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EMOTIONAL LEARNING AND MECHANISMS OF INTENTIONAL PSYCHOLOGICAL CHANGE

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Appraisal theory is currently one of the most influential psychological theories of emotion (Parkinson, 1997). According to most versions of appraisal theory, emotional experience stems from an evaluative interaction between person and environment. An individual evaluates or appraises the qualities of an object, person, or event and an emotional experience results. Lazarus (1968, 1991, 1993; Lazarus & Folkman, 1984) has presented a comprehensive appraisal theory of emotion based on a central tenet: One must consider both environmental presses and attempts to cope with those presses to understand fully the nature and intensity of emotional experience. *Primary appraisal* refers to the individual's evaluation of whether a situation has relevance for his or her personal well-being, and is an assessment of whether or not a threat is present in the environ-

ment. Threat is defined by the presence of cues indicating imminent damage or harm (either physical danger or danger to the individual's self-worth or self-esteem; Eysenck, 1989; Paterson & Neufeld, 1987). *Secondary appraisal* refers to the individual's evaluation of available resources, and is an assessment of whether he or she has the resources to cope with the threat, should it materialize. The specific emotional response is thought to result from a combination of primary and secondary appraisal processes. Most appraisal theories of emotion emphasize the association between the content of secondary appraisal processes and the specific emotional experience (such as sadness, fear, or anger).

In this chapter, we focus on a signal detection framework to describe how multiple experiences with threat in early life will lead to an automatic judgment strategy designed to minimize misses, a "zero-miss strategy," later in life. We suggest that a zero-miss strategy is related to enhanced emotional responsivity and is extremely difficult to change in adulthood because it is deployed without awareness. Furthermore, we argue that the only way to change this strategy is through the development and deployment of intentional strategies that can be learned in adulthood, and we consider the psychotherapeutic context as one place where this intentional self-development can take place. We then review evidence for these ideas from learning and neurobiological research. In addition, we make some prescriptive suggestions for the psychotherapeutic change process based on this research.

We begin by drawing on signal detection theory (SDT) to explain how primary appraisal patterns, and thus emotional reactivity, are developed and maintained over the life span with little attentional effort. Using the concepts of sensitivity and bias, we suggest that a person's previous learning history can decrease sensitivity to threat cues (i.e., reduce accurate detectability of threat) and/or increase response bias, thereby producing a zero-miss judgment strategy and enhanced emotional responsivity. This can be adaptive or maladaptive, depending on environmental contingencies. We then argue that the zero-miss strategy and the associated emotional consequences are automatically deployed and therefore resistant to change, primarily because of previous emotional learning that is well entrenched. Next, we present evidence from neurobiological and learning studies of emotional conditioning in animals and humans in support of our framework. Based on this evidence, we suggest that individuals must develop and deploy new judgment strategies in a deliberate, intentional fashion to overcome their previous emotional learning history, but only when emo-

tional relearning is targeted and skills for the management of negative affect are taught. Finally, we suggest that psychotherapy is only one potential context in which this intentional self-development can take place.

PRIMARY APPRAISAL OF THREAT AND ENHANCED EMOTIONAL RESPONSE

An Overview of Signal Detection Theory

Signal detection theory was originally designed to assess an observer's behavior when attempting to detect weak psychophysical signals (Green & Swets, 1966/1974; McNicol, 1972). Considerable evidence suggests that SDT provides a good framework for investigating a wide range of human judgment behavior, including judgments of subtle, covert psychological experiences (e.g., pain, distress, fear, and memory), judgments of ambiguous social information (Grossberg & Grant, 1978; Harvey, 1992; Swets, 1986), and, most recently, primary appraisals of threat (Feldman Barrett, 1996; Feldman Barrett & Fong, 1996). A primary appraisal of threat is a judgment of a high subjective probability that danger to the self will develop (Milburn & Watman, 1981). The harm can be either psychological or physical. Psychologically, threat typically consists of negative evaluations of the self, which can cause lowered self-esteem or negative affect (Feldman Barrett & Williams, 1998).

SDT's most significant theoretical contribution lies in its ability to separate an observer's behavior into two components: sensitivity and response bias (Harvey, 1992). *Sensitivity* has been defined as an observer's ability to detect accurately the presence or absence of target information. Sensitivity may vary because of differences in perceptual abilities or because of the properties of the stimulus. Any stimulus that has a high probability of occurrence, is intense, or is imminent (i.e., the proximity to danger is near) will be less ambiguous and therefore easier to detect (McNicol, 1972; Miller, 1979; Paterson & Neufeld, 1987). Threat cues, because of their social nature, are often difficult to interpret and identify, making them highly ambiguous (Fiske & Taylor, 1991; Paterson & Neufeld, 1987) and thereby limiting sensitivity to them.

In contrast to sensitivity, *response style* or *response bias* is defined as the observer's tendency to favor one response over another, independent of the base rate for the stimulus. Thus a response bias for threat exists when an individual judges a situation or person as threatening more or less

frequently than threat objectively occurs in that environment. Of course, psychological threat is difficult to assess in many cases because the actual status of the event is ambiguous and no concrete criterion for the judgment exists. For instance, a person may appraise a situation as threatening when in fact no harm is intended. When there is no clear objective stimulus criterion, judgment accuracy is difficult to assess. There are strategies for creating a criterion where one does not exist, however. For example, a third-party observer who is independent of the situation can be used to determine the presence or absence of the stimulus criterion (i.e., whether a threat occurred or not). Although the third-party observer may have motivations that influence where he or she sets the stimulus criterion, they are not the same motivations as those of the perceiver (which constitute bias). Thus the actual absence or presence of the threat cue is decided by an external source; it is ambiguous and probabilistic, but the relativity is taken out of the hands of the perceiver, and this allows one to distinguish between the decision criterion, which is related to the perceiver's perception of the stimulus, and the stimulus criterion, which is not. This is a crucial point, because response biases are particularly likely to operate with the detection of threat: Sensitivity to threats can be limited and therefore response bias has more room to influence any given judgment. Furthermore, there is no requirement that individuals must be consciously aware of their response biases, and in fact biases typically function outside the observer's awareness (Harvey, 1992).

