

# Emotional Engagement in Professional Ethics

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**ABSTRACT:** *Recent results from two different studies show evidence of strong emotional engagement in moral dilemmas that require personal involvement or ethical problems that involve significant inter-personal issues. This empirical evidence for a connection between emotional engagement and moral or ethical choices is interesting because it is related to a fundamental survival mechanism rooted in human evolution. The results lead one to question when and how emotional engagement might occur in a professional ethical situation. However, the studies employed static dilemmas or problems that offered only two choices whose outcome was certain or nearly so, whereas actual problems in professional ethics are dynamic and typically involve considerable uncertainty. The circumstances of three example cases suggest that increasing personal involvement and uncertainty could have been perceived as changes, threats, or opportunities and could therefore have elicited an emotional response as a way to ensure the reputation, integrity or success of oneself or a group to which one belongs. Such emotional engagement is only suggested and more studies and experiments are required to better characterize the role of emotional engagement in professional ethics.*

## Introduction

Two recent papers in quite different journals dealt with the results of experiments that provide convincing evidence for the nature and level of emotional engagement in subjects confronted with moral dilemmas or with problems in professional ethics. Joshua Greene and coworkers<sup>1</sup> used functional magnetic resonance imaging (fMRI) to determine which parts of the brain were activated when a subject was confronted with a

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suite of moral dilemmas in which there were only two options available, both having bad consequences. They found that when a subject was confronted with a dilemma that required a high level of personal involvement (e.g., a situation where one was required to kill one person to save seven others), the parts of the brain commonly associated with emotional processing became highly activated, whereas if the subject was confronted with a problem that required simple reasoning (e.g., Should I take the bus or walk?), parts of the brain associated with cognition or thinking were more active.

If an emotional response is generated by actual or potential personal involvement in the resolution of a moral dilemma, could the same hold true for problems in professional ethics? It seems that this is indeed the case. Shane Connelly and coworkers<sup>2</sup> conducted experiments in which a group of subjects were asked to make hypothetical managerial decisions that involved ethical choices. They found that both positive and negative emotions were active when the decision involved inter-personal relations or issues, and less active when issues related to the organization or the work group were involved. This suggests that emotional activation or engagement could occur when there is personal involvement associated with an ethical decision in a professional environment.

The connection between emotions and ethical decision-making has a long history and has been dealt with in several previous publications which make the argument that emotions are essential to rational and ethical decision-making.<sup>3-9</sup> The results given in the studies by Greene and coworkers<sup>1</sup> and Connelly and coworkers<sup>2</sup> provide significant empirical evidence as to the circumstances in which emotions are engaged in ethical situations.

There are aspects of problems in professional ethics that are not captured by the experiments described above. Each of the experimental studies involved static situations that offered the subject few (usually two) options whose outcome is certain or nearly so. The purpose of this paper is to use some actual cases to demonstrate how, by means of circumstances and uncertainty, ethical problems can evolve from impersonal to personal and thus possibly engage the emotions in a more gradual way, and to show the ways in which people confronted with such problems seek options other than the ones initially available.

## **Difficult Moral Dilemmas**

Trolley problems are classical ethical dilemmas. The trolley problem was originally formulated by Philippa Foot<sup>10</sup> and has been used as a model for decision-making in medical ethics, specifically for cases involving abortion and organ transplants. Variations of the problem have been discussed.<sup>11-13</sup> Consider the following two variants of the trolley problem:

### ***Bystander at the Switch***

You are strolling by a railway track and notice that a runaway train is rolling down the track at high speed toward seven men working on the track. The seven men will have little chance to escape being run over by the train because the

tracks where they are working are located in a steep-walled valley. Next to you there is a lever that will throw a switch to divert the train onto a siding on which one homeless man is sleeping. Should you pull the lever and kill the sleeping man but save the seven?

### ***Fat Man***

You are standing on a footbridge that crosses over a railway track. A runaway train is rolling down the track at high speed toward seven men working on the track. The seven men will have little chance to escape being run over by the train because the tracks where they are working are located in a steep-walled valley. Next to you there is a large individual (the fat man) who, if thrown in the path of the runaway train, would either stop or derail the train. Should you throw this fat man off the bridge?

*Bystander* requires small personal involvement. The bystander is detached, does not know the seven workmen or the man sleeping on the siding, does not have to look at the result once the lever is pulled, and can perhaps take some comfort that the sleeping man will never know what hit him. *Fat Man*, on the other hand, involves considerable personal involvement. One would actually have to approach the large individual and, without any formal greeting, use all one's strength to throw him over the bridge railing. In order that the man has no chance to roll off the tracks, you would have to do this just before the train is about to go under the footbridge so you would probably see the gory results.

