

An Exploration of Emotion and Cognition during Polygraph Testing

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"There is nothing either good or bad, but thinking makes it so."

--W. Shakespeare, Hamlet

Abstract

The fight-flight, or fear, response is often the focus of attention when examining the role of emotion in the psychophysiological detection of deception (PDD, polygraph) setting. This paper asserts that rather than fear alone, many other emotions may play a role during PDD. We go further to examine the relationship between cognition (appraisal) and emotions. Although there remains no consensus in the exact mechanism of this relationship, most research has identified at least two distinct patterns, or levels, of appraisal: subconscious and conscious awareness. Both levels of appraisal trigger emotions. We have also seen that the specific emotion triggered can vary widely among individuals based on their prior experiences, values, goals, and expectations and most importantly, how the situation is appraised.

Cognitive appraisal plays a significant role in triggering emotion and physiological reactions. These reactions must be interpreted with caution as it is not clear which emotion has evoked which pattern of response. Although there is no doubt that there are physiological changes that accompany emotion, we are yet unable to distinguish specific emotions using PDD technology.

Introduction

The principles of the Psychophysiological Detection of Deception (PDD) examination are grounded in the psychophysiological sciences with the well-established "fight-flight" response being a foundational tenet. However, the role of cognition and appraisal in triggering an autonomic nervous system (ANS) response and putative hypothalamic mediated

somatomotor center changes (Janig, 2006) have often been overlooked. This paper asks 1) How important is cognitive appraisal in triggering emotion? 2) Are the changes in ANS arousal and presumed hypothalamic mediated somatomotor center changes in the PDD setting due to fear, another emotion, or a combination of emotions? 3) Can the PDD charts distinguish between specific emotions? 4) What does all this mean for PDD?

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Although there is no universal agreement on the definition of emotion we will use the term to refer to the conscious experiences and physiological changes that occur in response to external or internal stimuli. Emotions have three components: physical arousal, behavioral manifestation and inner awareness of the feeling. Cognition refers to the conscious or subconscious mental processing of information to acquire, process and store knowledge. This includes appraisal of situations and circumstances to determine appropriate response. Cognition and emotion are intricately intertwined. Although different theoretical perspectives will disagree as to the precise relationship between emotion and cognition and how they combine to influence ANS arousal and commonly suggested hypothalamic mediated somatomotor center changes, it can be agreed that each plays a significant role.

Purpose of Emotions

Emotions are the result of evolutionary fine-tuning that is intended to ensure the survival of an organism. Emotions have essentially one primary purpose. Emotions prepare an organism for reaction (Ekman & Davidson, 1994; Lazarus, 1991). Emotions can be seen as tools that regulate behavior in relation to patterns laid down through evolution.

Cannon (1927) described fear reactions as an overall sympathetic nervous system (SNS) arousal resulting behaviorally in what he called fight-or-flight. When presented with an emergency situation, Cannon believed the animal can choose to fight the danger or attempt to flee. Fighting and running away both involve an initiation of movement, whereas immobility, another behavioral option suggested by Gray (1988), is just the opposite. Gray (1988) introduced the term Behavioral Inhibition System (BIS) to describe a series of responses to fear stimuli that include; increased arousal, behavioral inhibition, and increased attention. The freeze response became an integral part of Gray's early BIS hypothesis and describes an inhibition of ongoing behavior. Updated descriptions of the BIS by Gray and McNaughton (2003) characterized behavioral inhibition as decreased motor activity when presented with fear or anxiety associated with an approach-

avoidance based conflict. The updated theory separated pure "freeze", which is typically associated with the fight or flight response, from those that were behaviorally inhibited. This introduced the concept of higher brain functions being able to override programmed behavior as such adaptive capabilities would serve to expand a response repertoire that can increase the chance for survival.

The biological function of emotions is to prepare the organism for a reaction, often in the form of a physical action, even though a reaction may not be needed and may not occur. Emotions, however, allow a head start towards a reaction. There are a number of physiological changes that occur in anticipation of a potential negative encounter. This feed-forward type of physiological preparation is referred to as allostasis (Handler, Rovner & Nelson, 2008). Allostasis can be described as a central nervous system mediated, integrated brain-body response geared towards viability or survival. It occurs in regulatory systems which have no fixed set point and all are the result of evolutionary tinkering.

