# A Critical Mass of Knowledge:

## Heightened Stress and Retention Interval

# Estimator variables: Criteria for a "critical mass of knowledge"

- 1. There should have been published at least one up-to-date meta-analysis of a body of studies providing effect size estimates for this variable, thereby providing solid empirical generalizations.
- 2. There should exist a sound theoretical analysis of the operation of this variable within an eyewitness identification context.

# Effects of heightened stress: A theoretical synthesis

- Deffenbacher (1994) synthesized Tucker & Williamson's (1984) asymmetric neural control systems model and Fazey and Hardy's (1988) catastrophe model of anxiety and performance.

# Asymmetic Neural Control Systems

- We have two neural control systems for governing response to environmental contingencies, the *arousal mode* of attention control and the *activation mode* of attention regulation.

# Arousal Mode: The orienting response set

- 1. Attention directed toward the most informative/interesting aspect of the stimulus pattern.
- 2. Physiologically, lowered blood pressure & muscle tonus, heart rate deceleration.
- 3. Purpose of this mode to support alert wakefulness and responsiveness to changing stimulation (no threat eye witnessing).

# Activation mode: Stress response or defensive response set

- 1. Tasks serving to increase cognitive anxiety (worry) and/or somatic anxiety (conscious perception of physiological activation) elicit this mode of attention regulation required by vigilance, escape, avoidance, or “pressure” tasks.
- 2. Physiologically: Accelerated heart rate, increased blood pressure and muscle tone.
- 3. Psychologically: Readiness for action and tight attention controls on information processing.

# Summary

- 1. If engaged in nonthreatening perceptual intake, one is in the *arousal mode* and memory is enhanced for the central, most informative aspects of the environmental display, aspects that are the focus of the orienting response.

- 2. A threatening display will elicit a defensive response characteristic of the *activation mode.* Memory will either be modestly increased or dramatically decreased, depending on the relative amounts of cognitive and somatic anxiety elicited, as predicted by the catastrophe model of anxiety and performance. It provides a 3-dimensional anxiety-performance space permitting predictions regarding effects on memory of varying amounts of cognitive and somatic anxiety when one is in the activation mode of attention control.

# Fazey and Hardy's catastrophe model of anxiety and performance

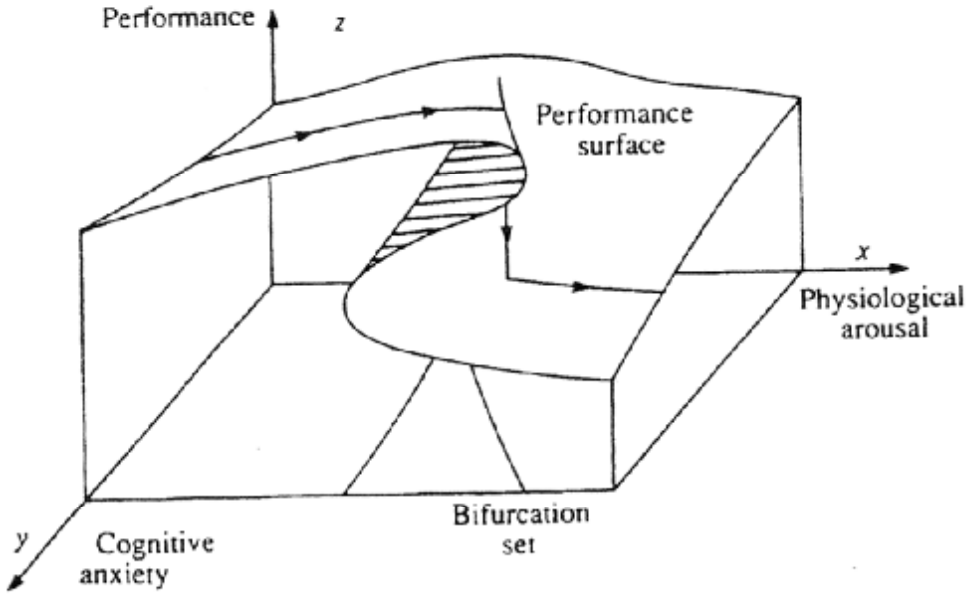


Figure 1. Fazey and Hardy's (1988) catastrophe model of the relation between anxiety and performance. Reproduced with permission from the *British Journal of Psychology*, 1991, *82*, p. 167; copyright The British Psychological Society

# Empirical confirmation of catastrophic decline of eyewitness memory

Several studies have confirmed a catastrophic decline under high stress conditions: Bothwell et al. (1987)—decline from 68% correct identification rate to 32%; Peters (1988)—decline from 66% to 41%; Morgan et al. (2004)—hit rate declined in one condition from 62% to 27%; Valentine & Mesout (2008)—"scary person" encounter, with low anxiety persons having a 75% hit rate at a photo lineup versus 18% for high anxious persons.