An act-utilitarian would see no difference between these two dilemmas: either one person dies or seven people die so, in each case, simply choose the alternative that creates the greatest good or the least bad. If there were an accepted rule that maximized utility for society in all situations including trolley problems (e.g., "never kill" or "always save as many people as possible"), a rule-utilitarian would act according to that rule. A Kantian would also see no difference between the two dilemmas: in both cases there is the possibility of using a person as a means to an end and this is wrong in a universal sense.

But these are attempts to use pure reason to resolve a difficult dilemma. When "people off the street" are confronted with *Bystander*, their reaction differs considerably from when they are confronted with *Fat Man*. Most are willing to pull the lever but very reluctant to throw someone off a bridge. This difference in reaction, in one case more utilitarian and in the other more Kantian, has puzzled philosophers and psychologists for some time.

Is there an alternative to reason? David Hume, an 18<sup>th</sup> century Scottish philosopher said that morality was a matter of sentiment rather than fact<sup>14</sup> (p.34) meaning, for example, that if one thinks it immoral or wrong to pull the lever or to push the fat man off the bridge, it is only because one has negative feelings about these actions. The actions are not immoral in an objective sense. Why then does one have such feelings?

This intrigued Joshua Greene who hypothesized that the two problems, *Bystander* and *Fat Man*, trigger different emotional circuits in the human brain, i.e., pulling a

lever to divert a train is less “emotionally salient” than throwing someone off a bridge and this might explain the difference in reaction. The problem was to obtain some empirical evidence that this was the case.

## Images of the Emotional Brain

During the 1990s, numerous brain imaging studies using Positron Emission Tomography (PET) and Functional Magnetic Resonance Imaging (fMRI) showed that certain parts of the brain become active in the event of an emotional stimulus such as a picture or movie of an angry or a happy person or a particular situation. Much of this work is discussed by Richard Davidson and William Irwin.<sup>15,a</sup>

Greene and colleagues<sup>1,16</sup> posed 60 different problems or dilemmas to subjects undergoing an fMRI scan of their brains. The problems and dilemmas were divided into three different types: non-moral problems, moral-impersonal dilemmas, and moral-personal dilemmas. An example of a non-moral problem is “Given the time available, should I take a bus or walk to work?” *Bystander* is an example of a moral-impersonal dilemma and *Fat Man* is an example of a moral-personal dilemma. The fMRI scans were used to determine which parts of the brain were activated when a subject was confronted with a particular problem or dilemma. Their findings can be summarized as follows:

- Non-moral problems and moral-impersonal dilemmas initiated activity in portions of the brain associated with working memory or cognitive processing (i.e., reasoning), whereas moral-personal dilemmas initiated activity in portions of the brain associated with emotional processing.
- The time to respond to a moral-personal dilemma was greater than the time required to respond to a moral-impersonal dilemma when the response to the moral-personal dilemma involved actual personal engagement (e.g., pushing a person off a bridge).

Some object to the hypothetical nature of dilemmas such as *Bystander* and *Fat Man*. In the case of *Bystander*, the subject has two undesirable options whereas in reality there may be other options and likely occurrences. *Fat Man* suffers from the problem that the fat man would have to be extremely large to stop the momentum of a moving train. However, these objections may be a result of a neural response in a part

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a. (Very simply) Neurons in an activated region of the brain need oxygen which is extracted from blood flowing near the neurons causing a decrease in oxygenated blood in the region. However, after 3-6 seconds of activation, there is an increase in arterial or oxygenated blood flow to the region. An applied stimulus leads to activation of a particular region in the brain and the corresponding changes in oxygen level can be measured indirectly using PET or fMRI. In PET the subject is injected with a small amount of a radioactive oxygen nuclide which will be concentrated in areas where neural activity occurs. The locations of these areas can be mapped by measuring the radiation levels from different parts of the subject’s brain. In fMRI the subject’s head is placed in a magnetic field which is changed by the levels of oxygenated blood in the brain. The locations of these changes are mapped by the response to a radio frequency signal.

of the brain. The longer time required to respond to a moral-personal dilemma was accompanied by a significant MRI response in an area of the brain known as the anterior cingulate cortex (ACC). The ACC is believed to be responsible for detecting and resolving conflicts between different stimuli.<sup>17</sup> This suggests that moral-personal dilemmas cause conflicts, presumably between the cognitive and emotional parts of the brain. To respond to the dilemma, one must inhibit one undesirable response and allow another which takes time.

