Spider Phobias as Seen in Analysis and in the Neuroscience Laboratory: An Examination of Two Methods

Unconscious Inhibition: Brain Evidence Favoring a Psychoanalytic Understanding

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The field of neuropsychoanalysis has opened the way to exploring avenues of converging scientific interests between psychoanalysis and other disciplines, such as cognitive psychology and neuroscience. This is certainly a welcome development. Yet we must take into account the potential for misunderstandings if the exchange is not to founder before it truly begins. The clinical observations of the psychoanalyst are entirely different from the laboratory findings of the cognitive psychologist and neuroscientist. It is to be expected that many scientists look upon the explanations offered by psychoanalysts as esoteric and without scientific support, in particular the notions of unconscious motivated inhibition, or defense, and the existence of powerful albeit disguised unconscious conflicts. Often this rejection is based on a limited knowledge of psychoanalytic theory and its underlying assumptions, as the rejection of many psychoanalysts of experimental findings is based on a limited knowledge of experimental methodology. Having practiced as a psychoanalyst and also conducted laboratory research I am aware of the frailties and strengths of both perspectives. And yet it is remarkable how the two most fundamental propositions of psychoanalytic theory, the "pillars" as Freud referred to them, have become of increasing interest to neuroscientists and cognitive psychologists on entirely independent grounds. I refer to the notion of an unconscious mental life instantiated in the brain and the recognition that people, normal as well as abnormal, have odd and seemingly irrational ways of thinking which nevertheless follow their own rules rather than being simply the result of error or lack of knowledge.

With respect to the unconscious, I will call your attention to a striking turn of events: After almost four decades from 1950 to 1985 during which few articles were published in psychological and neuroscience journals dealing with the unconscious, there was a sudden burst of cognitive and neuroscience research on the unconscious marking a tenfold increase in such articles continuing to this day (Figure 1). What had to happen to sweep away a century of criticism of the unconscious going back at least as far as 1890 when William James referred to the unconscious as scientific "whimsy" and leveled ten arguments against the unconscious, the tenth being a rejection of unconscious motivation? It is beyond the scope of this presentation to

delve into the factors producing this remarkable historical turnaround. Suffice it to say these factors are still with us. Nevertheless, there is now broad agreement supported by hundred of experiments that unconscious processes exist. The importance of this change should not be underestimated. Whenever a science acknowledges the existence of a phenomenon rejected for years which was closely associated with another science rejected on these very grounds, it has to usher in a period of extensive scrutiny and efforts to examine how this now accepted phenomenon is similar to or different from the one they had previously rejected. Indeed this is what is currently happening. And perhaps this paper is a contribution to that scrutiny.

Healthy disagreement exists about the nature of unconscious processes and their import for a theory of mind and brain. Are they only active in perception and memory as "implicit" influences on consciousness? Or can they also be affective and motivational? Are they simply dispositional and not continuously active? Are they purely physiological and not mental? Are they solely to be described in process terms, and only consciousness possesses actual content? Are they part processes in themselves incapable of consciousness but contributing to the formation of a conscious state in the so-called global workspace? Do they solely facilitate mental activity as in the concept of automatic spreading activation and only consciousness can exercise selectivity and control? As a psychoanalyst I much prefer this battleground to the previous one in which the unconscious was written off as a scientific phenomenon worthy of investigation.

With respect to the existence of another mode of thought in addition to rational thought, in recent years cognitive psychology has witnessed the emergence of what some refer to as dual process cognition or the existence side by side in each of us of seeming rule-based non-rational thought and rational thought (Stanovich and West, 2000). Briefly, here is a short table listing the characteristics of these two kinds of thinking (Table 1). My colleague, Linda Brakel and I, published a commentary in *Behavior and Brain Sciences* (2003) calling attention to the historical fact that Freud could lay claim to being the first dual process theorist. We pointed out that what Freud called secondary process mapped onto System 2 and what he referred to as primary process mapped onto System 1. However, there was much more to Freud's dual process theory than is reflected in this table which I will refer to later in this presentation.

As another historical note of more than passing interest is the fact that Daniel Kahneman, who received the Nobel Prize for demonstrating that economic decisions were based on more than rational considerations, spent a summer as David Rapaport's research assistant. Rapaport was one of the great psychoanalytic systematizers. Subsequently Kahneman published his first book, a monograph called *Attention and Effort* (1973), in which he posited the existence of unconscious attention, a preoccupation of Rapaport's, and accommodated another important

Rapaport concern, psychic energy, which Kahneman referred to as effort. Perhaps this was the first instance of psychoanalytic influence on an important cognitive science figure.

In identifying these historical trends, my intention is to address several issues over which disagreement exists and a lack of conceptual clarity bedevils scientific exchange. I will start with a clinical example of a spider phobia from my own psychoanalytic practice, draw out from this illustration the propositions and hypotheses underlying my explanation of the phobia, and then turn to a number of experiments from our laboratory designed to test these propositions and hypotheses. Fittingly, I will end with one of our recent experiments dealing with spider phobias. Please bear in mind that I offer this clinical account as an illustration based on the primary data of observation but subject to my own biases and blind spots. Of necessity what I will describe is highly selective. My hope is that it will provide a point of departure for what I wish to develop as the thesis of this paper: Objective experimental evidence is accruing in support of fundamental psychoanalytic propositions and some of the clinical hypotheses based on them.

The Clinical Illustration

The patient was a young woman in her late twenties who sought analysis because she discovered to her distress and bafflement that she could not go through with her impending wedding. She loved her husband-to-be. He was kind, affectionate, and considerate. Yet when she slept with him she was frigid, unlike her experience with other men with whom she was orgasmic but did not love. Early in the analysis she mentioned that she was terrified by spiders. Notably, she endowed spiders with huge fangs she envisioned capable of biting and tearing. She doubted very much she had ever seen a spider like that, or that one ever existed. She thought that spiders killed by injecting venom. She looked on the phobia as an aberration because she thought of herself as a fearless person. As the analytic exploration of her sexual life progressed she became more capable of describing her sexual experience with her fiancé. She enjoyed foreplay with him, but as soon as he entered her the trouble began. She would arch her back, curl her fingers and find herself fighting off the urge to scratch and bite him, a revelation that took her by surprise. (For present purposes I will not go into the transference implications of these revelations.) At a further point in the treatment as she continued to explore her complex, long-lasting relationship with her fiancé and rehearsing how she felt when he entered her, she paused and then said quietly, “I am the spider.” For her this was a well-earned turning point in her understanding of her sexual life. In time her spider phobia disappeared.

The Psychoanalytic Understanding

In the light of this necessarily brief account how can we understand the nature and origin of her spider phobia? What hypotheses can we formulate on the basis of this understanding which can then be put to the test under more systematic and controlled conditions. What might it tell us about the unconscious and about this other way of thinking Freud called primary process?

Immediately striking is the parallel between her description of the feared spider and her description of herself during sex with her fiancé. Equally important is the fact that until that moment in the analysis when she saw this parallel we can suppose she was unconscious of it. In psychoanalytic terms, the spider was a displaced (cognitive psychologists would say 'implicit') representation of some aspect of herself. As a result of the analysis she had became aware of the link between herself and the spider.

But how account for the fear, and in particular the special form it took--a fear of its fangs? If we accept that the spider was in fact a representation of one aspect of herself, what aspect? Here we arrive at the most controversial kind of inference psychoanalysts make. I posited the existence in the patient of powerful biting and tearing impulses whose expression she must guard against. But there is one context in which she almost loses control over them- during sex with her fiancé. It is this threat to repressive control which necessitates the phobic symptom. It is not her own biting and tearing impulses she fears, but the spider's.

