# Operator Error and Emotions

*Operator Error and Emotions - a major cause of human failure.*

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## Abstract

This paper proposes the idea that a large proportion of the incidents attributed to operator and maintenance error in a nuclear or industrial plant are actually founded in our human emotions. Basic psychological theory of emotions is briefly presented and then the authors present situations and instances that can cause emotions to swell and lead to operator and maintenance error. Since emotional information is not recorded in industrial incident reports, the challenge is extended to industry, to review incident source documents for cases of emotional involvement and to develop means to collect emotion related information in future root cause analysis investigations. Training must then be provided to operators and maintainers to enable them to know one's emotions, manage emotions, motivate one's self, recognize emotions in others and handle relationships. Effective training will reduce the instances of human error based in emotions and enable a cooperative, productive environment in which to work.

## Introduction

Emotions may be the underlying cause of much of the human error that we witness in industry today. Root cause analysis surely doesn't delve into this area of causes enough because there may not be an easily recognizable set of emotion based facts to document for a given case. Root cause analysts are not about to record such speculative, difficult and indeterminent information as facts in a case. The event is over and past and who knows exactly how those involved felt under the circumstances. "You would need to be a psychologist to attempt such a thing." The analyst's thrust and the thrust of those involved in an event investigation is to get on with what actually happened; the facts.

At the moment, emotional data is just too hard to collect. People are reluctant to share how they felt as an event unfolded. They probably wouldn't tell you that they froze; at which time, cognitive performance would plummet and be severely inhibited. A co-worker may be able to relate such observations about others, if they were involved in the event.

The questionnaires and fact finding tools that draw out how people felt during an incident, their emotional state and their own personal self observations need to be developed. Root cause investigators need to be trained in effective techniques and workers need to be trained to self observe their situation, control emotions, avoid actions and ask for assistance in difficult and emotion stirring situations. Supervisors need to be able to recognize when harmful emotions have been triggered and reconsider the tasks assigned to the affected persons.

## What is Emotion?

The Oxford English Dictionary defines emotion as "any agitation or disturbance of mind, feeling, passion; and vehement or excited mental state."

Emotion is definitely a difficult topic to address; but when we look at a listing of emotions, we can all agree that we have experienced many of the emotions listed in the various categories below. In fact, the English language probably does not yet contain all of the words to adequately name the various emotions we humans experience, let alone describe the full range of human emotions.

Is there a primary set of emotions from which all other emotions stem? Daniel Goleman suggests the following candidates: [Goleman, 1995]

| **Anger** | **Sadness** | **Fear** | **Enjoyment** |
|---|---|---|---|
| Acrimony | Cheerless | Anxiety | Amusement |
| Animosity | Dejection | Apprehen-sion | Bliss |
| Annoyance | Dread | Concern | Contentment |
| Exasperation | Edginess | Conster-nation | Delight |
| Fury | Fright | Dread | Ecstasy |
| Hatred | Gloom | Edginess | Euphoria |
| Hostility | Grief | Fright | Gratification |
| Indignation | Loneliness | Misgiving | Happiness |
| Irritability | Melancholy | Nervous-ness | Joy |
| Outrage | Qualm | Panic* | Mania* |
| Resentment | Self-pity | Phobia* | Pride |
| Vexation | Severe* Depression | Qualm | Rapture |
| Violence | Sorrow | Terror | Relief |
| Wrath | Terror | Wariness | Satisfaction |
| | Wariness | | Sensual pleasure |
| | | | Thrill |
| | | | Whimsy |

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Primary set of emotions candidates (continued)

| Love | Surprise | Disgust | Shame |
|---|---|---|---|
| Acceptance | Shock | Abhorrence | Chagrin |
| Adoration | Astonish-ment | Aversion | Contrition |
| Affinity | Amaze-ment | Contempt | Embarrassm-ent |
| Agape | Wonder | Disdain | Guilt |
| Devotion | | Distaste | Humiliation |
| Friendliness | | Revulsion | Mortification |
| Infatuation | | Scorn | Regret |
| Kindness | | | Remorse |
| Trust | | | |

Operators and Maintainers experience these emotions. We all experience many of these emotions sometime in our life, simply because we are social beings and we interact with our environment and those around us. All of these interactions are occasions for the triggering of any number of these emotions at any time.

