



# Neuroscience Meets Psychoanalysis

Suppression and dissociation, two psychoanalytic defense mechanisms, are now studied by modern neuroscience **BY HEATHER A. BERLIN AND CHRISTOF KOCH**

Nothing is so difficult as not deceiving oneself.

—Ludwig Wittgenstein

How much of what you consciously experience in your daily life is influenced by hidden unconscious processes? This mystery is one of the many that continue to confound our understanding of ourselves. We do not know how conscious impulses, desires or motives become unconscious or, conversely, how unconscious impulses, desires or motives suddenly become conscious.

Advances in technologies such as functional magnetic resonance imaging permit scientists to directly measure

brain activity. This ability has led to a revival and reconceptualization of key psychoanalytic concepts, based on the idea of inner forces outside our awareness that influence our behavior. According to psychodynamic theory, unconscious dynamic processes defensively remove anxiety-provoking thoughts and impulses from consciousness in response to our conflicting attitudes. The processes that keep unwanted thoughts from entering consciousness are known as defense mechanisms and include repression, suppression and dissociation.

Suppression is the voluntary form of repression proposed by Sigmund Freud in 1892. It is the conscious process of

pushing unwanted, anxiety-provoking thoughts, memories, emotions, fantasies and desires out of awareness. Suppression is more amenable to controlled experiments than is repression, the unconscious process of excluding painful memories, thoughts and impulses from consciousness.

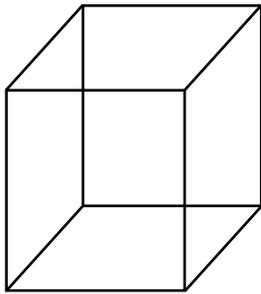
If you are grieving over the death of a loved one or the breakup of a relationship, you may consciously decide to suppress thinking about the situation to get on with your life. Or, in another example, you may have an impulse to tell your boss what you really think about him and his abysmal behavior, but you suppress this thought because you need the



Just a couch? Psychoanalysis concepts explored by Freud on this couch, now at the Sigmund Freud Museum in London, are being linked to brain mechanisms.

COURTESY OF HEATHER A. BERLIN (Berlin); FATMA KONUSKAN (Koch); AP PHOTO (Freud's couch)

People suppressing unwanted memories can be tracked in ways **only dreamed of** by Freud.



Do similar neural mechanisms underlie both visual perceptual suppression and psychoanalytic suppression? In these bistable figures, perception switches between the two perspectives of the Necker cube (far left), the silhouette of the vase and faces (middle), and the duck and rabbit (right).

job. In both cases, the desire is conscious but is thwarted by the exercise of willpower resulting from a rational decision to avoid the action. The impulse or drive may display itself in other ways, however: you may develop a nervous cough around your boss even though you are not sick. Or a suppressed sexual desire may resurface in a careless phrase or slip of the tongue. In general, “forgotten” thoughts, memories and urges can influence behaviors, conscious thoughts and feelings and can express themselves as symptoms or even as mental illness.

Although some claim that suppression is a psychoanalytical myth with no scientific support, fMRI data suggest otherwise. Psychologist Michael C. Anderson, now at St. Andrews University in Scotland, and his colleagues carried out what they call a “think/no-think” experiment to explore the brain basis of memory suppression. Two dozen volunteers had to memorize 48 word pairs (for example, ordeal-roach or steam-train). Subsequently, while lying in a scanner, subjects were shown the first cue word and had to either recall the second, associated word (called the respond condition) or prevent it from entering consciousness (suppress condition). Actively suppressing the matched word while lying in the scanner had the effect of reducing recall of the word afterward (as compared with the respond condition); this result is not just simple forgetting that occurs with the passage of time.

The imaging data that Anderson and

his colleagues collected showed that the volunteers suppressed the words by recruiting parts of the brain involved in “executive control,” namely, areas in the prefrontal cortex, to disengage processing in sectors of the brain important for memory formation and retrieval, in particular the hippocampus. This finding is noteworthy because earlier experiments showed that the amplitude of activity in the hippocampus is proportional to memory recall—the stronger the activity, the higher the likelihood of remembering. A second intriguing observation is that the brain is more active when avoiding recalling a memory than during recall itself. People suppress unwanted memories by exerting willful effort that can be tracked in the nervous system in ways only dreamed of by Freud—who was, after all, a neuroscientist by training.