She herself recognized that attributing huge fangs to spiders which bite and tear is a distortion of reality. One could say that rational thought, although clearly available to her, does not inform her actual experience of spiders, but that some other form of thought does. Confronted with similar phenomena in his patients, it is this form of thought Freud called primary process. In this particular instance a part stands for the whole- fangs stand for the entirety of her disturbed sexual experience, but more specifically they stand for her biting, tearing impulses. Had the patient been more in touch with these unwelcome urges during intercourse, she might have come for analysis earlier in her troubled relationship rather than waiting until her wedding date was looming. Perhaps it was the phobic symptom which made it possible for her to remain unaware of the seriousness of her disturbed relationship, and allowed her to maintain what otherwise was a loving relationship.

To the analytic ear there is much more to the story that for present purposes must remain unexplored in favor of concentrating on the phobia itself.

To summarize:

1. A key underlying assumption: She was unconscious of the source of her phobia: We assume that she was unaware of her fear of biting and clawing her fiancé during sex. until it was revealed in the course of the analysis.
2. Her own biting and clawing impulses were defended against, that is, unconsciously inhibited, motivated by her wish to avoid harming her fiancé, and to keep from becoming aware of herself as an aggressive, hostile person. The inhibition was motivated.
3. By way of a primary process link the spiders became the fearful objects which bit and clawed, not herself.

In order for this account to stand up rather than being simply asserted as true, we would need independent evidence that 1) unconscious processes exist and are not simply a convenient psychoanalytic assumption, 2) not only do unconscious processes exist, a necessary but not sufficient condition, but at least some unconscious processes are unconsciously inhibited, 3) this unconscious inhibition is unconsciously motivated, 4) lastly, unconscious thinking follows different principles, such as part standing for whole, and under certain circumstance like the formation of a phobia, can infiltrate our usually rational perception of reality.

In what follows I will take up each of these propositions and present evidence from my own and other investigators' research in support of the propositions, as well as indicating what additional research is necessary, or what research contradicts these propositions.

Proposition 1. Unconscious mental processes exist and are instantiated in the brain.

If I had tried to support this proposition in a talk delivered fifty years ago, I would have needed to rely on a small number of studies mainly conducted by psychoanalytic investigators. But as my previous graph illustrated, about 20 years ago a sea change took place and ever since the number of studies in cognitive psychology and neuroscience demonstrating the existence of unconscious processes in perception and memory in particular has grown by a factor of ten, and are still increasing in number. This is welcome news to someone like myself and a number of other colleagues who started to publish evidence for unconscious processes about fifty years ago. As for my own early contributions, in 1968 I published in *Science* (Shevrin & Fritler, 1968) the first report of event-related potential brain markers for unconscious perception. In that same publication I reported correlations between unconscious primary process aspects of language and

alpha synchronization, to which I will return with new data in the last part of this paper. In 1973 I published a summary and evaluation of 11 studies replicating and extended these findings (Shevrin, 1973).

But there were many others, so many that by 1971 Norman Dixon, a British investigator of unconscious processes, published two books in which he drew together well over a hundred studies on unconscious processes. His first book was called *Subliminal Perception: The Nature of a Controversy* (1971), while his second book was called simply *Preconscious Perception* (1980). The difference in titles I believe captures the change about to take place in psychology and neuroscience. In 1980, I had myself published an article with Scott Dickman in the *American Psychologist* called, *The Psychological Unconscious: A Necessary Assumption for All Psychological Theory?,* in which we brought together evidence from seven different fields demonstrating the prevalence of unconscious processes.

Almost all of these early, pioneering studies were undertaken by psychoanalytic investigators or by investigators sharing a psychodynamic frame of reference. A noted cognitive investigator of unconscious processes, Khilstrom has commented on this body of research which failed to exercise the kind of influence earlier in the field one might have expected despite meeting acceptable standards of experimental rigor. Khilstrom accounted for this disinterest on the part of experimental psychologists as caused by their "distrust ... towards anything smacking of psychoanalytic theory" (1996, p.26). One purpose of this presentation is to lessen that distrust.

My foray into history is also intended to show that there is by now a body of research extending over fifty years providing conclusive evidence that unconscious processes exist. And insofar as many of these studies, more so recently, have drawn upon brain methodologies such as event-related potentials and brain imagery, we can also claim that these unconscious processes are instantiated in the brain. Challenges to the existence of unconscious processes no longer take an empirical form, largely methodological, but now they have a more theoretical cast to which I have referred earlier.

> Conclusion. A *fundamental principle of mental functioning central to the psychoanalytic conception of the mind can now be accepted as established by rigorous scientific investigation. It follows from this conclusion that any theory of mind or brain must take unconscious processes into account. It also follows from this conclusion that any treatment of mental disturbance must take unconscious processes into account.*

Proposition 2. Some unconscious processes are subject to inhibition.

Two psychoanalytic concepts continue to raise hackles among cognitive and neuroscience investigators: motivated unconscious inhibition, or defense, and the related concept of motivated disguise. In order to avoid, as Khilstrom put it, anything that "smacks of psychoanalytic theory," efforts are made to separate the "cognitive unconscious" from the "Freudian unconscious." But the Freudian conception of the unconscious encompasses *all* unconscious processes. Freud argued that consciousness itself cannot be understood without positing the existence of unconscious processes. There are some unconscious processes that are readily available to consciousness, called preconscious, and other unconscious processes that are in one way or another kept from becoming conscious, the dynamic unconscious. It is the former which cognitive scientists and neuroscientists identify as cognitive, and the latter is *terra incognita* for most.

In what follows I will address the issue of unconscious inhibition. When addressing the third proposition, I will discuss evidence for the motivational aspect of unconscious inhibition.

I shall start with a general consideration. It is an accepted fact that the nervous system at all levels operates on the basis of a balance between excitation and inhibition. Inhibition can be defined as one neural system impeding an excitation from another neural system to activate other neural systems. It is also the case that the excitation doesn't simply disappear, but must be continuously inhibited until the neural context changes.

An excellent example of this interplay of excitation and inhibition is provided by the sleep-dream cycle. When the sleeper enters REM sleep the dream experience is kept from enactment by a providentially evolved motor atonia originating in the brain stem. Normally, this motor atonia continues actively during the entire REM period. We now know what happens when this motor atonia is absent usually because of degenerative neurological disease: The dreamer enacts the dream often with unhappy consequences. This act of neural inhibition keeps the excitatory neural activity instantiating the dream from activating appropriate motor neurons, and other neural systems, which would be involved in executing the actions otherwise solely dreamt. We also know from other sleep states in which muscle atonia is lacking that considerable motor activity occurs as in sleep walking, sleep talking, and a variety of bizarre fragmented actions. All such sleep enactments are referred to as parasomnias. I will be expanding further on the import of parasomnias for defense and disguise.

I would like to suggest that the psychoanalytic concept of defense is a higher level psychological instance of this broader category of inhibition characterizing the way the nervous system functions, and is thus as biological as motor atonia.

I turn next to our own research on unconscious inhibition. In order to facilitate my presentation and not burden the listener with too many distracting tables and graphs, when I describe experimental results which have already been published and therefore refereed and found acceptable I will not burden you with illustrations detailing those results but refer you to the publication itself. But when the results have not yet been published I will present the details for your examination.

