
Physiological Reactions to Stress Induced by a Game

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Worksheets for Multimodal Perception and Cognition

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Chapter 1

Physiological Reactions to Threats

In this chapter, we will discuss the physiological reactions happening in the body and mind when put in a stressful situation. The chapter begins with a section about the perception of threats and how the autonomic nervous system reacts to the perceived threat. The next section will describe the cognition related to the perception of threats, and the last section will go through the motor reactions related to this.

1.1 Perception of Threats

Animals, as well as humans have a build in sensor system to perceive threats to their survival. The sensor system uses the senses of the body, as well as the mind, in its aspect of memorizing a similar situation and the evaluation of the magnitude of the threat. We humans have through the years developed a much more detailed sensor system, and we are able to use it not only to perceive situations threatening our survival, but also to recognize situations which might compromise our social status. The most common way of experiencing the evolved sensor system, is when being put in a stressful situation, as this would activate the autonomic systems of the body in a physiological reaction. Such a situation could be forgetting to deliver a report at work, and be pointed out by your boss, or just general being stressed because of the current workload.

1.1.1 Changes in Behaviour due to Perception

It is believed that emotions have been developed to affect our behaviour when put in a stressful situation, in order to identify and react to a perceived threat, to increase the survival rate. Evidence show that emotions can change our behaviour in a positive or negative direction depending on the situation. This also gives us the opportunity to prepare for stressful situations by training the control of our emotional response to a threat. A reaction to the current situation can this way be altered by knowledge gained from past events, which could be the aforementioned training of emotional

control or recall of a similar situation. As the action or motor performed by the individual is directly linked to the emotional state, which is dependant on our past memories or physiological reaction, the reaction time in humans is directly related to how we perceive a emerging threat. If the threat is pointed towards us: If a gun is pointed at the viewer, our reaction time is slowed. When a gun is pointed towards another person, our reaction time is increased compared to a neutral state. This gives evidence of our perception of the threat changes how the body reacts to the situation. [Jr. et al., 2003]

1.1.2 Bodily Changes as Result of Threat Perception

When a threat is perceived, the first reaction of the brain is to activated the amygdala part, which processes emotions, memory and decision-making. The information about the situation is send to hypothalamus, which creates Adrenocorticotropt hormon (ACTH). This starts the production of the stress hormone cortisol and adrenaline, making the body respond by increasing heart rate, blood pressure, decrease the immune system functionality and other negative changes which make a constant stressful environment harmful to the health. If the amygdala is constantly negatively stimulated, it can lead to depression and other anxiety disorders, altering the reaction to stressful or harmful situations. Depression can in this sense also be helped by changing the way the amygdala reacts to stressful situations as it has a direct relation to the information send further to the autonomic nervous system (ANS) regulating the autonomic body functions. One of the primary parts of the ANS is the sympathetic nervous system, which is sometimes referred to as the fight or flight system, as it automatically alters the autonomic body functions to create a sense of anxiety or aggression. The anxiety or aggression creates a bias for what action is make in a stressful situation, and the next section will further dig into the action taken dependant on the physiological changes in the body when put into a stressful situation.[Pocock, 2006] [Kalin, 2014] [Jansen et al., 1995]

1.2 Cognitive Respond to Threats

The main aspect of the cognitive aspect of responding to a threat, is the evaluation of the physiological changes as described in 1.1. As we gain information from the brain and body because of how we perceive a threat, we start to evaluate the autonomic bodily changes to respond with the best possible reaction. Mainly we look at the two categories which are fight and flight, the oldest principle, dating back to 1929 [Cannon, 1927], described as reactions of anxiety and anger. An example where anxiety is created, would be a situation where you are late for a meeting or a class, where you experience every body else is getting ready for a test or presentation, which you yourself did not remember to prepare for. This situation creates a sense of anxiety, where the heart rate rises together with blood pressure, respiration, and other autonomic bodily changes as a reaction to the perceived threat, inducing a flight reaction, fleeing the location where the situation occurred. On

the other hand, if you were dependant on another colleague or student, and it were their fault you did not get the information about the test or presentation, you would be more biased towards an emotion of anger, wanting to fight, in either a physical or verbal action. [Cannon, 1927]

1.2.1 Changes in Cognitive Response

The feeling of anxiety or anger when put in a situation of perceived threat, is dependant on the individual and their past memory of equal situations and their teaching of the reaction and changing of specific emotions. A great example of the cognitive process is a fire alarm situation. When a fire alarm goes off, the normal view of the situation would give you the perception of harm or threat. This initialises the cognitive process, which can decide the reaction to the event dependant on previous knowledge. If you for instance are at home, hearing the fire alarm, you would first evaluate the situation dependant on the people present. If you for instance are alone, the actions you have taken in the last couple of moments would influence your reaction, shower steam could set off the alarm, or burned food, and you would not flee but rather fight in the aspect of stopping the events setting off the alarm. On the other hand, does the alarm go off in the work place or university, you would be more biased to flee if it is the first time the alarm goes off, taking the action of flight. These are also dependant on the feelings of anger, as you just burned the food, or anxiety, as you do not know what set off the alarm at work.[Cannon, 1927]

