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Edited by

Sharon Shavitt
University of Illinois
at Urbana-Champaign

Timothy C. Brock
The Ohio State University

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3

PSYCHOPHYSIOLOGICAL APPROACHES TO ATTITUDES

Detecting Affective Dispositions When People Won't Say, Can't Say, or Don't Even Know

JOHN T. CACIOPPO
The Ohio State University

RICHARD E. PETTY
The Ohio State University

MARY E. LOSCH
University of Iowa

STEPHEN L. CRITES
The Ohio State University

You have been recommended for a promotion to a position you have long coveted. Before making a final ruling on your promotion, however, you have been asked to submit to a lie detection test to ensure you are a person of good morals and are loyal to company and country. You suspected that refusing would be tantamount to admitting fault, but the wires, electrodes, and interrogative style of the examiner are more stressful than you anticipated. "Have you ever lied when filing your tax returns?" "Have you ever used any illicit drug?" "Have you ever considered having an extramarital affair?" "Have you ever considered violating a professional confidence?" "When filing your tax returns last year, did you overstate your deductions by approximately: $10? $100? $500? $1,000? $5,000? Over $5,000?" "Do you want this promotion because of: the vacation time? the money? the power? the creative opportuni-

ties? the status?" You can feel the coveted promotion slipping through your clammy hands.

While taking your seat on an airplane, you notice the person next to you is a very attractive member of the opposite sex. You notice, too, that this person expresses indifference as you are seated, but you also detect that the person clearly blushed. Does the person wish to be ignored, or would your effort to start a conversation be welcomed?

Both of these stories involve psychophysiological responses. Psychophysiology is the scientific study of human thought, emotion, and behavior as revealed or implemented in physiological events. Attitude researchers have traditionally been interested in psychophysiology for its presumed ability to measure how people truly feel about a person, object, or issue. Although the power to know what others are thinking might seem very desirable, there are few invasions of privacy more serious than the invasion of a person's innermost thoughts and feelings. Stable social relationships and exchanges may be served well by the fact that people's thoughts and feelings are not always apparent to those with whom we interact. Still, we have all encountered instances in which it would have been helpful if we could have gotten beyond what someone was saying to know what their true attitudes were. Attitude researchers face this problem in every study they conduct, for the self-report measures discussed by Ostrom et al. in Chapter 2 are of use only to the extent that they are valid reflections of people's true attitudes.

This chapter concerns the theory behind and several strategies for studying people's thoughts, feelings, and attitudes through the examination of physiological processes and events. This approach is somewhat unique. Consider, for instance, that most of the research discussed in this book involves manipulating situations and asking people to report their attitudes. Such an approach assumes that people are willing and able to tell you their true attitudes. Indeed, even discrepancies between self-reported attitudes and behaviors are not interpreted as questioning the validity of the self-reports but rather as indicating that alternative forces such as habits and social norms also influence individuals' behaviors. In contrast, a major theme of the present chapter is that attitudes and their consequences extend beyond what individuals are willing and, in some cases, are able to tell in words. Among the topics discussed in this chapter are the utility of psychophysiology in measuring and investigating attitudes people are unwilling to report and its possible utility in the study of attitudes people are unable to report.[1]

Attitude Assessment: Lessons from Lie Detection

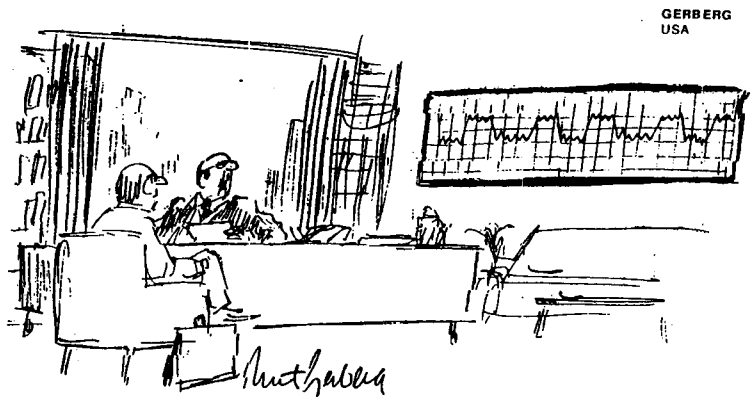
Lie detection is perhaps the best known psychophysiological approach (actually, a class of approaches) to the problem of trying to determine what someone really thinks or knows. The term *lie detection* evokes images of polygraphs (devices for measuring physiological responses) and criminal investigations, with good reason.

The Department of Defense alone administers tens of thousands of such tests each year, most in specific incidents of suspected crimes. Television and films depict lie detection tests as capable of revealing deep secrets (e.g., criminal guilt, paternity), and famous lawyers such as F. Lee Bailey exalt the virtues of lie detection tests. Contrary to this public image, however, the major use of physiological measurement for the purpose of lie detection is in screening employees for government and businesses (see Figure 3-1). Several million such tests are given each year, in fact, and the number is growing (Lykken, 1981). Is anything to be learned from this work for the study of attitudes?

Bogus Pipeline

Lessons from the Detection of Deception

According to Hassett (1978), the use of lie detection to investigate crimes may have begun with a clever prince centuries ago. The suspects in a crime were brought to his palace, were lined up with their hands behind them, and were informed that, in an adjacent room, there was a sacred donkey that would bray when the guilty person pulled its tail. The suspects were told to go in turn into the darkened room alone with the donkey, to pull its tail, and to return then to their position in line, with hands clasped behind. In fact, the donkey was neither sacred



"No. It's my polygraph."

FIGURE 3-1 Business ups and downs?

Source: Gerberg USA; Cartoonists & Writers Syndicate.

nor did it bray when a guilty person pulled its tail. These details, however, were of no consequence for the determination of the suspects' guilt or innocence. This is because the prince had dusted the donkey's tail with black powder; the theory was that only the suspect with something to hide would enter the darkened room and, out of fear of being detected, would only pretend to pull the donkey's tail. Hence, once all the suspects had returned to their place in line, the prince had them extend their hands in front of them, palms up. The suspect with clean hands was presumed guilty.[2]

Attitude Assessment

An analogous modern-day procedure for measuring attitudes is known as the *bogus pipeline*—so called because people are led to believe that a machine (rather than a sacred donkey) has a pipeline to their thoughts and attitudes. Gerard (1960; cited Gerard, 1964) may have been the first contemporary social psychologist to convince subjects he could measure their true feelings with a polygraph. In Gerard's study, subjects were told their task was to make a choice between two alternatives by pressing a button with either the left or right index finger. The alternatives were multipointed stars projected side by side on a screen for one-fifth of a second, and subjects were to choose the star with the greater number of points. Subjects were told that the study concerned not their considered judgments but their first impulses. All subjects had electrodes attached to their right and left forearms and were led to believe that the highly sensitive physiological recording equipment would register their first impulse by indicating their initial tendencies to press a button. Hence, there was little use in subjects not pressing the button that reflected their true choice between the alternatives.

