
Testing Freud's Hypothesis That Word Forms and Word Meaning Are Functionally Distinct: Subliminal Primary-Process Cognition and Its Link to Personality

Karen Klein Villa (Brighton, MI), Howard Shevrin (Ann Arbor).

Michael Snodgrass (Ann Arbor), Ariane Bazan (Ghent), & Linda A. W. Brakel (Ann Arbor)

One of Freud's seminal hypotheses first appearing in his monograph *On Aphasia* (1891) posited that word meaning and word presentation (e.g., phonemic and graphemic properties) needed to be distinguished if aphasic symptoms were to be accurately understood. In his later psychoanalytic writing, this supposition was generalized to refer to the primary-process uses of language in dreams, symptom formation, and unconscious processes (1900, 1915). To test Freud's hypothesis that word meaning and word presentation are functionally distinct when processed unconsciously (Freud, 1891, 1915), 50 participants were tested with a priming paradigm in which a "palindrome" prime, presented either subliminally or supraliminally, was followed by two target alternatives. In the forward condition, the prime (e.g. DOG) was followed with a semantic associate (e.g. CANINE) and a distractor. In the "palindrome" condition, the prime was followed with a semantic associate of the reversed word (e.g. ANGEL) and a distractor. The participants' task was to choose the word they preferred. The supraliminal results confirm classical semantic priming, but only in the forward condition. Subliminally, however, while no main results emerged, there were interaction effects with self-rated personality factors and stimulus detectability. High trait anxiety induced priming facilitation, while in low anxiety there was inhibition, for both forward and palindrome conditions. On the other hand, high scores on the Hysteroid–Obsessoid Questionnaire, a measure of repressiveness, lead to inhibition of the priming effect while facilitation was observed with low scores—but only for forward priming. Consistently, these interaction effects were even stronger when stimulus detectability was low than at higher levels of detectability, ruling out any skeptical account that the measured effects might be due to residual conscious perception. Taken together, these findings support Freud's hypothesis that the perceptual object dimension of a word, being functionally distinct from its meaning, can give rise to novel sequential processing, an effect that is more likely to occur unconsciously (i.e., $d' \leq 0$) and under conditions of anxiety.

Language has long been considered by cognitive scientists and psychoanalysts alike a window into the processes of the mind. In particular, the semantically ambiguous and creative nature of discourse has helped us to understand clinical phenomena (i.e., symbolic representations of unconscious conflict and their influences on symptom formation) as well as cognitive processes such as language comprehension, the structure of semantic memory, and lexical modularity. The focus of this paper is on the latter phenomenon of lexical modularity, in which the meaning of a lexical item is functionally distinct from the representation of its form (e.g., written or spoken). We present evidence that the perceptual presentation when processed subliminally is treated separately from word meaning, a finding at variance with the usual close linkage of presentation

and meaning, and that this finding is a function of individual differences, primarily the degree of self-rated anxiety and the degree of stimulus detectability.

As discussed below, Freud was among the first to outline a distinct role for the perceptual aspects of words in the unconscious. His suppositions would later be reflected in cognitive models of language that empirically established lexical modularity. This is the first study to scientifically test the principle of lexical modularity in unconscious cognition. After discussing Freud's early writings, we turn to reviewing word-recognition (i.e., comprehension) models that consider the various components of lexical modularity (i.e., orthographic, phonological, and semantic). This discussion is followed by a review of how the form and meaning systems of words can be represented and employed

Karen Klein Villa: Spring Arbor University, Brighton, MI, U.S.A.; Howard Shevrin, Michael Snodgrass, Linda A. W. Brakel: University of Michigan Health System, Ann Arbor, MI, U.S.A.; Ariane Bazan: University of Ghent, Belgium.

Correspondence to: Karen Klein Villa, 121 W. North St., Suite 10, Brighton, MI 48116 (email: villapk@charter.net).

differently in normal and pathological states. We then turn to how selection and sequencing lexical decisions in language production may apply to our current paradigm. Finally, in addition to clarifying the hypotheses under consideration, we summarize the influence of individual differences that must necessarily be considered in any study of subliminality.

Literature review

Early forerunner

In his monograph on aphasia based on his experience as a neurologist, Freud (1891) was among the first to emphasize the importance of distinguishing between word meaning and word presentation. *Word meaning* refers to the semantic property of words, its capacity to "stand for" or "refer" to something. The *word presentation*, on the other hand, insofar as it is made up of all the perceptual characteristics of the word (i.e., graphemic, phonetic, etc.), represents the "thinglike" perceptual properties of words. In addition to the visual image and sound image, Freud (1891) identified a motor-speech image and motor-writing image, the latter two referring to the kinesthetic sensory information associated with a word. In the aphasia monograph and in his later writings based on experience with a range of psychopathologies, Freud hypothesized that the perceptual aspects of words (i.e., the word presentations) when processed unconsciously interact differently with word meaning than is usually the case consciously. As the following literature review shows, research on the role of lexical modularity in unconscious mentation has not been pursued in the substantial theoretical and empirical investigations undertaken by cognitive scientists and psycholinguists. Yet, increasingly, recent research has underscored the important role that unconscious processes play in cognition (Bernat, Shevrin & Snodgrass, 2001; Brakel, Shevrin & Villa, 2002; Snodgrass, Bernat, & Shevrin, 2004; Snodgrass, Shevrin & Kopka, 1993a). If supported, our hypothesis that word meaning and word presentation are functionally distinct would demonstrate an important qualitative difference between conscious and unconscious lexical processes. Freud (1950 [1895]) also theorized that this qualitative difference between unconscious and conscious lexical processing was associated with two qualitatively different forms of thinking that he referred to as the primary and secondary processes (see also Rapaport, 1967). When word meaning and word presentation are integrated as in conscious processes, rational, logical thought is possible (the so-called secondary process).

However, in unconscious primary processing, Freud posited that word meaning and its perceptual aspects are dissociated (i.e., unrelated word meanings are activated by the word presentation), rendering rational, logical thought impossible (the so-called primary process). To test this hypothesis for a distinct role for the perceptual aspects of words in the unconscious, Shevrin (1973) presented pictorial rebuses (e.g. the word "penny" formed by a picture of a pen juxtaposed by an image of a knee) subliminally in a series of studies and reported a similar unconsciously occurring dissociation between word meaning and presentation consonant with the primary- and secondary-process distinction. More recent research has demonstrated that primary- and secondary-process modes of thinking can produce radically different types of categorization of nonverbal stimuli (Brakel, 2004; Brakel, Kleinsorge, Snodgrass & Shevrin, 2000; Brakel & Shevrin, 2005; Brakel, Shevrin, & Villa, 2002). By positing two different forms of thinking, Freud (1950 [1895]) was proposing a forerunner of a number of contemporary dual-systems theories of thinking extensively reviewed recently by Stanovich and West (2000). Brakel and Shevrin (2003), in a commentary on the Stanovich and West article, have further shown the similarities between Freud's primary- and secondary-process model of thinking and the dual-systems theories recently described by Stanovich and West (2000).

In addition to suggesting that lexical modularity operates in a unique manner in primary-process cognition, the current investigation provides supporting evidence that the primary processes are influenced by personality variables and individual-difference variables such as anxiety, level of repressiveness, and the level at which a stimulus is detected/perceived. The Shiffrin and Schneider (1977; Dell, 1986) concept of automatic spreading activation occurring in semantic networks suggests that motivation only influences controlled conscious processes. However, Freud's model posits that motivation can operate unconsciously and influences the manner in which the dissociation between word meaning and word presentation is expressed. This difference in the place of motivation with respect to consciousness is one of the central conceptual differences between the cognitive-science view of the unconscious and the psychoanalytic view. The notion of a motivationless, automatic unconscious might apply in the psychoanalytic sense to preconscious processes, but would not account for dynamic unconscious processes. It is also important to note that there are critics from within cognitive science who have raised questions about the concept of automaticity (Allport, 1989). Freud (1901) theorized that speech parapraxes are not merely random mal-

functions, but meaningful psychological acts that stem from attempts to inhibit suppressed intentions competing with other, more powerful intentions. For example, an audience member at a conference who intends to communicate that he would like the door closed in order to better hear the speaker, but is simultaneously distracted due to an inner state of boredom, may state "close the bore" instead of "close the door." In this instance of displacement, a perceptual distortion (i.e., the substitution of "b" for "d") of the intended word conveys the implicit and unconscious state by revealing an entirely new conceptual category of meaning. According to the Freudian account, in order for the slip to occur the word "door" had to be treated as a word presentation so that the phonemic similarity between "d" and "b" could govern the semantic activation of "bore," a meaning related to the unconscious motivation.

The operation of unconscious motivation has found support in the psychobiological research of Robinson and Berridge (2003), in which it was found that unconscious "wanting" plays an important role in the decision making associated with addiction. In addition, Shevrin, Williams, Marshall, Hertel, Bond, and Brakel (1992) have demonstrated that relationships between personality factors and psychological unconscious conflict can be registered as neurobiological signals (namely, event-related potentials). These investigations provide objective, independent evidence that individual differences, anxiety, and defensive organization can influence primary-process mentation. Given this frame of reference, we will consider the important role of individual differences, anxiety, and defensive organization in determining the interplay of word meaning and word presentation in unconscious processing. Should it be shown that the unconscious processing of word presentations occurs independently from the processing of word meanings, a highly objective empirical method might be opened for investigating the nature of unconscious processes.