1) How important is cognitive appraisal in triggering emotions?

A brief overview of prevailing theories is warranted to understand the intricate relationship that cognition plays in triggering emotion and therefore the physiological response. One of the earliest modern theories is the James-Lange Theory of Emotion which states that when presented with stimuli the ANS automatically responds with physical changes. When the individual becomes aware of these physical changes they label their emotions. For example, a person sees a snake, her heart starts beating fast, she becomes aware of her bodily changes and realize "My heart is beating hard therefore I am afraid" (James, 1884; Lange, 1885). The James-Lange theory states that conscious awareness of the emotion occurs *after* the ANS response. The role of cognitive appraisal of the stimulus is not a component in this model.

In the following decades the Cannon-Bard Theory of Emotion described the ANS response and experience of emotion as occurring *simultaneously* (Cannon, 1927;

Bard, 1934). Cannon-Bard theory states that when presented with stimuli, sensory data is processed by the brain (thalamus) and simultaneously sent to the organs of the nervous system and cortex.

In the 1960's Schacter and Singer (1962) asserted that cognitive appraisal plays a key role in the experience of emotion. For example, when exposed to a snake, a person will interpret the snake as a threat and simultaneously the ANS will be aroused. The second response will be the conscious awareness of fear. This model is radically different from previously proposed models in

that the role of cognition and appraisal of the stimulus is significant in the process.

Robert Zajonc (1984) supports the James-Lange theory and described an exposure effect and wrote that some emotional reactions can bypass the cognitive appraisal and trigger an immediate ANS response. In contrast, Richard Lazarus' cognitive mediation theory (1984) reports that we must cognitively attend to our physiological response in order to ascertain our emotion. See Table 1 below for a comparison of the major theories of emotion.

Table 1. Theories of Emotion

Theory	Stimulus	Initial response	Secondary response
James-Lange	Snake	ANS arousal	Interpretation of ANS reaction. Conscious awareness of fear. ("My heart is beating hard, <i>so</i> I must be afraid")
Cannon-Bard	Snake	Sensory Processing by the Thalamus	ANS arousal Conscious awareness of fear ("My heart is beating hard <i>and</i> I am afraid")
Schachter-Singer two-factor theory	Snake	Cognitive appraisal ANS arousal	Conscious awareness of fear ("The snake could harm me and I am afraid of it")
Zajonc Exposure effect	Snake	ANS arousal	
Lazarus Cognitive Mediation Theory	Snake	Cognitive appraisal ("this is a threat") Feel fear	ANS response

Modern theorists use the Zajonc-Lazarus debate (Buck, 2000) as an example of how semantics and definitions can produce different theories of emotion. At contest in this debate was whether a subject could respond to a stimulus subconsciously, without knowing what it was. Zajonc (1984) argued that a person could respond emotionally independent of cognition, and that cognition requires mental work or evaluation of a stimulus. Zajonc held that when

emotional responses occurred subconsciously, they occurred in the absence of cognition. Lazarus (1984), on the other hand, argued that cognition occurs in concert with any primitive evaluative perception. For our purposes, we will accept an integrative assumption that both are correct, and that cognition includes both early and late responses as illustrated by the work of LeDoux (1996) in the area of conditioned fear. LeDoux found strong evidence for two neural

paths of activation for conditioned fear in rats. Information from external stimuli may reach the amygdala via the sensory thalamus (low road) while a second path was routed through the sensory cortex (high road). Several nuclei within the amygdala are responsible for activating a number of fear responses. The low road path provides a “quick and dirty” warning while the high road path allows for slower but more accurate assessment of the stimulus (LeDoux, 1996).