According to SDT, the observer perceives situationally relevant information that he or she then compares to an internal decision criterion (X_c). The location of this decision criterion determines the observer's response bias (Harvey, 1992). This process is portrayed in Figure 15.1. If the available evidence is stronger than the decision criterion, then the observer will say yes, the stimulus is present; if the evidence is weaker than the decision criterion, then the observer will say no, it is not (for discussion of responses using continuous or probability ratings, see Harvey, 1992; Macmillan, 1993). To determine the accuracy of the observer's perception, judgments are compared to a stimulus criterion (Y_c) indicating the probability that the stimulus actually did or did not occur. For a given decision criterion and stimulus criterion there are four possible judgment outcomes. A *positive hit* occurs when the observer responds yes and the target stimulus did appear; a *correct rejection* occurs when the observer responds no and the target stimulus did not appear; a *false alarm* occurs when the observer responds yes but the target stimulus did not appear; and a *miss* occurs when

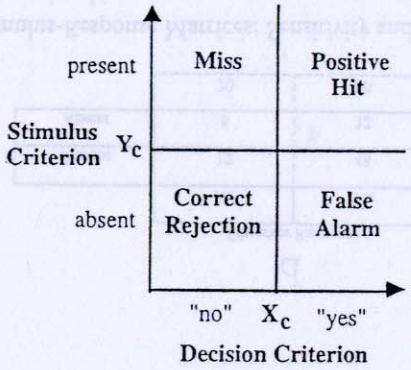

Figure 15.1. Decision Space

the observer responds no but the target stimulus did appear. Notice that as X_c increases, the observer has a higher threshold for saying no. As a result, positive hit and false alarm rates will decrease, whereas the miss and correct rejection rates will increase. As X_c decreases, the observer has a lower threshold for saying yes, so that the positive hit and false alarm rates will increase, whereas the miss and correct rejection rates will decrease.

An observer's decision criteria are influenced by three factors: (a) the observer's beliefs about the base rates of the event, (b) the goals that she or he has when making a judgment about the event (Egan, 1975; Green & Swets, 1966/1974; Healy & Kubovy, 1978), and (c) the observer's perception of the severity and consequences of a miss or false alarm (Feldman Barrett & Fong, 1996), especially when the identity of a stimulus cue is uncertain.

Evaluating the observer's hit rate in the context of the number of misses and false alarms provides information about his or her sensitivity and response bias (Harvey, 1992). Figure 15.2a presents a stimulus-response matrix for an observer with perfect sensitivity: He or she has a hit rate (positive hits + correct rejections) of 100%, with no false alarms and no misses. Figure 15.2b presents a matrix for an observer with no bias: He or she produces judgments that match the stimulus marginals (the base rate for the event). Notice that this observer also has a sensitivity greater than zero because his or her hit rate is greater than chance. Figure 15.2c presents a matrix for an observer with complete bias: He or she judges the event to occur 100% of the time. Figure 15.2d presents the most typical stimulus-

response matrix: Most observers display some degree of sensitivity as well as response bias in their judgments.

Primary Appraisals of Threat From an SDT Perspective

When making judgments under uncertainty, most researchers agree that it is adaptive to use the base rates of the event (Nisbett, Krantz, Jepson, & Fong, 1982; Tversky & Kahneman, 1982). This judgment strategy allows the observer to minimize both false alarms and misses while maximizing hit rates. In general, however, people tend not to rely on base rates when making judgments in uncertain conditions (for a review, see Kahneman & Tversky, 1982). Psychologists have argued that this failure to use base rates exists for a number of cognitive reasons (e.g., people attend to the wrong information or fail to apply statistical logic).

There is also a motivational reason for not relying on base rates, namely, self-protection (Feldman Barrett, 1996; Feldman Barrett & Fong, 1996). Judgment errors (i.e., misses and false alarms) may differ in their consequences and reinforcement power, and this should in turn affect people's judgment strategies. Failing to detect a veridical threat (i.e., a miss) will cause a person to experience the full force of the threat and incur psychological or physical damage. In contrast, detecting a threat when none is there (i.e., a false alarm) will cause interpersonal disruption, behavioral restriction, and needless anxiety (e.g., Mathews & MacLeod, 1994), resulting from the erroneous perception of the self as vulnerable and of others as intending harm when this is not the case (Horney, 1950; Leary, 1957; Sullivan, 1953). We propose that because people are motivated to protect themselves, their response biases (i.e., where they locate their decision criterion, X_c) are determined by the types of errors they are trying to minimize.

The relative costs of misses and false alarms are determined by environmental conditions (Feldman Barrett & Fong, 1996). In threatening environments, when the base rate for threat is high (i.e., there is a large prior probability of threat in the environment), misses should be more costly and judgment strategies should be associated with the goal of reducing the number of misses at the expense of producing more false alarms. Consider the stimulus-response matrices in Figure 15.3 that represent an environment with a high base rate for threat. If the observer can accurately appraise the presence or absence of threat in every event (Figure 15.3a), he or she has a hit rate of 100%, with no misses or false alarms. However, considering

a

State of Stimulus	Observer Response: No	Observer Response: Yes	
Present	0	60	60
Absent	40	0	40
	40	60	

b

State of Stimulus	Observer Response: No	Observer Response: Yes	
Present	24	36	60
Absent	14	24	40
	40	60	

c

State of Stimulus	Observer Response: No	Observer Response: Yes	
Present	0	60	60
Absent	0	40	40
	0	100	

d

State of Stimulus	Observer Response: No	Observer Response: Yes	
Present	12	48	60
Absent	8	32	40
	20	80	

Figure 15.2. Stimulus-Response Matrices: Sensitivity and Bias

a. Perfect sensitivity and no bias.
b. Imperfect sensitivity and no bias.
c. Imperfect sensitivity and complete bias.
d. Imperfect sensitivity and some bias.