Cognitive neuroscience modeling of visual word recognition

In analyzing human language, there is a sharp distinction between the capacity to perceive and reproduce sequences of speech sounds and the capacity to endow these sound sequences with meaning (Goodglass, 1993). A great deal of scientific evidence exists to support this modular language-processing architecture in which distinct systems for the structural (i.e., orthographic and phonemic) and semantic processing

of words exists (Coltheart, Patterson, & Leahy, 1994; Dijkstra, Frauenfelder, & Schreuder, 1993; Henderson, Dixon, Petersen, Twilley, & Ferreira, 1995). Current parallel-distributed processing models of language posit that different forms of lexical knowledge such as orthographic, phonemic, and semantic exist in a distributed fashion and are represented in parallel and accessed simultaneously during perceptual word recognition (McClelland & Rumelhart, 1981; Seidenberg & McClelland, 1989). As such, the network should entertain multiple hypotheses about the lexical identity of incoming visual word information, thus accounting for the ambiguous nature of word processing.

From a cognitive standpoint, interactive models of word recognition (e.g., the Interactive Activation Model, McClelland & Rumelhart, 1981; the Cohort model, Marslen-Wilson, 1987, 1990; and TRACE models, McClelland & Elman, 1986; Seidenberg & McClelland, 1989) assume various amounts of facilitation (e.g., excitation) and inhibition among the different levels of analysis (i.e., graphemes, phonemes, and semantic meaning). Activation of a cohort of associates occurs within and between each of these three levels with a process of lateral inhibition working to suppress competitor words (which have become activated through initial sensory input) to narrow the field of cohorts and eventually arriving at the target word. Competitor activation effects are observed to be strongest when the sensory perceptual input is somewhat ambiguous, as with words that share similar sounds but have different meanings (homophones; e.g., "sole" and "soul") or with homographs in which the same word may have multiple meanings (e.g., "bank"). While interactive models assume that bottom-up, sensory and top-down, conceptual processes may operate simultaneously during word recognition, both the TRACE and Cohort models assume that bottom-up sensory input is the most important factor influencing activation levels, given that it is sensory/perceptual input that eventually disambiguates a stimulus by inhibiting competitor associates (Eberhard, 1994). This process can occur either through a graphemic-to-phonological-to-semantic route or via a more direct graphemic-to-semantic route (Taft & van Graan, 1998). Although inhibition as referred to by psycholinguists is not the same as that referenced by psychoanalysts, it is noteworthy that the concepts of excitation and inhibition are applicable to the entire nervous system; without these complementary processes the nervous system could not function. In fact, one might say that the psychoanalytic concepts of impulse and defense are psychic counterparts (or perhaps derivatives) of these basic neural principles (Shevrin, 2006).

These models of word recognition also assume that lexical processing involves the activation of different types of information rather than access to stored lexical codes (Seidenberg & McClelland, 1989). Such a framework supports the supposition either that all meanings of an ambiguous word can be accessed with equal strength (Onifer & Swinney, 1981) or that partially weighted activations of one or more meanings in a distributed network of representations can occur (McClelland & Kawamoto, 1986). It is this resolution of ambiguity in the context of the mutual processes of facilitation and inhibition (Burgess & Simpson, 1988; Grainger, 1992; Paul, Kellas, Martin & Clark, 1992; Simpson & Burgess, 1985; Simpson & Kang, 1994) in primary-process thinking that is of particular interest to us, especially the idea of how ambiguity exploitation and resolution may serve the processes of *condensation* and *displacement* (discussed below) so characteristic of primary-process mentation.

Evidence for the role of the word presentation in normative, clinical, and neuropathological states

Freud indicated that this unconscious sensory/perceptual treatment of words was at work in a number of clinical phenomena, including manic and schizophrenic speech as well as dreams and everyday slips of the tongue (Freud, 1901). Freud (1917 [1915]) suggested, for instance, that "for a dream, all operations with words are no more than a preparation for a regression to things" (p. 229). This regression from words to things Freud referred to as a "formal" regression, or as one going from secondary- to primary-process mentation. Similarly, psycholinguistic interactive models of word recognition (referred to above) of bottom-up and top-down processes are referring to the mutual influences of semantic and sensory/perceptual levels. Freud posited that the formation of dreams resulted from the dream work, an archaic, primary-process mode of thinking employing the mechanisms of *displacement* (i.e., diverting the interest or intensity attached to one idea onto a less threatening substitute idea) and *condensation* (i.e., combining superficial features of stimuli to form a new entity with its own associates), which serve to transform latent dream thoughts into manifest dream content. Shevrin and Fisher (1967) confirmed this rebus-like quality (i.e., combining featural aspects of a stimulus to form a new entity) of primary-process cognition in dreams. Participants were shown stimuli following rapid eye-movement (REM) and nonrapid eye-movement (NREM) awakenings. The stimulus was a picture of a pen and a picture of

a knee forming the rebus for penny. During a free-association task, participants gave more rebus associates, or penny associates, following REM awakenings than NREM awakenings. Essentially, primary-process cognition and the use of condensation characterized REM states and secondary-process cognition characterized NREM states.

The sensory qualities of words can also be observed in unconscious "slips of the tongue." As stated previously, Freud suggested that speech parapraxes are not merely random malfunctions, but meaningful psychological acts that stem from attempts to inhibit suppressed intentions competing with other, more powerful intentions. Similarly, clinical symptoms can be conceptualized as recurrent, uncontrollable "slips" in speech, action, emotion, and imagery (Baars, 1992). Speech observed during manic episodes, in addition to being pressured and prosodic, may deteriorate to "clanging" in which phonemic sounds/features govern word choices rather than meaningful conceptual relationships. Formal thought disorder, too, is typically diagnosed by its disorganized thought processes, and "loosening of associations" is considered a hallmark of schizophrenia. Schizophrenic speech is often neologistic and does not conform to organized and conventional linguistic rules (i.e., secondary process). Rather, psychotic discourse is quite concrete and illogical and, according to Freud (1915), is characterized by speech in which a hypercathexis of the word presentation occurs.

Schizophrenic speech, too, can be so incomprehensible as to resemble the linguistic disorganization (i.e., word salad) seen in receptive (i.e., Wernicke's) aphasia. This "jargon-like" use of language has been described as a dissolution of the phonemic and semantic components of language (Alajouanine & Lhermitte, 1973). Paraphasic errors in fluent aphasia (i.e. Wernicke's aphasia) can consist of phonemic or whole-word substitutes as well as neologistic productions. Language production in this neuropathological condition can be characterized as "empty" and impoverished of semantically significant words. In addition, the selective impairment of naming letters and comprehending letter names is commonly seen in receptive aphasia, again suggesting that the graphemic and phonemic components of language operate as distinct systems relative to semantic dimensions. Conduction aphasia is also characterized by a predominance of phonemic paraphasias that are thought to reflect a breakdown at the stage of organizing the phonological sequence for motor execution (Goodglass, 1993). The salient feature of these paraphasias is the disordered selection and sequencing of syllables and phonemes. The neurological

structure damaged in conduction aphasia is the arcuate fasciculus, which essentially connects the auditory comprehension area with the motor speech center and is important in the perception and short-term storage of phoneme strings and their assembly for production (Damasio & Damasio, 1980).

These neurological disorders and their associated aphasic symptoms each have characteristic paraphasic errors in which the structural features of a word are dissociated from the same word's semantic referent. Freud (1891) first identified these speech disorders in his monograph on aphasia in which he divided speech disorders into two classes: (1) verbal aphasia, in which only the associations among elements of the word presentation are disturbed and (2) *asymbolic aphasia* in which the association between the "word presentation" and the "thing presentation" (i.e., semantic referent) of a word is disturbed (Freud, 1891, p. 78). The nomenclature proposed by Freud has not been commonly adopted. However, what we now call "classical anomias" (Geschwind, 1967) most typically reveal this dissociation between word structure and word meaning. Anomias are characterized by a selective deficit in the ability to *name* objects, while the access to the object's referential meaning is preserved (Gainotti, Miceli, Caltagirone, Silveri, & Masullo, 1981). Remarkably, anomias are often observed for very narrowly defined categories such as animals, fruits, vegetables, or body parts (Gainotti, 2000; Hart, Berndt, & Caramazza, 1985; Hart & Gordon, 1992). Individuals with such anomias do not lose their ability to semantically access an understanding of these concepts but have severe word-finding deficits selective for the names of these narrow categories. For example, Crosson, Moberg, Boone, Gonzalez, and Raymer (1997) describe a patient with a category-specific naming deficit selective for medical items and conditions that could not be explained by deficits in broad semantic classifications (e.g. man-made vs. natural) or by word frequency, concept familiarity, imageability, or abstractness.

Damasio, Grabowski, Tranel, Hichwa, and Damasio (1996) have argued that category-specific naming failures can be attributed to a deficit in lexical retrieval and not in semantic processing. These authors compared the locus of the focal lesion in patients with specific anomias and the locus of PET-activation for the naming of certain word categories in normal volunteers. They were able to show that the normal process of retrieving words denoting concrete entities depends on anatomically separable regions of the left cerebral hemisphere that are different for different kinds of items (Damasio et al., 1996). In a commentary of that article, Caramazza (1996) proposed a linguistic

model in which semantic word knowledge operates as a distributed network in both cerebral hemispheres, whereas lexical word knowledge is a distinct organized system of local word representations in the left temporal lobe. This model in which the meaning of words is functionally distinct from the representation of their forms (e.g., phonological or graphemic), further supports the autonomy and separateness of these two systems (Caramazza, 1996; Damasio et al., 1996; Rapp & Caramazza, 1996), as Freud (1891) originally postulated. As reviewed here, lexical decisions during these normative, clinical, and neuropathological states can be governed by a disconnection between the perceptual/featural aspects of words and the semantic knowledge of words. Therefore, we next consider how sequencing of these featural aspects of words in language production may be operative in primary-process cognition.

