The Fight or Flight Response (as of 7/23/12)

Freeze-Flight-Fight Response
The flight or fight response, also called the "acute stress response" was first described by Walter Cannon in the 1920s as a theory that animals react to threats with a general discharge of the sympathetic nervous system. The response was later recognized as the first stage of a general adaptation syndrome that regulates stress responses among vertebrates and other organisms.

The onset of a stress response is associated with specific physiological actions in the sympathetic nervous system, primarily caused by release of adrenaline and norepinephrine from the medulla of the adrenal glands. The release is triggered by acetylcholine released from preganglionic sympathetic nerves. These catecholamine hormones facilitate immediate physical reactions by triggering increases in heart rate and breathing, constricting blood vessels and tightening muscles. An abundance of catecholamines at neuroreceptor sites facilitates reliance on spontaneous or intuitive behaviors often related to combat or escape.

Normally, when a person is in a serene, unstimulated state, the "firing" of neurons in the locus ceruleus is minimal. A novel stimulus, once perceived, is relayed from the sensory cortex of the brain through the thalamus to the brain stem. That route of signaling increases the rate of noradrenergic activity in the locus ceruleus, and the person becomes alert and attentive to the environment.

If a stimulus is perceived as a threat, a more intense and prolonged discharge of the locus ceruleus activates the sympathetic division of the autonomic nervous system (Thase & Howland, 1995). The activation of the sympathetic nervous system leads to the release of norepinephrine from nerve endings acting on the heart, blood vessels, respiratory centers, and other sites. The ensuing physiological changes constitute a major part of the acute stress response. The other major player in the acute stress response is the hypothalamic-pituitary-adrenal axis.

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Fight-or-Flight Response
“A term introduced by the US physiologist Walter Bradford Cannon (1871 – 1945), and popularized in his book The Bodily Changes in Pain, Hunger, Fear and Rage (1929), for the syndrome of physiological responses of an organism confronted with a situation that evokes fear, pain, or anger, such responses being mobilized by the secretion of adrenaline (epinephrine) from the adrenal medulla, preparing the organism to fight or to flee. It includes increase blood pressure, accelerated heart rate, deep and respiration, increased sweating, dilation of the pupils, diversion of blood flow from the digestive tract to the skeletal muscles and cessation of digestive processes, release of sugar from reserves in the liver, and closure of the sphincter of the bladder, leading to retention of urine.” (Oxford Dictionary of Psychology, Andrew M. Colman, 2006, p. 283)

Prefrontal Cortex
The frontmost portion of the frontal lobe, in front of the primary and secondary motor cortex, uniquely large in the human brain, involved in anxiety and also in brain function such as working memory, abstract thinking, social behavior and executive functions such as decision-making and strategic planning, any or all of which are affected by lesions in this area. The right prefrontal cortex is involved in monitoring behavior, resisting distractions, and providing an awareness of self and of time. (Oxford Dictionary of Psychology, Andrew M. Colman, 2006, p. 594)
Prefrontal Cortex

"Individuals contemplating the best way to explain the mysterious workings of the prefrontal cortex – and the problem-solving, analytical processes it supervises, thought processes that cognitive neuroscientists call 'executive functions' - need space, a large flat surface where they can organize their reference materials. The brain facing a confrontation also needs space to spread out its reference materials while it decides how to react. This desktop of here-and-now, a component of executive function known as 'working memory,' has commandeered a swath of prefrontal cortex to serve as a sort of mental scratch pad, where the brain can juxtapose current sense data and mental images of similar experiences, jot down the pros and cons of various response options, free associate, muse about the past, and run through various what-if scenarios. One response emerges from the split-second mind mapping exercise, an option that stands out above all the others. Working memory files the spare responses, and directs brain centers that initiate and control voluntary movement to carry out the chosen course of action.

‘Working memory is critical to comprehension,’ explains Goldman – Rakic. ‘As a result, it's a core process necessary for executive function.’ The essence of working memory – and the reason it's critical to comprehension – is its ability to simultaneously compare past and present, the raw data brought to you live by perception and images from the brain's archives. These recollections – Antonio Damasio calls them ‘dispositional representations,’ meaning that they're reconstructed, like digitized photographs, from fragments coded in the firing patterns of related neurons – are not just dusty old artifacts. As Damasio points out, they are animated by emotion, linked to the inanimate features of the memory and reactivated when it is summoned to the center stage of working memory. Thanks to this emotional overlay, remembered images, like current images, have meaning and value.

The ability to manipulate representations, as well as concrete information, means that our behavior can be guided by ideas, concepts, and plans rather than depending solely on environmental cues. Representational knowledge, in other words is what adds the element of reason to risk assessment. It is the door that admits moral beliefs, intellect, and learning. In addition, it is the mechanism that invests these abstractions with meaning. Peace is attractive because the image of behaving nonviolently can be retrieved along with pleasant inspirational feelings, and when the memory of hitting someone resurfaces coated with a thin slime of guilt, we’re not likely to use force in that situation again.