### Evidence of Suppression

Linking suppression to widely accepted brain mechanisms involved in behavioral control moves this concept from the domain of the psychoanalyst’s couch [see *illustration on opposite page*] to the physical realm of the brain.

A different form of suppression, known as visual perceptual suppression, occurs when an object—or part of one—is not consciously seen even though the image is always clearly visible. A common example is the bistable figure, such as the drawing of the cube, the vase-face or the duck-rabbit in the triptych illus-

tration above. The eyes see the same lines and shapes on the page, but what you consciously see in your head changes from the duck to the rabbit and back again. When the image of the duck is being consciously seen in your mind’s eye, the image of the rabbit is “suppressed,” and vice versa.

Another example of visual suppression is binocular rivalry. Here two different images are simultaneously present, one in each eye. Say a photograph of a smiling girl is projected into your left eye and an image of a car is projected into your right eye. Rather than appearing as the girl superimposed on the car, the two pictures rival for conscious access, and one will suppress the other briefly. For a few seconds you will see the girl’s face; suddenly, patches of the car begin to shine through until the face is entirely gone, and you’ll see only the car. Subsequently, the smiling eyes will break through the automobile, and it will disappear to be replaced by the girl’s face, and so on in a never-ending pas de deux.

So although the physical input to the eyes always remains the same, your conscious perception of it changes from one moment to the next and back again. Bistable percepts are ideal for tracking the footprints of consciousness in the human brain using functional brain imaging [see “Rendering the Visible Invisible” [Consciousness Redux], by Christof Koch; *SCIENTIFIC AMERICAN MIND*, October/November 2008].

## (consciousness redux)

Provided the eyes don't move or blink, this ceaseless dance is under only very limited voluntary control. Thus, from the point of view of psychoanalysis, it would be more proper to call this perceptual *repression* rather than perceptual *suppression*. Whether the neural mechanisms underlying visual perceptual suppression and repression are related to those underlying psychodynamic suppression or repression remains to be determined.

### Emotions Apart

Dissociation is another controversial psychological state in which thoughts,

identity states. These states are characterized by different emotional responses, thoughts, moods and perceived self-images that recurrently and alternately take control of a patient's behavior and consciousness. DID is considered to be a result of identity fragmentation rather than proliferation of separate personalities. So patients do not have more than one personality (a proliferation of selves), but rather they have less than one (a fragmented self).

Dissociative identity disorder is often associated with severe and prolonged childhood trauma (such as neglect or emotional or sexual abuse) and develops

tion prevails long after the traumatic experiences have ended.

Neurobiological studies of DID support the validity of the clinical diagnosis and suggest that one brain can generate two or more distinct states of self-awareness, each with its own unique pattern of seeing, thinking, behaving and remembering. Physiological markers such as changes in electrical skin conductance (related to sweating), heartbeat, response to medication, allergic reactions and endocrine function behave differently depending on which state the patient is in. For example, Simone Reinders and her colleagues at the University

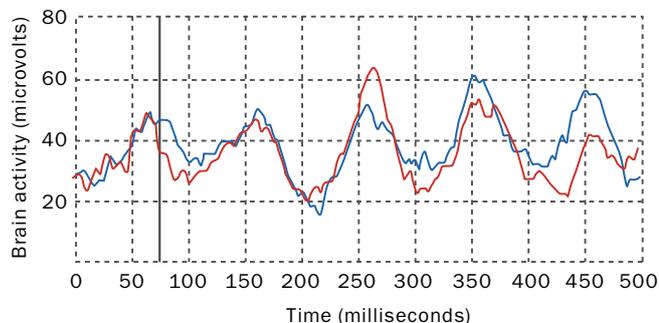
## ( Empirical tests of dynamic unconscious processes will inevitably revise the original "talking cure." )

emotions, sensations or memories are separated from the rest of the psyche. Originally championed by French psychiatrist Pierre Janet, dissociation can occur in healthy individuals such as when you blank out for a mile or two while driving along a freeway, become completely absorbed by a book or movie, or find yourself walking into a room in your house only to forget why you ventured there in the first place.