the ambiguous and inconsistent nature of most psychological threats (Fiske & Taylor, 1991; Paterson & Neufeld, 1987), it is unlikely that a person would obtain this perfect hit rate because the ambiguity and unpredictability of stimuli would reduce sensitivity. If the individual relies on base rates (Figure 15.3b), he or she will experience misses 16% of the time and false alarms 16% of the time. Thus 16% of the time the individual would face a threat unprepared because she or he failed to detect it, and 16% of the time she or he would prepare for a threat that never materialized. In a threatening environment, the individual may perceive misses to be more costly because of the magnitude or frequency of harm that is incurred. Aversive learning associated with failing to detect a threat when it is present will likely take place, and as a result the individual will minimize misses at the expense of engaging in more false alarms.[1]

To reduce the number of misses, the individual can substantially lower her or his decision criterion, thereby causing most cues to exceed threshold and be perceived as threats. Feldman Barrett and Fong (1996) call this a *zero-miss strategy*. Any cue, however weak, will exceed threshold and the individual will perceive the presence of a threat. By responding to every event as a potential threat, the individual maximizes his or her positive hit rate and minimizes misses (Figure 15.3c). In a sense, such an individual is being trained to be emotionally responsive to the environment.[2]

Each primary appraisal of threat will result in a negative emotional response that must be dealt with in some way. Individuals can protect themselves from harm (and the associated negative affect) by manipulating either their external or their internal environment (Lazarus & Folkman, 1984). They can manipulate their external environment through actions designed to decrease either the probability of the threat's occurrence or the impact of the threat once it occurs (Lazarus & Folkman, 1984). If behavioral interventions are not possible, the threatened individual can manipulate his or her internal environment through cognitive strategies and can change the meaning of the event in conscious thought (i.e., defense mechanisms; Lazarus & Folkman, 1984). In this case, the conscious construal of the event is distorted, and negative affect is damped as a result.

Although the zero-miss strategy allows the individual to avoid missing a potential threat, it has a cost because it produces an increase in the false alarm rate. For some portion of the time, individuals using a zero-miss strategy will perceive threat where the probability of danger is low or nonexistent, and there may be negative consequences associated with this form of dysregulation. Yet when the base rate for threat is high, this increase

a

Reality	Appraisal: No Threat	Appraisal: Threat	
Threat	0	80	80
No Threat	20	0	20
	20	80	

b

Reality	Appraisal: No Threat	Appraisal: Threat	
Threat	16	64	80
No Threat	4	16	20
	20	80	

c

Reality	Appraisal: No Threat	Appraisal: Threat	
Threat	0	80	80
No Threat	0	20	20
	0	100	

d

Reality	Appraisal: No Threat	Appraisal: Threat	
Threat	0	20	20
No Threat	0	80	80
	0	100	

Figure 15.3. Stimulus-Response Matrices: Strategies and Environments

a. Correct judgments in a threatening environment.
b. Use of base-rate information in a threatening environment.
c. Use of zero-miss strategy in a threatening environment.
d. Use of zero-miss strategy in a nonthreatening environment

in false alarm rates is only slight, and the emotional and possibly even physical consequences of a miss far outweigh the costs of a false alarm. As a result, the cost associated with an increased false alarm rate might be preferred over the cost of misses under these environmental conditions. Although we might not describe the zero-miss strategy as accuracy-seeking or rational (i.e., one is not using statistical information and formal logic to make primary appraisals), it is a rule learned through interactions with the environment that allows for optimal adaptation in a particular context (Einhorn, 1982). Thus false alarms can be considered "errors" in the strictest sense, but they are not mistakes with respect to a broad frame of reference, because the zero-miss strategy that produces an increase in false alarms is adaptive for individuals living in conditions of high threat (see Funder, 1987).

Thus far, we have reasoned that the perceiver adjusts the location of the decision criterion (i.e., sets his or her response bias) as a function of (a) the prior probability of psychological threat in that environment, (b) the motivation to protect the self, and (c) the relative consequences of misses and false alarms. We reason that the individual should employ a zero-miss strategy in any environment or context where a threat cue is present or in any similar context that shares cues (i.e., such as persons, objects, sounds, smells, or other sensations) with the environment in which threat was previously evoked (Bouton, 1988, 1993).

If the detection of threat is under the control of feedback and reinforcement contingencies, then the individual who habitually uses a zero-miss strategy will develop a model of the world as a highly threatening place. People learn the utility of their decision strategies on the basis of the number of positive hits (and therefore the number of misses) while generally ignoring the number of false alarms (Einhorn, 1982). Thus the individual growing up in a high-threat environment learns from experience that a zero-miss strategy produces the most beneficial effect. Furthermore, escape from threat is a negative reinforcer, the intensity of which increases with the intensity of the threat. Through feedback and reinforcement, the individual will develop cognitive structures that facilitate threat detection and set the expectancy that all experiences are potentially dangerous or harmful. As a result, the individual who lives in a threatening environment develops well-entrenched assumptions that ambiguous stimuli are threatening stimuli (Ittleson & Kilpatrick, 1951; Kahneman & Tversky, 1982). These assumptions function automatically and effortlessly (Posner, 1978) and are usually inaccessible to conscious knowledge or intention (Kahne-

man & Tversky, 1982). As a result, the individual may be well adapted to the conditions of the current environment, and yet may be completely unaware that he or she has been trained to be an "expert" in threat detection.

In sum, an individual may develop and maintain primary appraisal patterns over his or her life span with little attentional effort or awareness. The ambiguity typically associated with threat cues limits sensitivity. Limited sensitivity, combined with high base rates for threat in the environment, influences an individual to adopt a self-protective goal associated with a low decision criterion, X_c. The result is an individual who has developed a view of the world as threatening and dangerous, who is emotionally responsive, but who is well adapted to the conditions of a threatening environment. This same individual may be unable to calibrate his or her judgment strategies, however, when the base rates for threat change.