If working memory goes wrong, reasoning comprehension go out of the window. When the workspace contains incomplete, irrelevant, or erroneous information, or when the association between environmental data and representational knowledge are fuzzy, the brain may reach irrational and even bizarre conclusions. If working memory is disconnected, the brain has only the rough outline of reality sketched out by the limbic loop of the emotional network to go on. If it is damaged, representational thinking will be lost.

The brain deprived of cortical input must rely on first impressions, whether they're right or wrong. Predictably, patients with damage to the prefrontal cortex . . . Act on impulse. Without working memory, they are ‘environmentally dependent,’ reacting to events rather than interpreting them.

However, the prefrontal cortex doesn't have to be struck with a blunt object to fall down on the job. Chronic or extreme stress, for example, can enter erroneous information about the environment into representational memory. Disease can interrupt retrieval, analysis, or output. Events that interfere with chemical transmission, especially the precision essential to optimal dopamine function, can confuse working memory.

When early warning mechanisms misfire, risk assessment mechanisms miscalculate, and fact checking mechanisms fail, no defenses remain to control behavior. Excessive and inappropriate responses are the inevitable result." (The Biology of Violence, Debra Niehoff, 1999, pp. 191-192)
Working Memory
"According to a theory put forward by the English psychologists Alan (David) Baddeley (born 1934) and Graham J(ames) Hitch (born 1946) in a book chapter in 1974, a temporary store for recently activated items of information that are currently occupying consciousness and that can be manipulated and moved in and out of short-term memory. It consists of a central executive into buffer stores, called the phonological loop and the visuospatial sketchpad, its functions are carried out largely in the prefrontal cortex of the brain, and it is tested in a variety of organisms by means of delayed response tasks and tests of object permanence. In 2000, Baddeley proposed a third buffer store, called the episodic buffer, providing limited – capacity storage for integrated episodes or scenes using multiple codes." (Oxford Dictionary of Psychology, Andrew M. Colman, 2006, pp. 818-819)

Working Memory
"... traumatized veterans, as well as adult survivors of physical and sexual abuse during childhood, posted significant deficits in short-term memory, especially for the recall of verbal information. But even they were taken aback by the results of MRI scanning in a group of 26 veterans with PTSD and 22 carefully matched control subjects. The patients with PTSD had clear evidence of structural defect that could explain the memory problems; on the right side of the brain, they had an average 8% reduction in the volume of the brain region originally assigned to the limbic lobe by Broca – the hippocampus. Even more compelling, scores and scans were correlated: the greater the memory deficit, the greater the reduction in hippocampal volume.

Part of the limbic system for over a century, today the role of the hippocampus in motion takes a backseat to its importance in the management of short-term memory. Damage to the hippocampus (e.g., during epilepsy surgery) can cause short-term memory deficits similar to those reported by Bremner and his colleagues in trauma victims. In patients with Cushing's disease, and endocrine disorder caused by hyperactivity of the adrenal gland, exhibit deficits in short-term memory that also correspond to MRI documented reductions in hippocampal volume thought to be caused by prolonged exposure to toxic levels of adrenal stress hormones. . . (other researchers) have observed similar reductions in hippocampal volume among men and women with a history of chronic physical or sexual abuse. Whether, as a result of the socially sanctioned violence and combat action, criminal act, or parental rage, brain imaging demonstrates that one reason some victims cannot simply ‘get over it’ is that the violent act is literally been seared into their brains. John Krystal comments of the structural changes observed by Bremner and others are ‘just one sign that what the suffering victims have carried around for such a long time is part of something that's very real, as real as breaking a leg.’ He adds, ‘Trauma not only leaves physical marks as we can observe on the outside - imaging studies suggest that it also leaves physical scars on the inside.’ (The Biology of Violence, Debra Niehoff, 1999, pp. 111-112)

Violence
"This inclusive biology views violence is a developmental process rather than a genetic or cultural mandate. The process begins with a nervous system biased towards survival and social responsiveness, equipped to respond aggressively or fearfully when the threat to survival is extreme. The constitutional boundaries of such a nervous system are not constant but vary from individual to individual, reflected in differences in perceptual acuity, interactive style, attentiveness, and social orientation. Features of the environment pullout critical threads of this basic fabric to create the raised design that we know as behavior, progressively increasing or decreasing the risk of violence, or provoking and maintain fear, an interactive process between gene and environment, performed by brain seeking balance." (The Biology of Violence, Debra Niehoff, 1999, p. 52)
Various Research Articles

Examining the presence of anxiety in aggressive individuals: The illuminating role of fight-or-flight mechanisms.
Kunimatsu, Melissa M., Marsee, Monica A.
Abstract:
Background: Although internalizing and externalizing problems are often considered in isolation from one another, they frequently co-occur in individuals leading to unique behavioral profiles. Objective: To examine the overlap and divergence of anxious and aggressive behaviors, as well as the differential presence of anxiety within the forms, functions, and subtypes of aggression. Methods: This is a theoretical literature review conducted by reviewing recent manuscripts detailing numerous correlates of anxiety and aggression and then synthesizing them into a potential conceptual model. Results: Conceptualizing anxiety and aggression as behavioral representatives of the fight-or-flight response, this paper considers their overlap and divergence on various emotional (e.g., emotion regulation) and cognitive (e.g., perceptions of control) mechanisms. Variations in these mechanisms as they relate to the forms (relational/overt), functions (proactive/reactive), and form-function subtypes of aggression are also examined. Conclusions: The clinical utility of considering these cognitive and emotional mechanisms when dealing with aggressive behavior is discussed. Concluding remarks seek to conceptualize anxiety and aggression as parts of an interconnected fight-or-flight system.