Lexical decision making in linguistic production

Interactive activation-based models of language distinguish between two kinds of decisions operating in language production—namely, selection decisions and sequence decisions (Dell & O'Seaghdha, 1994)—which we believe are also relevant to the phenomena described above. *Paradigmatic* decisions (i.e., selection decisions) involve selecting a single linguistic unit from a predetermined set of potential competitors for a linguistic role, such as which unit will serve as a noun in a sentence. *Syntagmatic* decisions, on the other hand, involve selecting how linguistic units will be correctly sequenced at a particular time. So, for example, when producing the phrase "red ball", the activation of *red* must initially dominate that of *ball*, with *red* subsequently being inhibited in order that *ball* may become activated. Similarly, in the production of the word "CAT", a sort of chain associative mechanism is at work in which each item in the sequence activates its successor in a forward excitatory manner. That is, the "A" in CAT is processed in the context of "C" having become activated first and subsequently inhibited as the "A" is activated, a unidirectional sequencing process that is characteristic of reading. However, we propose that since words are treated as perceptual entities (word presentations) in the unconscious without initial access to their semantic referents, unidirectional sequential processing is not required. As with any perceptual object, directionality is irrelevant and thus processing can occur bidirectionally from a semantic standpoint. This property of the word presentation as contrasted with word meaning is the basis for the palindrome effect.

Two principles regarding syntagmatic processing are important if we are to consider how syntagmatic linguistic decisions are made during subliminal primary-process thinking. First, Dell and O'Seaghdha (1994) differentiate between two types of syntagmatic decisions: noncreative and creative. *Noncreative* syntagmatic decisions involve well-known sequences (e.g., "Venetian blind") which are already stored in memory, while *creative* syntagmatic decisions involve the construction of novel sequencing (e.g., "blind Venetian"). Noncreative syntagmatic decisions further employ a filter layer in which perceptual groupings (i.e., word beginnings and endings: Patterson & Coltheart, 1987; Treiman & Chafetz, 1987) or complex sequences are stored and used in solving such linguistic tasks as anagrams. Creative syntagmatic sequencing, then, is the focus of the current study. We hoped to determine the manner in which novel sequencing, or creative syntagmatic processing, contributes to the sensory/perceptual treatment of words (i.e., structural, phonemic) in unconscious cognitive operations.

With regard to a second principle of syntagmatic processing, Dell and O'Seaghdha (1994) posit that syntagmatic (sequencing) decisions are explicitly tied to the intended utterance of the speaker, whereas paradigmatic decisions are not. This is due to the fact that a particular sequence is not dependent on a predetermined set of competitors as are paradigmatic decisions where associates remain within the same category; rather, real-time sequencing occurs in the context of what the speaker intends to convey. Therefore, syntagmatic sequencing decisions are intricately connected with working-memory processes and the intentional/motivational aspects of a communication. For this reason, we suggest that syntagmatic (sequential) processing is especially dominant in unconscious primary-process thinking where unconscious motivations can inadvertently contribute to speech errors and other "slips" in actions, thoughts, and perception. We further suggest that this mechanism of the novel sequencing of the perceptual features of a word allows for the produced speech errors traversing semantic categories and thereby communicating an apparently unintended utterance with an entirely different meaning (e.g., from "door" to "bore"). Rapaport (1967) has previously referred to this dimension of primary-process thinking as "connotative-recruiting," positing that the perceptual aspects of a word (i.e., the word as thing) are used to enrich or extend an originally identified meaning. Indeed, Freud (1905) discussed how part of the pleasure afforded in jokes (e.g., play on words) derives from the psychic expenditure saved from using the same or similar words to move from "one circle of ideas to an-

other" and that this transformation occurs secondary to the sensory aspects of a word (i.e., its sound and visual images).

MacKay (1992), in applying his Node Structure Theory to the notion of speech errors, discusses how sequence nodes determine the serial order in which content nodes for action, perception, and thought become activated. Sequence nodes can prime (i.e., prepare for activation) content nodes in which the "most primed" node reaches threshold and becomes activated, a process that is certainly susceptible to error (e.g., slips of the tongue) especially as "extraneous" nodes reflecting alternative intentions than the original intention receive stronger priming and become activated. For the purposes of the current study, we are proposing that primary-process cognition is characterized by syntagmatic processing of featural/attributional aspects of words (i.e., orthographic, phonemic) and that syntagmatic processing will prime paradigmatic decisions at the conceptual level, thereby contributing to a secondary-process lexical decision.

In order to test our hypothesis, we chose to use a type of palindrome consisting of a reversible sequence of letters that can be read differently forward and backward—for example, DOG and GOD—as an avenue to experimentally represent structural and semantic ambiguity. In particular, we were interested in whether subliminal (i.e., operationally unconscious) presentations of such palindromes would indeed be processed as perceptual stimuli in which sequencing would occur in both directions, thus activating multiple and unrelated semantic categories (e.g., present DOG, and associates to DOG and GOD are both activated), and that this would not be the case for supraliminal (i.e., operationally conscious) presentations. Before turning to describing our method, however, we review a number of individual-difference variables that we have found to influence subliminal effects in previous research.

Individual differences influencing unconscious cognition

Rapaport (1967) posited that personality and its use of defensive organization can have a powerful regulating control over cognition. From our previous work in unconscious perception and cognition, we have found that primary-process mentation is significantly influenced by individual-difference variables such as cognitive preferences and unconscious defenses to ward off overwhelming states of unpleasant affect. In a series of experiments, Snodgrass, Shevrin, and Kopka (1993a) asked participants to identify subliminally presented

words using one of two strategies: either allowing the word to "pop" into their mind (i.e., relaxing conscious control over thoughts) or effortfully looking at (i.e., consciously controlling) the stimulus. In addition, participants were asked which of the two strategies they prefer—"popping" or "looking." Results indicated that when the task was congruent with the participant's preference (i.e., the participant was asked to use the look strategy and also had a look preference), performance was facilitated on the experimental measure. On the other hand, when task and preference were incongruent (i.e., look-preference participants who were asked to use a "pop" strategy), participants performed below chance, or inhibited, on the experimental measure. This pattern of results illustrates an important qualitative characteristic of unconscious processes—that inhibition can occur in situations in which conscious perception would characteristically produce facilitation. These findings have been replicated by researchers in other laboratories (Van Selst & Merikle, 1993), and the assembled findings are considered extensively in Snodgrass and Shevlin (2006).

Furthermore, participants who demonstrated this pattern of inhibition/facilitation in the Snodgrass, Shevlin, and Kopka (1993a) studies also scored high on personality indices of "repressiveness," suggesting that unconscious inhibitory defenses were influencing subliminally acquired perceptual information. From the psychoanalytic standpoint, *repression* is a generic and broad concept that refers to the active exclusion from conscious awareness (i.e., inhibition) of certain aspects of threatening material. Repression can be accomplished in many different ways; however, one important dichotomy is the repression of semantic/ideational content versus the repression of affect. Hysterics typically employ the latter form of repression, suppressing the semantic content of ideas associated with disturbing feelings. Obsessionals, on the other hand, often block disturbing affects associated with various ideas and have no difficulty accessing the semantic content of threatening material. On this basis, we chose to use an instrument that indexes this bipolar repressive dimension: the Hysteroïd–Obsessoid Questionnaire. Given that our study focused on the lexical content of a word stimulus, we wondered, in particular, whether content-repressive subjects (i.e., hysterics) might show less of a palindrome effect. In addition, we administered a unipolar measure of repressiveness, the Marlowe-Crowne Social Desirability Scale, as an overall index of inhibitory defensiveness. Given our view that form-related primary-process manipulations and slips with words (i.e., speech errors) occurred particularly under conditions of regression

(e.g., fatigue, anxiety), we also decided to administer a measure of anxiety, the Taylor Manifest Anxiety scale. Our purpose in doing so was to understand how inhibitory defenses and associated anxiety would influence the unconscious processing of words. These indices of personality function are discussed in more detail in the measures section.

The unconscious inhibition described above cannot be explained by typical conscious-perception models (Reingold & Merikle, 1988, 1990) or by cognitive models such as the subliminal mere exposure effect (Kunst-Wilson & Zajonc, 1980), both of which would predict facilitatory responses only (Snodgrass, Shevlin, & Kopka, 1993b). Unconscious inhibitory defense must also be distinguished from the lateral inhibition processes at work in the interactive word-recognition models described above. In the latter case, a cohort of associates becomes activated, and gradually competitor associates are suppressed or inhibited so that the target associate can become activated. In the case of unconscious inhibition, there are no competing responses to be suppressed but only acquired information that is actively avoided in order to manage unpleasant thoughts or affects. It is possible in the current paradigm to argue that both perceptual readings of a reversible word provide a type of response competition; however, we are arguing instead that multiple meanings become activated and are not immediately suppressed. In other words, the unconscious defense may actually influence response selection among multiply activated meanings from perceptual associates to a word.