As is frequent in the evolution of theories, as new information and new technology become available for examining the process of emotion emerge, new perspectives develop. Rather than dismiss any early theory as being right or wrong, it would be more accurate to state they were incomplete. We may still only know a small part of the process but understanding is improving. Ekman's current ideas on the process of emotion encompass many of the previous theoretical perspectives. Ekman (2003) presents the concept of autoappraisal that occurs instantaneously when a sudden threat arises. We will use a common example of driving. A car suddenly heads toward you and will hit you if no action is taken. You swerve and miss the vehicle. All this may happen in less than a second. What process took place? Your sensory registers (eyes) saw the oncoming car. This information was sent to the brain which in turn instantly appraised the situation as being imminently dangerous and needing action. The brain triggered the arousal of the ANS and the body was able to coordinate action to avoid the threat. Within seconds we apply conscious appraisal to the situation and may acknowledge feeling fear or other emotions. The autoappraisal can occur at a subconscious level and is so rapid that early theorists assumed there was no time for cognitive intervention to be occurring. Ekman and others (such as Roseman, 1984) believe that there has to be some form of initial appraisal that triggers the ANS system to action. Additional conscious cognitive appraisal occurs after the ANS response. It would seem that cognitive appraisal may have several roles in the triggering of emotion. The initial autoappraisal or subconscious appraisal that is the initial trigger for physiological response and a secondary conscious appraisal occurs beyond the initial reactions. During this secondary, or

conscious, appraisal of the situation, physiological and outcome data is assessed. It is this secondary appraisal that can trigger a large variety of emotions in individuals due to different experiences, perceptions and meaning assigned to the initial stimuli. This becomes relevant for the polygraph examiner. Intertwined with the concept of autoappraisal is the process of classical conditioning. If a fearful stimulus has been experienced in the past and resulted in a negative consequence, a conditioned response can occur when the individual is exposed to that stimuli, similar stimuli or even unrelated stimuli that occurred at the same time as the original event.

During PDD testing, examinees are presented with a number of stimuli, in the form of test questions, and are essentially asked to attend to each sequentially. Presumably, as the examinee attends to each test question they conduct an appraisal with respect to what that test question means to them. This appraisal relates to the examinee's goals and how those goals may be affected within the PDD setting. Cognition and appraisal are a process of evaluating a stimulus for goal congruence within the examinee's motivational framework. While it is not feasible to attempt to state we know what particular meaning a given examinee attributes to an individual test question, it is possible to discuss a number of possibilities of what the examinee *could be* thinking in terms of goal congruence. Appraisals are simply an evaluation and then assignment of emotional meaning, value or salience (Power & Dalgleish, 2008; Scherer, 2000).

In the usual diagnostic PDD setting we can typically assume that the goal of the examinee is to maintain freedom and be viewed as innocent of accusations. These goals have high relevance to most individuals, and the PDD examination and potential outcome can be highly incongruent with achieving these goals. Ego-involvement is also high due to the extreme personal implications regarding one's identity and self-esteem should results of the PDD threaten the public persona. We have suggested that emotions are the response to appraisals of the significance of a given situation with respect to goals. We offer there are two routes of appraisal through which emotions may occur

and both are applicable to PDD testing. Both routes of appraisal involve a cognitive component and are equally capable of eliciting an emotion. One route is a conceptual, computational or schematic route and the other is a reinstatement of a previously learned or evaluated situation (Power & Dalgleish, 2008). The former will be developed or computed through a situational analysis. The latter relies on memory of an earlier response and produces a faster, though potentially less accurate response. In either case a situation that is appraised as having significance for a person's goals can elicit an emotional reaction either as a result of a reinstated prior emotion or because the person has perceived the situation to be one that will affect their goals.

A PDD related example of a conceptual, computation or schematic route for generating an emotional state.

This route of appraisal describes one that is essentially pieced together in a conceptual or story-like manner. In this case the appraisal is being conducted as the pieces of information become available. For example take an examinee in a public safety pre-employment screening polygraph test that has been less than forthcoming about his past criminal activities. During his pre-test discussions of these issues he silently compares his personal involvement in criminal activities against what he believes are societal norms or what the hiring agency will accept. He concludes that telling the complete truth about what he has done may be incompatible with the hiring preferences of the agency to which he has applied. He may believe that in order to continue in the hiring process he must lie about these acts or minimize his admissions. This requisite deception may then result in the activation of one or more emotions, which are in response to an appraisal. Perhaps the examinee is angry with himself for having done these things, considering them stupid. Alternatively he could be angry with the hiring agency for inquiring into what he feels is a private matter or one that may have happened long ago. He may feel some level of guilt for what he has done or possibly experience some degree of shame or embarrassment at the prospect of the polygraph examiner and hiring agency discovering this issue. There may also be

some anxiety or even fear surrounding the thought of not getting the job or being labeled as someone who is not qualified for the job, thus ending his law-enforcement career. Some of these emotions could have occurred because during the appraisal process, the examinee became concerned that his past acts are incongruent with the goal of obtaining the job. Other emotions could result from the examinee being reminded of past transgressions which are socially objectionable. This is just one possible example of the multitude of ways the examinee could use a bottom-up or constructive approach to generate emotional states.