Outside of an MRI device, informal observations and a poll of about 90 high school students show that during the time required to respond some people do a variety of things that may be a mechanism for avoiding a decision or seeking alternatives where there are few options.<sup>b</sup> A common response is to protest the hypothetical nature of the problem. Others ask various “what-if” questions such as “What if the fat man knew the cure for cancer?” It is of interest to know if and how this mechanism might manifest itself in a professional ethics situation.

## Management in the Laboratory

Connelly and coworkers<sup>2</sup> conducted a controlled laboratory study of the relationship between emotions and managerial decision-making. The subjects were 189 college students who were first asked to complete the Discrete Emotion Trait Scale (DETS) which measured trait or enduring emotions.<sup>18,c</sup> Next, the subjects completed a “managerial in-basket” task in which they had to respond to sixteen situations as if they were a manager in a hypothetical organization.<sup>19</sup> Two courses of action were provided for each situation, one of which was considered ethical, the other not. Eight of these situations involved interpersonal issues, where an unethical choice would result in gain for the subject at the expense of another individual. The other eight situations involved organizational issues, where an unethical choice would provide a benefit for the subject but affect the performance of the organization. Paraphrased examples of the two types of questions are given below:

### *Interpersonal item*

Mark, the son of a close friend, needs a job. Without promising anything, you offer to interview Mark. He performs well, but there is another candidate who is

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- b. Brian Smith, a high school teacher in Burlington, Ontario, subjected about 90 Grade 11 and 12 physics students to *Bystander* and *Fat Man* and took a poll of their responses including the time it took to make a response. [Personal Communication] Most students had little difficulty pulling the lever, but expressed extreme reluctance to push the fat man off the bridge. The time it took each student to respond to *Fat Man* was significantly greater than the time it took to respond to *Bystander*. The students were also asked to comment on these dilemmas; the results were varied and interesting but all suggested that they were seeking alternatives.
  - c. Psychologists distinguish “state emotions” from “trait emotions”. State emotions are one’s emotional experience at a particular time while trait emotions predispose one to particular state emotions at any time. Just as attitudes are one’s habitual tendencies to respond or act in a particular manner, trait emotions are one’s habitual emotional display, one’s regular temperament. For example, anxiety is a trait and anxious is a state.

better qualified. You and your friend are in the process of buying a summer home for your two families. Do you hire Mark?

### ***Organizational item***

You are the manager of a product group in a large manufacturing company. The revenue generated by a sales representative is computed using the amount of the product requested from inventory by the sales representative to supply customers. This includes sales of broken or defective products which are usually exchanged by the customer for a working product. Actual revenue should be the value of all products leaving inventory less the value of exchanged products, but this is reconciled later in the year when an inventory audit is carried out. Thus, if sales representatives encourage customers to report any defect, no matter how inconsequential, and to exchange the product when the defect is discovered, sales will appear to be greater than they actually are. However, this could result in increased production to meet the supposed demand which could unnecessarily strain company resources. You are up for a raise depending on the sales volume in your group. Do you encourage the sales representatives to adopt a policy of “total customer satisfaction” by asking customers to return all products with any defect?

It should be obvious to a casual observer that “no” is the ethical choice in both cases.

The DETS questionnaire resulted in scores for levels of trait emotions in a subject. Regression of the results of the sixteen ethical questions against the levels of trait emotions revealed that trait emotions could account for 29% of the variance in ethical choices involving interpersonal issues. Trait emotions showed no significant correlation with ethical choices involving organizational issues.

## **Emotions, Decision-Making, and Ethics**

The connection between emotions, decision-making and ethical decision-making is complicated somewhat by the different interpretations and models of the origin of emotions and how they are generated. What is needed is a model of emotion and how it is elicited in a professional context. Models of emotion are discussed by Randolph Cornelius.<sup>20</sup> Some basic concepts and issues related to the theory of emotion can provide some insights into the nature of emotional engagement in ethical decision-making. However, it is not possible to connect a particular theory of emotion with ethical decision-making; further experimental research is required to do that.

A central idea about the origin of emotion is that thought or cognition is required to elicit an emotion.<sup>21</sup> When people think about a situation they appraise it for personal relevance. Structural theories of emotion<sup>20 (p.140)</sup> postulate that the result of the appraisal is a point in a multi-dimensional space that is uniquely associated with a particular emotion. The structure of the multi-dimensional space can be depicted in a tree-like

diagram with the reaction to the appraisal as the root [See, for example, 20, Figure 4.3], hence the term “structural”. A simple example of a dimension is the probability,  $P$ , of a desirable outcome, ranging from impossible ( $P = 0$ ) to uncertain ( $0 < P < 1$ ) to certain ( $P = 1$ ). Depending on the probability of the event, different emotions will be elicited; disappointment if the outcome is impossible, hope if it is uncertain, and joy or happiness if it is certain.

