Frontal lobe contributions to hypnotic susceptibility: A neuropsychological screening of executive functioning

Deane Aiktns & William J. Ray

The Pennsylvania State University,

Yale University School of Medicine,

Published online: 31 Jan 2008.


To link to this article: http://dx.doi.org/10.1080/00207140108410081

Taylor & Francis makes every effort to ensure the accuracy of all the information (the “Content”) contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.
FRONTAL LOBE CONTRIBUTIONS TO HYPNOTIC SUSCEPTIBILITY: A Neuropsychological Screening of Executive Functioning

DEANE AIKINS AND WILLIAM J. RAY

The Pennsylvania State University

Abstract: Current theory on the cognitive mechanisms of hypnotic experience suggests that hypnosis is mediated by a dissociation between contention-scheduling mechanisms and a supervisory attention system. This theory is based on neuropsychological research with frontal lobe dysfunction patients, who show performance deficits similar in executive functioning to hypnotized individuals. To test an extension of this theory, high hypnotically susceptible \((n = 9)\) and low hypnotically susceptible \((n = 7)\) participants were given four tests of executive functioning. In a baseline condition, high susceptible individuals performed significantly better on one of the four tests (the Wisconsin Card Sorting Test). The role of increased cognitive flexibility in hypnotic susceptibility is considered as a possible component of the dissociated control model of hypnosis.

What are the cognitive mechanisms underlying hypnotic experience? Although there has been a great deal of debate over the nature of hypnosis either as a discrete state or as an individual difference, there has been little explicit discussion of the mechanisms by which hypnosis occurs (see Kirsch & Lynn, 1998, for review). Neo-dissociation theory (Hilgard, 1986) posited a dissociation in consciousness as the mechanism for hypnotic experience, whereas socially oriented theories (e.g., Spanos, 1986) have focused on the participant’s ability to detect social cues and willingness to respond to hypnotic suggestions (see Kirsch & Lynn, 1995, for review). Another alternative is the dissociated-control model, which uses an information-processing model of hypnosis based on dissociations of executive functioning (Woody & Bowers, 1994).

The dissociated-control model (Bowers, 1992; Woody & Bowers, 1994; Woody & Sadler, 1998) characterizes the inability to monitor or govern
basic motor and perceptual functions associated with hypnotic suggestion as breakdowns between contention-scheduling mechanisms and a supervisory attentional system. Contention-scheduling mechanisms are responsible for initiating and carrying out basic motor and cognitive functions. The supervisory attentional system is responsible for directing goals and intentions in addition to monitoring and indirectly modulating the contention-scheduling processes. According to the authors, hypnotic experiences occur when hypnotic suggestions inhibit the supervisory attentional system, thereby weakening the connections to the contention-scheduling mechanisms. This weakening allows the contention-scheduling mechanisms to originate some degree of direct motor and information-processing activity. The preservation of independent activity at the level of contention scheduling during a hypnotic experience would be consistent with clinical observations that, while hypnotized, many basic tasks may still be carried out, whereas more complicated and goal-directed tasks are inhibited. The area of the brain most associated with planning, organization, selective attention, and inhibitory control is that of the frontal lobes (Stuss & Benson, 1984).

The dissociated-control model of hypnosis originated from cognitive research with frontal lobe dysfunction patients (Norman & Shallice, 1986). Woody and Sadler (1998) suggest that hypnotic behavior can be likened to these pathological conditions in a functional but not a structural sense. Patients with frontal lobe dysfunction often appear quite capable of initiating and performing several tasks individually, while unable to coordinate and successfully prioritize the execution of multiple tasks simultaneously. This ability has been traditionally referred to in neuropsychological theory and research as "executive functioning" (Lezak, 1995). According to the dissociated-control model, executive-functioning deficits found in frontal lobe dysfunction are the result of a damaged supervisory-attentional system that no longer governs the contention-scheduling mechanisms necessary for complex and goal-directed behaviors. Indeed, frontal lobe dysfunction patients perform poorly on tests designed to measure aspects of the supervisory-attentional system, such as volition, planning, and cognitive flexibility (e.g., Norman & Shallice, 1986; Shallice & Burgess, 1991).