2) Are the changes in ANS arousal and hypothalamic mediated somatomotor center changes in the PDD setting due to fear, another emotion, or a combination of emotions?

The existence of basic emotions, that is, a universal set of emotions that are common to all humans has been debated by researchers of emotions for centuries. It seems that the concept of a basic emotion, for example, anger, may in fact comprise of a range or family of emotions (Ekman, 2003). So rather than consider each of the basic emotions as a single affective experience, it may be more helpful and accurate to consider each basic emotion as a family or cluster of related emotions. There is a moderate degree of consensus that a small set of emotions can be considered basic or universal (Ekman, 1992). These basic emotions are anger, fear, disgust, surprise, happiness and sadness. Several researchers (Power and Dalgleish, 2008) point out that surprise does not always result in an emotion, and have dropped it from the list. Since surprise is not indisputably an emotion state and is not an affect state we would want to produce during a PDD test, we will follow the recommendation of a number of emotion researchers and drop it from the list of what we consider "basic emotions". That leaves us with those emotions that are listed in Table 2 along with their accompanying appraisals. These few emotions have been identified to play an essential role in daily survival, such as escaping from harm (fear), avoiding toxic food (disgust), and pursuing reproductive endeavors (happiness).

Table 2. The key appraisals for each of the five basic emotions, adapted from Power and Dalgleish (2008).

Basic Emotion	Appraisal/cognition
Anger	Frustration or perceived blocking of a role or a goal, directed at the perceived thwarting agent
Fear/Anxiety	Physical or social threat to self or goal
Disgust	Something repulsive to oneself or society.
Sadness	Actual or potential loss or failure of a valued personal role or goal.
Happiness	Positive move towards a valued personal goal or role.

As presented in Table 2 the appraisals that trigger anger relate to the real or perceived blocking of a significant goal or role relevant to the individual. In the PDD setting the examiner or the questions being asked can be perceived as being an obstacle toward maintaining goals. Fear and anxiety, similarly are triggered by the appraisal that there is a threat to oneself or one's goals. Again the PDD examiner or the questions asked may elicit this appraisal.

3) Can PDD charts distinguish between specific emotions?

Since the late 1800's the question of emotion-specific autonomic nervous system activity has been explored. This exploration started with James (1890) and Cannon (1927) who could only explore the issue from a theoretical basis. William James (1890) believed emotions were the result specific changes in skeletal muscles and other physiological changes, the self-awareness of which created the emotion. Since then, a second wave of interest sparked research in the 1950's which provided some evidence for emotion-specific ANS activity (e.g. Ax 1953). However, the research methodologies were flawed, providing questionable results. A third wave of research was initiated in the 1980's led by Paul Ekman. Ekman has continued to examine the relationship

between ANS response and emotion and has provided the most convincing evidence to date that ANS activity is emotion-specific.

Several studies have attempted to find differences in autonomic nervous system (ANS) arousals. Sinha, Lovallo and Parsons (1992) found systemic differences among emotions which have negative valence. Anger resulted in greater diastolic blood pressure and increased peripheral resistance when compared to fear. Levenson, Ekman and Friesen (1990) compared anger and fear using finger temperature and reported an increase in temperature for anger and a decrease for fear. Cacioppo, Petty, Losch and Kim, (1986) reported increased electromyographic activation of corrugator muscles during negative affect stimuli and greater activation of zygomatic activity with positive affect stimuli. Levenson, et al (1990) reported the finding of four reliable differences among the negative affect emotions of fear, anger, sadness and disgust. They found: (a) anger produced a greater increase in heart rate when compared to disgust; (b) anger produced a greater increase in finger temperature when compared to fear; (c) fear produced a greater increase in heart rate when compared to disgust and (d) sadness produced a greater increase in heart rate when compared to disgust.

Although these studies suggest that there is evidence for emotion-specific ANS arousal, other studies have failed to show consistent results. It may be that the primary observable physiological responses are not sufficiently measured with current instrumentation, such as used during PDD.