1.2.2 The Reactions According to Fight/Flight

As shortly exemplified in the above section 1.2.1, the two main reactions referred to in literature when describing actions in a stressful situation, is often the fight/flight reactions. These are often seen as opposites, as the one is taken if situations creating anger, the fight, and the other in situations of anxiety. Emotions created from physiological changes bias the individual in either direction, which involves many of the autonomic bodily reactions from 1.1 but also other hormones comes into play, as the testosterone, oestrogen and dopamine. These reactions are thought as the two main actions taken in stressful situations, but others have started to show up in research, the freeze (tensing of muscles to unable to act to the situation), fright (becoming afraid), faint (automatic shut down to get away from the situation) and tend/befriend (social awareness reaction, most seen in women). We have decided to look more into the fight, flight, freeze and tend/befriend reaction, and described them further in the section below as motors to the cognitive response of a stressful situation [Harley, 2012] [Bracha, 2004] [Taylor et al., 2000]

1.3 Motors/Actions

The last step of the human reaction to a stressful situation, is the motor or action part. The model can be referred to as the human information processing model, which consists of four steps:

- Sensing
- Perception
- Cognition
- Motor (Acting)

The motor steps is the actions we can start interpreting as how the full processing of the perceived information has occurred. We define the different motor categories as fight, flight, freeze and tend/befriend, and in the following we define each category. To provoke a stressed reaction we use a game which has a level that can not be completed to create a stressful situation for the individual. The game used for the test is described in a later section. The categories are described with a definition of the action and what information processing the user has gone through to react according to the category. The specific actions related to the category will be described, as this will be the basis of how we can categorise the stressful reaction to the broken level in the game. [?]

1.3.1 Fight

The fight action is greatly biased by an aggressive state, which is shown in actively trying to deal with a posing threat. The feeling of aggression is associated with the will to fight, which is induced by the physiological response of releasing hormones when a threat is perceived. As adrenaline is released, heart rate rises, muscles tense up, making the body ready to fight of the threat. This motor is part of the body's automatic energy conserving system, where the body can be in a state of lowest possible energy until a threat is perceived, where it in an instant can release the hormones suddenly raising the energy available to a much higher level than normal. Fighting can be seen as tension building up in the body, needed to be expressed physically.

The fight reaction to a stressed situation is becoming more and more active in solving the problem or fighting of the threat, which can result in a physical reaction, violence, verbal expression of anger or annoyance.

1.3.2 Flight

The flight response can be associated with the feeling of anxiety, where fleeing is considered the best option. Flight is often the first action which is considered as it would raise the possibility of survival compared to getting into a fight. If escaping the situation is not an option, the fight response is initialised through the increasing emotion of anger. The flight response is as fight also amplified by the hormone release happening in a threatening or stressful situation. Muscles tense and heart rate increases to help a faster escape. For the flight response, blood will gather in the legs compared to the fight response, where blood flows to the upper body, either giving extra physical strength to escaping or fighting the situation. A terminal depression is often associated

with constant anxiety, because the individual is more biased towards the flight response than fight response, creating anxiety in all mildly stressful situations.

Flight is represented fleeing or escaping a situation because of rising anxiety and the idea of not being able to solve the problem or deal with the posing threat. It is often seen as fleeing the location or removing one self from the situation.

1.3.3 Freeze

As a last resort, freeze can be used when escaping and fighting is not a possible solution. The best example is when being attacked by a bear, where running away would increase the chance of it chasing and the physical superiority of the bear would omit the fighting response. Playing dead or becoming passive would give the greatest chance of survival, making the freeze response become the best option. Freeze can be triggered when no obvious solution is present, either in fight or flight, but might transition into the other motors as a solution presents itself by evaluation of the situation. Freeze can be trigger when muscle tense up, but no solution in fight or flight can be chosen to deal with the threat or situation.

The freeze response can be seen as becoming passive, trying the same solution over and over can be seen as passiveness if it does not help remove the stressful situation, but done because no other response is possible.

1.3.4 The Reactions According to Tend/Befriend

In a study done by [Taylor et al., 2000](Taylor,2000) it is proposed that a female stress response can be characterized by the the pattern tend and befriend. This pattern involves joining and strengthening social groups in order to share resources, in particular in groups of other females. The study suggests that this pattern builds on biobehavioral attachment/caregiving system that depends on oxytocin, estrogen, and endogenous opioid mechanisms, among other neuroendocrine underpinnings, and that this is an alternative to the biobehavioral response of fight/flight. In this the actor is actively trying to solve a stressful situation by strengthening social networks and relying on shared resources. [Taylor et al., 2000]

Chapter 2

Tests

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