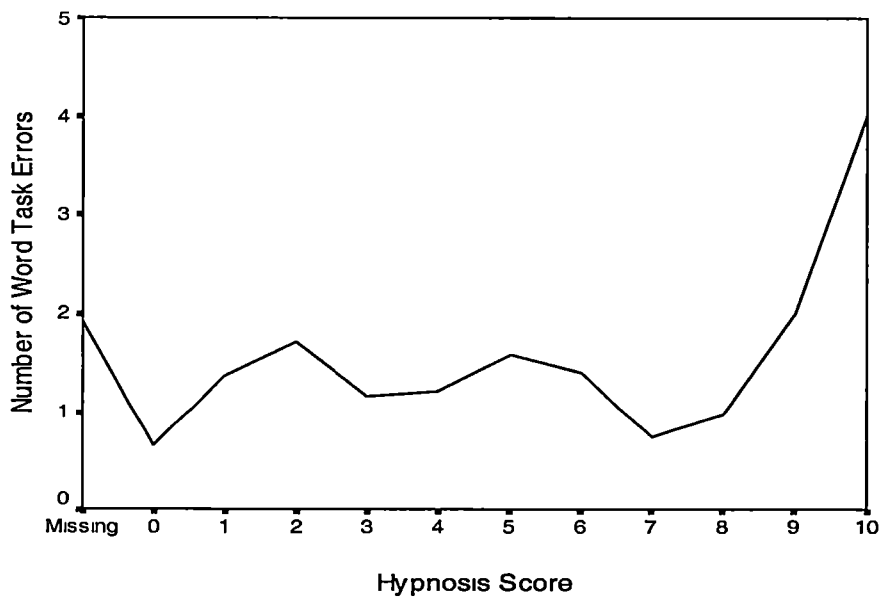


Figure 7: Mean Number of Word Task Errors with Subjects Classified by WSGC Scores

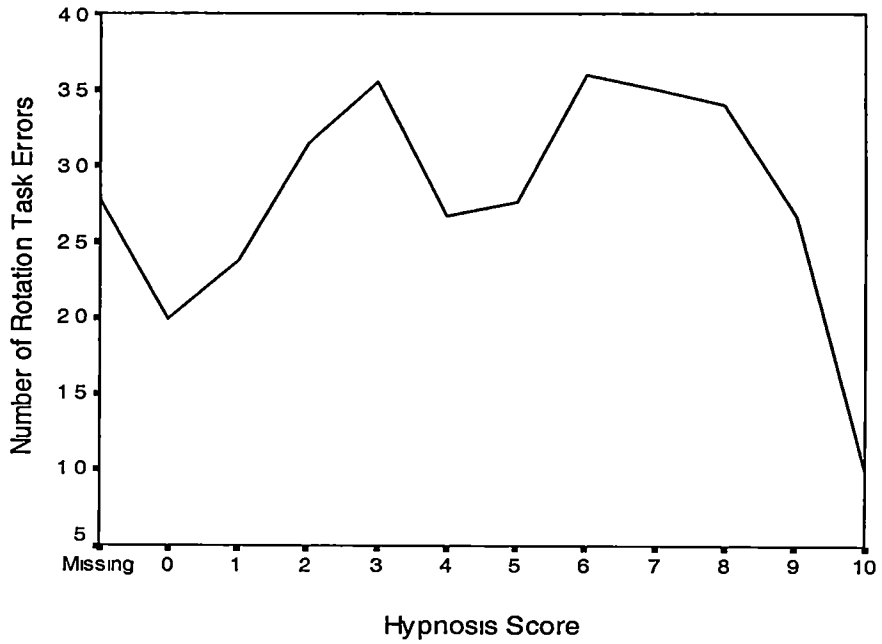


Figure 8: Mean Number of Rotation Task Errors with Subjects Classified by WSGC Scores

