Subliminal Perception

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Glossary

Backward mask A stimulus, usually a meaningless letter string or image, presented immediately following a critical stimulus to eliminate its afterimage.

Dissociative paradigm A research methodology used in subliminal perception research that seeks to find a dissociation between measures of conscious and unconscious responses to stimuli. Participants will be unable to consciously recognize the stimuli that are presented to them, but will be unconsciously influenced by them.

Limen Threshold.

Mere exposure effect The tendency for repeated exposures of a stimulus to enhance a person's attitude to that stimulus.

Objective measure of awareness Measures of conscious awareness that rely on an individual's ability to discriminate between stimuli that were presented versus not presented.

Semantic priming The presentation of a particular stimulus (a 'prime') intended to facilitate responses to a subsequent, semantically related stimulus. For example, being exposed to the word 'bread' will make an individual faster to recognize the word 'butter.'

Subjective measure of awareness Measures of conscious awareness that rely on an individual's self-reports of their perceptual experiences or conscious processing.

Subliminal Below the threshold of consciousness.

Supraliminal Above the threshold of consciousness.

Tachistoscope A device used to present stimuli for short, but very precise, durations.

One of the most long-standing controversies in psychology concerns the existence of subliminal perception: whether it is possible to perceive something even when we do not have the subjective experience of perceiving it. Though the study of subliminal perception began in the 1800s, scientific attitudes toward it have vacillated between acceptance and denial. Additionally, the broader public, including the media and government officials, have been concerned about the possibility of individuals being influenced and manipulated without their conscious awareness.

The study of subliminal perception has intrigued scientists mainly for the insight it provides into consciousness. First, research on subliminal perception provides a way of testing whether conscious and unconscious processes are fundamentally different from one another. Does a particular stimulus, when presented subliminally, have different effects than when it is presented so that people are consciously aware of it (i.e., supraliminally)? Second, this research allows scientists to investigate the nature and function of consciousness, such as whether consciousness is necessary for some process or effect. Finally, presenting stimuli subliminally allows scientists to rule out demand or other active strategies on the part of experimental subjects as alternative explanations for their effects.

Definition

One of the primary controversies regarding subliminal perception has been how to define it. The word itself was introduced by Johann Herbart and comes from the Latin word limen, meaning threshold. Thus, subliminal perception, strictly speaking, is perception below the threshold of consciousness. What is meant by the terms 'threshold' and 'consciousness' have been enduring matters of debate.

Methodology

Subliminal presentation of stimuli hinges on presenting the stimuli in such a way that the stimulus is registered by the appropriate sensory system and activates its corresponding representation, but the activation is minimal enough that the stimulus does not reach conscious awareness. The amount of internal activation of the representation is a result of the duration of the stimulus and of its intensity.

The vast majority of research on subliminal perception has focused on visual stimuli. Initial research manipulated intensity by using very weak stimuli: stimuli that were too far away, too faint, etc., to be consciously perceived. As technology advanced, with the arrival of first the tachistoscope and later computers, research shifted to involve very briefly presented stimuli.

For how long should a stimulus be presented to be subliminal? Unfortunately, even after stimulus characteristics are taken into account, there is no absolute threshold that can be universally recommended: thresholds for a given stimulus vary both intra- and interpersonally. One method of handling such variability is to set thresholds uniquely for each individual. In such a threshold-setting task, researchers typically present subjects with stimuli for different durations. After each presentation, subjects indicate whether they saw anything or not. (While subjects may be able to report seeing 'something,' they generally cannot report exactly what they saw.) With such tasks, care must be taken in selecting the durations for which stimuli are presented and the order in which these durations are used. For example, if stimuli are presented at consistently shorter durations, as in a standard simple staircase procedure, subjects are likely to predict the duration of the next stimulus. An alternative method is to use a fixed duration brief enough to be subliminal for most subjects, using an awareness check on these same subjects to ensure the stimuli were indeed subliminal.