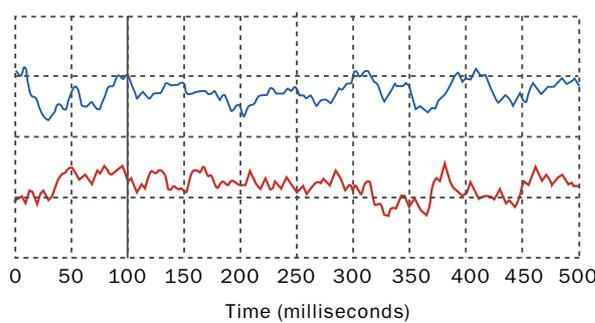
More extreme forms of dissociation manifest themselves in mental diseases such as dissociative identity disorder (DID)—formerly known as multiple personality disorder—which involves the presence of two or more distinct

as a way to cope with an overwhelming situation that is too painful or violent to assimilate into one's conscious self. The person literally "goes away" in his or her head to flee from the anxiety-producing experience from which there is no physical escape. This dissociative process allows traumatic feelings and memories to be psychologically separated off so that the person can function as if the trauma had not occurred. While in one mental state, the patient has access to traumatic autobiographical memories, say of a rape, and intense emotional responses to them. But when in her other state, she claims not to recall anything related to her rape. This defensive use of dissocia-

of Groningen in the Netherlands recorded subjective reactions (emotional, such as fear, and sensorimotor, such as restlessness), cardiovascular responses (heart rate, blood pressure and heart rate variability) and cerebral activation patterns in 11 DID patients. While the patients were first in one mental state and then the other, they were read a story from their life that pertained either to their trauma or to a nontraumatic autobiographical event. When in their neutral mental state, patients reacted to the story of their traumatic experience as if it were a neutral memory and claimed not to recall it; when in their traumatic personality state, they had a significant

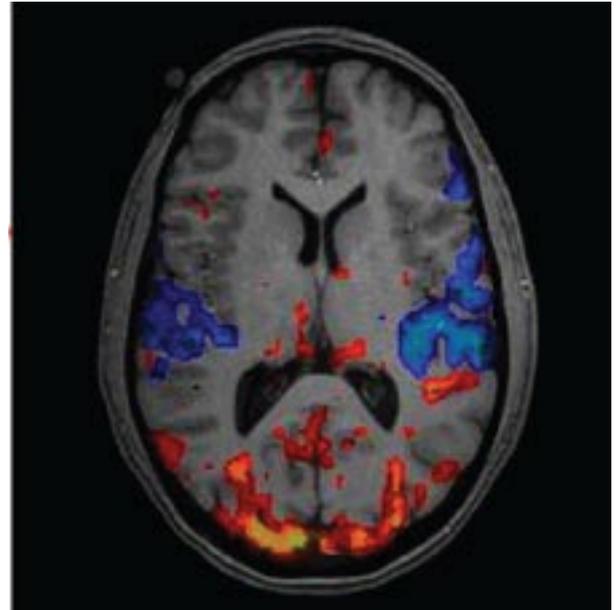
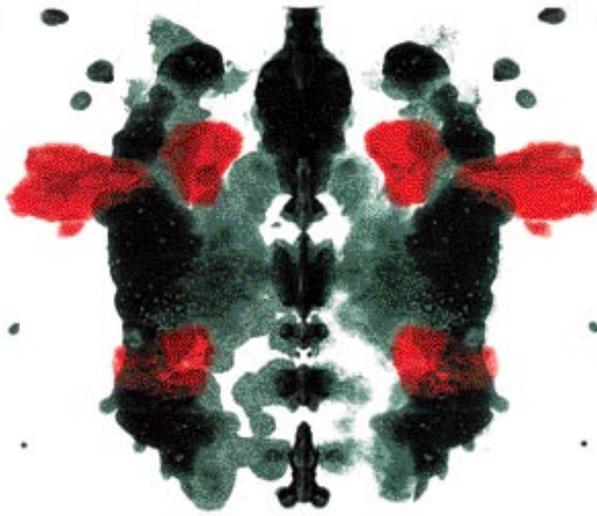


Electroencephalographic recording from a woman with dissociative identity (formerly multiple personality) disorder. She had normal brain activity when looking at a checkerboard pattern that alternated



its squares 10 times a second in her sighted state (left). But when in her blind state (right), activity was almost absent, suggesting that two different identities can indeed exist in the same skull.