In a series of experiments published in *Cognition* (2006), Snodgrass and I offered extensive, replicated evidence that unconscious inhibition occurs, is related to psychological factors highly individual in nature, although the specific motivations involved cannot be discerned by the method we used. The results I will describe were replicated across seven experiments in our own laboratory, and one replication executed in another laboratory. We demonstrated that when detection of a stimulus presented at 1msec is at chance, nevertheless powerful unconscious influences exist taking the form of inhibition and facilitation as a function of context and individual differences. Different contexts were created by instructing subjects to employ two strategies in guessing which of four words was flashed at 1 msec. The two strategies were called the 'look' and 'pop' strategies.. In the 'look' strategy subjects were told that they might do better at guessing the words if they paid close attention to the stimulus field and based their guesses on what they thought they saw. In the 'pop' strategy subjects were told that they might do better at guessing the words if they let them 'pop' into their heads. Subjects were also asked to state which strategy they preferred. No mean difference between strategies was found, but once strategy preference was introduced as a factor, a stable, replicable interaction between preference and strategy appeared. The subjects who preferred looking when asked to use the pop strategy performed significantly ***below*** chance. Bear in mind that they could not consciously see the words flashed, nevertheless their choices indicated that *unconsciously* they were *inhibiting* correct responses. If their choices were random no effect would emerge. A comparable but weaker effect was found for the subjects who preferred to pop in the look condition.

Equally intriguing was the finding that when lookers were asked to follow the look strategy, a strategy they preferred, the lookers performed ***above*** chance. We could demonstrate that above chance performance did not mean they were conscious of the stimuli. Quite otherwise. When a measure of how well they had detected the stimuli (d') was correlated with how well they did in guessing the words, the outcome was a ***negative*** correlation -- the more they might have consciously seen something the *less correct* were their guesses; the *less* well they detected the stimuli consciously the better they did at guessing correctly. It seemed that even a bit of consciousness served to inhibit correct guessing, while an *absence* of consciousness improved

guessing. One could say that at the deeply unconscious level the experiments were done, referred to as the objective detection threshold, the usual expectations do not apply that have been demonstrated many times over -- the more you are conscious of a stimulus the better you perform.

Drawing upon unpublished data from these same pop/look studies, we can show that personality factors as measured by well established personality inventories interact with strategy in the same way as preference. The two tests are the Hysteric/Obsessive Quotient (HOQ) (Caine and Hawkins, 1963) and the Marlowe-Crowne Test of Social Desirability (MC)(1960). For the HOQ subjects on the more hysterical end tended to inhibit correct guessing in the pop strategy, and increase correct guessing in the look strategy (Table 2) (Statistical results Table 3). Similarly subjects who need to be on the more socially desirable end of the MC followed the same pattern. The HOQ findings are of special importance because we have results in other experiments to be referred to below indicating that the hysterical end of the scale is related to repression. These results support the hypothesis that unconscious inhibition is a psychological process strongly mediated by personality factors, and possibly by repression.

One can infer from these findings that the interaction between conscious and unconscious processes is itself *unconscious.* When asked to pursue the pop strategy the looker is more likely to *avoid* giving correct responses with no awareness that the subject is doing so. It is equally clear that the subject possesses unconscious knowledge of the correct response in order to inhibit it. We are dealing not solely with a physiological process but with a mental process; in Brentano's definition of mentality, the activity is "about" something, and has intentionality. I mention this implication in response to those who take the position that unconscious processes are entirely physiological, or entirely dispositional, or entirely process without content. On the other hand, the psychoanalytic unconscious is mental as well as physiological, active as well as dispositional, and contentual as well as a process. I don't believe we could understand my patient's phobia psychoanalytically without viewing what goes on unconsciously in this light. Like our subjects, she is unaware of the interaction between her conscious fear of spiders and her own unconscious desire to bite and claw. However, in the case of the experimental subject we do not have any idea about the unconscious motivation that may lie behind the unconscious inhibition, the avoidance of the correct word. In the case of my patient we are positing the presence of an unconscious motivation on the basis of the patient's revelations during the course of analytic work. These observations, however, fall short of meeting criteria of objectivity. Other approaches will be needed in order to provide evidence for the role of unconscious motivation bringing about unconscious inhibition and defense.

Conclusion. *The evidence cited provides support for the proposition that at least some unconscious processes are subject to unconscious inhibition. These effects occur at a deeply unconscious level and are mediated by individual differences.*

Proposition 3. Some unconscious inhibitions are motivated unconsciously.

In the evidence so far cited, we can identify two levels of unconscious inhibition. One level appears to be built into the nervous system. I refer to the pervasive balance between excitation and inhibition ordering how the nervous system functions. It might be better to refer to this level as *non-conscious* since most of this activity cannot be said to be mental. On the other hand, muscle atonia in REM sleep appears to be at a different level It is doubtful that the muscle atonia is motivated; yet it acts to inhibit a complex mental activity, dreaming. One could say that muscle atonia appears to be an evolving form of inhibition not subject to motivational influence.

What happens when muscle atonia fails and the syndrome of Rapid Eye Movement Behavior Disorder appears? Schenck and Mahowald (2002) have studied 96 cases of this disorder. Typically they are older males with some evidence of degenerative neurological disease which has compromised the brain stem sites responsible for maintaining the atonia. It is revealing to quote the author's account of a typical case, "Men with RBD often dreamt that they were fighting to protect their wives from an attacker -- only to find out upon awakening, that they were actually attacking their wives in bed" (p.121). Surprisingly, these attacks did not alienate the wives because they, and again quoting the authors, "… realized that their husbands were acting out of character in their sleep, since during the daytime these men were placid, mild-mannered, and without any propensity for irritability or angry outbursts."

These findings speak eloquently to the psychoanalyst who would be prepared to describe these men as relying on the defense of reaction formation against hostile and aggressive impulses that for neurological reasons breaks down during REM sleep. In the absence of muscle atonia, they enacted their hostility. But remarkably their dreams were of protecting their wives from the very attack they were in fact visiting upon them! I suggest that this is the first sleep dream cycle evidence for the operation of disguise in REM dreams. Hobson has pointed to this absence of evidence for disguise in dreams as scoring heavily against Freud's theory. These cases of REM Behavior Disorder provide us at least the beginnings of the needed evidence.

I would like to construct hypothetically from a psychoanalytic standpoint the pathological process involved in these cases. At a certain point in REM sleep let us assume that powerful hostile impulses are activated that appear to simultaneously result in physical attacks on the

spouse because of the failure of muscle atonia and a dream of protecting her from an attack . One would suppose that had the muscle atonia been functioning only the dream of protecting the wife would have occurred. I hypothesize that the failure of muscle atonia makes it possible for the *underlying* defended against hostile impulses to be enacted, while at the same time the actual dream process continues independently disguises these unconscious wishes by turning the attack into a dream of its opposite, otherwise the enactment itself would have been that of protecting the wife against attack and the dream would then have paralleled the behavior. This reversal of actual attack into protection from attack in the dream fits well with the reported mildness of these patients in their waking life.

Further supporting this interpretation is the study of men suffering from RBD by Fanini, Ferini-Strambi, and Montplaisir (2005). They rated the dreams for degree of hostility expressed and also administered a questionnaire to assess the extent of self-reported waking hostility. They found a negative correlation: men who rated themselves as relatively unaggressive while awake had the more aggressive dreams, and the reverse was true for men who rated themselves as more aggressive when awake. The first part of this result would fit nicely with Schenck and Mahowald's observations. These observations also make it hard to accept the Hobson explanation that dream events are random in nature, if only because there appear to be striking non-random personality consistencies requiring explanation.