The appropriate duration for a given stimulus, in addition to being determined by characteristics of the stimulus and the subject, will also depend on whether the stimulus is presented foveally or parafoveally, and whether it is masked. Foveal presentation involves presenting stimuli in the center of a person's visual field, or at foveation, whereas parafoveal presentation involves presenting stimuli on the periphery or fringe of the field. The foveal visual field extends from 0 to 2 degrees of visual angle from the focal point of attention, with the parafoveal visual field extending beyond this, from about 2 to 6 degrees of visual angle.

To fix subjects' eye gaze, researchers usually begin by presenting a fixation point, followed by the stimulus. For foveal presentation, the stimulus is presented at the same location as the fixation point. For parafoveal presentation, researchers need to determine the parafoveal area of the screen, so the stimulus can be presented within that area. Calculating this area involves taking into account the distance between a subject's eyes and the screen: the farther away the subject is from the screen, the greater the area on the screen that falls within the foveal region.

Parafoveally presented stimuli may be presented for longer periods of time while remaining subliminal than foveally presented stimuli. However, it is important to ensure that the subject's visual focus is on the desired fixation point; otherwise, a parafoveally presented stimulus can become a foveally presented stimulus. Thus, researchers often vary the delay between presentation of the fixation point and presentation of the stimulus, as well as the location in which stimuli are presented, to prevent subjects from anticipating the stimulus and shifting their attention accordingly.

Brief presentation of a stimulus is usually not enough to guarantee subliminality because a visual stimulus tends to persist in the visual iconic memory store for a time after it has physically disappeared. This persistence is akin to the afterimage that is seen after viewing a bolt of lightning. Researchers use the technique of backward masking to erase or overwrite this afterimage: they present a pattern mask, typically a random letter string or other meaningless stimulus with the same structural characteristics as the critical stimulus (e.g., a random letter string for a word stimulus, a scrambled set of facial features for a face stimulus), immediately after the critical stimulus.

Subliminal presentation is often embedded in a particular task requiring some sort of response to keep subjects alert and engaged, as opposed to passive viewing. Additionally, the use of such a task ensures that the subjects' attention stays fixated on a particular location. A routinely used task for parafoveal presentation is a vigilance task wherein subjects must indicate which side of the screen the 'flash' (the subliminal prime–mask presentation) occurs. The onset of these flashes (i.e., the time between trials) is also varied to further maintain attention.

Historical Background

Early research on subliminal perception took a psychophysical approach, searching for thresholds of sensory experience. Peirce and Jastrow, in the late 1800s, were probably the first to empirically demonstrate subliminal perception. In their study (which was also the first properly randomized experiment), subjects (actually Peirce and Jastrow themselves) were asked to distinguish between two objects of similar weight or between two similar pressures, to indicate which of the two was heavier or greater, respectively. In addition to making forced-choice discriminations, they also rated their confidence in their judgments on a 0–3 scale, where '0 denoted absence of any preference for one answer over its opposite, so that it seemed nonsensical to answer at all.' Peirce and Jastrow found that even when subjects reported 0 confidence, they could still accurately discriminate between the two alternatives at well above chance levels.

A few years later, Sidis presented subjects with cards one at a time, each containing a single printed letter or digit. The subjects were so far away from the cards that they often reported seeing only a dim, blurred spot, or even nothing at all. However, the subjects performed better than chance not only at reporting whether the card contained a letter versus a digit, but also at guessing its precise identity. Stroh and colleagues found similar results with auditory stimuli: subjects were able to identify whispered letter names at better than chance levels under conditions where they reported not hearing any sound.

In these studies subliminal perception was demonstrated via a dissociation between two measures of conscious awareness: a subjective measure that used self reports, and an objective measure that used a measure of discriminative abilities. According to a subjective measure (e.g., asking whether subjects were aware of the primes), subjects did not appear to have been consciously aware of the stimuli. According to an objective measure (e.g., forcing subjects to guess which of two stimuli was presented), subjects appeared to have perceived the stimuli. This dissociation between subjective and objective measures was taken as evidence of subliminal perception.