Failure to Calibrate to a Changing Environment

One aspect of adaptation is the ability to assess and respond to changes in the environment (Keren, 1987). When the amount of threat endemic to the environment decreases, it would be adaptive for the individual to abandon a zero-miss strategy and to calibrate his or her judgment strategy to the new environmental conditions. If the base rate for threat decreases and the individual does not adjust his or her decision criteria accordingly, that person's false alarm rate will increase substantially (e.g., comparing Figures 15.3c and 15.3d, false alarm rates increase from 20% to 80%), as will the psychological consequences associated with that type of error. As a result, the individual will appear highly emotionally reactive to the environment, often "overreacting" to cues that others would consider nonexistent (i.e., the individual will experience and express frequent and intense negative emotional responses, whether or not the environment warrants them). The negative affect that results from an excess of false alarms may be difficult to manage if the individual has not learned effective affect regulation skills. In addition, the individual may also have developed particular physiological response patterns, such as enhanced cardiovascular or gastrointestinal reactivity to threats (e.g., Krantz & Manuck, 1984), that can also heighten the negative affective experience associated with a primary appraisal of threat.

An individual with a high false alarm rate may also experience significant interpersonal disruption that results from being suspicious and expecting the worst from others, and this may actually increase the number of perceived or real threat cues in the environment. Such an individual may use offensive or preemptive strategies to avoid anticipated threats from others, which may cause disruptions in communication and may, in turn, alter other persons' behavior to produce a self-fulfilling prophecy. For example, if another person is confused, angered, or threatened by the individual's preemptive maneuver, this may lead to an even greater likelihood that he or she will pose a threat to the individual. In addition, the individual may not have significant others to rely on to help with affect management because of the difficulty of maintaining a supportive social network when one is overly vigilant to threat.

Therefore, from a number of psychological vantage points, false alarms are more costly than are misses when the base rates for threat are low. As a result, a zero-miss strategy, although adaptive in a threatening environment, is not so adaptive in a nonthreatening environment. Individuals who rely on a zero-miss strategy may have difficulty calibrating their judgments to changes in environmental conditions. Failure to adjust decision criteria in response to new base rates for threat can occur for cognitive, behavioral, and emotional reasons.

Cognitive reasons. Individuals using a zero-miss strategy may fail to detect changes in their environment because their sensitivity to the absence of threat cues is limited by cognitive bias. Previous experiences with threat produce cognitive structures that direct attention to information that is consistent with threat and filter out whatever is inconsistent (Fiske & Taylor, 1991). As a result, an individual will develop cognitive structures that (a) facilitate threat detection, (b) chronically prepare the individual to deal with ambiguous events as if they are threatening, and (c) produce the expectancy that most experiences have the potential to be dangerous or harmful. Previous research suggests that implicitly held expectancies mediate the large effects of context on recognition and exert their greatest influence on the interpretation of ambiguous stimuli (Epstein & Roupenian, 1970). Expectancies that have developed over a lifetime of previous experience not only have a profound effect on judgments, but they are usually inaccessible to conscious knowledge or intention, function automatically and effortlessly, and essentially constitute a dispositional preparedness for detecting threat (Ittleson & Kilpatrick, 1951; Kahneman

& Tversky, 1982; Posner, 1978). As a result, the individual may not be consciously aware that he or she has been "trained" to detect or avoid threat and may have limited sensitivity to the increase or decrease in threat cues in a new or changed environment. In addition, decision rules are typically learned deductively (Einhorn, 1982) and are used without intention or awareness (Lewicki, Hill, & Sasaki, 1989). These decision rules structure the encoding of ambiguous information such that it is seen as confirming evidence and thereby strengthens the further use of the rule (Kahneman & Tversky, 1982). As a result, confirmatory biases lead people to try to verify, rather than falsify, their working hypotheses about the world. In turn, individuals may suffer from the illusion of validity (Einhorn & Hogarth, 1978), causing them to be overconfident of the truth value of their judgments.

Behavioral reasons. Individuals using a zero-miss strategy may fail to calibrate to changes in the base rates for threat because of behavioral restrictions. Avoiding certain situations and certain people is one way to avoid a miss. Such avoidance prevents individuals from encountering disconfirming evidence, however, and that in turn likely contributes to the maintenance of a zero-miss strategy.

Emotional reasons. Individuals using a zero-miss strategy may fail to calibrate to a change in environmental conditions due to previous emotional learning. By *emotional learning,* we refer to an individual's ability to retain associations between specific stimuli or contexts and the emotional responses to those stimuli or contexts. Emotional learning is essentially a bottom-up phenomenon. By *bottom-up,* we mean that it occurs via processes that are quick, nonreflective, and automatic. Both the subcortical activation associated with emotion (e.g., LeDoux, 1996) and the automatically deployed appraisal processes we are describing here occur without awareness or conscious allocation of attention, and so can be considered bottom-up processes. We suspect that individuals using a zero-miss strategy are likely to have learned strong, stable associations between specific stimuli and contexts on the one hand and bottom-up processing producing negative affect, in particular fear, on the other. It is these associations that make it especially difficult for the individual to learn and maintain new associations to changed environmental contingencies. We review the evidence for this claim below.

In addition to having strong associations between fear responses and previously threat-related stimuli or contexts, the individual using a zero-

miss strategy may also exhibit new learning if he or she engages in an inadvertent miss. Following a miss, not only will the individual suffer the consequences of exposure to the threatening stimulus, but he or she may recollect or even reexperience previous situations in which he or she was harmed in some way. Furthermore, the individual's perceived physiological reactivity to threats may function to heighten the intensity of negative affect associated with a miss.

Thus misses will likely retain strong motivational currency for someone using a zero-miss strategy, not only because the miss may have current negative consequences, but because it may also evoke the long-retained memories of negative emotional responses experienced in the formative environment, where misses were costly. Because judgment errors (i.e., inadvertent misses) are emotionally disruptive to the individual, they may retain strong reinforcement power and may subsequently reinforce readoption of the original zero-miss appraisal strategy.