The influence of stimulus detectability on unconscious effects

Our research has also demonstrated that the detectability of a subliminal stimulus has important influences on experimental unconscious effects (Snodgrass & Shevlin, 2006). In a series of experiments using Greenwald and colleagues' (1995) regression technique in which unconscious effects are regressed onto the conscious perception criterion, Snodgrass (2004) has shown that facilitation effects in unconscious perception experiments were negatively, rather than positively, correlated with the *d*-prime (*d'*) measure (i.e., the Signal Detection Theory measure of perceptibility on a subliminal forced-choice task). This finding suggests that unconscious effects actually become stronger when conscious perception is completely absent, as when *d*-prime is less than or equal to zero (i.e., performance on the forced-choice task does not fall above chance). Snodgrass (2004) identified this nonmonotonic

relationship between d -prime and unconscious effects and has demonstrated the important moderating influence of stimulus detectability in unconscious-cognition experiments. This nonmonotonic relationship illustrates the importance, then, of using the objective detection threshold (i.e., $d' \leq 0$) in unconscious perceptual experiments (rather than the subjective detection threshold, which is based on a participant's subjective report of an inability to see a stimulus) in order to be certain that obtained results are due to unconscious processes and are not, instead, occurring secondary to a conscious perception artifact. The subliminality check used in the current study is described below, and the influence of detectability on our results is then examined.

Materials and method

Participants

Fifty paid participants were recruited through a University of Michigan publication. Participants were screened for right-handedness, vision correctable to 20/20, and no history of neurological or psychiatric illness. Due to the nature of the study, participants were also required to have English as a first language and have no history of reading or learning disability. Participants were not equated on reading ability; however, all were engaged in university-level studies. Participants had a mean age of 32.56 years ($SD = 14.91$, range = 18–70) and a mean education of 15.75 years ($SD = 1.94$, range = 12–20).

Personality measures

Hysteroid–Obsessoid Questionnaire

As stated above, the Hysteroid–Obsessoid Questionnaire (HOQ; Caine & Hope, 1967) was designed to index a hysteroid–obsessoid personality-trait dimension. The measure consists of 48 true/false items in which responders indicate how they usually act or feel. High scores reflect a more hysterical style whereas low scores reflect a more obsessional style. Representative items with the hysteroid response in parentheses include “One can understand most things without having to go into all the details” (true); “I am slow in making up my mind about things because I weigh all the pros and cons” (false); “I do not show my emotions in front of people” (false); and “I act out my feelings” (true).

With regard to reliability and validity, Caine and Hawkins (1963), using hospitalized psychiatric pa-

tients, reported that the HOQ correlated well ($r = .68$) with hospital staff judgments on the hysteroid/obsessoid dimension. Test–retest reliability was also established ($r = .77$). As described above, we hypothesized that tendencies to repress would be most relevant to our experimental paradigm.

Marlowe–Crowne Social Desirability Scale

The Marlowe–Crowne Social Desirability Scale (MC; Crowne & Marlowe, 1960) was originally intended to be a measure of response bias or the tendency to distort one's responses on self-report measures in order to “look good.” Personality theorists have long been concerned with the potential threat to validity that response bias might pose, and many major personality inventories include scales specifically designed to identify such biases (e.g., the K scale of the MMPI; McKinley, Hathaway, & Meehl, 1948). More recently, “social desirability” measures such as the Marlowe–Crowne are considered to measure a substantive personality dimension in its own right that has been variously labeled “need for approval” or “avoidance of disapproval” (Paulhus & Reid, 1991), and therefore the MC has been seen as indexing a defensiveness dimension (Paulhus, Fridhandler, & Hayes, 1998; Weinberger, 1990). The Marlowe–Crowne is a 33-item true/false scale in which higher scores indicate greater defensiveness. Test–retest reliability has been reported to be $r = .88$ (Crowne & Marlowe, 1964). Representative items ask participants to respond to typical shortcomings (e.g., “I'm always willing to admit it when I make a mistake”; “I have never deliberately said something that hurt someone's feelings”; “I sometimes think when people have misfortune they only get what they deserved”; and “I sometimes try to get even, rather than forgive and forget”).

Taylor Manifest Anxiety Scale

In order to assess anxiety, we administered the Taylor Manifest Anxiety Scale (MAS; Taylor, 1953; Bendig, 1956). The MAS is a widely used self-report instrument measuring general anxiety. The scale was originally developed based on items extracted from the Minnesota Multiphasic Personality Inventory (McKinley, Hathaway, & Meehl, 1948). The scale is a 42-item true/false inventory asking participants to respond to descriptions of somatic complaints (i.e., autonomic physiological arousal), motor tension and restlessness, inner tension, feelings of inadequacy, diffuse worry, and vague fears associated with anxiety (Livneh & Redding, 1986). The MAS is considered to be a valid

measure of neuroticism (Watson & Clark, 1984). Representative items include: "At times I lose sleep over worry"; "I feel anxious about someone or something almost all the time"; "At times I am so restless that I cannot sit in a chair for very long"; and "I am more self-conscious than most people." The measure has established test-retest reliability ($r = .82$) and correlates well with other measures of anxiety (e.g., MMPI, $r = .68$; Taylor, 1953). The MAS is not a measure of state anxiety but is appropriately used as a measure of trait (i.e., as a stable personality characteristic) anxiety (Hojat & Shapurian, 1986).

Stimuli

Primes

Prime words had a palindromic form¹—that is, when orthographically reversed they form another word. They were chosen from a nearly exhaustive list of known reversible words. A small subset of reversible words were excluded from the original set because they are rarely used in mainstream linguistics (e.g., DRAY, GNUS, YAW, ERGO, ETA, TAO, RAJA, TORT) or did not have distinct semantic associates (e.g., ARE). The remaining 76 palindromes comprised the priming list. The complete list of palindrome primes is presented in Table 1.

Targets

Target words were semantically related to either the forward or the palindromic reading of the prime, while distractor words were unrelated to either reading direction. For example, in the *forward priming condition* the prime DOG was followed by the target CANINE and the distractor SEQUEL, whereas in the *palindrome priming condition* the prime DOG was followed by the target ANGEL (i.e. semantically related to the palindromic reading GOD) and the distractor LEMON. Target and distractor words were equated on a number of different dimensions, including word frequency (Kucera & Francis, 1967); whether the words functioned as nouns, as verbs, or as both; number of letters; and number of letters shared with the prime. In addition, few target and distractor words shared the

first letter with the prime; however, when this was necessary, *both* target and distractor shared the first letter with the prime. No target or distractor was a reversible word. The target word was also counterbalanced for position (i.e., was randomly assigned to either the left or right) on the choice card in order to avoid response bias to one item position or another. Primes and target-distractor pairs were printed in capital letters in 18-pt Helvetica light and centered on 3×5-in. white cards.

Priming method

Procedure

Priming effects of a palindromic stimulus, presented either subliminally or supraliminally, were measured through the participant's response to a forced-choice preference judgment.² Experimental procedures are outlined in Table 2. After completing an informed-consent form and the personality measures, participants were seated in an adjustable chair in front of the tachistoscope. Participants were introduced to the tachistoscope and how it operates. Instructions were provided for both subliminal and supraliminal presentations. Initially, participants viewed the fixation field (a white card with a centered black dot in the middle). For the subliminal presentations, participants were asked to say "ready" when they were looking at the dot, were alert, and would not blink. Participants were told that a single word would be presented to them followed by a pair of words that may or may not be related to the first word; their task was to *choose the one word in the pair that they preferred*. The stimuli were presented in a 3-field Gerbrands Model T3-8 tachistoscope. All three fields of the tachistoscope were used: one for the prime, one for the target-distractor pair, and one for a fixation point, which was on at all times except for the duration of the stimulus presentations. Field brightness and ambient room lighting were set at 5 ft./lamberts. The temporal stimulus sequence was as follows: fixation field, prime presentation, target-distractor presentation, fixation field. In the subliminal series, energy masked primes were presented at the objective detection threshold—that is, at 1 msec. In the supraliminal series, primes were presented such that they could be readily seen—that is, at 3,000 msec. In both durations, target-distractor pairs were presented at 3,000 msec.

¹Strictly speaking, the term "palindrome" should only be used for a word (or a phrase) that reads the same in both directions—for example, "eye," or "racecar." In this study, we used words that, when read in the backward direction, yield another word. In strict technical terms this type of word is called a "semordnilap" (i.e., the word "palindromes" read backwards).

²A preference-judgment task was chosen based on the "mere-exposure effect," in which subliminally presented items are chosen over nonpresented items despite not being recognized as such (Kunst-Wilson & Zajonc, 1980).