A few other studies in this domain were published in the first half of the twentieth century. However, what was more notable was the outbreak of claims of subliminal influences on behavior in the mid-1950s, particularly by advertisers. In September 1957, James M. Vicary and Francis Thayer announced that they had presented messages such as 'Eat popcorn' and 'Drink Coca-Cola' for 1/3000 of a second during movie screenings in Fort Lee, New Jersey. They claimed that these subliminal presentations had increased popcorn sales 58% and cola sales 18%.

An outcry in the popular press followed, and both the US Congress and the Federal Communications Commission debated the legal and ethical implications of subliminal advertising. The practice of subliminal advertising was subsequently banned in the United Kingdom and Australia, and by American networks and the National Association of Broadcasters in 1958. However, Vicary's attempts to duplicate his claims under controlled conditions were unsuccessful, and in 1962 he admitted to lying about the experiment and falsifying the results. Nonetheless, the public seemed more convinced than ever of the possibility of subliminal perception and persuasion.

Meanwhile, the scientific community was meeting such claims as Vicary's with skepticism. In his 1960 critique of the scientific literature on subliminal perception, Eriksen argued against the use of subjective measures as valid measures of awareness. He stated that subjective measures were insufficient because they might not, or did not, represent an exhaustive measure of all relevant conscious experiences. Instead,

subjective reports might reflect subjects' response biases: subjects might partially or even fully perceive the stimulus, yet claim they had not seen it for various reasons. For example, a statement that a subject did not 'see' a stimulus may reflect the subject's preconceived ideas about the value of a particular conscious experience for making decisions, rather than a true absence of relevant conscious experiences. Thus, Eriksen argued that such subjective reports should be replaced by an objective measure, namely forced-choice discrimination. By this standard, a stimulus would be said to be subliminal only if subjects forced to choose which of two (or more) stimuli that were previously presented performed better than chance.

This represented a major shift in both theory and methodology for researchers working on subliminal perception. Previously, correct forced-choice performance had been assumed to reflect the perception of stimuli in the *absence* of conscious awareness. Now, according to Eriksen, correct forced-choice performance was assumed to reflect the *presence* of conscious awareness. This meant that researchers were now left with the problem of finding new indirect measures of subliminal perception.

Marcel was the first researcher to report the results of experiments showing evidence for subliminal perception while using an objective measure of awareness. In the 1970s and 1980s, he provided two types of experimental evidence for subliminal semantic processing. First, subjects who could not detect the presence or absence of a masked word were nonetheless semantically influenced by that word in their later responses. For example, subjects subliminally presented with the word 'salt' who were then asked to choose between 'pepper' and 'lotus,' chose 'pepper' more often. Second, he provided evidence for semantic priming with subliminal primes. In this paradigm, a prime word is first presented subliminally, and then a target word (to which subjects must respond) is presented supraliminally. Marcel found that target words were responded to more quickly when they were preceded by a semantically related prime word than by an unrelated prime word, even though the primes were presented subliminally. Such research was considered particularly surprising because it demonstrated higher-level processing of subliminal stimuli. Subsequently, other researchers replicated these effects not only with words but also with pictures.

However, as the supporting evidence accumulated, so did the skepticism and criticism. In 1986, Holender published a detailed review of masked priming, concluding that the findings were problematic in a variety of ways, including lack of reliability and poor assessment of whether stimuli were actually presented subliminally. Again, the identification of serious methodological flaws caused great doubt as to the existence of subliminal processing.

These cycles of new evidence, followed by skepticism, particularly skepticism as to the subliminality of stimuli, continue to be a recurring theme in the literature on subliminal perception. By now, the mere existence of subliminal perception has been firmly established. What continues to be controversial to this day is how deeply subliminally presented stimuli are processed, and, as a consequence, how much they can affect people's attitudes, judgments, and behavior. The evidence for simpler forms of subliminal processing is considered to be strong. For example, there is much evidence that subliminal stimuli are processed orthographically (i.e., in terms of letter identities and positions). But researchers disagree as to the extent that higher-level subliminal processing, such as semantic processing, occurs.