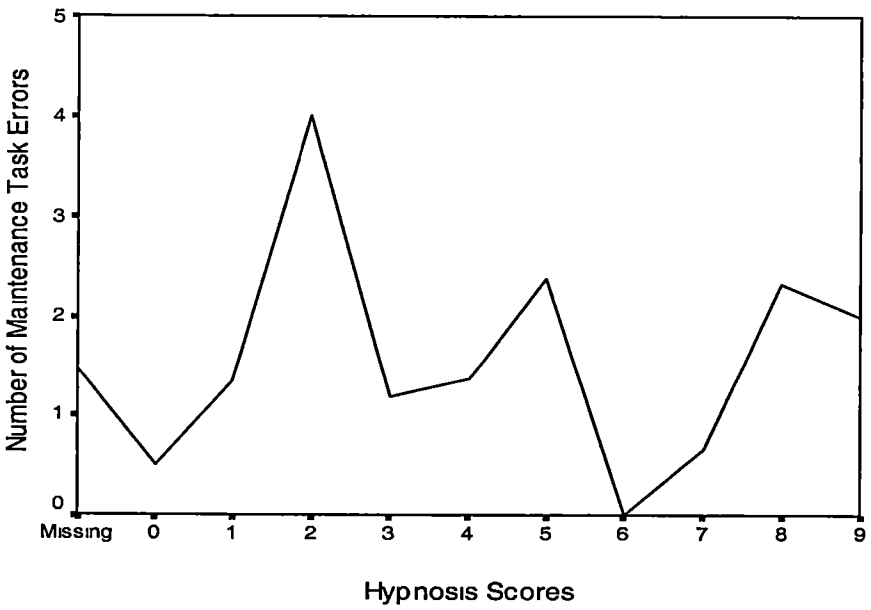


Figure 9: Mean Number of Maintenance Task Errors with Subjects Classified by WSGC Scores

Similar tests for a possible non-linear trend between adjusted computer imagery task response times and hypnotizability were performed by three separate multiple regressions with WSGC scores as the dependent variable and adjusted imagery task response times entered as independent variables followed by their squares in the regression equation. Again all three regression analyses were non-significant with R^2 values ranging from 0.023 to 0.184. Figures 10, 11 and 12, which display adjusted computer imagery task response times with subjects classified by WSGC scores, also fail to indicate a clear trend.

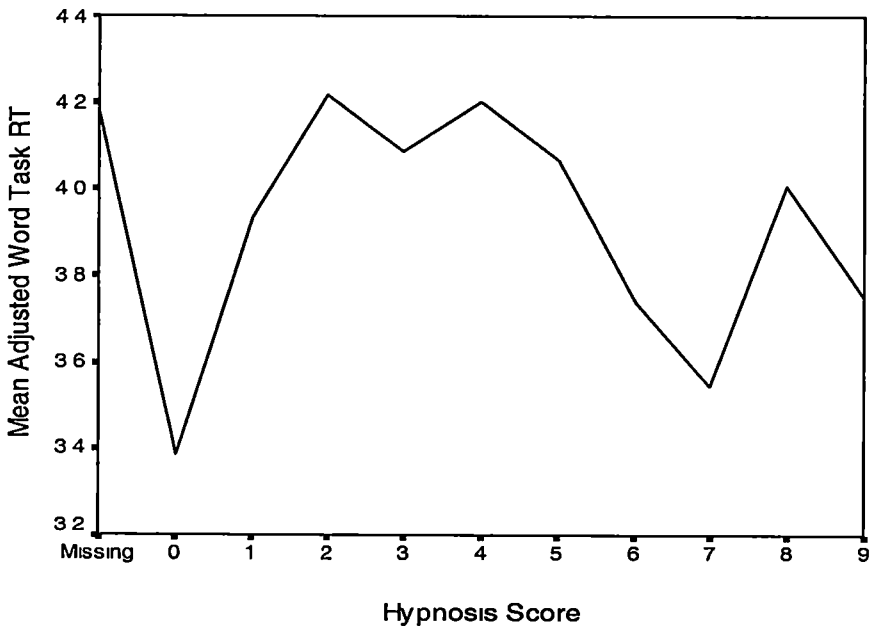


Figure 10: Mean Adjusted Word Task Response Time with Subjects Classified by WSGC Scores