One could attempt to explain these RBD findings as simply a matter of intense uncontrolled emotion. This explanation runs into difficulties in accounting for the *reverse* relationship between the enacted attack *on* the spouse and the dream of protecting the wife *from* attack since they both involve overt anger and aggression.

But why the reversal of the object of the aggression? At the very least there must be a motive to protect the wife from the dreamer's hostility, visible in the daytime as the desire to be kind and unaggressive toward his wife. Similarly my patient's overt hostility toward her fiancé is defended against by a motor act of arching her body, almost another form of motor inhibition- you cannot attack anyone with your limbs and trunk musculature immobilized. Here the motor inhibition is unconsciously motivated rather than occurring as a non-conscious physiological process. I suggest that an explanation of this nature accounts for more of what actually happens in my patient and in the older men suffering from motor atonia.

In our own research we have taken a more direct approach to the issue of unconscious motivation and defense. In a study on social phobics we brought together three methods: 1) a psychoanalytically guided assessment method in which each patient was interviewed at least three times; these interviews were tape recorded and transcribed; 2) a subliminal method in which key

words and brief phrases drawn from the interviews were presented subliminally at the objective detection threshold (1msec), and then supraliminally (30msec); 3) a physiological method in which event-related potentials (ERPs) were obtained to the words as they were flashed. The methodological objective was to draw upon the strengths of each method, while compensating for the weaknesses of each. Thus subjective clinical judgments, rich in observation but poor in objectivity, was compensated by the objectivity of the subliminal and supraliminal experimental procedure, which in turn was compensated by the non-psychological, neurophsyiological character of the event-related potentials.

The clinical team was asked to arrive at a psychodynamic formulation involving: 1) the patient's own account of the social phobic experience, 2) the patient's own explanation of the symptom, 3) an hypothesis as to what conflicting unconscious motivations might have caused the symptom. As the clinical team member undertook these tasks they were also selecting words or brief phrases from the transcripts which captured the patient's conscious experience of the symptom and the unconscious conflicting motivations. A complex process at arriving at consensus and a final word selection was conducted, ending up with four classes of words: 1) conscious symptom words; 2) unconscious conflict words; and two groups of control words, 1) ordinary unpleasant words to control for the unpleasant nature of the experimental words; 2) ordinary pleasant words to control for the emotional nature of the words. These words were then presented in the tachistoscope and event-related potentials obtained. We developed a special method for analyzing the event-related potentials based on a time-frequency feature analysis. We developed this method because the usual event-related potential analysis of amplitude components was mainly designed to be used in experiments in which the same stimuli were used repeatedly thus reducing variance, while in our case there were different words for each subject within each of the four categories. A time-frequency feature analysis using an information metric was more sensitive to repeated patterns despite increased variance introduced by unique word selections.

On the basis of a discriminant analysis we found that the unconscious conflict words were better discriminated from the other categories subliminally but not supraliminally; the reverse was found for the conscious symptom words. As long as the unconscious conflict words were processed subliminally the brain responses treated them as different from the other words; but once they were presented consciously the brain "acted" as if they were no different from the other words. It is not difficult to take the next step and infer that some inhibitory process was at work when the unconscious conflict words were presented supraliminally. This inference was further supported by a positive correlation between the HOQ and the experimental effect. The

experimental effect was defined as the difference between the degree of subliminal discrimination of the unconscious conflict words and the degree of supraliminal discrimination. We found a significant positive correlation (.76). The more hysterical subjects showed the greater experimental effect. When subjects were asked to sort all the words into as many categories as they wished, it turned out that the unconscious conflict words were put in the greatest number of categories, suggesting that they simply did not go together consciously, in contrast to their greater discriminability as a class unconsciously.

These results suggested that the clinical judgment of the psychoanalysts was supported. It also should be noted that the results were based on quite different words for each subject; it couldn't be otherwise considering the highly unique and individual character of each conflict. Nevertheless, regularities emerged because the words, no matter how different their dictionary meaning, performed the same psychological function for each subject. A preliminary report of the study was published in *Consciousness and Cognition* (Shevrin, Williams, Marshall, et al. 1992) and a book length report in 1996 (1996).

The time-frequency feature analysis results suggest that conflict between unconscious motives which is essentially what the clinicians were hypothesizing to be the case (see three case illustrations in the book) must be instantiated in the brain. The critical electrode placements were central and parietal, quite expectable when cross modal, complex processing is involved. Recent neuroscience research by Berridge (2004) has in fact located where in the brain unconscious motivation is instantiated. Berridge has identified a subcortical mesolimbic dopamine system as involved in what he has labeled unconscious 'wanting,' defined as a primitive motivational system functioning unconsciously, as contrasted to conscious wanting functioning at a higher cortical level.

> Conclusion. *Although the evidence I have called to your attention is very much in need of further support and replication, the research I have cited has taken an important step toward establishing the existence of unconscious motivation as a psychological, neurophysiological, and neuroanatomical reality.*

Proposition 4. Unconscious thinking follows different principles from conscious thinking.

My patient's attribution of biting, tearing fangs to spiders, the basis for her great fear of them, was not her real perception of spiders. In fact she denied that it was; she was aware that spiders were not like that. But her conscious, rational judgment did not prevail over her

unconsciously motivated need to see them that way and flee their presence. Importantly, she *experienced* spiders as biting and tearing; it was not simply a judgment or thought, otherwise the need to avoid and flee them would not have been so urgent.

But this account is based on clinical theoretically derived inferences. I am assuming that the appearance of spider fangs in her experience of spiders was determined by an unconscious motivation which activated a form of thought different from rational thought. I have cited evidence for unconscious motivation. Is there also independent evidence for the assumption that unconscious thought follows different rules from conscious thought. In what follows I will provide what I believe to be evidence of that kind. I will start with some theoretical consideration, then describe some early experiments addressing the issue, and then end with one of our recent experiments with spider phobic.

As early as his monograph *On Aphasia*, Freud (1953/1891) proposed that language had two aspects: semantic and perceptual, the former referring to the meaning of the word, the latter to its phonemic, graphemic, motoric, and kinesthetic properties -- in short, as an object of perception in addition to being a counter in meaning. It was already well known that the non-semantic, prosodic elements of language played a substantial role in schizophrenic thought disorder and in manic states. As Freud began gathering evidence from his psychoanalytic patients he noted that the interplay of the referential and perceptual aspects of language seemed very much at work in slips of the tongue, dreams, and symptom formation. This form of language usage was not limited to schizophrenia and manic states. These observations were the basis for his assumption that unconscious thinking followed what he called primary process links, and conscious thought secondary processes links and the interaction of these two modes of thought played out in dream formation, psychopathology as in phobias, slips of the tongue, and psychosis. I should note that this hypothesis did not require a total identity between primary process and unconscious processes, or of secondary process with consciousness. There are obvious conditions under which primary process occurs consciously as in schizophrenic thought disorder, and conditions under which secondary process occurs preconsciously. Rather we are dealing with a relative balance which is affected by a number of factors such as depth of unconscious processing (preconscious versus dynamic unconscious) nature of the stimuli (cognitive vs. affective), nature of the response (guessing a word vs. free associations). I address the role of these factors elsewhere (Shevrin, 2003).

