The Psychology of Human Action

4

Case Study

It is 2:00 a.m. and two police officers are conducting a routine traffic control. Suddenly, the driver of a van starts to shoot at one of the police officers. Being protected by her bulletproof vest, the officer is shot only in her right arm. The second police officer immediately opens fire and shoots the attacker in the chest and abdomen. Two ambulances and an emergency physician in a roving EMS four-wheel-drive vehicle are dispatched and arrive 8 min later at the shooting site. On arrival, the emergency medical service (EMS) finds a 28-year-old alert and oriented female police officer who is bleeding from the brachial artery. She complains of complete loss of sensation and strength in her right arm. No other injuries are found. The paramedics apply a pressure dressing and the bleeding is controlled. The officer's blood pressure is 95/50 mmHg and the heart rate is 90 bpm. Because the physician is busy inserting an intravenous line in the police officer, he asks one of the paramedics to evaluate the injured driver who is lying next to his car. The attacker is tachypneic and obtunded and has weak peripheral pulses. At the physician's orders, an oxygen mask and an intravenous line are placed and volume resuscitation is initiated. Once the police officer is transferred to the ambulance, the physician directs his attention to the attacker who has become unresponsive.

On examination, he finds several bullet entry points in the chest and abdomen. The central pulse is weak and fast. The patient is emergently intubated. No breath sounds are appreciated on auscultation on the side of the bullet holes. Cutaneous emphysema on the same side develops rapidly. The patient is positioned for emergency thoracentesis and a chest tube is placed successfully. An outward rush of air and blood confirms correct chest tube placement. During the emergency transport of the wounded driver, the patient continues to lose blood and has unstable blood pressure. Despite the difficult conditions of a moving ambulance, the physician places additional IV lines and

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repeatedly administers boluses of epinephrine to maintain circulation. It is not until shortly before he arrives at the hospital that the physician becomes aware that he had been so immersed in patient care that he forgot to inform the emergency department about the patient's penetrating chest injuries. As a consequence, the thoracic surgeon arrives with delay in the emergency department to join the resuscitation team. The primary exam confirms the suspected diagnoses of hemopneumothorax and massive intra-abdominal hemorrhage.

Despite surgical intervention, the patient dies in the operating room. The police officer also undergoes surgery during the same night. She recovers but maintains a neurological deficit in her right arm.

An emergency physician is confronted with two patients, one moderately and the other severely injured following a shooting: On the one hand is a hemodynamically stable female police officer with arterial bleeding as a result of a perforating injury of the brachial artery. On the other hand is the male aggressor with shock due to massive intra-abdominal and intrathoracic blood loss. Without having examined both of his patients and then treating them according to medical urgency, he spends almost a quarter of an hour with the less injured police officer, delegating the treatment of the multiple-injured patient to the paramedic. The physician is familiar with the injury pattern and the vital threat to the patient. Nevertheless, he does not address this problem personally until after providing immediate treatment to the police officer. Once he finishes caring for the police officer, he personally begins to spend valuable time with the badly injured patient on site; that is, he decides to "stay and play." This is another error because patients with perforating injuries of the chest are known to benefit from a "scoop-and-run" rapid transport to the closest trauma center with a minimum of treatment done on site.

4.1 The "Psycho-logic" of Cognition, Emotions, and Motivation

The goal of healthcare efforts is effective and safe treatment of patients. Modern medicine aims to provide rational, explainable therapy at any time. That aim implies a model of the "logic of behavior" in which behavior is always determined by logical reasoning (Fig. 4.1a). Problem solving is oriented toward the best possible solution for the problem, nothing more. Apparently, the emergency physician's management in the case report does not follow this model: He first takes care of the comparatively lightly injured person and spends quite a bit of time with her while the more seriously injured patient is treated by a far less capable provider. We can only speculate about the reasons for his behavior. It might be because the patient was the *victim* of a shooting, because she carried a police officer's uniform and was accompanied by a worried colleague, simply because she was young and female, or perhaps because that's

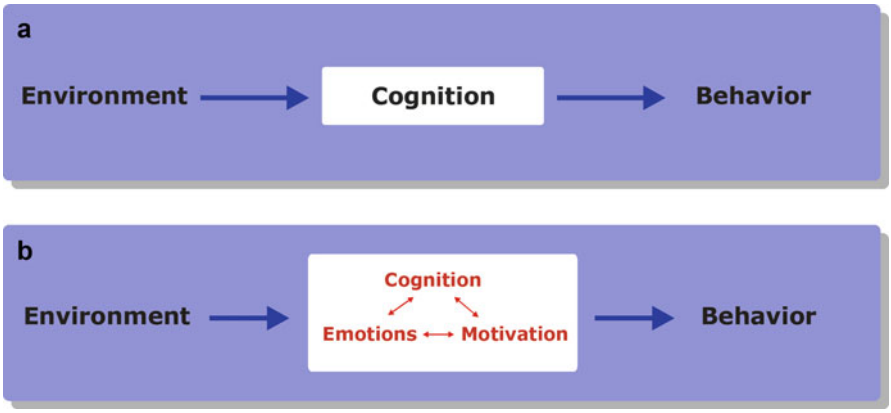

Fig. 4.1 Despite the widespread belief that logical reasoning guides human decision-making in response to environmental stimuli (**a**), evidence favors the notion that an individual's "psycho-logic," which is the idiosyncratic relation between cognition, emotion, and intention, has to be considered to understand decision-making (**b**)