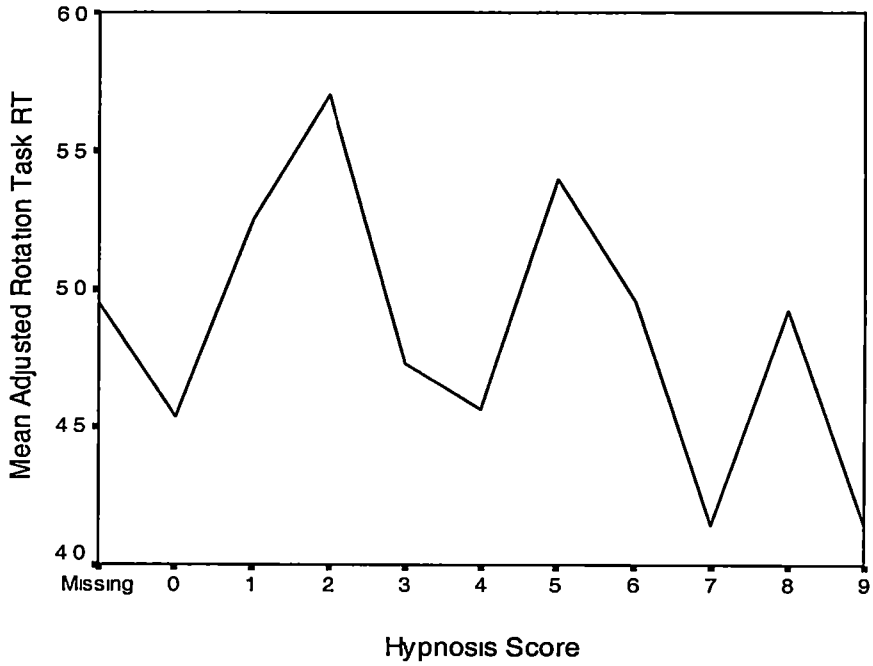


Figure 11: Mean Adjusted Rotation Task Response Time with Subjects Classified by WSGC Scores

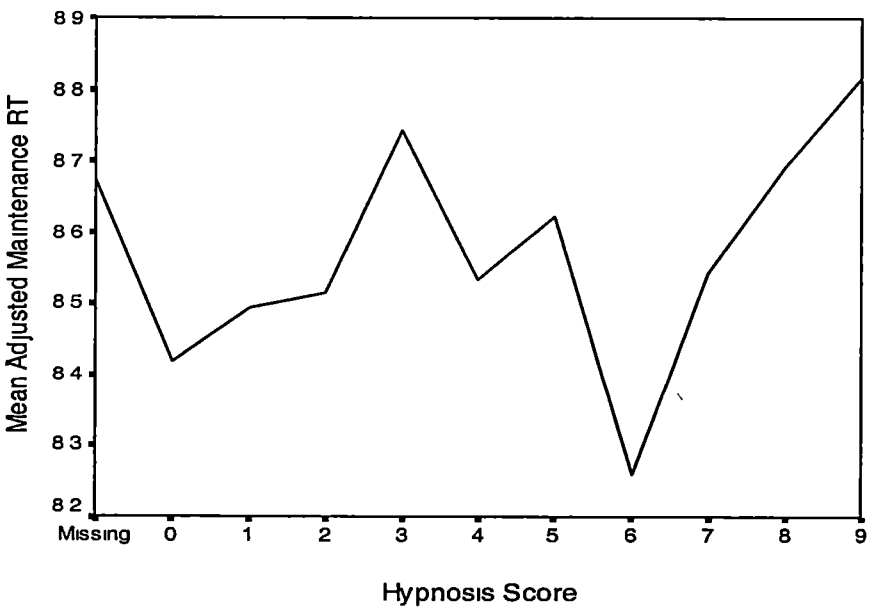


Figure 12: Mean Adjusted Maintenance Task Response Time with Subjects Classified by WSGC Scores