Neurological Evidence for Subliminal Perception

What is the chronology of subliminal perception? Where does a stimulus go, if it is perceived without reaching consciousness? Some insight can be gained from naturally occurring forms of subliminal perception. Area V1, the primary visual cortex, plays a central role in visual perception, detecting the basic elements of a visual stimulus (e.g., orientation). Nearly all signals from the retina pass through this area before proceeding to the other areas specialized for different aspects of visual processing. Patients with partial or total damage to V1 have a loss of vision in part or all of the visual field. However, some of them can still make accurate judgments and discriminations about visual stimuli presented to the 'blind' area. This condition, the ability to respond appropriately to visual stimuli in the absence of conscious visual experience, is known as blindsight. Blindsight represents an organic form of subliminal perception. The most thoroughly studied blindsight patient is DB, whose right occipital cortex, including most of V1, was removed surgically. DB reported no conscious visual experience in an area of the lower left quadrant of the visual field. However, he could detect whether or not a visual stimulus had been presented to this area and could also identify its location, though he insisted he was just 'guessing.'

One issue in the study of blindsight, as with the study of subliminal perception in general, is determining whether patients truly have no conscious visual experience in their 'blind' area. Studies that require patients to report on stimuli in the 'blind' area are subject to the same critiques as subliminal perception research that uses subjective criteria. Rafal and colleagues sidestepped this problem by running a study that did not require patients to report on characteristics of the 'unseen' stimulus. They found that blindsight patients were slower to respond to a light presented to the intact part of the visual field when another light was simultaneously presented to the blind area – even though they could not consciously detect the latter light. Thus, a light not producing any conscious awareness nevertheless interfered with visual performance on another task.

Blindsight is not a homogenous phenomenon; patients vary greatly in their preserved visual abilities and subjective experience. The precise brain mechanisms involved in blindsight remain unclear and probably vary from patient to patient as well. Possibilities include subcortical mechanisms, residual functioning within V1, and the cortical visual system.

In contrast to research on blindsight, which focuses on stimuli that cannot activate a particular brain region (because that region is lesioned), research on subliminal perception has mostly explored which brain regions are actually activated by subliminal stimuli. Such activation has been used to determine both what types of processing are possible with subliminal stimuli, and whether the effects of subliminal stimuli are driven by different patterns of brain activation than those of supraliminal stimuli. In 1998, Dehaene and colleagues were the first to show that subliminal stimuli can cause detectable neural activity

not just in brain areas involved in sensory processing, but also in areas associated with motor programming of responses. Subjects classified numbers between 1 and 9 as smaller or larger than 5. These target numbers were preceded by subliminal number primes that were also smaller or larger than 5. Subjects were faster when both the prime and the target belonged to the same category (e.g., prime 1, target 4) than when they belonged to opposite categories (e.g., prime 1, target 6), indicating that they had processed the subliminal prime on a semantic level. The researchers also recorded event-related potentials (ERPs) during the task and found evidence of prime-induced covert motor activation (measured via differences in lateralized readiness potentials (LRPs)): participants unconsciously prepared the motor response appropriate to the subliminal prime. Moreover, the temporal resolution of ERPs enabled the researchers to determine that the subliminal prime itself induced this preparation. These results were replicated by other researchers using arrows as stimuli, and were also demonstrated using functional magnetic resonance imaging (fMRI) to measure motor cortex activation.

Other researchers have utilized neurological techniques to look for evidence of semantic processing of subliminal stimuli, using ERPs to compare semantic priming effects for subliminal versus supraliminal primes. With supraliminal primes, semantic priming produces an attenuation of the N400, an ERP component thought to index semantic processing. The evidence for subliminal primes producing similar modulation is mixed, with some more recent experiments showing an effect.