Table 1
Palindrome prime list

<i>List 1</i>	<i>List 2</i>	<i>List 1</i>	<i>List 2</i>
1. WED	1. DEW	39. KEEP	39. PEEK
2. REVEL	2. LEVER	40. YAM	40. MAY
3. GEL	3. LEG	41. POTS	41. STOP
4. LOOT	4. TOOL	42. LAGER	42. REGAL
5. DOC	5. COD	43. LIVED	43. DEVIL
6. REPEL	6. LEPER	44. SUB	44. BUS
7. GUT	7. TUG	45. DELIVER	45. REVILED
8. DIAPER	8. REPAID	46. KEEL	46. LEEK
9. WETS	9. STEW	47. SPOOL	47. LOOPS
10. RAT	10. TAR	48. STRAW	48. WARTS
11. REEL	11. LEER	49. STAR	49. RATS
12. SNUG	12. GUNS	50. PAN	50. NAP
13. WAR	13. RAW	51. POOL	51. LOOP
14. GATEMAN	14. NAMETAG	52. RAPS	52. SPAR
15. TIPS	15. SPIT	53. PANS	53. SNAP
16. PARTS	16. STRAP	54. PEELS	54. SLEEP
17. STOOL	17. LOOTS	55. BAG	55. GAB
18. POT	18. TOP	56. STAB	56. BATS
19. GAL	19. LAG	57. MEET	57. TEEM
20. WON	20. NOW	58. MAD	58. DAM
21. DOG	21. GOD	59. BUT	59. TUB
22. TIME	22. EMIT	60. PLUG	60. GULP
23. PART	23. TRAP	61. FLOW	61. WOLF
24. STRESSED	24. DESSERTS	62. EROS	62. SORE
25. SPAM	25. MAPS	63. NIPS	63. SPIN
26. SLAP	26. PALS	64. STOPS	64. SPOTS
27. DECAL	27. LACED	65. TIP	65. PIT
28. PETS	28. STEP	66. GUM	66. MUG
29. DEER	29. REED	67. GOLF	67. FLOG
30. DRAWER	30. REWARD	68. RAP	68. PAR
31. SPOONS	31. SNOOPS	69. PIN	69. NIP
32. TAB	32. BAT	70. SAG	70. GAS
33. NET	33. TEN	71. DOOM	71. MOOD
34. LIAR	34. RAIL	72. LIVE	72. EVIL
35. GUMS	35. SMUG	73. PAWS	73. SWAP
36. DENIM	36. MINED	74. TUBA	74. ABUT
37. DRAW	37. WARD	75. MOOR	75. ROOM
38. TONS	38. SNOT	76. PAL	76. LAP

Table 2
Experimental procedure

Step 1. Each subject is randomly assigned to receive either the subliminal (duration = 1 msec) or supraliminal (duration = 3,000 msec) condition first; also randomly assigned is whether the subject's subliminal primes will come from List 1 or from List 2 (the mirror reverse of the palindrome primes on List 1).

Step 2. Individualized lists of prime-target pairs are created for each condition. (The following is a hypothetical example of a list created for a subject who was randomly assigned List 1 and the subliminal condition first.)

<i>List 1</i>			<i>List 2</i>		
<i>Prime</i>	<i>Target-distractor pair</i>		<i>Prime</i>	<i>Target-distractor pair</i>	
DOG	CANINE	SEQUEL	GOD	LEMON	ANGEL
WAR	PROFIT	COMBAT	RAW	CRUDE	AMPLE
PART	SECTION	MEETING	TRAP	BAIT	WASP
FLOW	GUSH	MASH	WOLF	SHEEP	CABIN
SAG	PRUNE	DROOP	GAS	BULK	FUEL
LIVE	BREATHE	COMPUTE	EVIL	BIRDS	DEMONS
POTS	GUITAR	FLOWER	STOP	KNIT	HALT
RAT	MOUSE	ELBOW	TAR	CHATTER	FEATHER

Items assigned to each condition

<i>Condition</i>	<i>Random assignment</i>	<i>Prime</i>	<i>Target-distractor pair</i>	
Forward priming	subset of 19 prime-target items from List 1	WAR	PROFIT	COMBAT
		SAG	PRUNE	DROOP
Palindrome priming	subset of 19 items with primes from List 1 and target pairs from the matching palindrome on List 2	DOG	LEMON	ANGEL
		FLOW	SHEEP	CABIN
Control forward	subset of 19 items from List 1 with target pair randomly assigned to each prime	POTS	BREATHE	COMPUTE
		LIVE	GUITAR	FLOWER
Control backward	subset of 19 with the target pair from List 2 randomly assigned to primes on List 1	RAT	BAIT	WASP
		PART	CHATTER	FEATHER

Step 3. Items are randomly ordered to create list for subliminal condition; List 2 is then used to create stimuli for the supraliminal condition using the same procedure.

Step 4. Detection task list is created by randomly assigning 38 primes from the subject's subliminal list and randomly ordering these primes with 38 blank cards.

Step 5. Subject completes informed consent and personality measures.

Step 6. Subject is seated in front of the tachistoscope and instructed to focus on the fixation dot and say "ready" when he/she is prepared to not blink (subliminal instruction). Prime is then viewed at 1 msec.

Step 7. Subject is then presented the target-distractor pair (duration 3,000 msec) and asked to "choose the one word in the pair you prefer" (preference judgment). There are 76 items administered.

Step 8. Supraliminal condition is then administered with the same preference-judgment instruction. List consists of 76 items from List 2 where both the primes and target-distractor pairs are presented at 3,000 msec.

Step 9. Subliminality check. A detection task is administered consisting of 76 items (38 primes from subliminal list and 38 blanks) with a forced-choice instruction (e.g., "words and blanks will be presented an equal number of times in random order, and you are to guess either word or blank").

Step 10. Debriefing interview. Subjects are shown a card of 10 palindromic primes and asked whether they can identify a characteristic all the words share and, if so, when in the experiment they became aware of the nature of the palindromic stimuli.

Each duration (subliminal and supraliminal) consisted of 76 prime–target pairs, for a total of 152 presentations. Participants verbally reported their choice from the target–distractor pair, which was then recorded by the experimenter.

List rotation

Individualized lists of prime–target pairs were created for each subject in order to counterbalance duration order (subliminal vs. supraliminal), list (List 1 vs. List 2), and condition (forward priming, palindrome priming, or controls) across items (see Table 2). Participants were randomly assigned to receive either the subliminal or the supraliminal duration first. Twenty-seven participants received the subliminal duration first, whereas 23 participants received the supraliminal duration first. Next, List 1 or List 2 (the mirror reversal for the palindrome primes) was randomly assigned to the subliminal duration. Once a list was selected, then four conditions were created by randomly assigning the 76 items from that particular list to the forward priming, palindrome priming, and two control conditions. Each condition consisted of 19 items. In the forward priming condition, primes remained with their originally selected target–distractor pairs. The palindrome priming condition was created by borrowing target–distractor pairs from the reverse image list such that DOG, for instance, would then be paired with LEMON and ANGEL. The first control condition was created by randomly assigning target–distractor pairs to primes within a randomly selected subset of 19 items. Since the target–distractor pairs were randomly assigned within the same list, this set of items was considered to function as the control condition for forward priming. The second control condition was created by borrowing the primes from the second list whose target–distractor pairs had been used in the palindrome condition and randomly assigning them to semantically unrelated target–distractor pairs from the remaining 19 items in the original list. This control condition served as the comparison condition for the palindrome priming condition. In a final step, all items were randomly ordered such that items were not grouped according to condition.

Subliminality check

Detection study

A 76-item forced-choice (i.e., word vs. blank) detection task was administered at the end of the experiment

to check for subliminality (i.e., the absence of conscious perception). This task list consisted of half of the primes ($N = 38$) from the participant's subliminal condition list and 38 blank cards, presented at 1-msec stimulus duration and 5 ft./lamberts luminance. Participants were told that words and blanks would be presented an equal number of times in random order and asked to decide whether the card presented was a word or a blank. Consistently, participants spontaneously reported they saw no stimulus. They were then encouraged to guess whether the card presented was a word or a blank, despite this absence of conscious awareness of the stimulus. They were asked to keep their responses evenly divided between the two choices of word and blank. The resulting average d' prime was near zero ($d' = -.067$, *ns*), suggesting that the stimuli in this study were indeed presented at the objective detection threshold. These data confirm that the subliminal method used in this study effectively precluded conscious recognition of stimuli at the exposure duration (i.e., 1 msec) and the luminance level (i.e., 5 ft./lamberts).

Debriefing

Following the presentation of the experimental stimuli and the detection task, participants were asked several questions to determine if at any time during the course of the experiment they were aware of the palindromic nature of the primes. After being asked to describe the purpose of the experiment, participants were shown a card with 10 palindrome primes and asked if they could identify any characteristic that all of the words share. If they were able to recognize the words as reversible, they were then asked to estimate at what point in the experiment they became aware that this was the case. Out of the 50 participants who completed the experiment, only 8 were able to identify the reversible words. When appropriate, findings associated with the "aware" subgroup are discussed in the results section below.

Results

Main effects

In Table 3 the mean scores are given for the supraliminal and the subliminal duration, the forward and the palindrome priming type, and the experimental and control stimuli. A significant Duration Priming Type \times Stimulus interaction, $F(1, 49) = 20.44$, $p < .001$, was obtained.

Table 3
Means for the within-subjects variables
in the Initial analyses

Duration	Priming type	Experimental	Control
Supraliminal	forward	14.52 ± .60	10.26 ± .37
	palindrome	9.64 ± .32	9.45 ± .36
Subliminal	forward	9.58 ± .37	9.94 ± .33
	palindrome	9.74 ± .35	9.86 ± .27

Mean hit score ± S.E.M.; total possible score = 19.00. The Duration × Priming Type × Stimulus interaction is significant; $F(1, 49) = 20.44$, $p < .001$.

For the supraliminal duration, the Priming Type × Stimulus interaction was significant, $F(1, 49) = 26.39$, $p < .001$. This interaction was carried primarily by a powerful standard forward priming effect, $F(1, 49) = 53.76$, $p < .001$; the palindrome priming effect did not reach significance, $F(1, 49) = 2.65$, $p = .11$. However, for the small group of participants who were *aware* of the reversible primes ($N = 8$), the supraliminal palindrome priming effect was significant, $F(1, 7) = 7.54$, $p = .03$. For the remaining participants, who were *not aware*, however, the palindrome priming was well below significance ($p = .65$), suggesting that the original near-significant finding for the palindrome effect was entirely due to the *aware* subjects.