From a PDD standpoint, this may seem like gloomy news if we were to be claiming to be able to pinpoint "fear" from among the many other potential emotional states an examinee may experience. Fortunately we do not have to subscribe to a "fear-driven" theory of PDD testing. We suggest we do not know and could not know what specific emotion or emotions may be contributing to ANS changes we measure during PDD in any particular individual. Instead we are content to admit that whatever contribution emotion makes to changes in our measurements, it is sufficient to allow us to effectively differentiate truthfulness from deception.

4) What does all this mean for PDD?

Imagine you are at the dentist having a cavity filled and the anesthesia is ineffective at masking the pain of the drill. As the dentist drills into your molar you experience a sharp pain coinciding with the sound of the drill. You hope your reaction to the pain will cause the dentist to stop and remedy the situation. But what about the next time you hear the sound of the dentist drill? It is possible that the sound of the drill can produce not only a cognitive response in the form of a memory, but may also result in an associative emotional reaction. This is an example of reinstatement of memory, or classical conditioning, of an earlier-formed evaluation which generates emotions "as if" an appraisal is occurring. The appraisal and the emotion should not be confused for being the same thing. When classical conditioning has occurred the appraisal work has already been done and the memory of the appraisal has been stored for this stimulus, allowing the emotion to more quickly and more reflexively occur. One need not stretch his imagination to appreciate the evolutionary benefits of such ability. Long term survival would seem more likely in an organism that does not have to perform a complete appraisal before generating an emotion and action in response

to a threatening event. One that can activate responses because of a memory of a similarly appraised encounter can act faster and perhaps respond more effectively.

Another possible example that offers a potential for a reinstatement of an emotion is the negative social connotations associated with lying. It is important to recognize that lying is both a goal-directed and common behavior, intended to reduce anxiety or threat associated with the truth about information for which a lie is told. This may occur in part because people are social creatures who often tend to seek approval and acceptance of their fellow humans, though they sometimes lie to achieve these goals. Most children are socialized from an early age to equate honesty with honor and goodness, that dishonesty is frowned upon, and that lying brings about punishment. We recognize that sometimes lying can also bring about reward when the deceptive behavior is not confronted. The choice to lie rests on the conclusion that lying will produce less internal anxiety or external consequences than would tell the truth. While lying is almost universally disapproved of, children are also socialized to understand the subtle boundaries surrounding verbal discretion, social politeness, and obsequiousness. In most societies lying in formal settings such as in discussions with a person in a position of authority is strongly discouraged and in some cases such lying is punished severely when it is discovered. For example, lying to a federal law enforcement officer during the course of an investigation is a felony in itself. It would seem there is a potential for anxiety to be associated with openly breaching such societal rules. There is also the potential for positive and conflicted emotions as the person hopes and seeks to obtain a desired result through telling a lie.

In our view the act of lying about the issue itself, for some people, may cause the test questions to function as a form of conditioned stimuli, reproducing a learned or associated internal anxiety state that is the result of a lifetime of conditioning experience. This experience may have resulted from accepting and rehearsing a system of socialized values that emphasize goodness and honesty. The possibility of getting caught in a lie and/or the punishment associated with being caught can generate a negative

emotional state. Thus even in a laboratory setting (where there is little jeopardy) the act of lying may create sufficient emotionality or conflicted response to produce measurable physiological reactions. Similarly, conditioned responses stemming from the behavioral act itself, independent of the act of lying about the event, may also play an additive role in the development of observable and measurable polygraph reactions, along with related neurobiological activity and mental effort.

Cognitive processes surrounding knowledge and memory of having engaged in an act can increase the salience of a test question about that act. Pretest discussion and review of the test question is thought to increase the salience of the test question for a person involved in the event, by stimulating thoughts, memory, and emotional experience pertaining to the event. Persons uninvolved in the event described by the test question have no associated memories, thoughts or emotional experience regarding the details of the incident. The memory tasks involved in lying can require additional mental effort or increased cognitive load, while attempting to suppress a memory or thought and divert attention to another matter when presented with the test stimulus question. Liars need to create their lie, assess that lie with regard to plausibility or believability, keep the lie straight during possibly numerous retellings and not confuse the lie with the truth. Liars also need to keep the lie separate from the truth and they need to monitor themselves more carefully in order to ensure they appear truthful and avoid giving away the falsehoods. In addition to the need to marshal sufficient mental ability to manage the content complexity and tell the lie in a convincing and coherent manner, liars must also try to conceal any emotional reaction which may occur in response to the either the event or the act of lying. This content complexity (Vrij, 2008) can add both emotional stress and cognitive demands to task requirements for dishonesty compared to similar requirements for truth telling.