It occurred to me that one might put these hypotheses to the test by constructing a stimulus which possessed both of these linguistic properties and to expose sub- and supraliminally. The stimulus was a picture of a pen and a knee (Figure 2). In English it forms the

rebus word, *penny,* a word totally unrelated in meaning to either pen and knee -- something I also determined by checking out word association norms. Furthermore, *pen* is not an association of *knee,* nor *kne*e of *pen*. In addition to *penny,* which might be considered in Freudian primary process terminology, a condensation, one could also track clang associations to *pen* and *knee*- words like *pennant* or *open,* and *neither* or *any*- word containing the sound but not carrying the word meaning. On the secondary process level we could track semantic associations to the words *pen* and *knee* such as *ink* and *paper, leg* and *bend*. We also decided to track associations to the rebus word itself which has interesting theoretical implications I will comment on later.

I will describe briefly two experiments, the first published in *Psychophysiology* (Shevrin, Smith, and Fritzler, 1971), and the second in the Journal of Abnormal Psychology (1967). In the first study, a replication and extension of earlier studies, we found that as hypothesized penny and clang associations were more frequent in associations following the 1msec flash of the penny rebus than after the 30 msec. supraliminal exposure; this was not found for the control stimulus. Thus exemplars of primary process language occurred more frequently unconsciously than consciously. We also found that secondary process associations to *knee* were more numerous in the subliminal than in the supraliminal condition. Free associations obtained after supraliminal exposure showed no superiority for either type of association. I will return to this finding after discussing the second experiment. Half of Freud's hypothesis was confirmed: primary process associations were more frequent sub- than supraliminally.

There were two other replicated findings that are of special relevance to our understanding of how language is processed unconsciously. Secondary process associations were correlated with an ERP amplitude component in the 200-350msec window, while the primary process components were correlated with ERP alpha. There was also a double dissociation: the secondary process associations were not correlated with alpha, and the secondary process associations were not correlated with the ERP amplitude. It seemed that we had stumbled upon brain correlates for Freud's theoretical constructs of primary and secondary process thinking.

In the study undertaken with Charles Fisher, we combined his interest in the sleep/dream cycle with mine in subliminal perception, although Fisher had been a pioneer in that research as well (Shevrin, 2003). One of the questions continuing to be posed in sleep/dream research concerns qualitative differences between Stage 1, REM dreams and Stage 2, NREM dreams. The evidence suggests that REM dreams are more bizarre than NREM dreams and have more narrative sequence. It struck Fisher and I that perhaps REM dreams would be more primary process-like, and NREM dreams more secondary process-like. We decided to flash the penny rebus and a blank control in *counterbalanced sleep sessions and obtain free associations after*

three awakening from each sleep state. The findings supported our hypothesis for the *penny* rebus effect and the pen and knee secondary process associations. More *penny* associations occurred after REM awakening than after Stage 2 awakenings; and the reverse was found for the pen and knee semantic associations (Figure 3). We also found that the subliminal effect for each sleep stage was greater than in the waking state preceding the sleep session. Apparently sleep in either state is more sensitive to the subliminal effects typical of that state.

The additional contribution of this study was to demonstrate how an unconscious process can be differentially affected by the physiological differences existing between the two sleep states. Again we have a qualitative brain difference between primary and secondary process responses which invites further study. A replication of this study is being undertaken at the University of Bremen by Jana Steinig with, of course, a German rebus.

In addition to using verbal approaches, Linda Brakel in our laboratory has developed a simple, easily administered non-verbal test for distinguishing between primary and secondary process thought. Most recently, Bazan and colleagues at the University of Ghent have demonstrated that this non-verbal test can distinguish between schizophrenics in an acute psychotic state from schizophrenics in a non-acute state (submitted).

In what follows, I would like to address the relationship between alpha synchronization, unconscious processing, and primary process. There has been a good deal of recent neuroscience research on power analyses of the EEG and ERPs, by which is meant the measurement of power at different frequencies (Klimesch, 1999). The alpha I measured some time ago would now be referred to as alpha synchronization, occurring when many neural systems, millions of neurons, are firing in phase at a certain frequency. The alpha frequency is defined usually as 8-12 cycles per second. Alpha synchronization is found to occur broadly across the back of the head when eyes are closed and disappears when eyes are opened; it is markedly prevalent during sleep onset, and , as I discovered, occurs during free associations (Figure 4). In waking it appears to accompany relaxed, dream-like states as in sleep onset when the drifting off is even more notable. As I mentioned earlier, it appears also to accompany primary process associations (Figure 5).

At first neuroscientists felt that alpha states marked a condition of mental ‘idling’ -- nothing seemed to be going on by which was meant that no specific task, usually cognitive, had been assigned to the subject during which alpha synchronization quickly disappears. Recent research, however, has demonstrated that alpha synchronization functions to actively inhibit a distracting visual stimulus (Kelly, Lalor, Reilly, and Foxe, 2006) or sustaining a period during

which subjects are asked not to remember words previously studied until they are asked to do so (Klimesch, Sauseng, and Hanslmayr, 2006). Perhaps it serves a similar inhibitory function when eyes are closed in the waking state, or during sleep onset. It may inhibit attention to external stimuli so that the dream-like state can be sustained. From a psychoanalytic standpoint, in states of reverie the individual is turning attention inward and allowing otherwise neglected or suppressed thoughts, feelings, and memories to emerge. Often as we know from common experience these reveries are patently wish fulfilling and violate the usual limits of time and space, hallmarks of primary process thought.

In a recent study in which line drawings of spiders were flashed at the objective detection threshold (1 msec) to spider phobics (n=10) and to a control groups of snake phobics (n=6). The control stimulus was a neutral stimulus. ERPs were obtained to both stimuili. Subjects were also asked to make ratings before and after the exposures which measured the degree to which they feared spiders. The average detectability of the stimuli was not significantly different from zero, thus meeting the criterion for the objective detection threshold. All analyses to be reported was done for total alpha defined as 9-12 Hz., high alpha defined as 10-12 Hz. and low alpha defined as 6-9 Hz. The literature suggests that high alpha correlates with stimulus meaning and low alpha roughly with alertness toward or attention to a stimulus.

Unless otherwise indicated, our measures were difference scores in which the factor of interest was corrected for the effect of the control stimulus. The first finding of note is that total alpha synchronization was correlated significantly with degree of phobic fear (.67, p=.05). The more the spider phobics showed greater alpha synchronization to the spider stimulus than to the control the more fearful were their ratings of spider. This effect was found for the left hemisphere (F3,C3,P3) and across both hemispheres at parietal sites (P3,Pz,P4), although the effect was stronger in the left hemisphere. Again we encounter individual differences, or bi-directional effects. There were also those spider phobics who showed little or no differential alpha synchronization to the spider stimulus and these subjects seemed not to fear spiders as much. The same correlations for snake phobics were non-signifiant (.25 and .09). There were no findings when the alpha band was partitioned into high and low alpha.

I suspect my patient would have been among those subjects who rated the spider as quite fearful. I would offer the further thought that being inordinately afraid of spiders would more likely accompany a more unrealistic view of what makes spiders fearful.