who he approached first. For whatever reason might be the true one, an uninvolved observer might get the impression that a couple of "illogical" factors governed the physician's behavior, and this impression indeed might be true. Human behavior is not exclusively governed by completely rational thinking. Human behavior always results from a complex interplay of cognition, emotions, and motivations mixed with the environment (including available skills). Therefore, it seems appropriate in this context to talk about a "psycho-logic" of our behavior as clinicians (Fig. 4.1b).

The "psycho-logic" of this interaction between reasoning, emotion, and motivation governs all our actions. It is paradoxical because on the one hand, it enables humans to cope with complex and dynamic environments such as anesthesia, intensive care, and emergency medicine. Emotion-based decision-making can be a valuable resource, especially under stress and time pressure (Chap. 9). On the other hand, the "psycho-logic" helps to explain why the emergency physician did not stay "coolheaded" and did not adhere to the advanced trauma life support (ATLS) protocol or other medical guidelines. Unnoticed by himself, his decision-making was likely influenced by his emotions and his personal needs just as much as by rational reasoning. Simply to state that the physician's decisions were "illogical" or "irrational" and that he instead should have been guided by "mere facts" does not address the issue fully.

4.2 Principles of Human Behavior

To better understand the above roughly sketched "psycho-logic" of human emotion and motivation that we will explain in detail later in this chapter, we first need to introduce some basic presumptions about human behavior. These presumptions rely on the work of action psychologists (Dörner 1999; Hacker et al. 1982; Miller et al. 1960).

4.2.1 Biopsychosocial Foundations of Behavior

Humans are *biological beings* who use their mind and body to meet their needs. As a result of their mental capacities, humans are *psychological beings* as well. We perceive our surrounding world in a way that helps us make sense of phenomena surrounding us. In addition, humans are *social beings* who cooperate in communities to survive. The parallel evolution of biological, psychological, and social processes led to a way of reasoning and acting ("action regulation") characteristic for the "biopsychosocial entity" of human being (Kleinhempel et al. 1996; Brenner 2002):

- *Biologically* the human brain, the peripheral nervous system, and the human body as a whole are the medium of action regulation. Human behavior is based on the phylogenetically determined structure of neuronal processes, a fact that becomes quite obvious if, for example, perception (Chap. 5) and the stress reaction (Chap. 9) are considered.
- From a *psychological point of view,* cognition and speech are the main tools for perceiving and regulating human behavior. Speech acts are the result of social relationships and are the most important instrument to regulate these relationships. Furthermore, human cognition is irretrievably connected with emotions and motivations.
- Human beings are essentially bound to living in groups and are biologically oriented to charity and cooperation. Individual psychological development is inseparably connected to *social* development,
- Our social dependence leads us to seek being integrated into a stable social community.

4.2.2 Action

Action is Conditional on External Demands and Internal Psychological Processes The demands of patient care are not entirely rational; our psychological processes, emotions, and motivations also get involved. The range of possible options the emergency physician could have chosen was defined by characteristics of the emergency situation: the site of accident, the kind of injury, the pathophysiological state of the patient, and the available technical and personal resources. They all were fixed determinants at the time the emergency medical team arrived on site.

At the same time, however, his behavior was also determined by the knowledge, thoughts, feelings, and motivations he brought with him or that he developed as a result of his assessment of the situation. Because human action results from reasoning, emotions, and intentions, there is an interaction with any situation. We use the term "psycho-logic" to help understand human action within a context or situation.

Action Is Intentional and Goal Directed Psychology understands action as a sequence of behaviors aimed at achieving a goal. An action in the psychological sense is "the smallest delimitable unit of consciously controlled activity" (Hacker 1986). Actions are influenced by goal-directed mental processes that are fundamentally initiated and sustained by implicit and explicit needs.

Action Can Be Described in Terms of a Control Loop Theoretical models of human behavior assume that mental processes can be described as control loops (Miller et al. 1960). Actions are oriented at an anticipated goal or set point: One tends to keep on doing something until the desired goal is achieved. The goal of the emergency physician developed and became refined when treating the severely injured patient. The main goal was to keep the patient alive. To do this, intermediate goals had to be accomplished, specifically to place IV lines, to intubate, and to insert a chest tube. That way a hierarchical and sequential order of thought is built and sustained until the main goal is accomplished (Hacker 1986).