Brain systems that mediate both emotion and cognition.
Gray, Jeffrey A.
Abstract:
Neurobiological research with animals suggests that the brain systems mediating emotion overlap with those mediating cognition to such a degree that it is difficult to maintain any clear distinction between them. Possible reasons for this overlap are discussed, using examples from 2 related fields: behavioral effects of drugs and studies of brain damage. A model of brain systems that simultaneously subserve emotion and cognition is presented. The model postulates the existence of 3 fundamental systems of this kind in the mammalian brain: a behavioral approach system, a fight/flight system, and a behavioral inhibition system. The neuropsychology of each system is briefly presented.

Examining the presence of anxiety in aggressive individuals: The illuminating role of fight-or-flight mechanisms.
Kunimatsu, Melissa M., Marsee, Monica A.
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examined. Conclusions: The clinical utility of considering these cognitive and emotional mechanisms when dealing with aggressive behavior is discussed. Concluding remarks seek to conceptualize anxiety and aggression as parts of an interconnected fight-or-flight system. (PsycINFO Database Record

**Autonomic arousal and relational aggression in heterosexual dating couples.**
Murray-Close, Dianna, Holland, Ashley S., Roisman, Glenn I.
Abstract:
This study investigated the association between romantic relational aggression and autonomic nervous system (ANS) arousal in the context of heterosexual dating couples (N = 115 couples). Results indicated that romantic relational aggression was associated with low resting sympathetic arousal, high resting parasympathetic arousal, and exaggerated fight or flight responses to a conflict discussion (sympathetic activation and parasympathetic withdrawal). However, ANS activity was more strongly associated with romantic relational aggression in the context of low-quality romantic relationships, and sympathetic activity was more strongly associated with aggression among females, whereas parasympathetic activity was more strongly associated with aggression among males. Results indicate that psychophysiological functioning may serve as a risk factor for the perpetration of relational aggression against romantic partners.

**Differentiating defensive and predatory aggression: Neuropsychological systems and personality in sex differences.**
Corr, Philip J., Perkins, Adam M.
Abstract:
Comments on an article by John Archer (see record 2009-17488-001). We draw a distinction between defensive and predatory forms of aggression, and how these forms relate to basic neuropsychological systems, especially the Fight-Flight-Freeze-System (FFFS; putatively related to defensive aggression), and the Behavioral Approach System (BAS; putatively related to predatory aggression). These systems may help further to account for proximal brain processes and personality influences in the context of sex differences.

**Does 'fight or flight' need updating?**
Bracha, H. Stefan, Ralston, Tyler C., Matsukawa, Jennifer M., Williams, Andrew E., Bracha, Adam S.
Abstract:
The authors propose the adoption of an expanded and reordered version of W. Cannon's term "fight or flight", coined in 1929. "Fight or flight" mischaracterizes the ordered sequence of responses that mammals exhibit as a threat escalates or approaches. In addition to the omission of the initial freezing response, other important fear responses have remained obscured, in part because of their omission from "fight or flight," and these other fear responses have important clinical implications as well. Tonic immobility is a clinically relevant survival response observed in humans and mammals. More recent research suggests the phrase "freeze, flight, fight, or fright" is a more complete and nuanced alternative to the original "fight or flight".
Freeze, Flight, Fight, Fright, Faint; Adaptationist Perspectives on the Acute Stress Response Spectrum.
Bracha, H. Stefan
Abstract:
This article reviews the existing evolutionary perspectives on the acute stress response habitual faintness and blood-injection-injury type-specific phobia (B11TS phobia). In this article, an alternative evolutionary perspective, based on recent advances in evolutionary psychology, is proposed. Specifically, that fear-induced faintness (e.g., fainting following the sight of a syringe, blood, or following a trivial skin injury) is a distinct Homo sapiens-specific extreme-stress survival response to an inescapable threat. The article suggests that faintness evolved in response to middle paleolithic infra-group and inter-group violence (of con-specifics) rather than as a pan-mammalian defense response, as is presently assumed. Based on recent literature, freeze, flight, fight, fright, faint provides a more complete description of the human acute stress response sequence than current descriptions. Faintness, one of three primary physiological reactions involved in B11TS phobia, is extremely rare in other phobias. Since heritability estimates are higher for faintness than for fears or phobias, the author suggests that trait-faintness may be a useful complement to trait-anxiety as an endophenotype in research on the human fear circuitry. Some implications for the forthcoming Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition as well as for clinical, health services, and transcriptomic research are briefly discussed.