Contemporary hypnosis theorists noted the performance deficit similarities with hypnotized participants and suggested that the dissociated-control model may be able to elucidate the cognitive mechanisms for hypnosis as well. Indeed, Gruzelier and Warren (1993) used tests of verbal and spatial fluency prior to and during hypnosis. The results supported a pattern of decreased executive functioning during the hypnosis condition consistent with the dissociated-control model. Interestingly, highly susceptible participants have demonstrated decreased ability on tests of memory that are sensitive to frontal lobe damage, both within
and outside of the context of hypnosis (Woody & Farvolden, 1998). The authors interpreted the decreased baseline performance as evidence for possible information-processing differences related to hypnotic susceptibility beyond the hypnotic condition itself.

Decreased executive functioning, both with and without the hypnotic context, leads to an interesting extension of the dissociated-control model of hypnosis, namely the process by which the supervisory-attentional mechanism is loosened in the hypnotically susceptible individuals. The cognitive impairments of frontal lobe dysfunction are markedly severe and often refractory to treatment (Stuss & Benson, 1984). Whereas hypnotic experience may appear functionally similar to frontal lobe dysfunction, highly susceptible individuals maintain the ability to resume normal levels of cognitive operation. This suggests there may be additional cognitive processing mechanisms that can allow the supervisory-attentional system to regain control over the contention-scheduling mechanisms’ independent operations in hypnotically susceptible individuals. There may be several variations in cognitive processing by which this is achieved. The first is a deficit model of hypnotic susceptibility in which highly susceptible individuals have particularly poor supervisory-attentional abilities that are magnified during the hypnotic context. Another possibility is that, as suggested by Gruzelier and Warren (1993), highly susceptible individuals are more flexible in their cognitive processes. In this case, the supervisory-attentional and contention-scheduling mechanisms are working so efficiently to allow for periods in which contention scheduling is carried out on a time-limited “auto-pilot” during hypnosis.

The purpose of the current study is to explore further the complex relationship between hypnotic susceptibility and executive functioning. We selected four tests that previously have been demonstrated to assess executive-functioning deficits in frontal lobe dysfunction: The Controlled Oral Word Association Test (FAS) (Benton & Hamsher, 1989); the Stroop Color Naming Test (Stroop, 1935); the Towers of Hanoi (Shallice, 1982); and the Wisconsin Card Sorting Task (Heaton, 1981). These tests also reflect a diversity along verbal and visual-spatial modalities to test the range of potential differences in executive functioning (as suggested by Lezak, 1995). To the extent that highly susceptible individuals are predisposed to an inhibiting of the supervisory-attentional system by cognitive mechanisms similar to those seen in frontal lobe dysfunction, we expect performance decrements on a test battery of executive functioning previously used with frontal lobe dysfunction patients. Alternatively, it is also possible that the process of inhibiting the supervisory-attentional system during hypnotic contexts requires improved baseline executive functioning, in which case performance on the frontal lobe tests should be superior for high susceptible participants.
Participants were chosen from introductory psychology classes offered at The Pennsylvania State University. In an initial group screening procedure, the Harvard Group Scale of Hypnotic Susceptibility (HGSHS; Shor & Orne, 1962) was administered to approximately 400 undergraduates. Nine high susceptible (hypnotic susceptibility score of 10 or more) and 7 low susceptible (hypnotic susceptibility score of 3 or less) individuals were chosen to participate in this study for extra credit. To better determine the extent to which differences in executive functioning are related to hypnotic experience as an individual difference, all participants remained blind to this study’s inclusion criterion.

Participants were brought individually into the lab where they were given a written explanation of the study and an informed consent form. Following the completion of these forms, the participants were seated in front of a PC computer. The instructions for each part of the experimental protocol were then provided. The entire testing session lasted approximately 1 hour.

**Controlled Oral Word Association Test (FAS).** Participants were instructed to generate as many words that began with the target letters F, A, and S. They were told that responding with proper nouns, numbers, and the same word with different endings (e.g., plays, player, playing) would be considered an error. Participants were given 60 seconds to complete each of the three trials. The total number of correct words and number of errors were recorded for each trial by the experimenters.

**The Stroop Color Naming Test.** A computer program generated screens of 50 words (five columns of 10 words each) consisting of the names of colors (e.g., blue, red, green, and yellow), which were presented on a black background in a variety of colors but one always incongruous to the named color (the word red would never appear in the color red). Participants were instructed to quickly read aloud the color each word was presented in, not the word itself, and then press the return key to advance to the next screen. Five screens of words were presented. The response time to press the return key was recorded for each screen and an average response time was then computed.