More consistent results have been found with subliminal repetition priming and fMRI. In repetition priming, visual recognition of a target word is facilitated when it is preceded by the same word, and as a result, neural activity is decreased in certain word-processing areas of the brain (contended to reflect tuning of cortical representations). Researchers have found evidence for such repetition priming even when the prime word is presented subliminally. Subliminal repetition priming has also been found when the prime and target are orthographically different, such as when they are written in the two different Japanese writing systems of Kanji and Kana, and when the prime and target are only semantically related (as opposed to being the exact same word). In such research, neuronal activity was found to be decreased in the left middle temporal gyrus, a region thought to be involved in semantic processing of words and objects.

fMRI has also been used to demonstrate emotional processing of subliminally presented faces. In these experiments, subjects saw subliminally presented fearful or fear-associated faces followed by a clearly visible neutral face that also served as a backward mask. Two studies found that the processing of these emotional faces was associated with increased activity in the amygdala, a brain structure integral to the processing of emotional stimuli, relative to neutral stimuli. Since then, these studies have been replicated with faces as well as other types of stimuli, including words.

Downstream Effects of Subliminal Perception: Attitudes and Judgments

Initially proposed by Zajonc in 1968, the mere exposure effect posits greater liking of a stimulus as a result of greater exposure to the stimulus. Experiments have demonstrated that the mere exposure effect is highly reliable and, furthermore, that it does not depend on conscious awareness of the exposure. In fact, subliminal mere exposure effects seem to be stronger than typical mere exposure effects. In one experiment by Kunst-Wilson and Zajonc, subjects were first subliminally exposed to several irregular polygons, five times each. Later, they were given pairs of polygons, one that had been subliminally presented and one that had not been previously presented at all. Subjects were asked to make two judgments: which one had been presented previously, and which one they liked better. Although subjects were no better than chance at determining which polygon had been presented previously, they showed an increased liking for the previously presented polygons.

Other research has shown mere exposure effects with subliminal faces. In an experiment by Bornstein and colleagues, subjects were subliminally exposed to a photograph of one of two males. In a later phase of the experiment, both men pretended to be research subjects and engaged in a task with the actual subject. When the two men disagreed during this task, the subject sided more often with the man whose photo had been subliminally presented in the first part of the experiment, and also reported liking that individual more.

A more complicated method of altering individuals' attitudes toward stimuli is evaluative conditioning, a way to transfer valence from one stimulus to another. In this method, a target stimulus is repeatedly paired with a negatively or positively valenced stimulus, and the target eventually acquires the same negative or positive valence. Evaluative conditioning has been demonstrated even when the negatively or positively valenced stimuli are presented subliminally. For example, in experiments conducted by Murphy and Zajonc, subjects were shown a series of clearly visible, unfamiliar Chinese ideographs. Immediately after seeing an ideograph, they rated how much they liked it. For half of the subjects, each ideograph was preceded by either a subliminally presented smiling face, or a subliminally presented scowling face. For the other half of the subjects, each ideograph was preceded by either a smiling or a scowling face that was presented supraliminally (for 1 s). When the faces were presented subliminally, subjects liked ideographs that had been paired with smiling faces more than ideographs that had been paired with scowling faces. This effect vanished when the faces were presented supraliminally.

Subliminally presented stimuli can also affect judgments about both others and the self. In an experiment by Bargh and Pietromonaco, subjects engaged in an unrelated task in which words were presented subliminally. Either 0%, 20%, or 80% of the words were related to the trait of hostility. Afterwards, subjects read a paragraph about a fictitious person ('Donald') who behaved in an ambiguously hostile way. The impression subjects formed of Donald was influenced by their subliminal exposure to the words: the more hostile words subliminally presented earlier, the more negative the impression of Donald became. Similar results have been found in later experiments with other traits such as kindness, and with subliminally activated social stereotypes, including stereotypes activated by subliminal presentation of photographs. In an experiment by Baldwin and colleagues, Catholic undergraduate women rated themselves more negatively on a series of traits after subliminal exposure to a photograph of the pope, but only if they were relatively religious.