For the subliminal duration, no main effects were found [all $F_s(1, 49) < 1$]. This is consistent with previous findings (Snodgrass, Shevrin, & Kopka, 1993a), which also show that once personality factors and stimulus detectability are taken into account, significant subliminal effects, however, do emerge (discussed further).

Interaction effects

Interaction with personality variables

To examine the effects of the personality variables, we performed multiple regressions using the personality scales as predictors. These regressions were initially performed separately by duration and priming type.³

³Because we had previously obtained interactions with the three personality scales among themselves, we performed preliminary analyses to check for the presence of such internal interactions. Following Cohen and Cohen's (1983) recommendations, these interactions were only retained if they (as a set) significantly increased the explained variance. Since in all such analyses, these interactions failed to significantly increase R^2 , they were dropped from the model. Consequently, all reported analyses include only the main interaction effects of the three personality scales with the priming.

The dependent variable in all analyses is the stimulus effect or "priming," calculated as the difference between the number of hits in the experimental (forward or palindrome) condition and in their respective control conditions. A "hit" is defined as the choice of semantic associate (instead of the distractor). Forward and palindrome priming were entirely uncorrelated for both supraliminal ($r = .082$, *ns*) and subliminal ($r = .131$; *ns*) durations.

Given that the personality predictors are continuous variables, their interaction(s) with the (categorical) stimulus effect are best examined using Aiken and West's (1992) regression procedures. Because these techniques are likely to be unfamiliar to many readers, a brief overview may be helpful. We first address two-way interactions, the simplest case—here, Personality × Stimulus interactions. First, recall that obtaining a significant interaction means that the effect of one of the involved predictors is not constant but, rather, varies as a function of some other predictor. Here, the stimulus effect is of primary interest, and we wish to examine how this effect changes as a function of the personality predictors. To do this, we use Aiken and West's procedures for evaluating the stimulus effect's direction and significance at different levels of the personality predictors. When we say "level," however, it is important to emphasize that this does not involve splitting the participants into subgroups on the personality predictors but, rather, estimating the stimulus-effect regression function at whatever point(s) on the personality predictors is most heuristically useful—often, say, 1 *SD* above and below the mean on the relevant personality predictor.⁴ Because this approach uses all of the data and retains the continuous character of the personality predictors, it is more powerful and precise than subgroup analysis would be.

For subliminal palindrome priming, the personality factors predicted performance: multiple $R = .45$, $F(3, 46) = 3.94$, $p = .014$. This result was carried by anxiety, $\beta = .47$, $t = 3.23$, $p = .002$. The HOQ and MC effects were nonsignificant (both $t_s < 1.16$). Thus, even though the overall palindrome mean showed no main effect in the original analysis, the effect emerged once the influence of anxiety was taken into account. This anxiety effect was substantial, $\eta^2 = .185$. To clarify the

⁴Given that the stimulus effect is already represented in the dependent variable (i.e., experimental hits–control hits), its direction and significance are reflected in statistics involving the y -intercept. Here, a positive y -intercept indicates facilitation; a negative value, inhibition. The y -intercept's significance reflects the significance of the stimulus effect when the personality predictor is zero. By rescaling the continuous predictor such that zero reflects point(s) of substantive interest, the significance of the stimulus effect at any desired point can be obtained (for more details see Aiken & West, 1992).

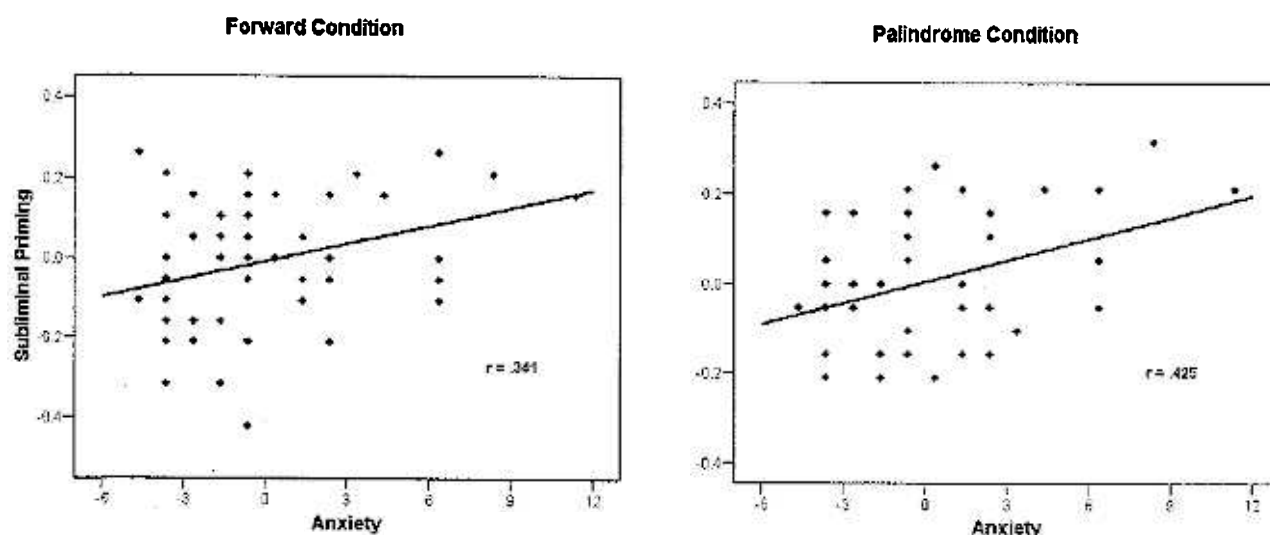


Figure 1. Subliminal priming for forward and palindrome priming (measured as the difference between experimental and control hit rates) as a function of anxiety (measured by the Taylor Manifest Anxiety Scale; centered values).

nature of the anxiety effect, we examined the predicted palindrome performance depending on anxiety level. Following Aiken and West (1992), we examined predicted palindrome performance with anxiety 1 *SD* below the mean, at the mean, and 1 *SD* above the mean. When anxiety was high, facilitation was observed—the average palindrome effect was 1.33: $t = 2.55$, $p = .014$. With mean anxiety, no effect emerged ($X = .08$, $t < 1$, *ns*). With low anxiety, however, inhibition was observed—the average palindrome effect was -1.166 : $t = -2.242$, $p = .03$. Strikingly, then, the anxiety effect reflects both significant facilitation and inhibition. That is, anxiety did not simply increase positive palindrome effects but, rather, produced either facilitation or inhibition, depending on level of anxiety.

For subliminal forward priming, the personality factors again predicted performance: multiple $R = .46$, $F(3, 46) = 4.02$, $p = .013$. Similar to the palindrome priming effect, anxiety was positively related to forward priming, $\beta = .29$, $t = 1.98$, $p = .054$. Additionally, the HOQ negatively predicted performance, $\beta = -.30$, $t = -2.17$, $p = .035$, which did not occur with palindrome priming. As above, we examined predicted performance at low, medium, and high levels of the predictors. When anxiety was high, a weak trend toward facilitation was observed—the average forward priming effect was .91: $t = 1.52$, $p < .14$. With mean anxiety, no effect emerged ($X = -.16$, $t < 1$, *ns*). With low anxiety, inhibition was observed—the average palindrome effect was -1.225 : $t = -2.054$, $p = .045$. Figure 1 depicts the relationship between anxiety and both forward and palindrome priming.

Again with regard to forward priming, when HOQ was high, inhibition was observed—the average forward priming effect was -1.33 : $t = -2.26$, $p = .029$. With mean HOQ, no effect emerged ($X = -.16$, $t < 1$, *ns*). With low HOQ, facilitation was observed—the average forward priming effect was 1.01: $t = 1.71$, $p = .094$. Figure 2 depicts the relationship between the HOQ and forward priming.

Taken together, these findings suggest a generally positive relationship between anxiety and subliminal priming—for both forward and palindrome priming—and a negative relationship between the HOQ and subliminal forward priming.⁵ Notably, these personality variables revealed subliminal priming effects that would not otherwise have been apparent. That is, without examining the influence of these variables no effects at all would have emerged in the subliminal condition.

In contrast to the subliminal condition, the personality variables did not predict either forward or backward priming under supraliminal conditions. For forward priming, the multiple regression with the three predictors was not significant [multiple $R = .30$, $F(3, 46) = 1.5$, $p = .227$]. For backward priming, the multiple R was again not significant [multiple $R = .25$, $F(3, 46)$

⁵These subliminal interaction effects, however, did not emerge in the small group of participants who recognized the palindromic nature of the stimuli upon debriefing when analyzed separately (i.e., the 8 so-called aware participants). This was true for both the forward and the palindrome interaction effects.

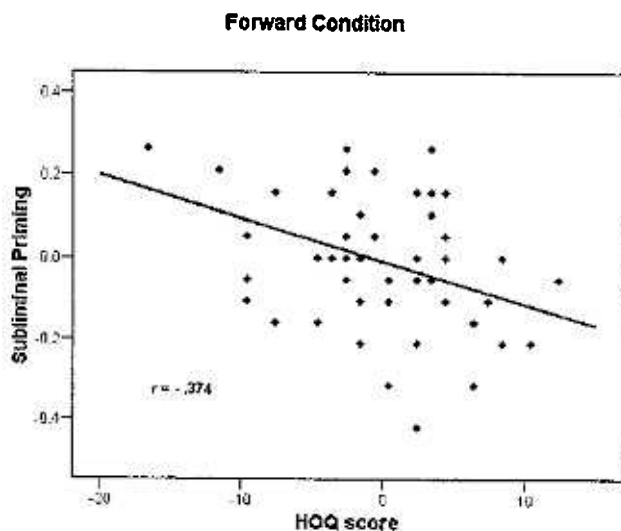


Figure 2. Subliminal priming for forward priming (measured as the difference between experimental and control hit rates) as a function of the HOQ score (Hysteroid–Obsessoid Questionnaire; centered values).