SOURCE: "BLIND UND SEHEND IN EINER PERSON. SCHLUSSFOLGERUNGEN ZUR PSYCHONEUROBIOLOGIE DES SEHENS" BY B. WALDVOGEL, A. ULLRICH AND H. STRASBURGER IN NERVENARZT, VOL. 78, NO. 11; 2007



Could more than a superficial resemblance link these icons of psychoanalysis (*inkblot*, left) and modern neuroscience (*fMRI scan*, right)?

STEFAN KLEIN / iStockphoto (inkblot); OXFORD CENTRE FOR FUNCTIONAL MAGNETIC RESONANCE IMAGING OF THE BRAIN (brain scan)

subjective and cardiovascular reaction to the traumatic memory and a different cerebral activation pattern, and they remembered the event. It appears that different identities can truly live inside the same skull.

### To See or Not to See

Sometimes the difference between the personalities can be as stark as night and day. Psychoanalysts Bruno Waldvogel and Axel Ullrich and psychologist Hans Strasburger, all in Munich, Germany, reported a dissociated patient who gradually regained sight during psychotherapy—after 15 years of diagnosed blindness. There was nothing wrong with the patient’s eyes per se, but she claimed she couldn’t see, and testing at the ophthalmologist bore this out. During the experiment reported here, one personality state had essentially normal eyesight, whereas a younger, male personality—which could be summoned momentarily by calling out his name—was blind. This phenomenon could be construed as hysterical ranting were it not for the electrical activity recorded by electroencephalographic scalp electrodes. When in her sighted personality, the EEG showed normal brain waves in response to a checkerboard pattern that alternated its squares 10 times each sec-

ond—from white to black and back again. But visually evoked activity was much reduced in her blind personality state [see illustration on opposite page]. There is no known mechanism that allows someone to consciously block vision with open eyes. This remarkable finding implies that the brain can rapidly intervene at a very early stage of the visual system, preventing visual information from reaching the patient’s cortex. How it does so remains a mystery.

What may be altered in dissociative disorders is not so much the degree of activity of a particular brain area but the degree of interactivity between areas. Functional integration of cortical and subcortical regions is necessary for cohesive conscious experience. The way the brain is connected and the way different parts of the brain communicate with one another are important. Dissociation may be the result of a disruption of certain connections among brain regions. Hence, dissociative disorders may result from the failure of coordination or

integration of the distributed neural circuitry that represents subjective self-awareness.

New advances in neuroscience and technology are revealing the neurobiology of the dynamic unconscious that Freud, Janet and others envisioned. In the process, inevitably, much of what was originally put forth based solely on the “talking cure” will be revised, refined and enhanced. Devising novel ways to empirically test dynamic unconscious processes such as repression, suppression and dissociation will reveal their neural bases. This effort will ultimately lead to more effective treatment options for psychiatric patients and help us to better understand our own consciousness. **M**

HEATHER A. BERLIN is assistant professor of psychiatry at Mount Sinai School of Medicine. CHRISTOF KOCH is Lois and Victor Troendle Professor of Cognitive and Behavioral Biology at the California Institute of Technology.

### (Further Reading)

- ◆ **Neural Systems Underlying the Suppression of Unwanted Memories.** Michael C. Anderson et al. in *Science*, Vol. 303, pages 232–235; January 9, 2004.
- ◆ **Psychobiological Characteristics of Dissociative Identity Disorder: A Symptom Provocation Study.** A.A.T. Simone Reinders et al. in *Biological Psychiatry*, Vol. 60, No. 7, pages 730–740; October 1, 2006.