Another question that has emerged from research on subliminal priming is whether the processes set in motion by subliminal priming are equivalent to those involved when a concept is activated consciously. To investigate this matter, McCulloch and colleagues subliminally primed one group of subjects with words related to forming an impression of a person (e.g., judge), and gave another group conscious directions to form an impression (e.g., think about what kind of person this is). All subjects then read a series of behavioral sentences, and later were given a surprise cued recall task. Those in the subliminal priming group had recall of behaviors equivalent to those in the conscious impression formation condition. Thus, in this case, subliminal presentation of words relating to impression formation presumably activated similar cognitive operations as conscious instructions to form an impression.

Downstream Effects of Subliminal Perception: Behavior

Though evidence of subliminal stimuli affecting judgments and attitudes is intriguing, it does not necessarily follow that such stimuli will also affect individuals' overt behavior. Indeed, a lengthy literature in social psychology has demonstrated far less correspondence between, for example, attitudes and behaviors than might be expected. Effects of subliminal stimuli on behavior are also more controversial, as the issue of subliminal advertising and persuasion fall under this heading.

In the past 20 years, social psychologists have repeatedly demonstrated that the same subliminal stimuli that can affect judgments and attitudes can also affect overt behavior. Bargh proposed that stimuli, including subliminal stimuli, can influence behavior directly, via a perception-behavior link that bypasses conscious thought. In one experiment, Bargh and colleagues asked subjects to complete a long, boring task on a computer. During the task, subjects were subliminally exposed to photographs of either Black or White faces. (Previous research had shown that exposure to Black names or faces activated the concept of hostility, part of the Black stereotype.) Then, after many trials, an error message appeared, and the experimenter informed subjects they would have to start the task again from the beginning. Subjects' reactions to this news were recorded with a hidden camera. Judges (blind to condition) who viewed these tapes indicated that subjects subliminally exposed to Black faces responded in a more hostile manner than subjects exposed to White faces.

Though plausible alternatives to the direct perception–behavior link have been proposed in the last decade, the more fundamental idea that subliminally presented stimuli can affect behavior has not been questioned. However, it is important to note that this type of research involves behavior that is both natural and appropriate to the particular situation involved. In fact, most models of such subliminal effects emphasize that these effects would not occur if they were inappropriate to the situation at hand. In other words, subliminal priming cannot cause people to do what they would not naturally do. These effects are also assumed to be transient, lasting minutes at best.

However, not all subliminal priming effects are assumed to be transient. In addition to the direct, perception–behavior route, subliminal perception also affects behavior through an indirect route, via goal activation. The representation of a goal consists of the means by which the goal operates or is carried out. Therefore, activating a goal representation will lead to the activation of its corresponding means, which in turn will result in the greater likelihood of the means being carried out. According to Atkinson and Birch's dynamic theory of action, goal-directed action tendencies increase in strength over time until the goal is acted on. Thus, in contrast to other forms of priming, in which construct activation decreases over time so priming effects are transient, the effects of goal priming actually increase over time.

Goals can be activated by a variety of primes. For example, people that are closely associated with particular goals can serve as primes for these goals. In one experiment, Shah used the names of significant others as primes for an achievement-related goal. Subjects were initially asked to provide the name of a significant other who would most want them to possess an achievement-related goal, and the name of a significant other who would care the least about this. Subjects were subliminally primed with either of the two names or a control prime (i.e., a random letter string). Subjects were then given an anagram task designed to measure goal-striving. Subjects subliminally primed with the name of the significant other who cared the most that they possess the goal persisted longer on the anagram task and found more correct solutions than those in the control group, and those primed with the name of the person that cared the least persisted less and found fewer correct solutions than those in the control condition. In sum, the subliminal activation of a goal can lead to not only better performance, but also persistence, another distinct feature of goal pursuit.