Of special interest in the light of the importance of unconscious inhibition is the relationship between spider detectability and alpha synchronization for the spider phobics. If alpha synchronization serves an inhibitory function then we should expect to find that for those

spider phobics having greater alpha synchronization for the spider stimulus in the main part of the experiment should inhibit detection of the spider in the subsequent detection task. This was in fact the case for high alpha for both the left hemisphere and across parietal sites (-.76, p=.02; -71. p=.05). It should be noted that the upper alpha band is associated with the processing of meaning. Spider phobics who had greater alpha synchronization to the spider stimulus than the control appeared to be inhibiting spider detection. And those who showed less such differential synchronization facilitated their spider detection. With this finding we have the first hint of a defensive inhibitory process at work for spider phobics who are especially fearful of spiders. The relationship with high alpha suggests that inhibition was directed at the meanings activated by the spider stimulus.

The last alpha synchronization finding of note is the relationship of alpha synchronization to an ERP component associated with the early detection of a stimulus and possible attention to it. This component occurs about 100 msec post-stimulus and is negative in voltage. For total alpha the correlations for the spider phobics were significantly negative for both the left hemisphere and parietal sites (-.67,p=.05); .66, p=.055 respectively). For snake phobics the correlations were .01 and .15, both non-significant. Paralleling the detectability results those spider subjects who showed greater alpha synchronization to the spider than the control tended to have smaller N100s to the spider stimulus than the control. One could say that again they were trying to inhibit any.

There is one final result involving the HOQ which we found previously in the pop/look studies to be correlated with inhibition .In this study we found that for spider phobics the HOQ was negatively correlated with spider detectability (Table 4). Here we have a measure related to hysterical and obsessive pathology indicating that more hysterical spider phobics show a tendency to inhibit detection of spider stimuli, while those more obsessive show a tendency to facilitate spider detection. This result on the face of it would appear to make diagnostic sense. I will mention one other supporting finding drawn from a totally different experimental paradigm and brain measures. In an extraordinary experiment, Libet was able to determine that it took on average 500 msec for a somatosensory stimulus to become conscious. Although this was the average there was a range of individual differences from about 200-800 msec. We hypothesized that those people given to repression would take the longer time for a stimulus to become conscious. One of the measures used was the HOQ. The finding supported our hypothesis: there was a positive relationship between hysteria and greater delay to consciousness (Shevrin, Ghannum, and Libet, 2003).

If we were to put these three findings together, the picture drawn can be described as follows: when the spider and control stimuli are flashed in randomized order, forty each, at 1

msec within about 100 msec following stimulus exposure those spider phobics who respond with greater differential alpha synchronization to the spider stimulus tend to inhibit noting the spider stimulus or pay attention to it. At the end of the experiment when the detection procedure is administered they again show a tendency to inhibit detection of the stimulus presented at the same 1msec speed. Lastly, those spider phobics who show differential alpha synchronization to the spider stimulus rate spiders as much more fearful than those who show less differential alpha synchronization. A greater fear of spiders is associated with unconscious inhibition of attention to the spider stimuli and unconscious inhibition of spider detection. Alpha synchronization appears to be the brain marker for these responses.

We also know from previous findings that alpha synchronization is correlated with free associations and primary process language elicited by subliminal presentations of the penny rebus. It becomes reasonable to suppose that the alpha synchronization accompanying the response to the subliminal spider for spider phobics for whom the spider is especially fearful that free associations obtained at the time of exposure would reveal primary process associations. This remains to be done.

The evidence cited would appear to support the view that unconscious thinking follows different rules related to the psychoanalytic concept of primary process and that alpha synchronization might be a brain marker for such thinking.

Conclusions

1. *A fundamental principle of mental functioning central to the psychoanalytic conception of the mind can now be accepted as established by rigorous scientific investigation. It follows from this conclusion that any theory of mind or brain must take unconscious processes into account. It also follows from this conclusion that any treatment of mental disturbance must take unconscious processes into account.*

2. *The evidence cited provides support for the proposition that at least some unconscious processes are subject to unconscious inhibition. These effects occur at a deeply unconscious level and are mediated by individual differences.*

3. *Although the evidence I have called to your attention is very much in need of further support and replication, the research I have cited has taken a step toward establishing the existence of unconscious motivation as a psychological, neurophysiological, and neuroanatomical reality.*

4. *The evidence cited would appear to support the view that unconscious thinking follows different rules related to the psychoanalytic concept of primary process and that alpha synchronization might be a brain marker for such thinking.*

Finally, the change that occurred around 1985 in the position of cognitive neuroscience on unconscious processes resulting in hundreds of studies confirming their existence, I hope will also mark the beginning of increasingly fruitful exchanges between neuroscientists and psychoanalysts in which each will learn to overcome their prejudices. There is much that can benefit from this collaboration, most especially to determine the nature and role of these unconscious processes in a theory of mind and brain.

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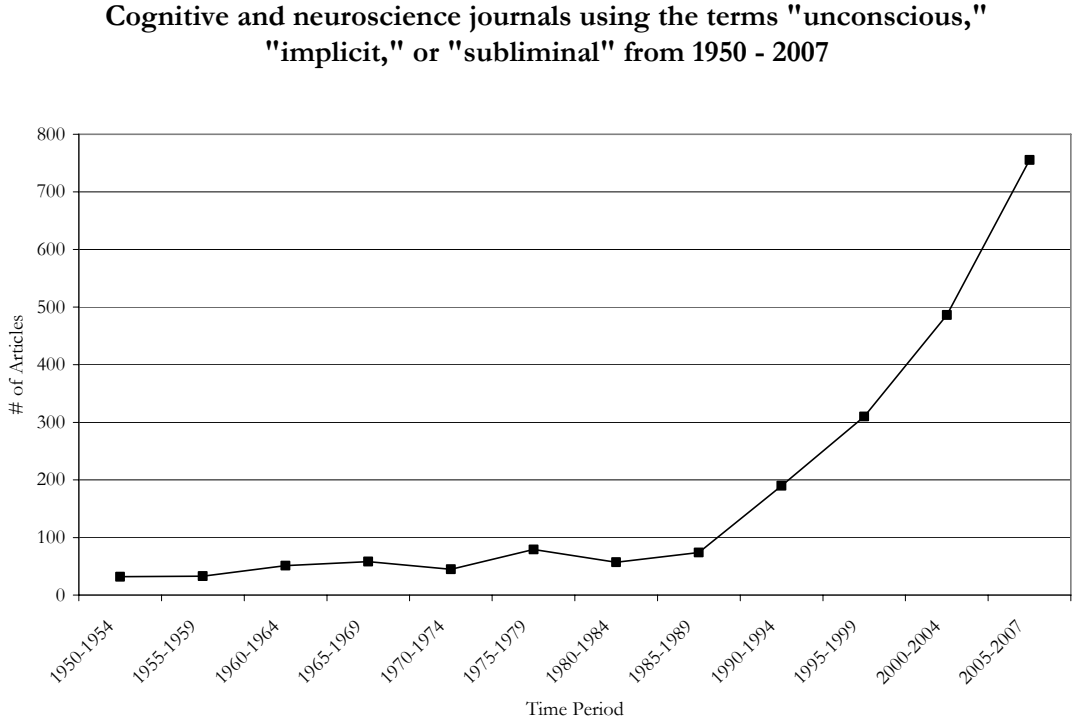

Figure 1. Cognitive and neuroscience journals using the terms “unconscious,” “implicit,” or “subliminal” from 1950 – 2007.

Properties	
associative	rule based
holistic	analytic
automatic	controlled
relatively undemanding of cognitive capacity	demanding of cognitive capacity
relatively fast	relatively slow
acquisition by biology exposure and personal experience	acquisition by cultural and formal tuition
Task Construal	
highly contextualized	decontextualized
personalized	depersonalized
conversational and socialized	asocial

Table 1. Stanovich & West (2003). Individual differences in reasoning. *Behavioral and Brain Sciences* 26: 527-534.