## What Triggers Emotions?

What triggers our emotions? How can we be so reasonable at one moment and so irrational the next? "The emotional mind is far quicker than the rational mind. It springs into action without pausing even a moment to consider what it is doing." [Goleman, 1995]

If we just consider the work place of the Operator and Maintainer you don't have to think very long before you can compile a long list of emotional triggers. Here are some of them:

- Supervisors try to shame co-workers into doing what they want.
- Co-workers try to shame co-workers into doing what they want.
- You can have confrontations with others whom you perceive might be impeding your progress on a job or in your career.
- Being told to do something you don't want to do.
- Being blamed for something unjustly or for something you did not do.
- Anger at equipment; or management who won't get the equipment fixed.
- Anger at things not going well. Frustration.
- Pressure to hurry.
- Being teased too much.
- Being lied to.
- Someone is angry with you.
- Someone says something that makes you sad.
- Someone doesn't trust you or your judgment.
- Being avoided; being ignored.
- Pressure because of family problems; this you brought from home.
- Come to work in a bad mood.
- Missed your car pool. The guys didn't wait for you.

- Elation – Everything is going so well. People feel good. You can be too happy about something.
- Stress – Stressors from various sources of stress.

Where are emotional events likely to occur in our power plants? The answer is that emotional events can occur in almost any place that people come in contact with each other. Events could happen at the Main Control Room desk where operators control the operation of the plant and converse with other operators and maintainers about the operation or maintenance needs. Events could occur in the Work Control area where Work Permits and work protection are discussed, prepared and issued to operators and maintainers. The Shift Supervisor's office might be another location where emotions could be triggered. Work performance, work assignments and serious work related discussions could easily spawn pleasant emotions or upset emotions. The Field Office and the Maintenance Shops are other areas where emotions can be spawned or allowed to simmer; later erupting into an emotional event at some other, usually more public location. The field work location is an obvious place where emotions can be triggered. Arguments may develop, something may go wrong or workers may be joshing one another.

How do we know that an emotional event is occurring? Paul Ekman, at the University of California at San Francisco, discovered those facial expressions for fear, anger, sadness and enjoyment are recognized by people in cultures around the world. You can see emotions in a person's face. You can "hear" emotions. People sometimes yell, scream, stomp their feet or punch walls. People often utter vulgarities or swear when they are angry. When the angered person finally takes their leave, they often stomp out and slam the door. People hum or sing when they are happy. There are multitudes of responses that can be observed; but the excitable displays are the most noticeable.

## Psychological and Physiological Response

The brain is unbelievably complex. We may never know exactly how the human brain is wired and what specific circuits in the brain are used for the various functions that we perform. But, in 1993, Joseph LeDoux discovered a connection in brain parts that seemed to explain the neurological basis for how we so quickly respond in the fight or flight engagements. [Lewis, 1993, Goleman, 1995]

Using an example that produces fear, we hear an unusual sound and our brain triggers our whole body into a state of alertness. The brain processes the raw sound waves and transforms them into the language of the brain. The ear is connected to the brainstem and the brainstem connects to the thalamus. From the thalamus, two branches emerge.

A small branch of brain connections leads to the amygdala and the nearby hippocampus. A larger branch leads to the auditory cortex in the temporal lobe, where sounds are sorted out and processed. This part of the brain seems to analyze the sound and we try to imagine the sound source.

The auditory cortex comes up with its hypothesis and sends that message to the amygdala and hippocampus, which quickly compare it to similar memories.

If we know the sound and are satisfied that no danger or alarm is present, then little else is done in the way of an alert. If there is uncertainty, the amygdala, hippocampus and the prefrontal cortex further heightens our uncertainty and fixates our attention and concern. If no satisfactory answer comes from this further keen analysis, the amygdala triggers an alarm and its central area activates the hypothalamus, the brainstem and the autonomic nervous system.

The amygdala signals the body to release the hormone which mobilizes the fight-or-flight reaction via a cascade of other hormones. The large muscles of the skeleton act. The muscles of the vocal cords tighten, creating the high-pitched voice of fright. Sensory circuits become more sensitive and the brain is set on edge.

The amygdala also signals cells in the brainstem to put a fearful expression on your face, make you edgy and easily startled, freeze unrelated movements your muscles had underway, speed your heart rate and raise your blood pressure, and slow your breathing. You may notice yourself suddenly holding your breath when you first feel fearful; all the better to hear more clearly what it is you are fearful of. It basically commandeers the brain for a crisis.