These sorts of behavioral and motivational effects differ from the single most controversial area within the domain of subliminal psychological processes: subliminal persuasion. The line between the previously described effects and the area of subliminal persuasion is fuzzy, but one key difference is that subliminal persuasion generally involves causing people to do things they cannot or would not normally do. Various people, beginning memorably with James Vicary in 1957, have made grandiose yet largely unsubstantiated claims about the effectiveness of subliminal persuasion. For example, in the 1980s, self-help audiotapes were very popular in the United States, despite the lack of rigorous scientific research on their effectiveness. When various researchers decided to test the claims of such tapes, they found that the tapes were ineffective. In one experiment, Greenwald and colleagues tested two tapes, one designed to improve memory and the other designed to improve self-esteem. Subjects were given one of the two types of tapes and were asked to listen to their tape daily. However, the experimenters switched the labels on half of the tapes. In other words, some subjects received a memory tape that had been mislabeled as self-esteem improvement, some subjects received a self-esteem tape that had been mislabeled as memory improvement, and the remaining half of subjects received correctly labeled tapes. After 5 weeks, the subjects completed self-esteem and memory tests and also indicated if they believed the tapes had been effective. The subliminal tapes had no effects on either self-esteem or memory, but there was an effect of subjects' expectations on whether they thought the tapes were effective. That is, subjects who thought they had listened to a self-esteem tape thought their self-esteem had

improved, and subjects who thought they had listened to a memory tape thought their memory had improved, regardless of which tape they had actually received.

What separates such tapes from the previously described research on subliminal effects on behavior, so that the tapes were not influential? One obvious difference is that subliminal self-help tapes claim to present long messages, such as phrases or entire sentences. Research by Greenwald and colleagues has demonstrated that individuals cannot process an entire sentence when it is presented subliminally. In one experiment, Greenwald and Liu subliminally presented two-word sentences to subjects. For each sentence, the meaning of the sentence differed from the meaning of the individual words. For example, the sentence 'enemy loses' has a positive meaning, but it consists of two words, 'enemy' and 'loses,' that are negative in meaning. The effects of the subliminally presented sentences were driven by the meaning of the individual words rather than by the meaning of the entire sentence.

Strahan, Spencer, and Zanna proposed that even presenting single words would not be sufficient for subliminal persuasion. They pointed out that a person's goals and motives are critical for subliminal persuasion to occur. Subliminal priming can be used to prime goal-relevant cognitions, but this priming needs to be combined with a motive to pursue the goal, for subliminal persuasion to occur. In one experiment, Strahan and colleagues brought subjects into the lab supposedly for a study on marketing research. All individuals were asked to refrain from eating or drinking for a few hours before the session. Once they arrived, half of subjects were given water to drink, and the other half were not. Thus, the latter group of subjects was thirsty and the former group not. Then all subjects completed a task on computer in which they were subliminally presented with either thirst-related words (i.e., thirst and dry) or neutral words (i.e., pirate and won). Finally, all subjects were asked to taste-test some beverages. Only subjects who were thirsty and had been subliminally presented with thirst-related words showed subliminal persuasion: they drank more of the beverages than the other subjects.

Can such persuasion be carried over to actual consumer choices? Strahan and colleagues found that their subliminal persuasion effects also led subjects to prefer products that were advertised as fulfilling their goal. For example, subjects who were thirsty and had been subliminally primed with thirst-related words preferred a beverage advertised as thirst-quenching over another beverage. Karremans and colleagues took this research a step further, proposing that if individuals already have a particular motive, they will be persuaded by subliminal priming of a brand that can satisfy that motivation. In one experiment, half of the subjects were given a very salty candy to consume to make them thirsty. Then all subjects completed a task on the computer in which they were subliminally presented with either the brand name of a beverage ('Lipton Ice') or nonwords made by scrambling the letters of the brand name ('Npeic Tol'). Finally, subjects were asked to indicate which of two brand name beverages they would choose if they were offered a drink right now. Subjects who were thirsty and had been subliminally primed with Lipton Ice were the only ones to choose Lipton Ice more often than the alternative. Hence, you can subliminally lead a horse to water only if it is thirsty in the first place. It is when people

are in a motivated state that specific subliminal primes can affect choice.