**The Towers of Hanoi.** A computer program generated a graphic representation of three pegs with three blocks of different sizes stacked on the left peg. Participants were instructed to move all three blocks to the right peg with the following rules: (1) only one block could be moved at a time; (2) only the top block on a peg could be moved; and (3) the larger blocks could never be placed on top of a smaller block. Participants would first select the peg they wanted to move a block from and then select the peg they wanted to move a block to. If a move would violate one of the three rules, the phrase “illegal move” appeared across the screen. The
computer scored total number of moves and total number of illegal moves attempted.

The Wisconsin Card Sorting Test (WCST). The WCST was computer administered according to standardized criteria (Heaton, 1981). Briefly, four stimulus cards with symbols differing in color, shape, and number were presented at the top of the screen, and response cards were presented individually at the bottom. The participant was instructed to place each response card below one of the four top stimuli cards and was told by the computer and the experimenter whether the pairing criterion was right or wrong. Guided by the feedback, the participant was to try to get as many cards as possible right. After pairing 10 consecutive cards by the first criterion (color), he or she was to shift to the second one (shape), and then to the third one (number). This procedure was repeated twice or until all 128 response cards had been used. The indices considered for this experiment were: total number of correct trials, total number of errors, total number of perseverative errors (those errors where the participant continues to sort the cards to a criterion after the experimenter has changed it), and number of trials to complete the first criterion.

Patients with frontal lobe damage typically show a great deal of difficulty with these tasks. They are unable to generate multiple responses to the FAS. On the Stroop, these patients often show increased latencies to respond. Frontal lobe patients often find the Towers of Hanoi and the Wisconsin Card Sorting Test particularly frustrating due to the task demands for abstract reasoning and flexible planning. These patients usually are unable to generate a strategy for the Towers task and frequently break Rules 2 and 3. Patients often are unable to maintain a response set on the WCST long enough to meet criterion and have difficulty shifting set criterion once achieved, thereby creating numerous perseverative errors (Lezak, 1995).

Following the completion of the experimental protocol, all participants were asked to guess the primary hypothesis. None of the participants correctly identified the link between hypnotic susceptibility and performance on the test battery. An alpha level of .05 was used to determine statistically significant group differences. All comparisons were made with independent group $t$ tests using the SAS software package.

**RESULTS**

Highly susceptible participants were able to complete the WCST with fewer trials, $t(14) = 2.21, p < .04$, suggestive of increased cognitive flexibility, including the ability to detect relevant abstract information and shift cognitive set. However, there were no additional significant group differences in performances (see Tables 1 and 2).

To examine the relationships between tests, indices from each were correlated using Pearson's $r$ (see Table 3). Hypnotic susceptibility was also included as a binomial variable reflecting the high and low groups.
A nonsignificant positive correlation was found between the total number of moves on the Towers of Hanoi and the total number of correct moves on the Wisconsin Card Sort, perhaps reflecting similar visual-spatial processing abilities that both tests measure. Both tests show weaker, nonsignificant correlations to the FAS total words and Stroop average reading time, in keeping with the inferred relative independence between these measures as mentioned by Gruzelier & Warren (1993).

**DISCUSSION**

The purpose of the present research was to evaluate the cognitive mechanisms that underlie hypnotic susceptibility in a baseline condition. The dissociated-control theory suggests that hypnotic experience may be explained through the dissociation of a supervisory-attentional system and contention-scheduling mechanisms. The current study found no evidence to suggest that highly susceptible individuals demonstrate a predisposition for executive functioning deficits. Rather, the
Table 3  

<table>
<thead>
<tr>
<th>Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Towers</td>
<td>—</td>
<td>.41</td>
<td>.03</td>
<td>.07</td>
<td>-.19</td>
</tr>
<tr>
<td>2. WCST</td>
<td>—</td>
<td>—</td>
<td>-.29</td>
<td>-.13</td>
<td>-.48</td>
</tr>
<tr>
<td>3. FAS</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>.15</td>
<td>.39</td>
</tr>
<tr>
<td>4. Stroop</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>-.27</td>
</tr>
<tr>
<td>5. HypSus</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Note.  