Neurotransmitters are triggered to rivet our attention on the source of fear and puts the muscles at a readiness to react as required. The amygdala also signals sensory areas for vision and attention, making sure that the eyes seek out whatever is most relevant to the emergency at hand. Coritical memories are reshuffled so that knowledge and memories most relevant to the particular emotional urgency will be most readily recalled, taking precedence over other less relevant strands of thought. Once the signals have been sent, you are pitched into full-fledged fear. Tightness in your gut, speeding heart, tightening of the muscles around your neck and shoulders or the trembling of your limbs; your body freezes in place as you strain your attention to hear further sounds. Your mind races with possible dangers and ways to respond. When we experience fear or anger, changes take place in our body. Heartbeat increases, breathing increases, the throat and mouth goes dry, we start to perspire more, we begin to tremble and we get that sinking feeling in the stomach. Pupils dilate, blood-sugar level increases to provide more energy, blood clots more quickly, blood is diverted from the stomach and intestines to the brain and large muscles and the hairs on our skin become erect causing goose bumps. We are ready for action.

The entire sequence – from surprise to uncertainty to apprehension to fear – can be happen within a second or so.

Our minds can trigger our emotions by thinking about a situation. This is the cognition pathway. We think and deliberate and hence we are quite aware of the thoughts that lead to feeling the way we feel. If you feel “I’m getting all the dirty work; s/he’s getting the cushy jobs; then an emotional response will follow.that you may find hard to control. The cognitive pathway to our emotions is slower to respond. It may take seconds, minutes of days before an emotional outburst is displayed. The expression, “I’ve been thinking about what you said….” indicates a cognitive generation of emotions. Our emotional mind will harness the rational mind to its purposes, so we come up with explanations for our feelings and reactions – rationalizations – justifying them in terms of the present moment without realizing the influence of the emotional memory.

Even though we can think about an emotional situation, it is difficult to simple decide to be happy, angry or sad.

Actions that spring from the emotional mind carry a particularly strong sense of certainty. It results from a streamlined, simplified way of looking at things that can be absolutely bewildering to the rational mind. When the dust settles, or even in mid-response, we find ourselves thinking, “What did I do that for?” We have sacrificed accuracy for speed because we relied on our first impressions. [Goleman, 1995]

Our emotional mind can read an emotional reality: he’s angry with me; she’s lying; this is making him sad, and in an instant, make the intuitive snap judgments about what we should say or do.

We can recognize emotions building in a person. Emotions can flit across the face in less than a half second. The person gets excited, vulgar, cursing, and loud and gestures with erratic hand and arm motions and body movements. Others will try to calm the excited person

down or control them somewhat by saying “go cool off”, “you’re all hot and bothered”, “you’re excited; calm down”, “go take a break”, “get a grip on yourself”, “you’re losing it”, “don’t blow it.”

## What can be the Results?

The results of our emotions running wild or just being in a highly activated state can have the wide ranging effects in the workplace. And, some of these results can be very costly to the business resources of time, people, materials, money, space and technology. When our emotions kick in and run their course, we may find that we:

- Have turned people off
- Alienated people
- People won’t help us
- People won’t cooperate with us; they put up barriers
- Could break equipment; especially delicate devices
- Have to repeat work; redo work; start again from the beginning
- Cause delays, finish late, hold others up; (screw them!)
- Are unproductive
- Cause distractions and disruptions in work
- Commit operating and maintenance errors

## What Needs to be Done?

What needs to be done in industry? Emotion based incident information and facts need to be collected during incident analysis and root cause review. The causes of any emotional based factors need to be addressed by management and these factors recorded in industrial incident reports.

The challenge is extended to industry, to review incident source documents for cases of emotional involvement and to develop means to collect emotion related information in future root cause analysis investigations.

The questionnaires and fact finding tools that help draw out how people felt during an incident, their emotional state and their own personal self observations need to be developed. Root cause investigators need to be trained in effective techniques and workers need to be trained to self observe their situation, control emotions, avoid actions and ask for assistance in difficult and emotion stirring situations.

Training must be provided to supervisors, operators and maintainers to enable them to recognize and to know their emotions, manage emotions, motivate one’self, recognize emotions in others and enable them to handle relationships where emotions can easily become a factor. Effective training will reduce the instances of human error based in emotions and enable a cooperative, productive environment in which to work.

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