A structural theory can be used to predict an emotion, given the results of the appraisal provided by a subject. Verification of a particular theory is done by comparing the predicted emotion with that felt by the subject. Several different models of the multi-dimensional space in which the result of the appraisal is located have been proposed.<sup>20</sup> (p.140-146) Application of structural models to the prediction of emotions in general situations has been successful and therefore it is conceivable that a structural theory could be developed for situations in professional ethics. Connelly and coworkers<sup>2</sup> used a structural model in their research. Alice Gaudine and Linda Thorne<sup>6</sup> proposed such a model which does show that certain emotional states could influence an individual’s ability to identify an ethical dilemma and to make ethical choices that are consistent with appraisals. However, experimental work is required to confirm the validity of the model.

A structural theory does not provide a reason why an emotion is elicited in a particular situation. Evolutionary theories of emotion suggest that emotions originate in primitive brain structures that evolved before the cerebral cortex which is associated with complex thought, i.e., emotion evolved before thought. Thus emotions are innate reactions to certain stimuli. Charles Darwin<sup>22</sup> suggested that emotions such as fear, anger, happiness, and sadness evolved because of their adaptive value in survival of a species. For example, a fear-inducing stimulus (e.g., sight of a predator) goes directly to the amygdala, a brain structure essential for decoding emotional stimuli. The amygdala generates a physiological response (e.g., flex muscles and flee) much faster than if the stimulus went to the cortex and hippocampus where it would be decoded by thought processes combined with memories and then passed to the amygdala, leading to a slower response. From the point of view of species survival, a quick response to a predator is a good way to ensure the possibility of passing on genes.

As cognitive abilities evolved in humans, it became possible for a complex society to form which included communication and interactions involving trust, cooperation, reciprocity, altruism, and care about the welfare of others. Standards for behavior and morality were required for such a system to survive and thus a variety of emotional responses to violations of these standards also evolved to encourage or enforce the standards.<sup>23</sup> Given this, it can be understood why a moral dilemma involving such things as murder, killing, stealing, non-cooperation, incest, and unfairness would elicit an emotional response.

The social constructivist perspective<sup>20</sup> (Chapter 5) suggests that appraisal leads to an emotional response that is culturally determined, that is, emotions are a product of culture and upbringing. Also, the manner in which emotions are expressed may play a social role. For example, an angry public response to a humiliating remark may be appropriate in Western culture but is unacceptable in Eskimo society. This cultural

variation in emotional response is not inconsistent with the evolutionary model for the origin of emotions. Consider the question: Which society is more likely to survive – the one that displays anger or the one that exhibits restraint? From the point of view of emotion and professional ethics, it is conceivable that rules for emotional display could also be learned or acquired by the “culture” of professional training.

Robert Zajonc<sup>24</sup> argues that emotion is post-cognitive and that what is first experienced in response to a stimulus is an “affective reaction”, a sense of goodness or badness, which occurs rapidly and automatically with minimal processing of the stimulus, but guides subsequent cognitive processing and emotional response. For example, consider the response to the words “bribery” and “salary increase”. The difference between the cognitive and post-cognitive theories for generation of emotions seems to be related to how cognition and appraisal is defined and how much is occurring. Nevertheless, if affective reactions occur rapidly and with minimal processing, they may serve as orienting mechanisms that assist with navigation through ethical problems involving complexity and uncertainty.

Cognitive psychology models human information processing as a combination of the automatic affective reaction and analytical or controlled processing to produce judgments and decisions. Ethical decision-making of a practicing professional often involves a conflict between self-interest and professional responsibilities. Donald Moore and George Loewenstein<sup>25</sup> argue that self-interest can lead to an automatic affective response whereas professional responsibilities require a more thoughtful response based on analytical or controlled processing. Normally there is no conflict between the two responses, but if there is, self-interest may likely win because its origins are primal and related to survival. Self-interest then exerts an influence on controlled processing leading to conflicts of interest and possibly other unethical behavior.

Whatever model for the generation of emotion is adopted, it would seem that emotions could be interpreted as responses to change, threats, opportunities, uncertainty, ambiguity, incomplete information, personal conflict, conflicting requirements, contingencies, and discordant events. Any one of these characteristics could possibly affect one’s reputation, integrity, and success and lead to emotional engagement. Thus, just as emotional engagement in a moral dilemma is the result of the evolution of survival mechanisms for the human species and society, it may be seen that emotional engagement could be a mechanism that protects or assists a professional confronted with ethical decisions involving conflict and uncertainty. Alternatively, emotional engagement could be what protects the professional’s self-interest leading to unethical or unprofessional behavior.