This procedure has been used to obtain more truthful reports of feelings and attitudes that subjects might otherwise have been unwilling to give:

> *The paradigm is based on the simple premise that no one wants to be second guessed by a machine. If a person could be convinced that we do have a machine that precisely measures attitudinal direction and intensity, we assume that he would be motivated to predict accurately what the machine is saying about him. (Jones & Sigall, 1971, p. 349)*

In a demonstration of this procedure, Sigall and Page (1971) had some subjects report their attitudes on standard paper-and-pencil rating scales (see Chapter 2 by Ostrom et al. in this volume) and others report their attitudes under bogus pipeline conditions. Subjects in the bogus pipeline conditions were told to hold a steering wheel connected to a pointer. Turning the wheel allowed the pointer to move from 0 to any point on the attached −3 to +3 attitude rating scale. Electrodes were attached to subjects' forearms, and they were told that the physiological recordings could predict how far in either direction they would turn the wheel. A few practice trials were conducted in which bogus physiological data, "predicting" the subjects' true attitudes toward the stimuli, were presented. (This accurate prediction of the subjects' attitudes was possible because, unknown to the subjects, the investigator had access to their opinions from a previous questionnaire.) Subjects were even asked to try to fool the "physiological measure" on one of these early trials. Of course, since the attitude predictions were based on subjects' responses to a questionnaire administered previously, they were uniformly unsuccessful in trying to "beat the machine."

Once the subjects were convinced that the machine could read their attitudes, the attitudes that were really of interest were measured. Half of the subjects, all of whom were white females, were asked to judge whether or not certain traits (e.g., honesty) were characteristic of Americans, and half were asked if the traits were characteristic of Blacks. Results revealed that Americans were rated more favorably by the bogus pipeline than the nonpipeline (paper-and-pencil scale only) group, whereas Blacks were rated less favorably by the bogus pipeline than nonpipeline group.

But how can one tell which set of judgments is really more valid (paper-and-pencil ratings or bogus pipeline)? The investigators did not actually have unique access to the truth. This, of course, was a problem in the prince's use of the donkey, as well. It would be better to create particular beliefs in subjects and then use rating scales and the bogus pipeline to determine which best reflected these known beliefs. This is exactly what was done in a study by Quigley-Fernandez and Tedeschi (1978). Subjects were first informed about how to perform well on an experimental test. They were later given a chance to cheat on the test and were subsequently asked if they possessed any prior information about the test. Subjects questioned under the bogus pipeline conditions confessed more often than those who were not. Hence, these data appear to confirm the theory underlying the bogus pipeline.

Summary

The accumulated evidence suggests that the bogus pipeline procedure may be effective in getting people to reveal information that they might normally be unwilling to report. There are three important limitations to this procedure, however. First and foremost, the subject's belief in the procedure is crucial to its success. As the procedure becomes more widely known or as people become more skeptical about lie detection, the incentive for their telling how they actually feel will be lost and the procedure will no longer be effective. Second, just as the innocent suspects who were asked to pull the donkey's tail must certainly have suffered anxious moments, evidence points, too, to the bogus pipeline as inducing negative arousal in subjects (Gaes, Kalle, & Tedeschi, 1978). This unfortunate feature might make the bogus pipeline inappropriate in certain settings (e.g., in studies of cognitive dissonance, where it might serve as a misattribution cue; see Chapter 5 by Cooper and Scher in this volume). Finally, the procedure is not particularly useful when a person's attitude toward a person or issue is not readily accessible—that is, when the person is unable to report his or her true attitude. Indeed, just as the anxiety created by a class examination can make it difficult to remember the answers to difficult test questions, the anxiety aroused by the bogus pipeline procedure may hinder one's ability to recall actual attitudes.

Physiological Arousal in Lie Detection and Attitude Assessment

There are important parallels between the detection of deception and the detection of attitudes. First, we saw in the preceding section that a person's belief in the validity of procedures is important for the effectiveness of the bogus pipeline procedure. As we shall see, this is also the case for the polygraph in contemporary lie detection. It would be nice if, instead, some simple physiological measure could be identified that would occur if and only if the person told a lie (see Figure 3-2). Unfortunately, there is no known bodily response or set of bodily responses that occurs when and only when one lies, just as there is none that provides a readout of and only of one's attitudes. To get around this limitation, physiological responses are observed under specially contrived circumstances in order to *infer* a person's honesty or attitudes based on unusual increases in bodily arousal in response to a question or stimulus.

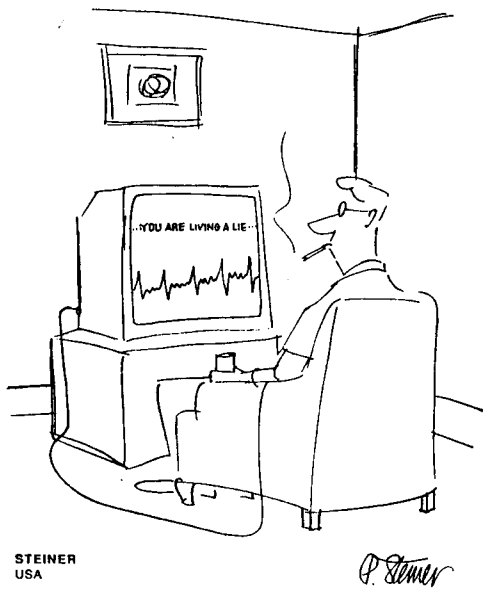


FIGURE 3-2 Psychologists wish they could identify a simple physiological response that would occur if and only if a person told a lie.

Source: Steiner USA; Cartoonists & Writers Syndicate.

One theory that has guided inferences in both studies of deception and studies of attitudes is that strong emotions are associated with physiological arousal (specifically, activation of the sympathetic nervous system). To the extent that lying or the threat of being detected while lying is emotionally arousing, then one would expect lying to be associated with greater physiological arousal than truth-telling. Before proceeding to examine how this theory has been applied to studies of attitudes, we illustrate its application in attempts to detect deception.

Lessons from the Detection of Deception

Most lie detection tests involve recording measures such as a person's heart rate, blood pressure, respiration, and electrodermal activity (sweating) in an attempt to detect evidence of unusual tension or stress that can be associated with lying. Prior to connecting a suspect (or potential employee) to the polygraph, a pretest interview is conducted (Iacono & Patrick, 1988). Many people find themselves so apprehensive about the threat of exposure that they admit to misdeeds during this period. For those who do not, sensors are attached, and a demonstration is staged to convince the subject that it is futile to try to fool the machine. For instance, the person selects a card from several and is told to deny having selected the card when it is presented again. Although there are several variations in procedures, the individual might be shown each of the cards, during which time physiological measures are monitored with chart and pens. When the card selected by the individual is presented, the polygrapher points to the changes in bodily response, charted by the polygraph, which purportedly foiled the individual's attempt to conceal this information. The examiner invariably can find a segment of the record to which to point to show *physiological activation* when the individual tried to lie because there are fluctuations in normal physiological activity even when people are sitting quietly.