# Meta-analysis of effects of heightened stress on eyewitness memory

- Armed with Deffenbacher's (1994) integrative theory, Deffenbacher et al. (2004) meta-analyzed data from 27 independent tests of the effect of heightened stress on eyewitness identification and 36 tests of recall of crime-related details.
- Studies testing the effects of "negative emotionality" on memory were not included, as their manipulations were quite likely generating orienting responses, not defensive responses in the vast majority of their participants.
- Only published studies were included, studies in which stress had been successfully manipulated, demonstrated by measures taken as soon as possible after encoding of the target person.

# Results of stress meta-analysis

- 1. The overall effect sizes were moderate, *d* = -.31 (high stress condition – low stress condition) for both proportion correct identifications and accuracy of eyewitness recall of crime-related details. The fail-safe N was 336 studies for identification accuracy and 453 studies for recall accuracy.
- 2. Effect sizes were notably larger for target-present than for target-absent lineups, for eyewitness identification than for face recognition studies, and for eyewitness studies employing a staged crime than for eyewitness studies employing other means to induce stress.
- 3. Negative effects of stress on memory were most visible in those with greater prior vulnerability to stress, witnesses higher in anxiety, neuroticism, or physiological reactivity to stressors.

# What to conclude?

1. Either a testifying expert or a trier of fact would need to determine from a particular set of circumstances and a particular witness whether there is any likelihood that the witness might have suffered a catastrophic decline in memory performance due to heightened stress during encoding of the perpetrator's face. Presumably, testing of a witness for his/her score on a measure of state anxiety or physiological reactivity to stressors would not be permitted. So…

# (continued)

2. Examine the pretrial record: A careful perusal of relevant police reports, transcripts of pretrial testimony, and depositions taken from witnesses to a crime. In my experience is not at all uncommon to find clear evidence that a witness had endured what was for him/her heightened stress at the crime scene, often reporting having been really frightened, sometimes admitting not remembering much detail about what had occurred, on rare occasion admitting to symptoms persisting for at least weeks, symptoms resembling those characteristic of PTSD.

# (continued)

3. Presence of evidence such as this might suggest that a typical person having these sorts of stress reactions may well have suffered a catastrophic decline in memory performance relative to the level that might have occurred with an unstressed orienting response to a stimulus.

# Effects of retention interval: Interval from end of crime to first memory test

- Deffenbacher (1986) conducted a meta-analysis of 33 studies and found a highly reliable effect of memory test delay (r = .25, as retention interval increased, forgetting increased.
- Shapiro & Penrod (1986) also documented statistically reliable effects of retention interval length, as part of their comprehensive meta-analysis.

# Meta-analysis of Deffenbacher et al. (2008)

- Between 1986 and 2008, the quantity of relevant published studies of retention interval effects increased by over 60%, with the number of null and negative effects also continuing to increase; the proportion of studies in the eyewitness identification tradition more than doubled, too.

# 2008 meta-analysis (cont.)

- Deffenbacher's (2008) meta-analysis included 53 independent tests of hypothesis that longer retention intervals have a negative effect on memory of the once-seen face: $r$ = .18, p<.005, 95% confidence interval (.10 to .26), $d$ = .37. The fail-safe $N$ = 1377 studies. No significant moderating variables were found.

# A problem

- Knowing that memory strength will be less at longer intervals as opposed to shorter retention intervals doesn't allow specification of the shape of the forgetting function, much less allowing prediction of how much memory strength might remain at any particular time after a witnessed event. Deffenbacher et al. 2008 added this degree of specificity with the aid of a theoretical forgetting function.

# Wickelgren's power-exponential theory of forgetting

1. The theory provides an estimate of initial memory strength (measured as *d'*), is relatively accurate at predicting where future points will fall on the function, as retention interval increases, and provides a statistically satisfactory fit to group data. Deffenbacher et al. satisfactorily fit this function to forgetting data from 11 studies having at least three retention intervals, which yielded a significant effect for retention interval and which permitted calculation of d' values as measures of memory strength for unfamiliar faces.

# Power-exponential theory (cont.)

2. The theory posits two mechanisms of forgetting, a time-decay process and a storage interference process. The time-decay process produces a negatively accelerated loss of memory strength, greatest in the first minutes after encoding. Time-decay produced forgetting slows over time due to a negative accelerated increase over time of memory consolidation

# More power-exponential theory

The interference produced forgetting is directly proportional to the similarity of target stimulus to subsequently encountered stimuli. Its influence on the rate of forgetting is noticeable at intervals between a week and month in length.

# Power-exponential theory in application

- Applied to the results of field studies of eyewitness memory, the theory yields predictions relevant to a fact finder's evaluation of witness credibility. For example, a plausible upper limit for witness initial memory strength corresponds to a probability of .67 of being correct on a fair six-person lineup.

# More theory in application

- Not only can the percentage of remaining memory strength be determined for any retention interval, but this strength estimate can be translated into an estimated probability of being correct on a fair lineup of a specified size.

# Conclusion

- We now have much more direct evidence bearing on the belief that the forgetting function for the once-seen face is Ebbinghausian in nature: Rate of memory loss for an unfamiliar face is greatest right after the encounter and levels off over time. Psychological science can now also provide rather more specific details concerning the decline and fall of a face's memory representation over time and succeeding facial encounters.