### **Uncertainty and the Evolution of Personal Involvement: Three Cases**

Moral or ethical problems in the “real world” are rarely like the life-or-death dilemmas used by Greene and coworkers<sup>1 (note 8)</sup> – if they were, professionals would seek other work. Real world ethical problems are messy affairs and involve different amounts of

personal involvement and uncertainty which, depending on circumstances, may change over time. The following cases are intended to illustrate this. It is suggested that the level of emotional engagement in these cases increases with the amount of personal involvement, conflict, and uncertainty.

### ***Runaway train in Commerce Ca.***

On Friday, June 20, 2003 in southern California, the Union Pacific Railroad was carrying out a switching operation with a freight train carrying lumber. Thirty cars of the train broke loose and rolled 27 miles west towards central Los Angeles at speeds of up to 50 mph before railway officials used a remote system to switch the runaway cars to a siding in the small city of Commerce. At 12:01 pm 18 of the 30 cars derailed off the siding damaging or destroying some homes in Commerce and causing minor injuries to 13 people. Fortunately no one was killed.

This case is very much like *Bystander* given above except that the consequences are less certain. A spokesperson for Union Pacific (UP) made the following statements to various reporters:

“UP knew the maneuver was likely to cause a derailment, but it would have been more dangerous to allow the train to continue moving into central Los Angeles.”

“... they did this [because] the train was headed to the more populated area of Los Angeles, where there are possibly commuter trains and more population.”

“The railroad had only 30 minutes to respond and made notifications to the best of its ability.”

It can be inferred from the first two statements that utilitarian reasoning played a major role in the decision to switch the cars to the siding. This is consistent with the typical response to *Bystander* which is to pull the lever. However, uncertainty was significant. Although the siding was a dead-end, the term “likely” in the first statement implies that there was some uncertainty with respect to a derailment. Also, it must have been assumed that no one was on the siding (sleeping?). The term “possibly” in the second statement implies that the potential for damage and injury in Los Angeles was unknown. The various uncertainties could have led to fear or considerable apprehension at least on the part of the decision-makers. The third statement shows that there was a very short time available to inform authorities in Commerce, but demonstrates a sense of responsibility and is defensive, possibly indicating something similar to guilt, embarrassment or shame.

### ***Slippery slopes***

John, a geotechnical engineer with 12 years of experience, works for a consulting engineering company. One morning he is told by Ray, a vice-

president, that he will be the manager of a project to stabilize slopes along a forestry road located in mountainous terrain. It is a four-month project with considerable scheduling, logistical, and materials supply issues. John is enthusiastic about this challenge and spends the rest of the morning examining the designs of the stabilization measures. In the afternoon he travels to the logging camp to inspect the slopes the next day.

The design of the slope stabilization measures was done by another engineer who has left the company. However, after seeing the slopes and reviewing the designs, John is convinced that within a long section of the road that has very high and steep slopes the proposed measures will be difficult or impossible to construct and may not work causing an unsafe situation. After returning to the office he expresses his concerns to Ray.

After hearing John's concerns, Rays says "I'm not sure I agree with you and in any event, we can't change the design now, it has been approved by the Ministry of Forests and it would cost too much to do a re-design." John expresses his reluctance to implement the measures as designed but Ray responds "John, we need a capable person to make this work, that's why we picked you for the job." John knows the design is inappropriate and does not want to be involved. He suggests that someone else should manage the construction, but Ray says that changing project managers would give the client the wrong impression and that, in any case, no one is available.

John then suggests "OK, we'll do this on a trial basis, say along a 100 foot portion of the section with the steep slopes. After that we should have a complete review with the forestry company, the Ministry and us." Ray agrees to this and the project starts.

Construction of the trial section of the stabilization measures begins. However, a minor landslide occurs in the section destroying most of the work done. John and the forestry company are not amused.

From the NSPE code of ethics<sup>26,d</sup> there are three ethical issues in this case:

- 1) Engineers may accept assignments and assume responsibility for coordination of an entire project provided that each technical segment is signed and sealed only by the qualified engineers who prepared the segment.
- 2) If an engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.
- 3) An engineer shall be a faithful agent of his employer or client.