As in the bogus pipeline, the creation of the *belief* in the ability of the machine to read the individual's innermost thoughts and feelings enhances the likelihood the individual will tell the truth; and for those who are still not compelled to tell the truth by the fear of exposure, the creation of the belief that they might well be exposed makes the individual even more nervous about anything he or she hopes to conceal. This nervousness, coupled with the special significance associated with the information one is trying to conceal, increases the likelihood that the individual will show a strong bodily response—for example, increased sweating, irregular breathing, and elevated blood pressure—when subsequently asked a question about something he or she wishes to conceal.

Attitude Assessment

The theory that strong emotions are associated with activation of the sympathetic nervous system also suggests that to the extent the presentation of a person or object evokes strong feelings, its presentation should be associated with greater physiological arousal than should presentations of people or objects toward which the person does not feel strongly. This theory has been of interest to attitude researchers because it suggests that extremely positive and extremely negative attitudes might

be associated with increased sympathetic activity, regardless of what people say about these attitudes. It is also conceivable that even more specific inferences about a person's thoughts or feelings can be suggested by a person's bodily responses if the situation in which these responses are measured is constructed appropriately.

One procedure for measuring sympathetic activation involves the measurement of sweat gland activity. A very small electrical current is applied across two electrodes that are attached to the hand. (The current is so small that subjects are unaware of it, and the current presents no threat of shock or trauma to the subject.) Changes in the resistance of the skin to the flow of electric current reflect changes in the activation of a particular class of sweat glands (eccrine glands). The more these glands are activated, the more filled they are with sweat (a good conductor), and the lower the resistance to current flow. This *electrodermal* measure became a favorite among attitude researchers because it was easy and inexpensive to record; with appropriate equipment, changes were easy to detect with the eye and to quantify by hand; the measure was assumed to reflect general physiological arousal; and the measure had a direct link to what common sense indicated should be related to such subjective experiences as stress and emotion, namely, sweating (but see Cacioppo & Sandman, 1981). However, the measure did not reflect the direction (favorable versus unfavorable) of the emotion.

The earliest applications of this theory supported the expectation that emotionally laden words and statements evoked larger electrodermal responses (EDRs) (e.g., larger increases in sweating). Syz (1926–1927), for instance, found that a group of medical students showed larger EDRs[3] to emotionally laden words such as *prostitute*. Similarly, Dysinger (1931; see McCurdy, 1950) presented both pleasant and unpleasant words and found that the sizes of the EDRs were correlated with the extremity of the words but could not predict whether the words were rated as being pleasant or unpleasant.

This result has been found to hold for a variety of attitude objects and, more interestingly, has been extended to show that more information about a person's attitude could be inferred if one knew in general terms whether the person felt positively or negatively about the attitude object. For instance, Rankin and Campbell (1955) measured EDRs while subjects were voicing whatever thoughts came to mind. The manipulation involved having an experimental assistant appear to adjust a set of bogus electrodes on the subject's hand. Following each adjustment, average EDRs were calculated. Rankin and Campbell found that the EDRs were larger following the adjustments made by a Black assistant than those made by a White assistant. Later investigations demonstrated that people with negative attitudes toward Blacks showed larger EDRs to pictures of Blacks than did people with relatively favorable attitudes, presumably because the negative attitudes were more extreme (e.g., Vidulich & Krevanick, 1966; Westie & DeFleur, 1959).

It is important to recognize, however, that in all these studies the EDRs are not a direct consequence (or measure) of attitudes—just as was the case in the use of physiological measures to detect lying. Most individuals, whether guilty or innocent, will show a bodily response (e.g., increased EDRs) when asked if they murdered a close friend or relative, and large differences between people in their

general anxiousness and physiological responsivity can make it difficult to separate the guilty party from the innocent party based on such a question. Similarly, the novelty, unexpectedness, or significance of stimuli can affect bodily responses such as people's EDRs, regardless of their attitude toward these stimuli. It would be no more appropriate, therefore, to conclude that a large electrodermal response following the introduction of the issue of nuclear power necessarily reflected an underlying emotional feeling about the issue than it would be to conclude that a particular individual was lying simply because a large increase in physiological activity was observed following a question.

Summary

Whether or not an individual responds physiologically to an attitude object or how much the individual responds to the object can be influenced by a number of factors besides the individual's attitude toward the object. These other factors include such things as an individual's concern about making a good impression, the novelty or unexpected nature of the stimulus, the significance of the stimulus to the individual, anger or embarrassment evoked by the stimulus, and the physiological (e.g., electrodermal) responsiveness of the individual. As we have seen, many of these problems can be overcome by the careful investigator.

For example, what if you wanted to know how strongly a friend felt about civil rights? Monitoring the changes in your friend's physiological response when you mention civil rights would not be very informative, because changes in bodily response could be due to the novelty of the question and testing situation, the individual's general physiological responsiveness, and so on. However, what if you were to monitor the changes in physiological response when you sequentially present a larger number of attitude objects, some for which your friend's attitudes were known beforehand? You might be able to determine whether the changes in physiological response were reflecting something about your friend's already known attitudes (e.g., the extremity of the attitudes). If physiological changes were greater when objects or issues about which the individual felt strongly were presented, then you would have greater confidence (though not complete certainty) that similar physiological responses evoked by other attitude objects reflected similarly intense attitudes toward the objects (see Cacioppo & Tassinary, 1990). It is the discrepancies between verbal reports and physiological responses that are often of the greatest interest. If your friend were to report the complete absence of prejudicial feeling toward an ethnic group but were to show strong physiological responses to members of the group, then greater caution and perhaps additional inquiries would be in order before accepting the validity of your friend's verbal reports or paper-and-pencil ratings.

The Significant Information Test

A related theory that has guided inferences in studies of deception in crime suspects is that a stimulus that is (or is made) highly significant to a person (e.g., the instrument used to murder someone) evokes stronger physiological responses

(e.g., larger EDRs) than does a stimulus that is not significant. Furthermore, the presentation of this stimulus would be expected to be associated with greater physiological responsivity only in the guilty individual to the extent that (a) the stimulus is familiar and has special significance only to the guilty individual and (b) the presentation of this information uniquely threatens to expose this individual as being the guilty party. Before proceeding to examine how this theory can be applied to studies of attitudes, we examine its application in attempts to detect deception in criminal investigations.

Lessons from the Detection of Deception

The theory outlined above has led to a technique for detecting deception called the *Guilty Knowledge Test (GKT;* see Lykken, 1981). In the GKT, subjects are not asked whether or not they committed a particular misdeed, but rather they are asked a series of questions about the crime. Each question concerns one feature of the crime, with multiple-choice alternatives including the correct answer as well as other plausible but incorrect choices. For instance, a suspect in a homicide might be asked whether the victim had been killed with a machete, hunting knife, butcher's knife, paring knife, or ice pick. All questions and response options are reviewed with the suspect prior to beginning the GKT. Only an individual who knows the details of the crime (that is, has guilty knowledge) is expected to respond most physiologically to the correct answer because this information has special significance only to the guilty individual, and its presentation threatens to expose the individual's guilt.

As noted in the preceding section, even an innocent individual may respond to a particular piece of guilty knowledge for some irrelevant reason (e.g., chance, prior history in an unrelated case), so GKTs consist of 10 such questions. This greatly reduces the likelihood that an innocent person would react most strongly to the relevant item in each of the 10 questions (Iacono & Patrick, 1988). One corresponding limitation of the GKT, however, is that the investigator (e.g., the police) must know several bits of information that are known by the guilty party but are not known by innocent individuals.