Summary

Thus far, we have argued that a zero-miss strategy produces an emotionally responsive individual who is an expert at functioning in a threatening environment, but this strategy may leave the individual at a disadvantage when the environmental conditions change. The individual using a zero-miss strategy has a strong pattern of bottom-up activation of threat detection as well as emotional memories associated with threat, resulting in experiences of frequent and intense negative affect. The individual is also in a constant state of preparedness for threat and thus is well adapted to a threatening environment. However, the individual will have difficulty calibrating to a low-threat environment. We now turn to findings from both nonhuman animal and human studies on emotional conditioning to demonstrate that emotional learning in contexts of threat is long-lasting and relatively resistant to change.

EMOTIONAL LEARNING ABOUT THREAT-RELATED STIMULI AND CONTEXTS

Throughout the animal kingdom, the ability to learn about conditions associated with danger or threat is present (LeDoux, 1996). It has been suggested that the neural systems that permit the organism to predict and avoid threat have been necessary for survival in the course of evolution.

Those organisms that best avoided harm and could predict its future occurrence were more likely to survive to pass along their genes and raise their offspring to reproductive maturity. Moreover, nonhuman animals and humans appear to share similar physiological and subcortical responses to stimuli and contexts that predict imminent danger.[3] In the emotional learning literature, this response is generally labeled *fear*; we will use this conventional terminology in describing those findings.

Because learning about fear cues appears to be so well conserved across phyla, we have amassed considerable data on the neural mechanisms and psychological processes integral to fear learning in both human and nonhuman animals (for review, see LeDoux, 1996; also see Bouton, 1988). These data have provided us with some important clues about the initiation and maintenance of fear learning, as well as the difficulties inherent in "unlearning" fear responses, that are consistent with our SDT analysis. Furthermore, findings from studies of extinction and counterconditioning of fear responding suggest that humans need to develop and employ deliberate behaviors in order to calibrate intentionally to new, less threatening environments.

Initial Learning About Threat

Initial emotional learning about threat is believed to occur when cues in the environment inadvertently become paired with an occurrence of true threat or danger. Consider the case of a child living in a physically abusive environment. Abusive events (i.e., the threats) take place typically within the home context and at the hands of a particular person or persons. As a result, cues from the abusive environment, the abuser, and other seemingly irrelevant cues that are merely present during the threatening events can become associated with danger. In the future, these serve as threat cues (i.e., indications that danger is imminent).

Learning about cues predicting threat is privileged. Thus learning about events that engender threat can occur quickly, often following only a single pairing of a threat and a co-occurring cue, and this learning can be retained without degradation for relatively long periods (e.g., over years; LeDoux, 1996). Other survival-related learning, such as conditioned taste aversions, is also attained rapidly and demonstrates a remarkable stability over long periods of time. Fear cues that are learned in formative environments and are retained in later life may outlive their usefulness to the individual, however, in that they may not be reliable predictors of danger in the adult

environment, where threat is likely to be less frequent. Because fear learning is so stable, associations with now irrelevant cues of threat may remain long after those cues no longer provide reliable prediction of danger. This retained fear response to cues that no longer predict threat typifies the adult using a zero-miss strategy.

Extinguishing and Counterconditioning Threat Responses

We have argued that individuals using a zero-miss strategy will find it difficult to calibrate their judgments to changing environmental conditions. Recent evidence from both learning theory and neurobiological studies of fear extinction and counterconditioning confirm that it is difficult to eliminate learned associations between true danger and potential threat cues. Since Pavlov's (1927) descriptions of spontaneous recovery, in which extinguished learned behaviors reemerged after the passage of time, we have known that neither extinction (the removal of the original learned association) nor counterconditioning (forming a new association between the learned fear cue and a nonfear response) completely removes the associations between threat cues (i.e., conditioned stimuli) and threats (i.e., unconditioned stimuli; Bouton, 1994a). Old associations are not replaced; rather, they merely coexist with new associations.

New (or counterconditioned) associations present a particular challenge to the individual using a zero-miss strategy. New associations to previous threat cues increase the ambiguity of the cues, because there are now multiple, competing associations linked to the same event. For the new associations to affect behavior, the individual must engage in considerable effortful processing and select from among the multiple associations with that cue. That is, the individual must develop and employ intentional, deliberate judgment strategies so that his or her attention and behavior are disproportionately influenced by the new association relative to the old.

Intentional, deliberate behaviors of any kind require attentional resources. Thus manifestations of the original fear learning should reemerge under circumstances in which attentional resources are limited. In situations where effortful processing is too demanding, in which the individual is under a substantial processing load or cannot effectively deploy attentional resources, or in which the new associations are less accessible, the learned fear response will reemerge because the individual cannot effectively access and use the newly learned associations to guide behavior

(Bouton, 1994a, 1994b; LeDoux, 1996, p. 250). For example, stressors can lead to the reemergence of responding to old threat cues (Jacobs & Nadel, 1985).

These hypotheses are further buttressed by neurobiological studies indicating that certain memories, particularly those related to fear, leave virtually indelible traces in the brain (LeDoux, Romanski, & Xagoraris, 1989; Quirk, Repa, & LeDoux, 1995). Such studies have shown that even after extinction of fear responses to a conditioned stimulus, an animal's brain retains changes in neuronal firing patterns (Sanghera, Rolls, & Roper-Hall, 1979) or in neuronal connections between cells (Quirk et al., 1995) that were not present prior to learning. Thus the neural traces that were strengthened during learning about threats are not eliminated by extinction, and this may help explain why the fear response can so easily reemerge. When extinction does occur, then, we cannot assume that the original learning is gone. Rather, it seems to be masked by newer learning. This masking of old responses by new learning may take place via connections from higher cortical structures, such as the medial prefrontal cortex, to subcortical areas integral to fear learning (such as the amygdala; Morgan, Romanski, & LeDoux, 1993). Moreover, the conscious apprehension of emotional states also likely requires cortical structures (such as the lateral prefrontal cortex, cingulate cortex, and orbitofrontal cortex; LeDoux, 1996, pp. 273-278). As a result, any process that limits cortical activity or requires the division of cognitive resources (e.g., increased cognitive load or multitasking that limits working memory resources) could permit a return of the initial fear response. This may explain why, when under significant stress, people experience a resurgence of the fear response. It also suggests that any interference with controlled cognitive processing may interfere with an individual's deliberate attempts to give up the zero-miss judgment strategy.