HOQ X Strategy Interaction		
	Strategy	
HOQ	Pop	Look
Low (Obsessoid) (n=101)	25.15 (4.17)	25.24 (4.39)
High (Hysteroid) (n=105)	23.91 (4.07)	26.00 (4.39)

Table 2. Performance (% Correct) by HOQ and Strategy – All Data.

Interaction:	F(1, 204)	= 5.48, p<.02.	Cohen's d: .16
Simple effects:			
Low :	F(1, 100)	= .02, p<.89.	Cohen's d: .01
High :	F(1, 104)	= 13.33, p<.0005.	Cohen's d: .36
Inhibition:	F(1, 104)	= 7.50, p<.007.	Cohen's d: .27
Facilitation:	F(1, 104)	= 5.36, p<.025.	Cohen's d: .23

Table 3. Performance (% Correct) by HOQ and Strategy – All Data

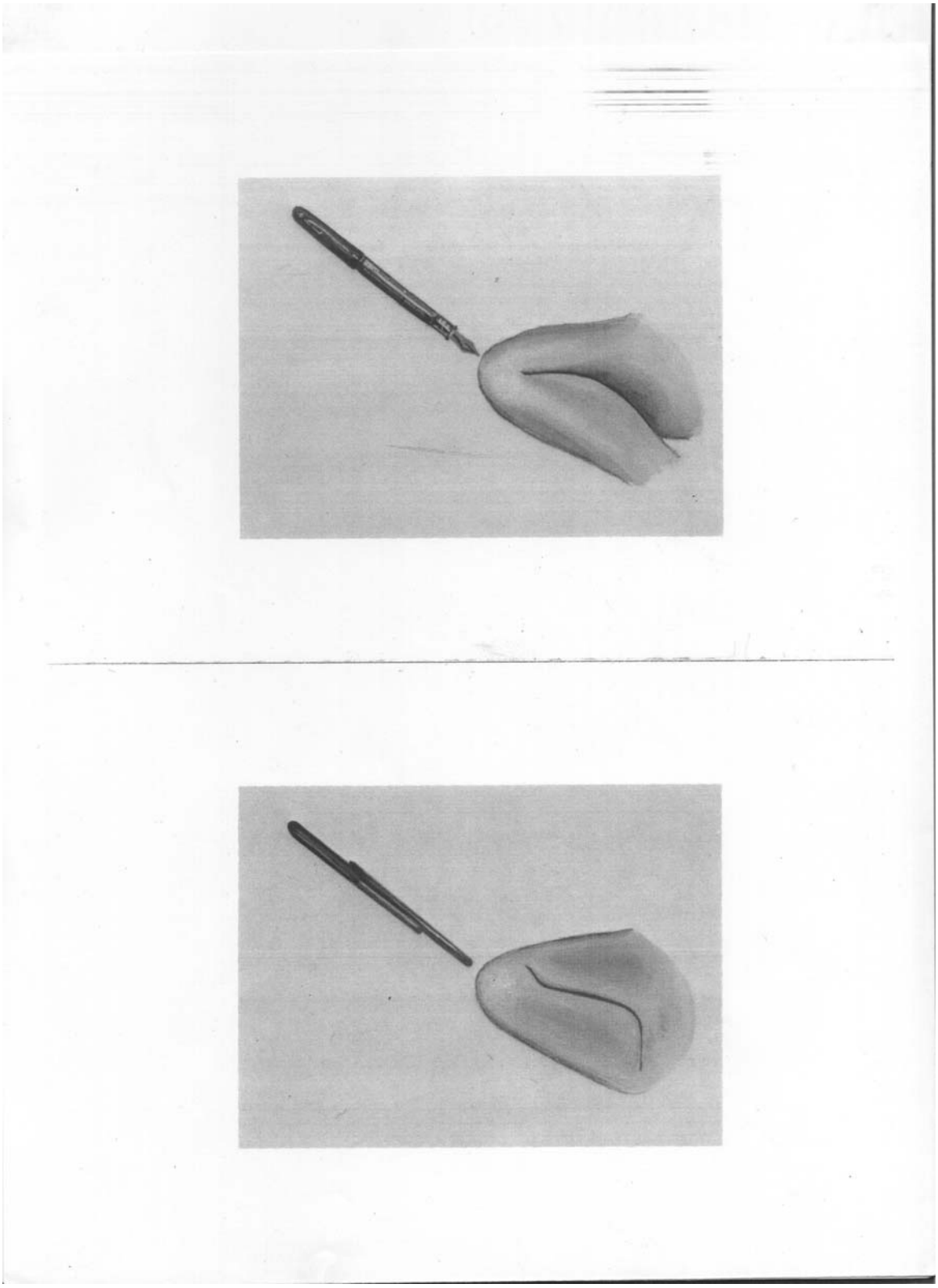

Figure 2. Rebus

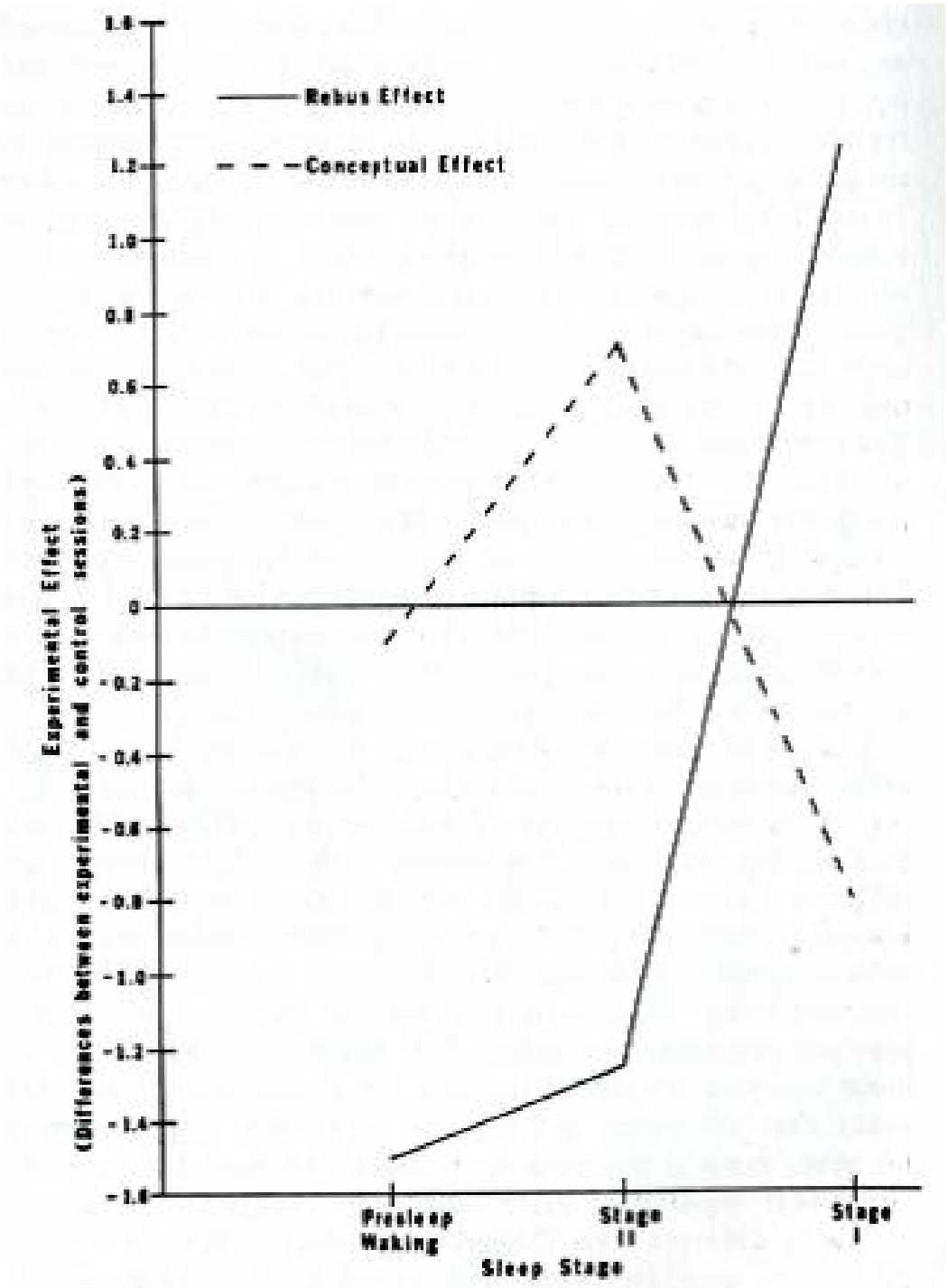

FIGURE 2. Rebus and conceptual subliminal effects as a function of sleep stages. (Median values: N = 10.)