Attitude Assessment

The limitation of the GKT in criminal investigations is not as serious an obstacle for the attitude researcher. If one assumes that individuals know their true attitudes or at least that their attitudes have special significance to them (much as their own name or the sound of their voice does), then one can think of this knowledge as analogous to knowing a particular detail about a crime. Knowledge of one's attitude is not likely to have as much significance for individuals as knowledge about a crime they committed. An individual's attitude might be made even more significant, however, by instructing the individual to memorize his or her attitude, think about the feelings that characterize it, and imagine a personal behavior that exemplifies it (e.g., see Ben-Shakhar & Gati, 1987). In the assessment phase, the individual is presented with a sequence of attitude positions, only one of which represents the individual's own personal position. This attitude position would be expected

to evoke more physiological responsivity than other positions because the person's own attitude has the greatest familiarity and personal significance.

As we noted above, the presentation of this information might also increase responsivity if individuals believed its presentation threatened to expose their personally or socially unacceptable feelings. That is, as in the case of the GKT, physiological responsivity to the presentation of their attitude position may be enhanced when individuals are motivated to avoid having their attitudes "exposed" by the polygraph during questioning. However, this threat does not appear necessary (Ben-Shakhar & Gati, 1987). Because the key to this procedure is the familiarity and special significance of a person's attitude position, rather than the threat of exposure of a particular piece of guilty knowledge, the test, when applied to the study of attitudes, might be termed the *Significant Information Test (SIT).*

Gur and Sackeim (1979) reported an interesting study that illustrated the potency of stimulus significance in evoking physiological responses, even when individuals could not identify which of the stimuli to which they were exposed was their significant stimulus. People listened to tape recordings of their own voice and to tape recordings of others whose voices sounded generally similar. The individuals were asked to try to identify the tape recording of their own voice, and EDRs were recorded during the presentation of all of the tape recordings. Many of the individuals who participated in this study were able to identify correctly which was their own voice, but not all were able to do so. Interestingly, the presentation of the individual's voice was associated with larger EDRs than was the presentation of other people's voices, even for individuals who were unable to identify the recording of their own voice. This result raises the possibility that using the SIT for attitude assessment could provide information about attitudes that individuals themselves might have difficulty specifying.

Summary

Research has demonstrated that an effective test for detecting deception is the guilty knowledge test (Lykken, 1981). The SIT for attitude assessment is based on the same theory as the GKT: Physiological responding peaks when a person's true attitude is presented because this information has special significance to the individual. The SIT, therefore, is a potentially powerful procedure for probing attitudes that individuals are unwilling to report. Moreover, given recent research suggesting that familiar, significant information can evoke physiological reactions, even though the person may be unable to recognize the information, the SIT may also provide a means for probing attitudes that individuals are unable to report. Of course, like the GKT, attitude assessments based on the SIT require that several questions be used to ensure the reliability of the assessment.

Event-Related Brain Potential Responses

As people process information, their brain generates electrical signals, which can be recorded from the scalp. Investigators have tried to use these signals, which can be recorded using electroencephalography (EEG), to explore the activities of the

brain and mind. The reasoning was that if the brain wave activity associated with two stimuli is different, the brain must have processed these stimuli differently. Although in theory, comparing the brain wave activity evoked by the stimuli may appear simple, in practice, it is complicated because the specific brain wave activity associated with a given stimulus (e.g., positive or negative attitude object) is very small, and the brain is doing many things in addition to evaluating the stimulus. These other activities can mask the activity evoked by the stimulus. For instance, the electrical signals from the brain change slightly about 300 milliseconds after the presentation of an item when the item differs from the category of items previously presented (e.g., a high-pitched tone presented after a series of low-pitched tones; a disliked item presented after a set of liked items). The change in brain wave activity is small and reflects only one of many operations being performed by the brain. Thus, one cannot see this change in brain wave activity when a single item is presented.

One method of "mining" this small electrical signal out of the other electrical activity being generated by the brain involves exposing people to an item (e.g., positive or negative attitude objects) many times while brain wave activity is recorded. The theory underlying this technique is that the brain will respond similarly to each presentation of the item and that the brain wave activity that is unrelated to the item will vary in a more haphazard way (i.e., randomly about zero). By averaging the brain wave activity associated with the presentation of many such items, the small changes in electrical signals evoked by these items become measurable. (This is because the measures of brain wave activity not associated with or time-locked to the item total zero using this technique.) The small changes in the brain wave activity that are left after averaging are called *event-related brain potentials* because they reflect changes in brain activity that are linked to some event (e.g., the presentation of a tone or an attitude object). These small event-related changes in brain wave activity have potentially important implications for the measurement of attitudes.

Lessons from the Detection of Deception

A recent paper by Farwell and Donchin (1991) examined the applicability of using brain wave activity for assessing deception. In their experiment, half of the subjects were induced to participate in a mock crime, and the remaining subjects were not induced to participate in that mock crime. Subsequently, the subjects were shown a series of stimuli, with a few crime-related stimuli included, while EEG activity was recorded. To subjects who *had not* participated in the mock crime (and who, therefore, were unaware of what the mock crime involved), the crime-related and crime-unrelated items on the list were indistinguishable. However, to subjects who *had* participated in the mock crime, the crime-related stimuli were distinctive and important (i.e., because the subjects were trying to conceal the fact that they had knowledge of the mock crime). Averaging the EEG activity revealed that the brain wave activity evoked by the crime-related items was different than the brain wave activity evoked by the crime-unrelated items but only for the subjects who had participated in the mock crime. For subjects who had not participated in the mock crime and who had no knowledge of the mock crime, similar patterns of brain wave activity were observed for the crime-related and crime-unrelated items.

Rosenfeld, Angell, Johnson, and Qian (1991) also used brain wave activity for the purposes of lie detection, but they used slightly different procedures than did Farwell and Donchin. In Rosenfeld et al. (1991), for example, subjects were told that they were suspected of committing four antisocial behaviors. Half of the subjects were known to have committed one of these antisocial behaviors, and the other subjects were known to have committed none of the antisocial behaviors. The antisocial behavior a subject was known to have committed was considered a "guilty-item" (e.g., smoked pot monthly), whereas any antisocial behavior that a subject was known not to have committed was considered an "innocent-item" (e.g., stole some clothes, took friend's money). Subjects were then shown a series of descriptions of antisocial behaviors while EEGs were recorded. Rosenfeld et al. compared the brain wave activity evoked by the guilty-items with the electrical activity evoked by the innocent-items and found the brain wave activity differed for those subjects who were, in fact, guilty of the antisocial behavior described in the guilty-items. Allen, Iacono, and Danielson (1992) recently conducted three experiments that produced similar results.