Reinstatement and Renewal of Threat Responses

Not only will stress make it difficult to access counterconditioned responses, it may provide cues similar to those in the formative environment, in effect priming old associations to the threat cue and ultimately leading to a reemergence of the learned fear response. This type of reemergence is called *reinstatement.* Reinstatement occurs when an extinguished fear response reemerges because the individual perceives a veridi-

cal threat (Bouton, 1988, 1994a; Bouton & Swartzentruber, 1991); that is, the old association is primed, and the fear response reemerges as a result. Fear can be reinstated easily—only a few exposures to a veridical threat cue are enough to prime old associations. For individuals who rely on the zero-miss strategy, reinstatement of fear could occur simply as a result of the occurrence of a few threats or stressors in the individual's home or work environment, even when the overall base rate of threat in the environment is low. Furthermore, if the individual fails to detect the veridical threat and there are adverse consequences of the miss, the result might be negative reinforcement of the zero-miss strategy.

The mere presence of a cue associated with threat also can be enough to prime old associations, especially when the individual is no longer in the context where extinction or counterconditioning occurred. This type of reemergence of the fear response is called *renewal.* Renewal occurs when cues that were associated with threat (i.e., conditioned stimuli) appear either in a new context or in the context in which the original associations were formed (Bouton, 1994a, 1994b; Bouton & Swartzentruber, 1991).[4] Thus, even if an individual using the zero-miss strategy manages to learn new associations to old threat cues and to allocate attention to employ the new judgment strategy in a particular context, fear may emerge when that stimulus is encountered in a new environmental context.

Generalization

Finally, considerable generalization in the learned fear response is likely to occur (Jacobs & Nadel, 1985). Contexts that share aspects of the original fear learning environment may renew learned fear responses. As a result, any feature of a new, benign environment that is perceptually similar to the threatening, former environment might induce an individual to readopt a zero-miss strategy. Furthermore, although initial fear learning tends to be context independent (i.e., considerable generalization occurs to other cues that come to signal threat), fear extinction is relatively context-bound and susceptible to disruption by changes from the counter-conditioned context (Bouton, 1988, 1993, 1994a, 1994b; Bouton & Swartzentruber, 1991). If, for example, the grocery store contains few cues associated with the context in which fear associations were extinguished, but does contain cues associated with the original fear context, then the similarity of cues between the old environment and the current environment (i.e., grocery store) can serve to renew fear.[5]

Can Automatic Fear Responses Be Unlearned?

Given the counterconditioning, reemergence, and generalization effects that we have just considered, it seems not only difficult for an individual to stop using a zero-miss strategy permanently when there are cues that can serve to initiate the fear response, but also unlikely that he or she will do so. Animal research provides evidence of learning and neurobiological processes that could easily support a stably maintained zero-miss strategy in humans. This evidence suggests not only that failure to calibrate completely is plausible, but that it perhaps should be expected. The only remedy for calibration seems to be the development and intentional use of deliberate judgment strategies. If the suppositions about learning processes and neuronal involvement in emotional relearning are correct, then these findings have prescriptive implications for the use of psychotherapeutic strategies for emotional relearning.

CONDITIONS FOR CHANGING THE ZERO-MISS STRATEGY

Thus far, we have examined how a formative environment filled with threat and danger can produce an emotionally reactive threat detection expert. Judgment strategies that were automatically deployed and therefore adaptive in the initial environment leave the individual maladjusted to any environment that contains considerably less threat or danger. The bottom-up, automatic emotional learning associated with primary appraisals of threat may help to maintain the zero-miss judgment strategy. If an individual modifies this learned judgment strategy in any way, he or she will encounter more misses. Not only will the individual suffer the full consequences of a miss, but the learned fear response is likely to be reinstated. If the individual is exposed to cues that are contextually similar to those in the formative environment, the fear response may be renewed. And because misses will be emotionally disruptive to the individual, they may retain strong reinforcement power and may subsequently reinforce the readoption of the original zero-miss appraisal strategy.

Furthermore, learning studies demonstrate that associations between cues of threat and actual threat can become weakened through either extinction or counterconditioning, but that learned cues of threat likely will always retain some power to reinitiate a fear response. In part, this is due to the fact that cues of threat likely trigger very quick, nonconscious

responses that, once evoked, will require the zero-miss individual to use conscious processing to deactivate or turn off the initiated fear response (LeDoux, 1996, p. 265). In addition, cues of threat learned early in development by the zero-miss individual likely have special properties, such as being relatively independent of context and being highly generalized to many other cues that have also come to evoke fear responses (Jacobs & Nadel, 1985). Thus the zero-miss individual in the adult environment, even one with few real threats, has a learning history that predisposes her or him to continue to respond to cues previously associated with threat, and it is unlikely that she or he will easily relinquish the long-standing, ingrained zero-miss strategy.

Given all of the obstacles, can an individual change his or her primary appraisal judgment strategy and the resulting level of emotional reactivity? We suggest that it depends. Calibration of judgment strategies (and the resulting decrease in emotional reactivity) requires several preconditions. First, for an individual to decrease his or her response bias (set a new decision criterion), increase sensitivity in the primary threat appraisal process, and thereby decrease his or her emotional reactivity, he or she must receive repetitive, unambiguous feedback about the outcome of judgments (see the literature on calibration in medical and weather prediction domains, e.g., Lichtenstein, Fischoff, & Phillips, 1982; Murphy & Winkler, 1971). It is very unlikely, although not impossible, that this type of information can be garnered in normal social interactions that are inherently ambiguous in meaning. This type of feedback may be available under certain social conditions, such as in interactions with close others or attachment figures, in a psychotherapeutic context, or in other training programs specifically designed to foster the development of top-down judgment strategies (i.e., processes that require attention deployment and conscious reflection).