It follows from the first item that no engineer should be forced to take on responsibility for work that he or she did not actually design. However, the design was signed by the former employee and John was given the opportunity to familiarize

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d. Codes of ethics of other associations of professional engineers are similar to the code of the National Society of Professional Engineers.

himself with it. Nevertheless, it is unfair for the company to force John to take responsibility and then to dismiss his professional opinion. As to the second item, John did inform Ray of his concerns and the potential hazards. The third item is more of a problem and is of interest from the point of view of personal involvement.

Conflict arises in that John wants to do the job and actually be a faithful agent of his employer, but is quite certain that the measures will not work and that a landslide hazard will continue to exist. He has two options: carry out the work and possibly be involved in a failed project or refuse to be involved and let down his employer. Neither of these options is good for his reputation or self-respect. This could lead to some form of an emotional response, likely fear or apprehension, possibly anger at being forced into such a position. To avoid the conflict John looks for alternatives such as finding another person to manage the construction and proposing the construction of a test section to see if the method works.

### ***Challenger Space Shuttle***

During the 1980s, solid fuel booster rockets for the space shuttle were made by Morton Thiokol (now ATK Thiokol) in Utah. The booster rockets are built in cylindrical segments which are transported by rail to the Kennedy Space Center in Florida and assembled at the launch pad. O-rings made of a rubber-like material were placed between each segment to provide a seal against escape of fuel combustion gases. It was known or strongly suspected by some NASA and Morton Thiokol engineers that the O-rings became less flexible in cold temperatures which would limit their ability to provide an effective seal. On January 27, 1986, the day before the launch of the Challenger (Flight 51-L), the predicted launch temperature was 29°F. During the evening of January 27, some engineers at NASA and at Morton Thiokol recommended that the launch be delayed. However, the recommendation was not followed, and on January 28 the Challenger blew up 73 seconds into its flight, killing all seven astronauts on board. Based on photographic evidence and evidence from the rocket debris, it was concluded that the most likely cause of the Challenger explosion was failure of the O-rings to seal due to the cold launch temperature.

Technical details about the disaster and the design and behavior of the O-ring joint are given in an article by Trudy Bell and Karl Esch.<sup>27</sup>

There were actually two O-rings in the joints, a primary one and a secondary one for redundancy. Laboratory and field evidence collected before the Challenger flight showed evidence of reduced flexibility or reduced ability of an O-ring to seal at cold temperatures. However, the available data and observations were unable to provide a conclusive link between cold temperatures and flexibility<sup>e</sup> and no data were available

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e Laboratory models of the joint were much smaller than the actual joint so that it was difficult to interpret the relevance of the results to the behavior of actual joints. The state of O-rings after previous launches was used as an indication of the ability of the O-rings to seal. If an O-ring did not move into a joint and seal, hot gases would “blow-by” and, in some cases, cause removal or erosion of O-ring material, the existence of which was considered an indication of poor

for temperatures below 53°F. A prediction of the effect of a cold launch temperature such as 29°F on the behavior of the O-rings was therefore uncertain.

The evening before the launch a teleconference call occurred between engineers and managers at Morton Thiokol (MT), the Marshall Space Flight Center in Huntsville, Alabama, and at the Kennedy Space Center. At the beginning of the teleconference, two MT engineers, Roger Boisjoly and Arnold Thompson, presented charts, data, and photographic evidence which they felt clearly demonstrated the problems with the performance of the O-rings at low temperature. Robert Lund, vice-president of engineering at MT, presented a recommendation that the launch not proceed unless the ambient temperature was above 53°F, the temperature at which the O-rings of a previous launch, Flight 51-C in January 1985, showed evidence of low flexibility.

Some NASA personnel expressed their displeasure with this recommendation which set a tone for the remainder of the teleconference and exerted considerable pressure on MT personnel to recommend a launch.<sup>f</sup> Through a series of statements, NASA effectively asked MT to prove that it was unsafe to launch given the available data, whereas the approach up until that time had been to prove that it was safe to launch, a subtle but significant difference.

Joe Kilminster, the MT vice-president for Space Booster programs, called for an off-line meeting of MT personnel. During this meeting, Boisjoly and Thompson tried again to use the available data to explain the rationale for being concerned about a launch the next morning. However, they gave up when it became apparent that no one was listening. Then Jerry Mason, the senior vice-president at MT, said that a “management decision was necessary” because it was not possible to resolve the issue of the effect of temperature using the available data. The decision was now confined to a small group of four engineer/managers: Mason, Lund, Kilminster, and Calvin Wiggins, vice-president and general manager of MT’s space division.