Towers = Total Moves; WCST = Total Correct Trials; FAS = Total Words; Stroop = Average Reading Time; HypSus = binomial grouping variable (0 = low, 1 = high), n = 16.

The results of our study suggest that cognitive flexibility may be an important qualitative feature that contributes to hypnotic susceptibility. Additional research in hypnosis and source memory indicates that hypnotized participants provide less detail in their recall of material and remember the “gist” of information rather than details (Brainerd, Reyna, & Brandse, 1995). With regard to dissociated-control theory, this may indicate that highly hypnotizable people process information in a more fluid manner which then mediates any differences in executive functioning. Future theorizing and research should address cognitive flexibility as a possible cognitive mechanism in hypnotic susceptibility in addition to executive functioning deficits as related to hypnotic experience, perhaps by including measures such as the Cognitive Flexibility Scale (Martin & Rubin, 1995) and the Alternate Uses Test (Lezak, 1995).

The current study addressed only hypnotic susceptibility and not hypnotic experiences. Thus, there is the possibility that the hypnotic situation itself brings forth a condition associated with less executive or frontal lobe functioning independent of baseline functioning. One intriguing model was presented by Woody and Szechtman (2000) in discussing hypnotic hallucinations. Such a possibility suggests that...
Hypnosis involves limbic system processes that bring forth processes similar to fixed action patterns that result in a dissociation between the normal relationship involving the “feeling of knowing” and sensory feedback as described by Damasio (1999). In such a situation, hypnosis would invoke processes that work below the level of awareness as with fixed-action patterns and leave the individual without the feeling of willed action. In the context of the present study, it may be the high susceptible individual with the greater cognitive and emotional flexibility that allows the appropriate condition to evoke these evolutionary-based fixed-action patterns.

REFERENCES


Beitrag der Frontallappen zu Hypnose-Suggestibilität: neuropsychologisches Screening der Exekutivfunktion

Deane Aikins und William J. Ray


Rosemarie Greenman
University of Tennessee, Knoxville, TN, USA

Contributions du lobe frontal à la susceptibilité hypnotique: un filtrage neuropsychologique des fonctions exécutives

Deane Aikins et William J. Ray

Résumé: La théorie actuelle sur les mécanismes cognitifs de l’expérience hypnotique suggère que l’hypnose est induite par une dissociation entre la gestion de l’ordonnancement des contraintes et le système attentionnel de supervision. Cette théorie est basée sur des recherches neuropsychologiques effectuées sur des patients atteints de dysfonctionnements du lobe frontal, qui ont manifesté un déficit de performance similaire au fonctionnement
executif d’individus hypnotisés. Afin de tester une extension de cette théorie, des participants hautement susceptibles (n = 9) et faiblement susceptibles (n = 7) ont été soumis à 4 tests de fonctionnement exécutif. Dans l’état normal, les individus hautement susceptibles ont obtenu des résultats significativement meilleurs dans l’un des 4 tests (le Wisconsin Card Sorting). Le rôle d’une flexibilité cognitive accrue dans la susceptibilité hypnotique est considéré comme une composant possible du modèle de contrôle dissocié de l’hypnose.

VICTOR SIMON  
Psychosomatic Medicine & Clinical Hypnosis Institute, Lille, France

Las contribuciones de los lóbulos frontales a la susceptibilidad hipnótica:  
Una prueba neuropsicológica de funcionamiento ejecutivo

Deane Aikins y William J. Ray

Resumen: La teoría actual sobre los mecanismos cognitivos de la experiencia hipnótica mantiene que la hipnosis depende de una disociación entre los mecanismos de contención y un sistema supervisor de atención. Esta teoría se basa en la investigación neuropsicológica con pacientes con disfunción en los lóbulos frontales, quienes muestran déficits en funciones ejecutivas similares a los de los individuos hipnotizados. Para investigar una extensión de esta teoría, administramos cuatro pruebas de funciones ejecutivas a individuos con alta (n = 9) y baja (n = 7) susceptibilidad hipnótica. En una condición de línea base, los individuos muy susceptibles se desempeñaron significativamente mejor en una de las cuatro pruebas (la Prueba de Clasificación de Cartas de Wisconsin). Consideramos al aumento de flexibilidad cognitiva en la susceptibilidad hipnótica como un posible factor en el modelo de hipnosis de control disociado.

ETZEL CARDEÑA  
University of Texas, Pan American,  
Edinburg, TX, USA