Second, to recalibrate his or her judgment strategy (and emotional response to an occasional miss), an individual has to overcome the various cognitive, behavioral, and emotional habits that increase the likelihood of his or her making judgments of threat when in fact no threat is really there. That is, the individual must reduce cognitive bias, reduce behavioral avoidance, and learn to actively inhibit the fear response associated with actual or learned threat cues. He or she can learn to achieve the first two goals through standard psychotherapeutic interventions. To reduce cognitive bias, the individual would have to (a) make his or her judgment strategy explicit and thus accessible for conscious intervention (e.g., increase reli-

ance on base rates for judgment) and (b) avoid confirmatory bias (i.e., learn to treat his or her view of the world as a hypothesis, rather than as a truism, and be willing to attempt to falsify this hypothesis). Such attempts at changing cognitive interpretations and bias are key to several forms of cognitive therapy (e.g., Beck, Rush, Shaw, & Emery, 1979). In addition to making cognitive changes, the individual would have to expand his or her behavioral repertoire to create a context within which to gather new information and try out new judgment strategies. The use of behavioral strategies for effecting psychotherapeutic change is typical of a variety of cognitive-behavioral approaches.

The third process, that of emotional relearning, is not so easily accomplished, as we noted above. If we take the view that both bottom-up processes (i.e., those that are quick, nonreflective, and automatic) and top-down processes (which are slower and require conscious reflection) are important to the construction of an emotional response, and if it is next to impossible to modify bottom-up processes, then the mechanisms for emotional change must focus on the development and implementation of top-down strategies. The emotional relearning aspect of emotional change has not played a major role in most psychotherapeutic modalities, however.[6] From the evidence reviewed, it is clear that although it is *necessary* for the individual to relearn new associations to cues that previously signaled threat, this relearning will likely not completely eradicate the old associations, and thus alone will *not be sufficient* to permit successful calibration. Given that a learned fear response can never be completely extinguished and can easily reemerge under various conditions, we propose that successful calibration also requires that a person (a) come to expect that the fear response will emerge at unexpected times and learn to label those responses explicitly as false alarms, (b) learn affect regulation skills that will permit him or her to tolerate the negative affect he or she will inevitably experience when occasional misses occur, and (c) develop strategies to maintain and flexibly deploy his or her attentional resources.

Prescriptions for Psychotherapy

Although calibration can occur in several contexts, people seem to gravitate to psychotherapy as a way of modifying their existing levels of emotional reactivity and associated judgment patterns. That is, people often choose therapy as a method for developing the intentional, deliberate judgment strategies that they need for behavior change. If a goal of therapy

is to eliminate responding to invalid cues of threat, then therapists should consider the many ways in which fear behaviors may reemerge. Therapists could begin with the assumption that fear reemergence is likely in most, if not all, clients.[7] Rather than focusing their efforts on attempting to eliminate relapse, instead therapists should assume that clients will continue to experience fear and focus their efforts on helping clients to continue calibration efforts even in the face of recurring fear responses. Permanent calibration will require that a client learn to tolerate negative affect and the other unpleasant manifestations of fear, and that he or she learn affect regulation skills while continuing calibration efforts.

In addition to a focus on management, rather than prevention, context is paramount to understanding when relapse to a zero-miss strategy will occur. A shift from the therapeutic environment (which is, in essence, the extinction or counterconditioning context; Bouton, 1994b) to the nontherapeutic environment may result in reemergent fear because the client is exposed either to cues associated with threat (as in renewal) or to actual threats (as in reinstatement). A renewal of the fear response can occur because the current external environment contains cues that the individual associates with threat in the formative environment (e.g., the sound of a drunk yelling, which is associated with an abusive parent) or even cues that have generalized to the present environment (e.g., the sound of anyone yelling). A reinstatement of the fear response can occur when new threats materialize in the current external environment (e.g., psychosocial stressors such as divorce or loss of a loved one). Either way, the individual may reexperience fear and resort to a zero-miss strategy outside the therapeutic context, even if this strategy has been essentially extinguished inside that context.

One strategy for avoiding renewal of fear is to make the client's current context as similar to the extinction context as possible (Bouton & Swartzentruber, 1991). In fact, relapse is predicted to be most likely when the constellation of contextual cues is more similar to the original learning environment than to the therapeutic environment (Bouton, 1994b). Some of the positive therapeutic impact of such tools as a palmtop computer containing suggestions for therapy may come from the strong associations the client has formed between such tools and the therapeutic context (e.g., Newman, Consoli, & Taylor, 1997). Recent studies in animals have also demonstrated that presenting retrieval cues associated with the extinction environment just prior to presentation of cues associated with threat seems

to prime the extinction associations and to reduce the renewal effect (Brooks & Bouton, 1993, 1994). Thus if therapy enables the client to recall or to have present aspects of the therapeutic context in his or her nontherapeutic environment, then the likelihood that fear will reemerge should be lessened. Based on learning theory, one also might predict that matching the extinction context to the original learning context would also maximize therapeutic success. Unfortunately, recent findings in rats demonstrate that renewal of fear can occur in a novel context even when both original learning and extinction have taken place in the same context (Bouton & Ricker, 1994).

Even if the client can retain or recall aspects of the therapeutic context, this may not preclude the reemergence of fear, because reinstatement effects also may come into play. Recall that reinstatement occurs when actual threats occur outside the therapeutic environment and fear responding reemerges (Bouton & Swartzentruber, 1991). One way to reduce reinstatement effects is to create strong associations between the nontherapeutic context and safety cues. Again, however, the practicality of this suggestion may be limited given that threats are typically present to at least some extent in the everyday environments of most people. In sum, these prescriptions for reducing the reemergence of fear lead to the inescapable conclusion that completely eliminating the possibility of relapse into fear responding may be a fruitless goal. Instead, we suggest that in addition to trying to minimize relapse, the therapist also work with the client to reduce the impact of the likely occurrence of at least some reappearance of inappropriate fear responding.