Attitude Assessment

As the preceding studies illustrate, unexpected and important stimuli evoke brain wave activity that differs slightly from the brain wave activity evoked by expected and unimportant stimuli. We have recently examined whether these findings could be used to investigate (and possibly assess) human attitudes. In an illustrative experiment (Cacioppo, Crites, Berntson, & Coles, 1993), subjects rated their attitudes toward a large number of objects and issues (e.g., pizza, raising tuition). These ratings were used to identify 75 items toward which the subject held positive attitudes and 75 items toward which the subject held negative attitudes. Next, EEG activity was recorded from each subject while items from this list of 150 attitude objects were presented on a computer screen located in front of the subject. These items were presented one at a time in blocks of 6 while the subject counted either the number of positive or negative items in the block. Sometimes all 6 items were liked by the subject, sometimes all 6 items were disliked, sometimes 5 of the 6 items were liked, and so on. In this way, many of the blocks of items contained mostly positive or mostly negative items.

The key question in this study was, What happens to brain wave activity when a positive item is presented in the middle of a list of negative items or when a negative item is presented in the middle of a list of positive items? The studies described in the previous section indicated that brain wave activity differed when an item from a different informational category (crime related or crime unrelated) was presented, but would the brain wave activity differ when an item from a different attitudinal category was presented? The results suggested yes; the brain wave activity differed when an item was presented that evoked the opposite feelings as had the preceding items. Indeed, this was the case, even though the brain wave activity evoked by the positive items did not

differ from the brain wave activity evoked by the negative items. It was not the items per se but the context in which these items were presented that led to different forms of brain wave activity. We have now repeated these results using personality trait descriptions (Cacioppo et al., 1993), and we have even found differences in the amplitude of the evoked brain potentials that reflect the intensity of subjects' feelings about an attitude object (Cacioppo, Crites, Gardner, & Berntson, under review).

Summary

The contemporary use of brain wave activity to investigate concealed information and attitudes is based on the theory that certain features of how an item is categorized are reflected in small but measurable changes in brain wave activity. When an item in a list of items does not fit or is *inconsistent* with an activated category, then the brain wave activity is different (i.e., it contains a larger, slow, positive potential that trails the stimulus presentation by about 300 milliseconds) than when the item fits or is *consistent* with the activated category. Of course, this only works if people are paying attention to the items in the list, so subjects in these studies are usually given a task that requires they respond to the stimuli based on the feature or categorical dimension that is of interest (e.g., counting the number of positive or negative words in a list). Recent studies have applied this theory to the detection of lying with some early success, and the application of this theory to attitude assessment also appears promising thus far. Additional research is required, however, before the value and limitations of this new approach to attitude assessment are known.

Physiological Indicators of Affective Direction

Overt Bodily Responses as a Function of Affective Direction

Physiological measures have thus far been viewed as useful only in assessing general physiological arousal or responsivity. This view, which has a long tradition in the field of attitudes, assumes that physiological measures can reflect the intensity but not the positive or negative nature of people's emotional reactions (see review by Cacioppo, Petty, & Geen, 1989). Yet anyone who has ever watched the facial expression of someone who just tasted something they truly disliked or the expression of a person who has just seen someone they truly love and have missed might suspect that a person's physical actions and expressions can reveal whether one feels positively or negatively about an object or person (see Chapter 2 by Ostrom et al.).

In the earliest studies along these lines, investigators did indeed watch people's visually observable expressions of emotion (e.g., smiles, posture, interpersonal spacing) to gauge people's attitudes toward others (e.g., Darwin, 1872; Galton, 1884). Galton, for instance, wrote:

> *When two persons have an "inclination" to one another, they visibly incline or slope together when sitting side by side, as at a dinner table, and they then throw the stress of their weights on the near legs of their chairs. It does not require much ingenuity to arrange a pressure gauge with an index and dial to indicate changes in stress. . . . I have made some crude experiments, but being busy with other matters, have not carried them on. (1884, p. 184)*

More recently, Ekman, Friesen, and Ancoli (1980) were able to gauge how much individuals liked particular segments of a videotape by monitoring when and to what extent subjects smiled while watching the videotape.

Electromyographic Responses as a Function of Affective Direction

Not all emotional processes are accompanied by visually or socially perceptible expressions or actions, however, and this fact has limited the utility of research on the outward expressions of emotions. For instance, Graham (1980) attempted to assess viewers' emotional responses to television advertisements using a comprehensive scoring procedure for measuring people's observable facial actions. Graham found that, for most of his subjects, there were too few observable facial expressions to the ads to make further analyses worthwhile.

There is now evidence, however, indicating that emotional reactions that are too fleeting or subtle to evoke an outward expression can nevertheless be measured physiologically (Cacioppo et al., 1989). Neural activation of the striated (e.g., facial) muscles results in electrical impulses that can be detected using electromyography (EMG), even when there are no perceptible muscle contractions. For instance, Love (1972) videotaped people's facial expressions while they were exposed to a proattitudinal or counterattitudinal appeal; he reported finding no differences in outward facial expressions, despite the fact that individuals reported more positive attitudes toward the proattitudinal than counterattitudinal communications. Cacioppo and Petty (1979) later replicated Love's finding while also demonstrating that the level of EMG activity recorded over selected muscle regions of facial expression (e.g., brow, cheek; see Figure 3-3) differentiated subjects who anticipated and were exposed to a message consistent with their attitudes from those who anticipated and were exposed to a counterattitudinal message.[4]

But what if individuals were reading an editorial in the newspaper or watching a political debate on television? Are these individuals not emitting miniature smiles or frowns? Recent research suggests there are small but measurable responses that can reflect the positive or negative nature of individuals' emotional reactions, even though these responses are more primitive in form than the more familiar, easily recognizable outward expressions of emotion (e.g., Cacioppo, Petty, & Marshall-Goodell, 1984; McHugo, Lanzetta, & Bush, 1991). Cacioppo et al. (1984), for instance, instructed subjects to imagine reading an editorial with which they agreed or disagreed or to read a page of (neutral) text as if they agreed or disagreed with it. Results indicated that there was more EMG activity over the brow

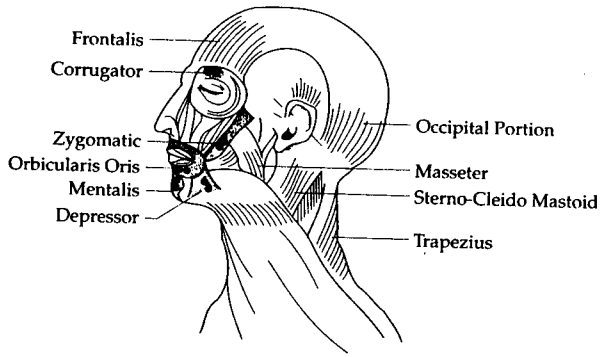


FIGURE 3-3 Sample facial EMG placements

Source: From "Electromyograms as Measures of Extent and Affectivity of Information Processing" by J. T. Cacioppo and R. E. Petty, 1981, *American Psychologist, 36*, pp. 441–456. Copyright 1981 by the American Psychological Association. Reprinted by permission.

region and less EMG activity over the cheek region when subjects imagined or actually read text with a negative rather than positive attitudinal instruction. Moreover, the EMG activity over muscles that have less of a role in the nonverbal communication of positive or negative feelings (e.g., the forearm flexors, lip muscle) was not altered by the attitudinal instruction followed by the subjects during the task. This suggests that there is a precise and eloquent orchestration of neural impulses to specific muscles, not simply a tension or general arousal response to emotional events.