A series of t-tests failed to find any significant differences for gender on VVIQ scores, computer imagery task error rates, response times or adjusted response times. However, when subjects were divided into high and low categories based on a median split of their VVIQ scores, computer task error rates, response times and adjusted response times, a series of 2x2 ANOVA tests - Gender (Male, Female) x Imagery Measure Performance (High, Low) - were performed with WSGC hypnotizability scores entered as a continuous dependent variable. The results of the ANOVA tests suggested an interaction effect between gender and number of errors on the maintenance task ($F(2, 48) = 3.417$, $p = 0.038$), and a possible interaction effect between gender and adjusted Word Task response time ($F(2, 47) = 2.971$, $p = 0.057$). However, a Bonferroni correction for the ten ANOVA tests was made which indicated that these interactions were not significant.

4. DISCUSSION

The central aim of this thesis was to use a modified form of the Harvard Imagery Battery (HIB) to assess the relationship between mental imagery and hypnotizability, in an attempt to replicate Kogon et al's 1998 paper on this relationship Four specific hypotheses were proposed The first hypothesis was that although the modified HIB was expected to be a more accurate measure of imagery ability, no difference in error rates between the two forms of the HIB were expected, nor were the error rates from the modified HIB expected to be (more) significantly correlated with Waterloo-Stanford Group C hypnotizability scores The mean number of errors made in the original study on the Word Task, the Rotation Task and the Maintenance task were 1 41, 1 57 and 1 26 respectively which were comparable to the equivalent means of 1 56, 1 52 and 1 67 obtained in this study Furthermore, as in the original study no significant correlation was found between number of errors made on the modified HIB in this study and WSGC hypnotizability

The second hypothesis was that the adjusted response times used in the modified HIB would be better predictors of WSGC hypnotizability than both the VVIQ scores and the original simple response times used by Kogon et al (1998) The correlations found between simple response times in all three HIB tasks and WSGC scores in this study were comparable to those found by Kogon et al , i e , non-significant However, the

same was also true of the correlations between adjusted response times and WSGC scores obtained with the modified HIB, indicating that partialling out simple reaction times did not significantly increase the predictive power of the HIB as a measure of imagery in relation to hypnotizability This failure to find a significant relationship between imagery as measured by the HIB and hypnotizability scores may be due to several factors Possible considerations include psychometric problems with the HIB itself, the existence of a possible nonlinear relationship between hypnotizability and imagery, and the need to control for gender effects on the nature of the relationship

Although the modified HIB has face validity as a measure of mental imagery, in this study two of the three tasks of the HIB (Word Task and Maintenance Task) had low inter-item reliability in terms of number of items correctly answered (Cronbach's Alpha of 0.48 and 0.57 respectively), thus raising the question of whether or not these tasks are measuring unique constructs Furthermore, although it was originally developed as an improvement upon self-report measures of imagery, each task score and response time should be related to some significant degree with VVIQ scores if it is to be accorded any validity However, no significant correlation was found between VVIQ scores and any of the computer measures The largest (yet still non-significant) correlation was between the VVIQ and the Word Task in terms of (1) number of errors made (0 183, $p = 0.129$), (2) response time ($r = -0.213$, $p = 0.16$); and (3) adjusted response time ($r = -0\ 213$, $p = 0\ 16$). However, even here a contradiction is evident as

the positive correlation between number of errors and VVIQ score suggests that vivid imagers make more errors on the Word Task.