Kilminster reasoned as follows: Although temperature effects were a concern, laboratory tests indicated that the primary O-ring could sustain three times more erosion than that experienced in the January 1985 launch of Flight 51-C<sup>29 (IV, p.818)</sup> and the secondary O-ring was available as a back-up. Lund eventually agreed with this interpretation of the data and “felt that there was some rationale that allowed us to go ahead.”<sup>29 (IV, p.816)</sup> When the teleconference resumed the group recommended that the launch proceed. The next day, the Challenger was launched and blew up.

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flexibility. O-rings launched at low launch temperatures suffered more erosion than O-rings launched at high temperatures, but for some launches at intermediate temperatures no O-ring erosion was observed. There were other seemingly random effects<sup>28 (p.73)</sup> which led some to conclude that there was little or no relationship between temperature and flexibility.

f The testimony of Allan McDonald, a MT manager, is an example of the reaction to some of the statements made by NASA personnel.<sup>29 (IV, p.729)</sup> Larry Mulloy was the manager of the Solid Rocket Boosters project at Marshall and is reported to have said in reference to the recommended launch temperature of 53°F “My God, Thiokol, when do you want me to launch, next April?” George Hardy was the deputy director of Science and Engineering at Marshall and is reported to have been “appalled by Lund’s recommendation.”

The ethical issue in this case is clear. All engineers (and all of the managers were engineers) have a duty to “hold paramount the safety, health and welfare of the public”.<sup>26</sup> All of the engineers at MT knew there were risks to the safety of the “astronaut public” at low launch temperatures and some engineers knew or felt that these risks were unacceptable. Why then was the launch approved?

The changes in personal involvement for the MT engineers are interesting. During the teleconference, the decision-making evolved from a collective process involving about 30 people into one within a small group of four engineer/managers and which excluded some engineers who were opposed to a launch. It is suggested that the engineers who were excluded from the decision were in a position similar to the *Bystander* who must decide whether to pull the lever and save the seven workmen. These engineers had two options: recommend a launch if it could be done safely or oppose a launch because there is the possibility that the O-rings will fail. Even though there was pressure to recommend a launch, there was no launch experience with temperatures similar to the predicted launch temperature and “experience trumps experiments.”<sup>28 (p.77)</sup> Although there may have been some personal risk for them to oppose a launch, it was not enough to counter their professional opinion.

The four engineer/managers were in a different and more complicated position. It is suggested that, to varying degrees, each of them was in a situation similar to that of the person on the footbridge next to the *Fat Man* so that saying no to a launch was analogous to pushing the fat man off the bridge to stop the train and save the seven workmen.<sup>g</sup> Only two options were available: approve the launch against the advice of their engineers and hope the risk was small, or disapprove the launch, delay the shuttle program, and assume the risk that MT would not be the sole contractor for booster rockets in the future. Both options had potential consequences for their careers and MT and reasons were needed for either option. In the case of approval, the group of four required reasons that it was safe to launch, whereas in the case of disapproval, NASA required reasons that it was unsafe to launch. This was conflicting and the available data could not provide conclusive reasons.

Some members of the group sought alternatives in the manner most people do when confronted with dilemmas or problems involving considerable personal involvement or risk. For Mason and Wiggins a judgment or “management decision” was the alternative because the available data were inconclusive. Kilminster was initially opposed to a launch, but found an alternative in his interpretation of the data which suggested the risk of O-ring failure was small. The case of Lund is particularly interesting. Initially Lund was reluctant to go against the recommendations of the engineers. However, the others had decided to approve the launch and so it was up to Lund only, a case of extreme personal involvement. Then Mason said to Lund the infamous statement: “Take off your engineering hat and put on your management hat”<sup>29, IV (p.773)</sup> and Lund finally agreed. It is suggested that the combination of Kilminster’s interpretation and Mason’s request gave Lund the reassuring alternative he needed to agree with the others.

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g. Given the long association of this group with the shuttle program, it may have been analogous to throwing themselves in front of the train.

Taking issue with the interpretation of the data and the use of judgment to approve a launch does not lead to understanding why the decision was made. It is believed that the decision was made to approve the launch because of the increasing and significant personal involvement of each member of the group of four and the personal and political risks associated with any recommendation they made. Faced with this dilemma, each member of the group found various rationales to, in this case, avoid the consequences of not recommending a launch.

As to the emotions being felt by the people involved, some reasonable speculations are possible. For the engineers opposed to the launch whose opinions were misunderstood or ignored, anger was the likely response.<sup>30</sup> Some said they were nervous or upset about the decision<sup>29</sup> (pp.702-704, pp.822-823) and the pressure from NASA would only heighten these emotions. It is likely that the group of four in the off-line meeting were more emotionally engaged, fearful of the consequences of not recommending a launch without having a technical basis for doing so.