Figure 3.

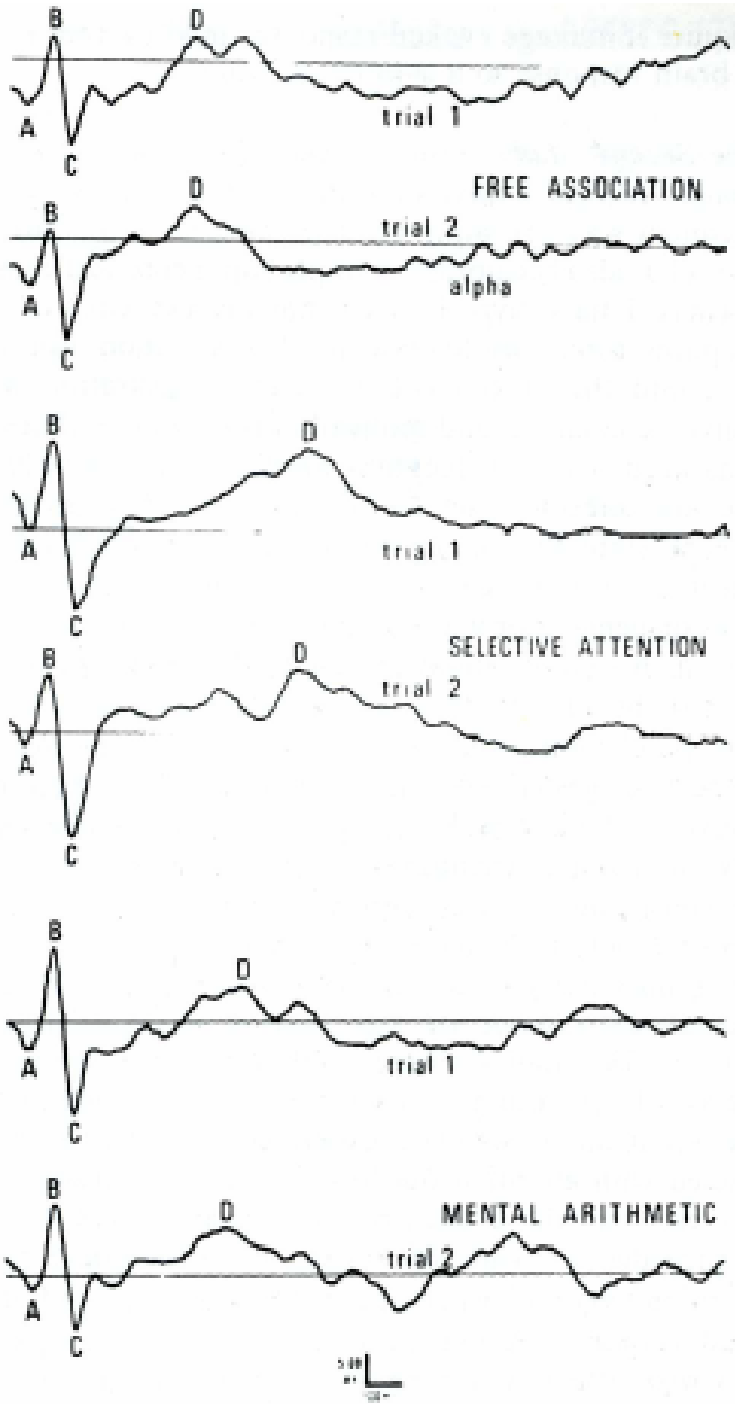

FIGURE 5. Set of 6 AER curves obtained from Subject A, 13-year-old male fraternal twin; each curve is based on 40 sweeps. Points A, B, C, and D mark peak amplitudes analyzed in study. Incidence of α bursts noted wherever present during last 1,000 msec. Baseline estimated from last 500 msec. of record.

Figure 4.

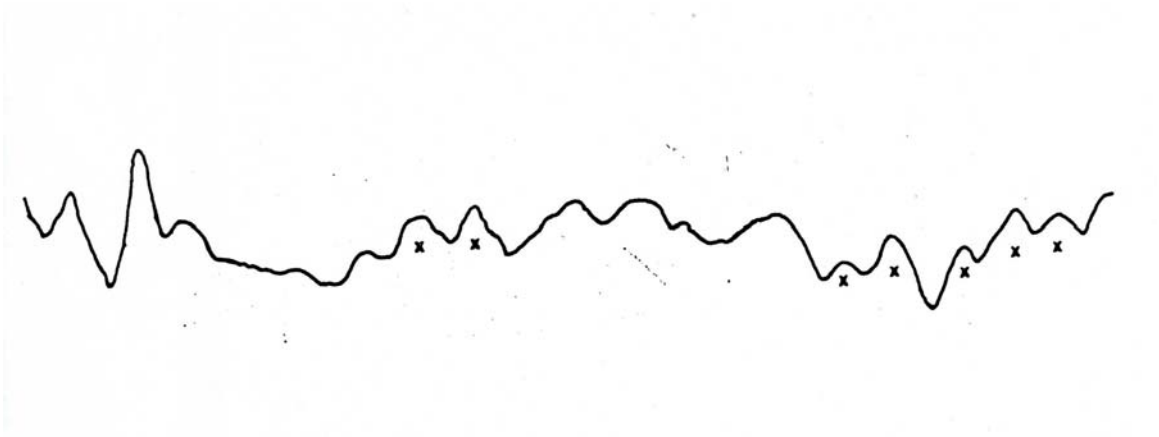

Figure 5. ERP to subliminal rebus stimulus (2 seconds): alpha synchronization

	Phobic	Groups
STIMULUS	Spider Phobics	Snake Phobics
Spider Stimulus	**-.84 (.009).**	**70 (ns)**
Rectangle Stimulus	**-.53 (ns).**	**35 (ns)**

Table 4. Correlations of Hysteroid-Obsessoid Quotient with dprime