= 1.01, $p = .396$]. Strikingly, then, the personality variables predicted subliminal, but not supraliminal, priming.

Moderating Influences of Stimulus Detectability

As indicated previously, overall detection performance did not exceed chance ($d' = -.067$), suggesting that conscious perception was not responsible for the putatively subliminal effects. According to Snodgrass's nonmonotonic model (Snodgrass, 2004), unconscious effects will frequently be negatively related to stimulus visibility, reflecting the tendency of conscious perception to override unconscious perceptual influences. When usable conscious perception becomes available (i.e. at d' exceeding the objective identification threshold), the correlation becomes positive. The negative relationship around the objective detection threshold is very powerful evidence against an alternative, skeptical account that weak conscious perception would be responsible for the subliminal effects. To test for these relationships, we added d' and its interactions with the relevant predictors to the subliminal regression analyses.

Extending the previous approach, obtaining three-way interactions means that the two-way interactions are not constant, but vary as a function of some third predictor (here, d'). Once again, the optimal analysis does not involve splitting participants into d' subgroups but, rather, examines the direction and significance of the two-way interactions evaluated at various

points of interest on d' (e.g., 1 SD above and below the d' mean).⁶

For subliminal palindrome priming, then, the predictors were anxiety, d' , and the interaction between anxiety and d' . We found that d' interacted with anxiety, moderating its relationship to palindrome priming, $\beta = -.618$, $t = -1.97$, $p = .055$. As above, we examined predicted performance at low, mean, and high levels of d' . As predicted, when d' was high, anxiety no longer predicted palindrome priming ($\beta = .022$, $t < 1$, *ns*). In contrast, with both mean d' and low d' , strong positive relationships were observed: $\beta = .293$, $t = 3.19$, $p = .003$; $\beta = .48$, $t = 3.64$, $p = .001$, respectively. In short, increased stimulus visibility eliminated rather than strengthened the relationship between anxiety and palindrome priming.

For subliminal forward priming, the predictors were anxiety, HOQ, d' , and the $d' \times$ Anxiety and $d' \times$ HOQ interactions. As before, d' interacted with anxiety: $\beta = -.748$, $t = -1.72$, $p = .092$. When d' was high, anxiety again did not predict forward priming ($\beta = -.172$, $t < 1$, *ns*). With mean d' , anxiety weakly predicted forward priming, $\beta = .155$, $t = 1.282$, $p = .207$; with low d' , anxiety significantly predicted forward priming, $\beta = .382$, $t = 2.415$, $p = .02$. No interaction was found between d' and the HOQ ($\beta = -.203$, $t < 1$, *ns*).

Overall, d' moderated the influence of anxiety on both forward and backward priming such that anxiety had its strongest influence with low, rather than high, levels of d' . Given that d' moderated the influence in the same way for both forward and backward priming, we collapsed these indices to most conveniently depict this interaction. Figure 3 illustrates the relationship of anxiety to overall subliminal priming at d' levels 1 SD below (low d') and 1 SD above (high d') the mean. Given that this finding occurred independently for both forward and backward priming, we feel confident that this is a genuine effect. Furthermore, although d' did not interact with the HOQ effect in this manner, it is important to note that a positive relationship did not emerge either. That is, the HOQ effect for forward priming did not become stronger with increased prime visibility, as skeptical accounts would predict.

⁶ Figure 3, which depicts the relationships between the personality predictors and the stimulus effect at different points on d' , may be initially confusing to those unaccustomed to subgroup analysis. Analogous to the previous analyses, the parts of the figure represent the two-way interactions estimated at different points on d' and retain all the data. Accordingly, each part possesses the full N ; the individual scores, however, change from part to part because they are adjusted differently depending on the value of d' at which the relevant two-way interactions are estimated.

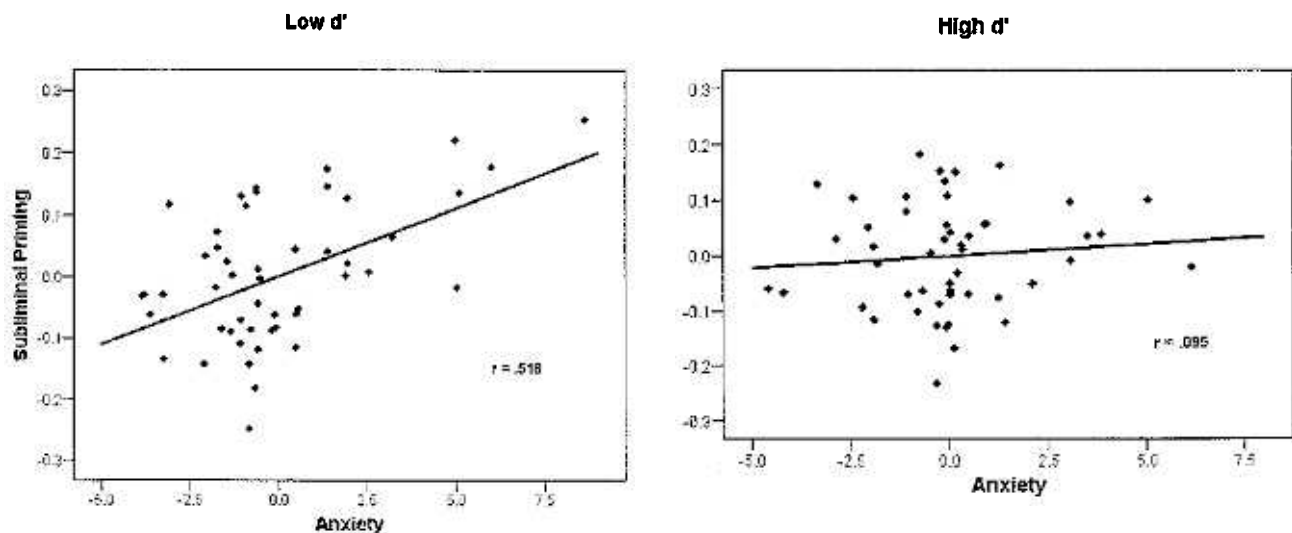


Figure 3. Subliminal priming (measured as the difference between experimental and control hit rates) as a function of anxiety (measured by the Taylor Manifest Anxiety Scale; centered values) at d' levels 1 SD below (low d') and 1 SD above (high d') the mean.

Discussion

Our main hypothesis that at the objective detection threshold (i.e., $d' \leq 0$) words would be processed as perceptual stimuli (i.e., in a bidirectional or reversible manner) was supported. To our knowledge the only theory that could readily predict this finding was proposed by Freud (1891) in his monograph *On Aphasia* and his later paper, "The Unconscious" (Freud, 1915). From a lexical standpoint, the word *presentation* had to be dissociated from customary word *meaning* arrived at by conventional left-to-right syntagmatic processing so that novel *reverse* syntagmatic processing could occur in which the new word subsequently activated its own semantic network. Our study also confirmed a powerful standard forward priming effect in the supraliminal condition where words are processed unidirectionally and referenced to their particular semantic category. This finding confirms numerous other studies establishing classical semantic priming with supraliminal stimuli (for review see Neely, 1991).

The subliminal finding, on the other hand, did not initially emerge without taking individual-difference variables and stimulus detectability into account. As we suspected, personality measures, especially self-reported states of anxiety, predicted the perceptual treatment of words presented subliminally. The level of anxiety predicted both the forward and the palindrome priming significantly, with high anxiety activating the semantic associations and low anxiety inhibiting these associations. This anxiety finding is of special

interest because it suggests a link exists between an emotional condition and lexical processing. In other research, Brakel and colleagues (Brakel & Shevrin, 2005; Brakel, Shevrin, & Villa, 2002) have found that anxiety predicts that adults will use a developmentally earlier form of categorization (attributional as opposed to relational). To our knowledge, no cognitive theory would predict this relationship.

On the HOQ, which is a measure of degree of repressiveness, we found a negative correlation with *forward* subliminal priming only. The more repressive an individual was, the less of a subliminal forward priming effect he/she demonstrated. The fact that this pattern did not emerge for palindrome subliminal priming or that our other measure of personality, the Marlowe-Crowne Social Desirability Scale, did not predict forward or palindrome priming is unclear. Certainly, this suggests that forward priming and palindrome priming function independently and may be subject to autonomous mechanisms. This supposition also gains strength in light of the fact that forward and palindrome priming were entirely uncorrelated in our study.

The personality findings taken together strongly suggest that such personality factors as anxiety and repressiveness play important roles in how subliminal stimuli are processed and also suggest that defensive processes are at work at the objective detection threshold (i.e., $d' \leq 0$). This interpretation is also supported by other research from our laboratory (Shevrin et al., 1992; Snodgrass & Shevrin, 1997).