Many authors have dealt with the ethical issues of this case and have provided interpretations of the actions of the engineers and managers involved.<sup>27-37</sup> The above should not be construed as yet another ethical analysis of this case; instead it describes the decision-making process in terms of the changing personal involvement leading to varying degrees of emotional engagement which, it is believed, played a significant role in the decision to launch.

## Summary

Using neuroimaging techniques it was shown that personal involvement required in a moral or ethical dilemma generated a response in parts of the brain associated with emotion.<sup>1,16</sup> Another psychological study used the answers to questionnaires given to a group of subjects to show the importance of particular emotions when personal issues are involved in a problem in professional ethics.<sup>2</sup> The two studies provide strong empirical evidence for the role of emotions in ethical decision-making, but the second specifically identifies the emotions involved. Another difference between the two studies was that the ethical questions posed in Greene and coworkers<sup>1</sup> require brutal life or death choices to be made whereas those in Connelly and coworkers<sup>2</sup> did not.

An ethical decision-making process may involve considerable uncertainty and may evolve over time from an impersonal situation to one with a significant personal focus. It is suggested that the level of emotional engagement increases with the amount of personal focus and is significantly affected by uncertainty. Three cases were discussed to demonstrate this possibility, each of which involved uncertainty, ambiguity, contingencies, conflicts, and discordant events. Such characteristics can be interpreted as a change, a threat, or an opportunity which are known to cause an emotional response and to affect decision-making. Emotional engagement could have occurred in these cases and changed with the level of personal involvement, but it is difficult to confirm this and impossible to determine the emotions involved.

Archetypes for professional ethics, like trolley problems which are moral dilemma archetypes, would be extremely useful models for pedagogical purposes, for

interpreting other cases, and particularly for development of the ethical workplace. Finding these requires determination of what emotions are engaged in problems of professional ethics, how the emotional engagement may change over time, and how these emotions affect decision-making. More elaborate experiments would be required to do this, ones that involve interactions between a number of subjects, changing or evolving conditions, and uncertainty. Structural models of emotional response in the workplace, similar to those developed in Connelly and coworkers<sup>2</sup> and Gaudine & Thorne<sup>6</sup> but in which issues such as personal involvement, ambiguity, change, threat, and uncertainty would be dimensions of the model, could be the basis of experiments relating appraisal of situations to an emotional response. One challenge would be to devise objective schemes for measurement along these dimensions. It may also be possible to confirm the locus of neural response by means of fMRI scans on subjects who are posed questions similar to those in the experiments of Connelly and coworkers.<sup>2</sup>

Since structural models are static, a different approach would be needed for determining emotional response under evolving conditions. Monitoring of people engaged in strategic games<sup>38</sup> may be a promising approach. For example, in the ultimatum game a proposer (human or computer) offers a human responder a method of splitting a sum of money. Functional MRI scans of subjects acting as the responder show that unfair offers elicited more emotional processing in the brain than fair offers.<sup>39</sup> Games which involve repeated interactions between players may also provide some clues as to changes in emotional engagement. There is precedent for this kind of investigation. Functional MRI scans were made of subjects while they were playing, or after they had played the iterated prisoner's dilemma game.<sup>40,41</sup> In both studies, a response to cooperators was found in a region of the brain associated with trust and reward, but changes in the nature of the response were observed if a defection occurred within a sequence of cooperative moves.

An ambitious scheme has been proposed<sup>42</sup> where it is suggested that "to make inroads into the neural basis of social interactions, the plain approach is clear: let humans interact socially while concurrently probing their brain activity." They suggest that the Internet can be used to link MRI scanners in widely different locations with subjects engaged in paced social exchanges. The logistics of such experiments would be a significant challenge and extended periods in an MRI device can bring on a claustrophobic reaction which could affect the results. An interesting review of the neuroscience involved in social interactions is given by Ralph Adolphs.<sup>43</sup>

Clearly there is some interesting technology to be applied to determine the emotional basis of decision-making in professional ethics. However, as more about this subject is discovered, it may be tempting to use "Sorry, but I'm emotionally wired that way" as an excuse for making an unethical decision. That excuse, however, cannot be supported by the evidence considered in this paper which is, in fact, consistent with the contrary proposition, namely that decision makers should seek to understand the moral and psychological elements that inform their choices.<sup>h</sup>

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h. Michael Bourke, an ethics instructor at the British Columbia Institute of Technology, provided this response to the author.

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