An innocent or truthful person, uninvolved in the event described by a polygraph question, is free of the burden of conditioned emotional responses to the act of lying and to the event described by the relevant questions. The innocent person is

also free of the complex demands on attention and cognitive systems, including any need to manage presentation or appearance while maintaining a separation of the truth from the development and presentation of a plausible alternative. The truthful examinee may devote attention and effort to assess the likelihood that the test will result in an error, and the potential consequences associated with an error. However, our position is that the emotional and cognitive demands which the relevant test question stimuli place on the truthful person are less than those required of someone who is involved in and chooses to lie about an event under investigation. The effectiveness of PDD stimuli would seem to be contingent upon whether there is reference to both an event in question and the examinee's involvement in that event. For example, someone being investigated for a bank robbery might be asked, "Did you rob that bank?" This manner of questioning would more directly associate the examinee with the act of concern than would an indirect approach involving question about lying, in person or in writing, regarding the event in question (e.g., Were you truthful in your written statement about not robbing the bank?). We know from conditioning studies that the closer a stimulus is to the conditioned target stimulus, the larger the reaction (Kehoe & Macrae, 2002).

A review of relevant, probable lie comparison (PLC) and directed lie comparison (DLC) questions in PDD testing.

In investigative polygraph testing, relevant question targets are dictated by the circumstances of the investigation and are commonly formulated around the most salient or intense aspects of the allegation. In screening programs, relevant questions should describe the test subject's involvement in possible behavioral concerns to risk managers or adjudicators and should be designed to add incremental validity to their particular program. Effectively formulated relevant questions will directly assess the test subject's behavioral involvement in the issue of concern.

PLC questions are presented to the test subject as being necessary for further evaluating the test subject's character and the issue under investigation. PLC questions are based on transgressions whose subject matter

is generally or conceptually related to the allegations of the examination and which virtually all persons may have committed, but which are likely to be denied in the context of the examination. PLC questions are broad in scope and usually based on actions categorically similar to that of the issue under investigation so as to present a plausible reason for being asked. As in other CQT techniques, the test subject is strongly, but indirectly, discouraged from making admissions to PLC questions. If the test subject makes an admission to a PLC question, the examiner notes that admission with some dismay, *"Really, you did something that would make me think you are a thief,"* and either minimizes the admission, "No, I am only concerned about serious things," or modifies the comparison question. An example of the latter is: *"Other than what you told me about, before this year did you ever lie to anyone who trusted you?"* Note the italicized modifier preceding the comparison question. The ultimate goal is to discourage admissions to PLC questions to ensure that the test subject perceives them as ambiguous and broad in nature. It is also important the examiner imply to the test subject that lying to any of the relevant or PLC questions will result in a failure of the polygraph test and the conclusion of deception to the relevant issue under investigation.

DLC questions are those which the examiner instructs the test subject to answer falsely (Honts & Raskin, 1988; Raskin & Honts, 2002). DLC questions may offer some relief to potential problems identified in PLC versions of polygraph testing. Examiners may experience difficulty in standardizing comparison questions in the PLC version. Each test subject brings with them his or her own life experiences and idiosyncrasies that may hamper maintaining a rapport while attempting to lay foundation for and set the PLC questions. Test subjects who have prior polygraph experience or those who have researched polygraph techniques may not be naïve to the PLC principles. This sophistication could make laying the foundation for the comparison questions challenging. Non-naïve test subjects may acquiesce to the procedure in order to not seem obstreperous in which case the PLC questions become similar to DLC questions.

One theory behind the DLC approach is that it is similar to the PLC approach in that it is assumed the subject's cognitive and (possibly some emotional) attention will be focused more on the questions that pose the greatest concern of failing the test. Thus, the truthful subject will be more concerned with whether or not they are a suitable subject and are producing appropriate responses to the DLC questions to show when they are lying. Though they have permission to lie on these questions, the questions still serve to draw the examinee's attention during testing. The theory further proposes the guilty subject will remain primarily concerned about the relevant questions on the test and will thus produce the greatest reactions to them. In this sense, the DLC questions operate as a diversionary item for the truthful subjects, who are more capable of being distracted away from the relevant questions than are the deceptive subjects.