EMG activity appears to vary as a function of the intensity as well as the direction of the emotional reaction. Evidence for this notion was provided in studies by Cacioppo, Petty, Losch, and Kim (1986; see also Cacioppo & Petty, 1979). Subjects were exposed to slides of moderately unpleasant, mildly unpleasant, mildly pleasant, and moderately pleasant scenes. Among the unpleasant scenes were pictures of litter along highways, trash dumps, and environmental wastelands, whereas among the pleasant scenes were white-sand beaches, colorful butterflies, and arching rainbows. Subjects viewed each slide for five seconds and rated how much they liked the scene that was depicted, how familiar the scene appeared, and how aroused it made them feel. Independent judges, who did not know which scenes subjects had seen, rated videorecordings of subjects' facial actions during the five-second presentations of scenes. The judges could not tell from looking at the videotapes of subjects whether the subjects were viewing positive or negative photographs. This result suggests that the scenes were so mild that outwardly perceptible facial expressions were not evoked. Nevertheless, analyses of facial EMG revealed that the activity over the muscles of facial expression varied according to

the direction *and* intensity of the individuals' emotional reactions to the slides: The more subjects liked the scene, the lower the level of EMG activity over the brow region; EMG activity over the cheek region tended to be greater for liked than disliked scenes; and EMG activity was higher around the eye when moderately liked than mildly liked or disliked scenes were presented (see Figure 3-4).

Summary

Attitude researchers have long sought to identify naturally occurring physiological responses that reflect both the direction and intensity of a person's feelings about an attitude object, but previous efforts to identify such measures have been unsuccessful (e.g., Hess, 1965; see reviews by Cacioppo & Sandman, 1981; Janisse, 1977; Petty & Cacioppo, 1983). This history makes particularly interesting the more recent studies suggesting that positive and negative emotional states have effects on facial muscle patterns that are so subtle they may not be detectable to the naked eye. There is even some evidence to suggest that these subtle effects on the facial muscles, especially the muscles around the eyes and brow, are not easy for people to suppress (Cacioppo, Bush, & Tassinary, 1992; see also Ekman & Friesen, 1982). It is possible that facial EMG can be informative about a person's emotional responses to something whether or not the individual is willing or able to report his or her underlying feelings. Further research is needed to test this possibility.

In addition, one should recognize that the context in which these measures are made remains important in studies of emotions and attitudes (Cacioppo, Martzke, Petty, & Tassinary, 1988; Cacioppo et al., 1986). Facial expressions are clearly controllable, and facial expressions can serve to communicate nonemotional information and to deceive as well as to communicate emotional states. It would be an error, based on these studies, therefore, to infer that the observation of increased EMG activity over the brow region *necessarily* meant the individual disliked something. It may, for instance, simply mean the person is concentrating on or is perplexed by the attitude stimulus rather than disliking it. Moreover, if the response did reflect disliking, the emotional response might be transient, specific, and completely irrelevant to the attitude object. Thus, although this research has been informative, it should be remembered that the context in which the recordings are made is important to consider when interpreting such physiological responses (Cacioppo & Tassinary, 1990).

Classically Conditioned Physiological Responses

In the preceding sections, we saw how researchers have attempted to measure and study attitudes by observing physiological responses that are the natural result of experience with attitude objects. We also noted that a major limitation of these approaches is the absence of some simple physiological response that would vary only according to a person's evaluation (or attitude) toward a person, object, or issue. Russian psychologists, however, have adopted a different strategy to the problem of detecting a particular thought, feeling, or attitude (see Cacioppo & Petty, 1983). The theory underlying their approach is that a physio-

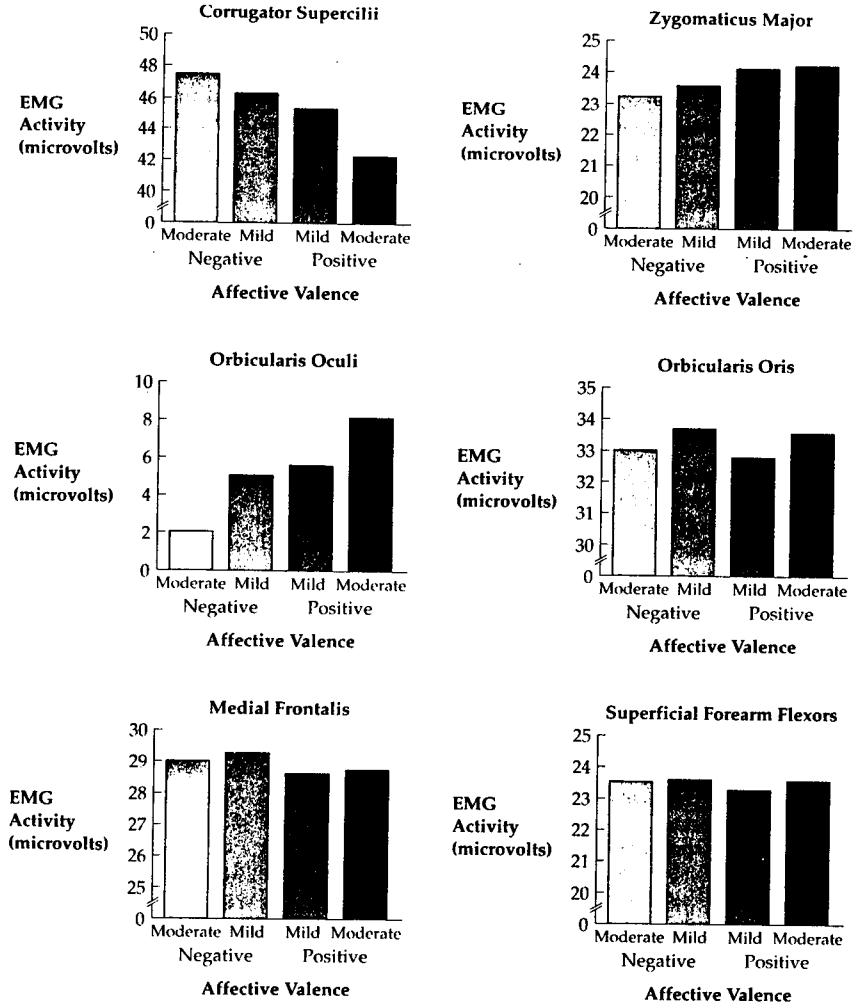


FIGURE 3-4 Facial EMG activity as a function of the direction and intensity of affective reactions

Source: From "Electromyographic Activity over Facial Muscle Regions Can Differentiate the Valence Intensity of Affective Reaction" by J. T. Cacioppo, R. E. Petty, M. E. Losch, and H. S. Kim, 1986, *Journal of Personality and Social Psychology, 50,* pp. 260–268. Copyright 1986 by the American Psychological Association. Adapted by permission.

logical response (e.g., salivation) could be linked uniquely to a particular meaning, such as *good*. By artificially creating a unique link between a physiological response and a concept such as *good*, one could then measure a person's attitude toward an object, person, or issue by recording the size of the physiological response that followed the presentation of the attitude object. The artificial linking of a physiological response (e.g., salivation) to a concept (e.g., *good*) was done with a variation of classical conditioning termed *semantic conditioning*, and the measurement of a person's attitude relied on a process called *semantic generalization*. Before describing some of the actual studies that have been conducted using this approach, we review the topics of semantic conditioning and generalization.