An alternative solution to the probably unrealistic goal of eliminating all real or conditioned threat cues would be to reduce the impact of such cues by teaching the client to be aware of them. If a client can identify threat cues from the original learning context or those that have generalized from the formative environment, then he or she can label the resulting fear response a "false alarm." This may be one way to break the association between the automatic fear response and the tendency to use a zero-miss strategy, thus reducing the likelihood of a relapse. Of course, in reality, it is difficult to identify these cues. Some cues are embedded in the context and, perhaps because they were learned via implicit processes, may not be accessible to conscious awareness (e.g., LeDoux, 1996). Furthermore, emotional and drug-induced states can also serve as contexts to promote renewal and may be difficult to eliminate or control (Bouton, Kenney, &

Rosengard, 1990; Bouton & Swartzentruber, 1991). Moreover, an individual who has engaged in a zero-miss strategy over a long period of time is likely to experience a higher base rate of interpersonal stressors that may serve either as cues associated previously with threat and promote renewal or as unlearned, veridical threats and promote reinstatement.

CONCLUSIONS

In sum, we suggest that therapy aimed at achieving the development of intentional self-regulation strategies, successful emotional learning, and therefore a reduction of the zero-miss strategy must include the following elements:

1. Provision of repetitive, unambiguous feedback about judgment outcomes in multiple contexts
2. Attempts to overcome cognitive bias by making judgment strategies explicit and accessible for conscious apprehension, and learning to avoid confirmatory bias
3. Prevention of behavioral avoidance and expansion of the behavioral repertoire to create a context for new learning
4. Activation of emotional networks in situ
5. Training of new affect regulation skills and tolerance of negative affect
6. Training to identify potential threat cues and to learn to label associated automatic fear responses as false alarms

None of these elements alone is sufficient for change. To the extent that any context includes all of these elements, the individual will be poised for change in both judgment strategy and emotional reactivity to the environment. Note, however, that acquisition and implementation of the skills noted above require active participation on the part of the individual. Active learning and implementation require both motivation and cognitive processing capacity. For example, it has been observed that some (if not all) therapeutic interventions require motivation. What has been less often noted, and little studied, is whether a client's cognitive capabilities influence the degree to which therapy can be successful when the therapeutic process makes intensive cognitive demands. For example, an individual requires some ability to use divided attentional processing in the event that

relapse occurs; he or she needs to regulate affect, whether it is tolerating an automatically activated response or deliberately managing the cognitive construction of that response, while at the same time continuing the business of calibration, and this requires the ability to multitask. It is even conceivable that simultaneous calibration and fear management efforts require considerable working memory capacity or other mental capabilities related to intelligence, attention, and/or memory. In addition, therapy demands active inhibition of previously learned responses, which requires considerable cognitive capacity.

It is perhaps the case that some individuals do not have the requisite cognitive skills and motivation to maintain extinction of fear actively and intentionally. Moreover, tolerance of ambiguity is probably an important personal resource for those trying to change their judgment and emotional response patterns. As we have suggested above, extinction or counterconditioning procedures lead to greater ambiguity in the meaning of previously learned cues of threat. Thus an increase in the ambiguity of cues is inherent to the reduction of learned fear responses and the calibration of judgment strategies. Furthermore, when cues with a long history of association with threat become ambiguous, there remains the possibility that cues in the environment will result in relapse. Thus clients (and therapists) should consider it sufficient to provide (a) alternative interpretations of cues that were previously associated with threat, (b) explanations that fear is likely to return, and (c) affect regulation skills that will be needed when fear reemerges. Sustained emotional reactivity should not be taken as an indication that therapy is not working.

NOTES

1. In contrast, a positive-illusion strategy will develop when the base rates for threat are low, because the individual will have the goal of reducing the number of false alarms rather than minimizing misses.

2. Although a zero-miss strategy likely develops with many primary appraisals over time, one vivid miss (e.g., being a victim of a random act of violence) might be enough to shift a person's judgment strategy in a single trial. Similarly, people don't develop food aversions every time they are ill, but aversive conditioning to a particular food can occur with one vivid experience of food poisoning.

3. Several authors have argued that data derived from studies of learning in animal models are relevant for understanding human far learning and unlearning (see Jacobs & Nadel, 1985; Mineka, 1985; Shalev, Rogel-Fuchs, & Pitman, 1992).

4. Both renewal and reinstatement can occur in situations other than aversive conditioning, including both appetitive classical and instrumental conditioning, suggesting that these learning phenomena are pervasive aspects of some learning processes (for a review, see Bouton, 1993).

5. Although most of the existing learning and neurobiological data have been obtained from nonhuman animals, it appears plausible that such effects can be observed in humans. Indeed, there is some preliminary evidence that both renewal and reexposure to a phobic stimulus (i.e., reinstatement) may be related to recovery of fear responding in spider-phobic subjects (Rodriguez, 1996). Unfortunately, virtually no other studies have specifically addressed the possibility that such learning phenomena may be influential in the reappearance of fear responding in humans. Future research is needed to demonstrate the existence of these phenomena and their potential power over fear reemergence in humans.

6. Of course, there are exceptions. For a nice example of the theoretical importance of emotional processing as an active ingredient of psychotherapeutic change, see Foa and Kozak (1986). In addition, cognitive-behavioral therapists have begun to explore the importance of emotional learning and emotional experience in successful psychotherapeutic change (Castonguay, in press; Castonguay & Goldfried, 1997; Castonguay, Goldfried, Wiser, Raue, & Hayes, 1996).

7. It is clear that relapse, and reemergence of fear, is an ongoing problem for clients receiving many forms of therapy (Foa & Kozak, 1986; Jacobs & Nadel, 1985; McNally, 1995; Shalev et al., 1992).

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