One of the last media outcries regarding subliminal priming was in the political sphere. In 2000, the word RATS was flashed very briefly in tandem with images of Al Gore before the entire word 'bureaucrats' was presented onscreen in a television commercial sponsored by the Republican National Committee. Could briefly presenting a negative word in combination with an image of a person indeed color the impression of that person? The scientific community largely dismissed this as unlikely for numerous reasons, the least of which was because a single pairing of a negative word with a well-known person is not likely to produce a change in the preexisting attitude toward that person.

Relevance to the Real World

Why should individuals perceive and be influenced by stimuli that do not reach conscious awareness? The processing capacity of consciousness is greatly limited: consciousness can only deal with a very small percentage of all incoming information. We would be unable to function if we were guided only by the information to which we could consciously attend. Being consciously aware of a stimulus redirects focal attention to that stimulus and decreases the amount of attention available for peripheral stimuli. Efforts to consciously 'take it all in' tax not only our attentional resources, but our self-regulatory resources as well. The depletion of our self-regulatory stores in turn has deleterious effects on our behaviors and judgments. Luckily for us, much of the time, we need not consciously attend to stimuli for adaptive behavior or accurate judgments to occur.

See also: Social Cognition.

Further Reading

Adams JK (1957) Laboratory studies of behavior without awareness. *Psychological Bulletin* 54: 383–405.

Bargh JA and Chartrand TL (2000) The mind in the middle: A practical guide to priming and automaticity research. In: Reis HT and Judd CM (eds.) *Handbook of Research Methods in Social and Personality Psychology*, pp. 253–285. New York: Cambridge University Press.

Bornstein RF and Pittman TS (eds.) (1992) *Perception Without Awareness: Cognitive, Clinical, and Social Perspectives*. New York: Guilford.

Cheesman J and Merikle PM (1986) Distinguishing conscious from unconscious perceptual processes. *Canadian Journal of Psychology* 40: 343–367.

Dijksterhuis A, Aarts H, and Smith PK (2005) The power of the subliminal: On subliminal persuasion and other potential applications. In: Hassin RR, Uleman JS, and Bargh JA (eds.) *The New Unconscious*, pp. 77–106. New York: Oxford University Press.

Eriksen CW (1960) Discrimination and learning without awareness: A methodological survey and evaluation. *Psychological Review* 67: 279–300.

Greenwald AG (1992) New Look 3: Reclaiming unconscious cognition. *The American Psychologist* 47: 766–779.

Holender D (1986) Semantic activation without conscious identification in dichotic listening, parafoveal vision, and visual masking: A survey and appraisal. *The Behavioral and Brain Sciences* 9: 1–66.

Kouider S and Dehaene S (2007) Levels of processing during nonconscious perception: A critical review of visual masking. *Philosophical Transactions of the Royal Society B* 362: 857–875.

Kunst-Wilson WR and Zajonc RB (1980) Affective discrimination of stimuli that cannot be recognized. *Science* 207: 557–558.

Marcel AJ (1983) Conscious and unconscious perception: Experiments on visual masking and word recognition. *Cognitive Psychology* 15: 197–237.

Pratkanis A (1992) The cargo cult science of subliminal persuasion. *Skeptical Inquirer* 16: 260–272.

Strahan EJ, Spencer SJ, and Zanna MP (2002) Subliminal priming and persuasion: Striking while the iron is hot. *Journal of Experimental Social Psychology* 38: 556–568.

Van den Bussche E, Van den Noortgate W, and Reynvoet B (2009) Mechanisms of masked priming: A meta-analysis. *Psychological Bulletin* 135: 452–477.