With respect to stimulus detectability, the overall

nonsignificant d' indicates that our experiment was administered at the objective detection threshold, a stringent measure of subliminality (Snodgrass, Bernat, & Shevrin, 2004). Moreover, we found further supporting evidence for a nonmonotonic relationship between d' and subliminal processing. Detectability (indexed by d') acted as a significant moderating variable in the correlation between priming effect and anxiety. This finding has substantive theoretical importance and provides additional support for Snodgrass, Bernat, and Shevrin's (2004) theoretical supposition that even the smallest amount of conscious perception at the objective detection threshold will diminish subliminal effects. Indeed, in the current data set, when d' approached or fell below zero (i.e., when less conscious perception was available), anxiety had its strongest influence on both forward and palindrome priming. These findings are counterintuitive as applied to fully conscious perception models or apparently subliminal studies conducted under conditions that exceed the objective identification threshold (i.e., subjective detection threshold). In both of these conditions, *positive* correlations are found between the amount in consciousness and the experimental effects (for review, see Snodgrass, Bernat, & Shevrin, 2004). This difference between conscious and unconscious processing constitutes an important qualitative difference in need of further explanation and is contrary to the view that suggests that unconscious findings are attributable to weakly perceptible conscious information. Our findings support the psychoanalytic contention that defenses operate unconsciously and have their greatest effects on unconscious processes prior to any consciousness; in fact, to the degree that consciousness is present, defensive operations such as inhibition are less likely to be at work.

We next turn to a fuller discussion of the implications of our findings for the understanding of unconscious lexical processing. We believe that our findings, while empirically validating Freud's notions for the use of words as perceptual stimuli in the unconscious, are also consistent with contemporary cognitive models of language comprehension and production. In order for a word to be treated as a perceptual entity, its perceptual qualities (i.e., its graphemic and phonemic form) would need to be processed separately from its semantic meaning. There is much empirical evidence for this type of lexical modularity in language processing, which assumes that words are locally represented as word-specific units that are orthographic and/or phonological in nature (e.g. Levelt, Roelofs, & Meyer, 1999; Rastle & Coltheart, 1999). In addition, recent psycholinguistic research suggests that "whole-word

shape" might play a role in visual word recognition (Grainger & Whitney, 2004; Perea & Rosa, 2002) and that when normal speech is artificially reversed, intelligibility of the message is preserved, as long as the length of the reversed speech segments does not exceed 100 msec (Saber & Perrott, 1999).

The current study also provides evidence that lexical modularity operates in a particular way in primary-process mental organization. With regard to unconscious language comprehension, words are not simply processed in a unidirectional manner as in secondary-process thinking, but can be processed bidirectionally, as demonstrated by semantic priming using palindromic stimuli. This primary-process novel sequencing of the structural aspects of a word allows for multiple meanings to be activated. As such, the word can operate as a more ambiguous stimulus activating diverse, unrelated semantic possibilities that can serve a variety of motivational purposes, among them defensive needs. Brain imaging studies have identified the middle part of the fusiform gyrus as the locus of *visual word form recognition* (e.g., Cohen et al., 2000). Recent research suggests that this neurological substrate has been implicated in a number of cognitive tasks including reading, visual face recognition (Haxby, Hoffman, & Gobbini, 2000), and, more specifically, when experts process highly familiar objects relevant to their field (Gauthier, Skudlarski, Gore, & Anderson, 2000). Word reading, therefore, recruits the same neurophysiological substrate as would the expert visual scanning of objects, for which there is obviously no *a priori* given direction. This linkage provides supporting evidence that the bidirectional treatment of words as perceptual objects exists in both neurological and cognitive domains.

The results considered here also demonstrate that the processing of concrete perceptual features (i.e., orthographic representation) form the basis of primary-process cognition. We have already noted that the Shevrin (1973) research in concrete features of word presentations related to the subliminal pictorial rebus influenced the course of free associations. In the case of this experiment, the concrete features take the form of graphemic and phonological word presentations, while in the Brakel et al. research they take the form of specific attributes of geometric configurations (cf. Brakel, 2004; Brakel & Shevrin, 2005; Brakel, Shevrin, & Villa, 2002; Brakel et al., 2000). These three quite different studies provide evidence for three avenues by which primary-process effects can occur unconsciously: (1) through concrete lexical features activated by *objects* as in ordinary language, (2) through concrete lexical features activated by *other words* as in ordinary speech, and (3) through concrete nonverbal features

activated by *geometric figures* without linguistic mediation. Moreover, the Shevrin research is based on associative processes, whereas the other two studies also draw upon classification and categorization processes. Taken together, these three studies demonstrate that primary-process mentation applies to both verbal and nonverbal stimuli, and to mental processes as different as categorization and association, thus supporting the view that the primary process is a general principle of mental organization.

The evidence from the current study that a structurally ambiguous word can be processed for both of its semantic meanings has further implications for theories regarding language production and how these models apply to primary-process cognition. Interactive activation models of language make a distinction between selection (i.e., paradigmatic) and sequencing (i.e., syntagmatic) lexical decisions (Dell & O'Seaghdha, 1994). The demonstration that palindromic, reversible words can be processed for multiple meanings provides evidence that syntagmatic (i.e., creative/novel sequencing) decisions govern primary-process cognition. Furthermore, syntagmatic processing of the featural or attributional aspects of words in the unconscious then primes paradigmatic (i.e., conceptual, semantic) decisions. We suggest that this mechanism is responsible for the manner in which semantic categories are traversed and transformed to convey seemingly unintended meanings of the communicator as in speech errors. Secondary-process mentation, which is directed by conscious cognition, is less subject to this type of ambiguity produced by novel sequencing, as demonstrated by our supraliminal finding in which only forward priming dominated the preference judgment. Under conditions of subliminality and anxiety, novel syntagmatic lexical decisions were more operative. We might also speculate that novel sequencing could be especially active during periods of creativity. Appreciating the attributes of a stimulus and integrating them in a novel way is the very essence of creativity and is demonstrated, for instance, in poetry, where the prosodic and rhyming elements of words are used in a unique manner.

Finally, we believe that the current study begins to demonstrate how the use of novel sequencing of the perceptual features of words may contribute to speech observed in pathological or symptom-revealing states. Schizophrenic speech, for instance, is often neologistic and does not conform to organized and conventional linguistic rules (i.e., secondary process). Rather, psychotic discourse is quite concrete and illogical and likely to be based on the same novel syntagmatic processes found in our study. On a more speculative

basis, one could consider the possibility that in slips of the tongue, as well as in the curious use of language in dreams, the same novel syntagmatic processes play an important role. In an earlier dream study, Shevrin and Fisher (1967) demonstrated that word presentations and their associations, activated by a subliminal stimulus delivered in the pre-sleep waking state, are significantly more frequent after REM sleep—in which dream reports are often more bizarre—than after NREM sleep, while semantic associations to the same stimulus are more frequent after NREM dreams. These findings might account for the seemingly more primary-process character of REM dreams, and the more secondary-process character of NREM dreams.

Our findings are also of clinical importance in understanding how linguistic elements are used in free association during the regression so typically associated with transference reactions. Language for reworking and reintegrating unresolved issues in the midst of regression to the past is a powerful vehicle for insight. Indeed, Ella Sharpe (1937), in discussing the use of language for the purposes of self-expression, states that "words acquire a second meaning and convey abstract ideas, but they do not lose as far as the unconscious storehouse of our past is concerned the concrete significance the words possessed when we first heard and used them" (p. 28). Sharpe appears to be referring to the earliest experience of language before language assumes its semantic function. To the young infant, words are sounds embedded in the affective and nurturant interaction with the caretaker, and thus the sounds of words become carriers of emotion and relational significance long before their meanings are apprehended. Regressions to this level occur regularly in dreams and symptom formation as well as in the regression involved in free associations. We can follow the free-associative path to insight with greater clarity if we understand that the perceptual use of words draws upon this deeper, earlier level of emotional and relational significance, and we can thereby understand how ambiguity exploitation and resolution in language operates in primary-process thinking. This is especially important, we believe, given Freud's (1915) conceptualization that the "talking cure" operates, at least partially, by linking the "thing-presentation" with the "word-presentation"—a process that is intricately woven into making conscious what is deeply unconscious, thereby contributing to symptom resolution and character change.

Of course, a number of limitations of the current study must be considered. While we chose target and distractor words based on the frequency of usage, we did not take into account the affective valence of cho-

sen stimuli. This may be an important consideration given that we are positing that affect and motivation exert considerable influence on subliminal findings. Furthermore, we chose self-report measures to assess personality variables that might influence unconscious cognition. As has been well documented, there are a number of limitations with self-report measures, including that subjects may not be accurate in reporting their own affective states and characterological patterns, and, instead, the measure may assess response bias rather than the target trait (Paulhus, 1991). Certainly, a larger sample size and greater control of those variables that might influence variance (e.g., measured reading ability, IQ level, and ethnicity) should be considered in any future subliminal study of palindrome effects.

In summary, we believe that our findings support the conclusion that primary-process cognition as conceptualized by Freud is characterized by novel syntagmatic processing of feature/attributional aspects of words (i.e., orthographic, phonemic) and that these syntagmatic processes will prime paradigmatic decisions at the secondary-process level. Our findings further suggest that creative syntagmatic processing is more likely to occur unconsciously (i.e., again $d' \leq 0$) and under conditions of anxiety. From a psychoanalytic standpoint, anxiety is a signpost indicating that some conflict over unacceptable desires or wishes activated unconsciously has occurred. Future research will focus on further delineating the relationship between primary-process lexical decision making, motivation, anxiety, and detection as well as potentially identifying qualitative differences between the process of defensive inhibition and the mutual processes of cognitive inhibition and facilitation.

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