Semantic Conditioning and Generalization

Classical conditioning involves learning to associate an initially neutral stimulus (called a *conditioned stimulus*, or *CS*) with some evocative stimulus (called an *unconditioned stimulus*, or *UCS*). The evocative, or unconditioned, stimulus is so named because its presentation alone evokes a response of some kind (called an *unconditioned response*, or *UCR*) in the person or animal. These relationships are illustrated in Figure 3-5.

Repeated pairings of the conditioned stimulus with the unconditioned stimulus results in the CS evoking the same response (called the *conditioned response* or *CR*) as does the unconditioned stimulus (see the top panel in Figure 3-5). Meat powder, for example, evokes salivation (UCR) in the dog. If the dog is presented with both a 1,000 Hz tone (CS) and meat powder (UCS) on repeated occasions, eventually the presentation of the 1,000 Hz tone alone will cause the dog to salivate (CR). Once this has been accomplished, presentation of similar test stimuli (e.g., a 900 Hz tone) can also evoke the conditioned response (salivation), although the less similar the test stimulus is to the original conditioned stimulus (1,000 Hz tone), the smaller the conditioned response that is evoked. This phenomenon is known as *stimulus generalization*.

In this example, tones of varying frequencies have served as the conditioned stimulus. Importantly, words such as *good* or *bad* can also be used as conditioned stimuli. Prior to the conditioning, a word such as *good* has no power to evoke a physiological response, such as salivation. Following conditioning (in which *good* serves as the CS, cranberry sauce injected into the mouth serves as the UCS, and salivation serves as the UCR), the presentation of the word *good* evokes salivation (i.e., the CR). This is called *semantic conditioning* because the meaning of the word, rather than simply the physical letters constituting the word, has become empowered to evoke the conditioned response (see the bottom panel in Figure 3-5). Words and objects similar in meaning to the conditioned stimulus can also evoke a response similar in form to the conditioned response. As was the case with the tones in the example above, the more similar in meaning the test word is to the conditioned stimulus, the more similar the observed response is to the conditioned response evoked by the test word. This effect, which is a special case of stimulus generalization, is called *semantic generalization*.

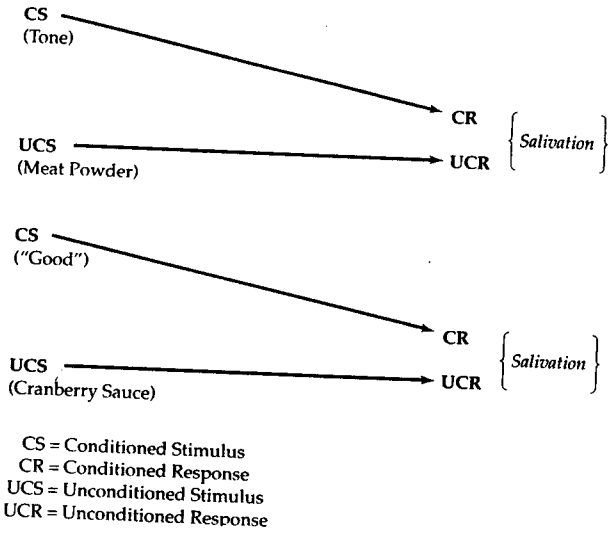


FIGURE 3-5 Top panel: Illustration of the classical conditioning of salivation to a bell. Bottom panel: Illustration of the classical conditioning of salivation to the word *good*. After repeated pairings of the conditioned stimulus (CS) and unconditioned stimulus (UCS), the CS alone elicits salivation.

Attitude Assessment

The classical conditioning approach to the assessment of thoughts, feelings, and attitudes grew out of the work of the Soviet laboratories of Kragnogorsky and Ivanov-Smolensky in the late 1920s and early 1930s, when, according to Razran (1961), it was observed that a conditioned response elicited by the sound of a metronome was also evoked by the announcement of the word *metronome* and vice versa. Razran (1961) also summarizes an early Soviet study in which semantic conditioning was adapted for measuring a person's attitudes toward political slogans. According to Razran, a 13-year-old boy was classically conditioned using cranberry sauce as the UCS to salivate to the work *khorosho* ("well, good") and to differentiate this word and response from the word *plokho* ("poorly, badly, bad"). That is, *khorosho* served as the reinforced stimulus, and *plokho* served as the unreinforced stimulus.

To validate the conditioning procedure, the boy's secretion of saliva was monitored for 30 seconds beginning with the spoken sentence *Khorosho uchenik otvechayet* ("Well the student answers") and similarly for the spoken sentence

Plokho vorobey poyot ("Poorly the sparrow sings"). The boy was reported to secrete 14 drops of saliva following the statement containing the word *khorosho* and only 3 drops of saliva following the statement containing the word *plokho*. This outcome provided evidence that the investigators had successfully linked the act of salivation to an evaluative meaning.

Over the course of the next several days, the boy's attitudes toward various local and national issues were examined without asking the boy to tell them anything but simply by measuring the boy's salivary responses to slogans and sentences (see Table 3-1). Theoretically, large salivary responses would indicate the boy felt positively about the statements, whereas small salivary responses would indicate the boy felt negatively. For instance, if little or no salivation was found following statements such as *The Soviet Constitution is the most democratic* and *The Soviet people love their Motherland*, then the boy's attitudes and loyalty to the Soviet Union might be questioned. That is, through semantic generalization, the *concepts* of good and bad were now associated with a physiological response. Hence, liked and disliked political slogans were now linked to this physiological response.

The data reported by Razran are summarized in Table 3-1. Inspection of these results reveal considerable support for the theory that physiological responses

TABLE 3-1 Salivation to Statements Following Conditioning

*Test Statement**	*Drops of Saliva*
Negative Statements	
The pupil was fresh to the teacher	0
Brother is insulting sister	1
The pupil failed to take the examination	2
The Fascists destroyed many cities	2
The pupil broke the glass	2
My friend is seriously ill	2
Intermediate Statement	
The pupil passed the examination with a mediocre grade	10
Positive Statements	
The pupil studies excellently	14
Leningrad is a wonderful city	15
The Soviet Constitution is the most democratic	17
The Soviet people love their Motherland	17
The fisherman caught many fish	18
The children are playing well	19
The Soviet army was victorious	23
The pioneer helps his comrades	23
The enemy army was defeated and annihilated	24

Source: Adapted from Razran, 1961.

*In addition to these statements, the word *khorosho* was announced seven times and elicited an average of 14.7 drops of saliva, whereas the word *plokho* was announced two times and elicited an average of 1.5 drops during the 30-second recording interval.