The HIB was also intended to be an improvement over self-report measures as it was expected to be less skewed and also to display a normal distribution, thus allowing for a less confounded comparison with hypnotizability (which is also a normal distribution – see Glisky et al , 1995, p.36 for a discussion of the possible problems of comparing non-normal distributions with normally distributed hypnotizability scores) However, the results indicated that while VVIQ scores were somewhat negatively skewed (-0 687), the HIB response times and adjusted response times were not markedly less skewed (ranging from 0 032 to 0.712) while error rates on the three tasks of the HIB were more skewed (ranging form 1 481 to 1 628) Also Kolmogrov-Smirnov tests of normality indicated that, while VVIQ scores were normally distributed in this study, the number of errors on all the HIB tasks and simple response times on the Rotation Task and the Maintenance Task were not

These points suggest that the failure to find a significant relationship between imagery and hypnotizability in this study may be due to psychometric problems with the measure used A related problem may be the level of difficulty of the items, as items on the HIB may not be assessing a wide enough range of ability Most subjects found the task relatively simple and this was reflected in the low number of mistakes that they made and the truncated range of scores Further improvement of the HIB might include the development of more difficult items such as longer words in the Word

Task with the target letters placed in variable positions from item to item Even with such improvements, however, it must be acknowledged that the HIB still assesses relatively basal level cognitive abilities and that a richer assessment of imagery may be required before any relationship with hypnotizability is to be discerned (assuming of course that there is one). For example, fantasy and the ability to become creatively involved in one's images may be more related to the phenomenon of hypnosis than imaging ability per se (Perry, 1973)

Another possible reason for the failure to find a relationship between imagery as assessed by the modified HIB and WSGC hypnotizability scores is related to the third hypothesis of this study, i e , that the relationship between imagery and hypnosis is nonlinear. As per Glisky et al (1995), the possibility of a nonlinear relationship was assessed by performing regression analyses with hypnotizability as the dependent variable For each regression analysis a score and its squared value were entered from an imagery task, e g , Word task response time or VVIQ score Squaring the predictor variable made it possible to test for possible quadratic relationships, which could account for the missing quadrant effect observed by Sutcliffe, Perry, & Sheehan (1970) – this approach was suggested by Glisky et al (1995) when analyzing VVIQ scores and hypnotizability However, no significant relationships were evident from this analysis and trend diagrams (Figures 6 – 12) did not suggest other possible nonlinear relationships for further analysis.

A final possibility that could explain the lack of significant findings in this study is the role that gender may play in how imagery ability relates to hypnotizability As noted in the introduction J R Hilgard (1970) found a significant relationship between imagery and hypnotizability for females, but not for males However, Fromm et al (1970) suggested that the relationship would be stronger for males. The fourth hypothesis of this study was that there would be gender differences in imaging ability and that this would effect the nature of the relationship between imagery and hypnotizability

However, a series of t-tests failed to show any gender differences in imagery ability Scores on the various HIB measures (error rates, response times and adjusted response times) as well as VVIQ scores were dichotomized into high and low scores to facilitate a series of 2x2 ANOVA's to test for an interaction effect between these dichotomized scores and gender with WSGC hypnotizability scores as the continuous variable. No significant main effects or interaction effects were found once Bonferroni's correction was applied Thus gender differences could not be used to explain the lack of findings in this study concerning the relationship between imagery and hypnosis.

In conclusion, the failure to find a significant relationship between measures of mental imagery and hypnotizability cannot easily be explained by gender differences or the nonlinearity of the relationship Therefore, the lack of a significant finding suggests

that either the measures used were inadequate to detect the relationship or that the relationship between imagery and hypnosis simply does not exist as it is posited in the literature on hypnosis As discussed above there are several reasons to question the reliability, the validity and other psychometric properties of the HIB Therefore doubt is cast upon our ability to assess the independent variable, mental imagery.

Should efforts continue to be made to refine how we measure imagery or should the attempt be given up as futile? I would argue that the very criticisms of the HIB mentioned above speak to the necessity of its continued improvement (and measures like it) through research, as the problems associated with it remain clear and thus amenable to change. While we know that an improved measure can be developed it remains premature to cease an investigation of the relationship between hypnotizability and imagery Just as its ephemeral nature has not prevented researchers continuing to focus their scrutinizing gaze upon mental imagery itself, so too should the seemingly ephemeral character of the relationship between hypnotizability and imagery not deter its further investigation

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