Generation of an emotional reaction

We will use examples provided by Power and Dalgleish (2008) to describe emotional generation. We do not mean to convey this is the only theory of value offered for studying how emotions arise; however, this model is simple to comprehend and seems applicable to PDD testing. Recall the earlier discussion surrounding our conceptual, schematic or story-board route and our associative or reinstatement route. We will use these routes as a means of demonstrating how interpretation and appraisal of questions, may lead to the emotionality we measure during PDD testing.

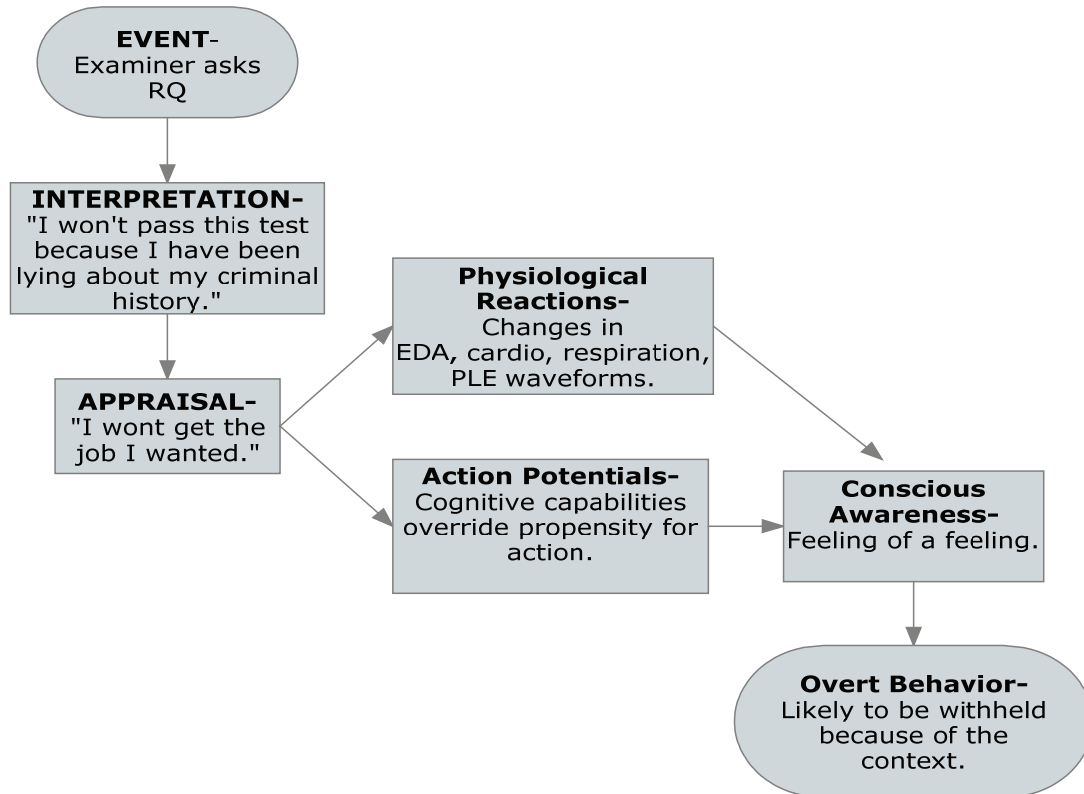
We begin our emotion construction exercise with a conceptual approach. You may remember this involves a building up of the emotion using what Power and Dalgleish (2008) list as the seven components of the emotional process. We will apply these steps to a scenario in which an examinee is taking a pre-employment screening polygraph for a public safety position.

In this case the examinee intends to deceive the examiner about his past criminal behaviors and the examinee has told the examiner during the pretest that he has engaged in little or no criminal activities. We will assume that one of the relevant questions

(R.Q.) on the test is, "As an adult have you ever committed any felony crimes?" We make no inference here that we support or oppose such a question. We are simply providing this as an example.

Following the component schematic of Power and Dalglish, we offer an example of how an emotional reaction may generate in a comparison question polygraph setting.

Figure 1. Diagram representing the steps involved in the generation of an emotion arising from deception during a polygraph examination.