(salivating) can be artificially induced to reflect a thought or attitude. The secretion of saliva during the 30-second period beginning with the announcement of the statements with which the boy was likely to agree averaged 18.8 drops of saliva, compared to 1.5 drops for statements with which the boy was likely to disagree. These results indicated that the boy had a positive attitude toward the Soviet Union.

Notice, too, that the statement *The pupil passed the examination with a mediocre grade* resulted in 10 drops of saliva. This suggests the possibility that the boy was not one of the better students. Although one would want to measure the response to several such statements before drawing any conclusions about the boy's thoughts and feelings about school, his intermediate level of salivation following the statement that the pupil performed middling on a test suggests that the boy would not be displeased with mediocre performances in school. You can see, then, how measures of the artificially induced physiological response can be used to make inferences about a person's thoughts, feelings, and attitudes.

The report of this Soviet research involved only a single individual. Is the same result observed when several individuals are tested under more controlled procedures? Subsequent research in Western laboratories has been promising. Acker and Edwards (1964), for instance, conducted a study in which a *vasomotor response* (constriction of the blood vessels in the left index finger) was classically conditioned to the word *good* or *bad*. Following conditioning, subjects were exposed to words that had been rated previously on an attitude scale. Thus, the investigators knew from this scale which words subjects thought were good and which words they thought were bad. In the subsequent test phase, the words were presented to subjects while vasomotor activity was monitored. Results indicated the appropriate generalization of vasoconstriction to words: Subjects for whom *good* had served as the CS showed vasoconstriction when words with positive connotations were presented, whereas subjects for whom *bad* had served as the CS showed vasoconstriction when words with negative connotations were presented.

Summary

An alternative to monitoring a naturally occurring physiological response to an attitude stimulus is to (a) link a unique physiological response (e.g., salivation) to the mental event of interest (e.g., a particular attitude) using semantic conditioning and (b) assess the extent to which this conditioned response is observed when various stimuli are presented. Although the classical conditioning approach is cumbersome in regard to the equipment involved and the initial conditioning that must be done, these costs may well be worth it to obtain a more accurate and complete mapping of a person's attitudes. Interestingly, this approach has seen some application in the study of attitudes but none, to our knowledge, in the area of lie detection. This may be one instance, therefore, in which there are lessons from the study of attitudes for investigators interested in the detection of deception.

Conclusions

Most of what is known about attitudes is the result of investigators asking people to report their attitudes. These reports might be made by responding aloud, as in telephone interviews, or by marking a position on a scale with a pencil. But do the responses people give truly represent their attitudes? For instance, research on attitudes and behaviors indicates that attitudes—as assessed by self-report measures—are sometimes predictive of intentional behaviors. Furthermore, research has shown that attitudes that come to mind quickly can have more impact on self-reports and short-term behaviors than those that come to mind more slowly (see Chapter 4 by Fazio and Roskos-Ewoldsen). However, just as long-term memories can influence a person's behavior subtly even when the person cannot tell you what those memories are, an attitude may also exert subtle influences on behavior even when the person is unable to identify or report the attitude. Although we have found it useful to ask subjects in our studies of persuasion to report their attitudes (see Chapter 6 by Petty, Cacioppo, Strathman, and Priester, this volume), we have not considered self-reports of attitudes to be the standard against which the validity of all other approaches should be measured (see Cacioppo, 1991; Cacioppo & Petty, 1986; see also Banaji & Greenwald, 1991).

How then can one study attitudes if one cannot always believe what people say? In attempting to answer this question, we have noted parallels between the study of attitudes and the study of concealed information (i.e., lie detection), and we have outlined several theoretically based approaches to detecting people's attitudes when they will not say, cannot say, or do not even know. Did former President Richard Nixon know about the Watergate burglary from the outset, or did he simply become an unwitting participant in a cover-up that ultimately cost him his presidency? Was Gordon Liddy, the convicted Watergate burglar, being loyal to the United States, as he claimed, or more specifically to his boss, Richard Nixon?

Different tactics discussed in this chapter might be the most appropriate to obtain answers to these questions. President Nixon claimed from 1971 through 1975 that he was unaware of the planning of the Watergate break-in and that he had not participated in any cover-up to protect himself or the participants. If Nixon had denied having advanced knowledge about the break-in using the bogus pipeline procedure, one would have greater confidence that he was telling the truth. We would still not know the answer to the key question, however: Had Nixon been informed of the break-in and did he help orchestrate the Watergate cover-up?

The SIT might have proved a more expedient probe of this question than the years of interviewing witnesses, plea bargaining for testimony, and investigative reporting that were required to implicate Nixon. This is because specific questions about the Watergate cover-up and the principals involved should have had greater significance to Nixon if he had been involved in the Watergate cover-up than if he had not been involved. Gordon Liddy was so cool and controlled under questioning, on the other hand, that linking physiological responses to a concept such as loyalty or favorability through semantic conditioning may have proven more informative.

As we have noted in the present chapter, to date, these procedures have sufficient limitations that the outcomes of such tests should be considered suggestive rather than definitive. But it is not difficult to imagine that, in the not too distant future, a sample of persons from the population might be tested physiologically to gauge the honesty of responding to key questions in national surveys or that facial EMG responses or event-related brain responses might be used to measure feelings that people are unwilling or unable to report accurately. With such advances will come new and challenging ways of thinking about attitudes and persuasion, exciting new developments in theory and applications, and, most importantly, social and ethical responsibilities to ensure individual rights and privacy.

Notes

1. Due to space limitations, the present chapter deals with the role of bodily responses as a means of studying attitudes and does not deal with the role of bodily responses in the development, maintenance, and changing of attitudes. Interested readers may wish to consult Buck (1984), Cacioppo, Petty, Losch, and Kim (1986), Petty and Cacioppo (1983), and Zajonc and Markus (1982) for discussions of how bodily responses might influence attitude change and resistance to change.

2. Of course, this procedure has some problems. For example, an innocent person who did not believe in the reliability of the donkey might refuse to pull the tail, thereby appearing guilty. Alternatively, a guilty person who did not believe in the donkey might comply with pulling the tail, thereby appearing innocent.

3. The skin resistance response (SRR) is the reciprocal of the skin conductance response (SCR). Measurement of electrodermal activity in units of skin conductance is preferable because it is less affected by the background level of electrodermal activity, is more linearly related to sweat secretion (Darrow, 1964), and tends to be more normally distributed (Edelberg, 1972). For the sake of simplicity here, we use the term *electrodermal responses (EDRs)* to refer to phasic increases in the sympathetic activation of the eccrine (sweat gland) system whether SRRs or SCRs were employed.

4. Although we shall refer to general facial areas (e.g., cheek, brow) rather than to specific muscle regions, we do so here for didactic purposes only. For instance, the *cheek* is of interest because the zygomaticus major muscle, which when contracted pulls the corners of the mouth upward and back (i.e., into a smile), is associated with positive emotional states, whereas the *brow* is of interest because the corrugator supercilii muscle, which when contracted pulls the brows together and down (i.e., into a frown), is associated with negative emotional states. Discussion of the actual placements and recording procedures are beyond the scope of this chapter, although interested readers might consult Cacioppo, Tassinary, and Fridlund (1990).

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