Our examinee who has been lying to us during the pre-test interview has likely determined his criminal behavior is incompatible with the hiring agency's acceptance standards. The examinee has decided to withhold the information rather than disclose it to the examiner. When the examiner presents the examinee with the test question the following schematic steps could be perceived to occur:

1. An event- the relevant question
2. An interpretation- the examinee is concerned he will not pass the test

3. An appraisal- the examinee weighs not passing the test against his goal of getting a job and determines not passing the test is incongruent with their goal. The examinee may also appraise the situation as ego-damaging, which can add negative valence to an emotional mix.

4. A physiological change occurs- depending on the individual examinee a number of basic and complex emotions can occur and each has an individual ability to contribute to the examinee's physiological arousal and this arousal can occur in preparation for an aversive event.

5. A propensity to act- evolutionary based action potential occurs but note humans have the ability to withstand acting on these
6. Conscious awareness- feeling of a feeling associated with the emotion the examinee is experiencing
7. Overt behavior- in most PDD cases humans will not engage in visible overt behavior like running away or striking out at the examiner because of the social context in which the examination takes place.

Emotional arousal can also occur through reinstatement of a previously developed schematic model, or a top-down route. Using the steps outlined by Power and Dalgleish we focus on the appraisal (Step 3) which is an evaluation of the event as it relates to goal relevance, congruence or incongruence or ego-type involvement. This appraisal process need not be done at the time of the encounter so long as it has been accomplished in the past and is in memory. The emotion process can be activated through an associative path discussed earlier. This low road takes advantage of cognitive efficiency which offers the organism a potentially adaptational advantage. Humans are able to rely on past experience to make faster appraisals in recurring situations. Relating this to our recent example we expect the lies told to the examiner, and possibly the background investigators, during our applicant's processing to be in his mind. Our applicant has likely already conducted an appraisal of the incompatibility of his past criminal behavior and lying during the hiring process to the agency norms. He then considered and appraised this inconsistency against his goal of gaining employment and found the two incongruent. Based on the fact that he lied about his past suggests he has appreciated this incongruence and has employed a lie strategy in attempt to keep it secret. We can imagine that hearing the related relevant question will be able to trigger an emotional response in our examinee because he has conditioned himself to that test issue through involvement in the behavioral event described by the test stimulus question (Handler & Honts, 2008). Asking the question simply brings the appraisal into the foreground causing the

examinee to attend to it and produce a response.

Discussion

The fight-flight, or fear, response is often the focus of attention when examining the role of emotion in the PDD setting. This paper asserts that rather than fear alone, many other emotions may play a role during PDD. We go further to examine the relationship between cognition (appraisal) and emotions. Although there remains no consensus in the exact mechanism of this relationship, most research has identified at least two distinct patterns, or levels, of appraisal: subconscious and conscious awareness. Both levels of appraisal trigger emotions. We have also seen that the specific emotion triggered can vary widely among individuals based on their prior experiences, values, goals, and expectations and most importantly, how the situation is appraised.

We further suggest that the test questions in the PDD setting are perceived by the examinee and cognitively appraised with regard to goals, and that these appraisals serve a mediating function for valence and salience of emotional and physiological response. We believe the appraisals can be generated in a schematic or conceptual manner or via a reinstatement of a previous evaluated conflict. We drew a parallel between each mode of generation and a hypothetical examination setting.

Clearly, cognitive appraisal plays a significant role in triggering emotion and physiological reactions. It is these reactions that must be interpreted with caution as it is not clear which emotion has elected which pattern of response. Although there is no doubt that there is a physiological component to emotion, we are yet unable to distinguish specific emotions using PDD technology.

An important point to reinforce at this juncture is just how complicated what we try to do is and how much potential room for error exists. PDD testing depends on the evaluation of the examinee's physiological reactions to test questions, and then works backwards to make inferences about whether the examinee's reactions correspond to expected responses from truthful or deceptive

persons. The success of these methods depends, in part, on the assumption that the primary thing which differentiates response magnitudes to various stimuli is the degree of salience which the examinee assigns the test question. That salience is revealed through physiological reactions which occur in

response to the examinee's cognitive appraisal, memory, behavioral experience, and emotional valence regarding the test stimulus questions. The complexity of these physiological systems and assumptions will inevitably prompt discussion about the potential for error in the PDD context.

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