Action Is a Result of Information Processing The regulation of human action can be understood as a form of information processing (Klix 1971; Dörner 1976). In this view, the concepts of motivation, emotion, and cognition all describe processes of information processing at different levels of the human cognitive system. An important aim of this information processing is to enable people to maintain a relationship with their environment that allows them to fulfill their implicit and explicit needs.

Emotion, Intention, and Reasoning Constitute an Autonomous System Without a total awareness of their existence, the emergency physician's interaction with his environment is influenced by his emotions, intentions, and thought processes. Our conscious self is not always aware of this influence. It even seems not to be necessary for the regulation of action; therefore, we can talk of an autonomous regulation of human action, one that works outside of conscious, in-the-moment awareness.

Human Action Is Embedded in a Social Context It is an essential characteristic of the psychological idea of "action" that individual actions always are "embedded" in a social context. Our individual goals always have a social side. What we think or do serves our individual needs as well as our social relations. Keeping social relations stable and productive is a powerful social need. Maybe one of the reasons for the priority treatment of the police officer was the desire to show respect for a profession that served society.

Action Can Only Be Described on the Level of Visible Behavior The physician's emergency management consists of a multitude of actions that can be observed and described. We can make statements about what he did and when it happened. The external, visible human action is called exactly that action. Actions are observable behaviors.

Of course, we even can form our personal opinion about the appropriateness of some of his actions based on what we see and our judgments, but we cannot know why. The internal powers that drive visible behavior stay hidden. So some of the more puzzling questions will have to remain unresolved: Why did he choose to handle the emergency the way he did? To what extent was he aware of underlying psycho-logic driving his actions? Did he realize he was violating existing treatment protocols? We can apply our theories to reality and try to find answers, but we cannot know for certain all that guided the emergency physician's actions. The theory of human action regulation conceptualizes how cognition, motivation, and emotion are integrated into controlling behavior in complex and dynamic domains of reality.

Action is a result of autonomous, internal information processing following control loops, embedded in social context, driven by the situation and internal needs. To better understand errors in acute care settings, the following premises are helpful:

- *Errors follow the "psycho-logic" of human action regulation*. Every action, even if it is a mistake, is based on an intention and "on purpose." The physician committed an error because he took care of the less injured police officer instead of the multiple-injured patient. This does not imply that the physician explicitly wanted to harm the other patient. It only means that the intentions governing his actions did not properly prioritize the health and safety of the multiple-injured patient. The delayed medical management was caused by other intentions (such as caring for the police officer) being stronger at that moment. When there are competing intentions, the autonomous system is a strong factor in how the physician chooses between them. The main criterion for that choice is not necessarily an external one, that is, the objective reality of the patient's injuries. Fulfilling internal needs, for example, being friendly with a young woman, helping a fellow civil servant, etc., can be as important or more important. Of course, the physician's decision appeared incorrect from a medical point of view, yet his treatment error was caused by a range of normal psychological processes.
- *Errors do not necessarily originate from irrational or deficient psychological mechanisms* but from generally useful psychological process. Errors and mistakes follow, just as correct actions do, the laws of the "psycho-logic" regulation of action.
- *Errors can be avoided*. Despite being rooted in normal psychological processes, errors are not a fate that we must accept. Circumstances that promote and enable error can be analyzed in advance (Reason 1997; Chap. 3). Working conditions and organizational structures can be designed to help avoid and mitigate errors. Moreover, conscious effort and efficient teamwork can often overcome errors resulting from faulty "psycho-logic."

Before we provide more detail regarding the psychological processes that play a role in action regulation, we summarize the characteristics of human action as follows:

- Human action can only be fully understood when considering the "psycho-logic" of human action.

- Human action is the sum total of biological, psychological, and social processes.
- Human action is influenced by the human history of development (phylogenesis), individual development (ontogenesis), and cultural heritage.
- Human action is intentional and goal directed.
- At the visible level, human action can be described in terms of behavior and activities. The underlying processes (emotions, motivations, and cognition) cannot be observed.
- Action can be understood in terms of information processing.
- Erroneous decisions are psychological and rational in the moment and are the result of normal decision-making processes.

4.3 Motivation

4.3.1 From Needs to Intention

4.3.1.1 Requirements, Needs, and Motives

When internal regulation mechanisms are no longer able to regulate the physiological requirements, they are experienced as needs (Fig. 4.2; Bischof 1985). Hunger, for example, is a need based on a requirement for nutrition which cannot be met by the body's own supplies. As soon as a need is perceived (e.g., "I'm hungry"), an action is triggered. During the past decade, several classifications of basic drives have been proposed (e.g., Reiss 2004). Eventually, they can be narrowed down to a few categories of basic needs: existential needs, sexuality needs, social needs (e.g., closeness/affiliation, status, legitimacy), and informational needs (e.g., knowledge, safety, curiosity, and competence; Dörner 1999; Dörner and Güss 2013). The

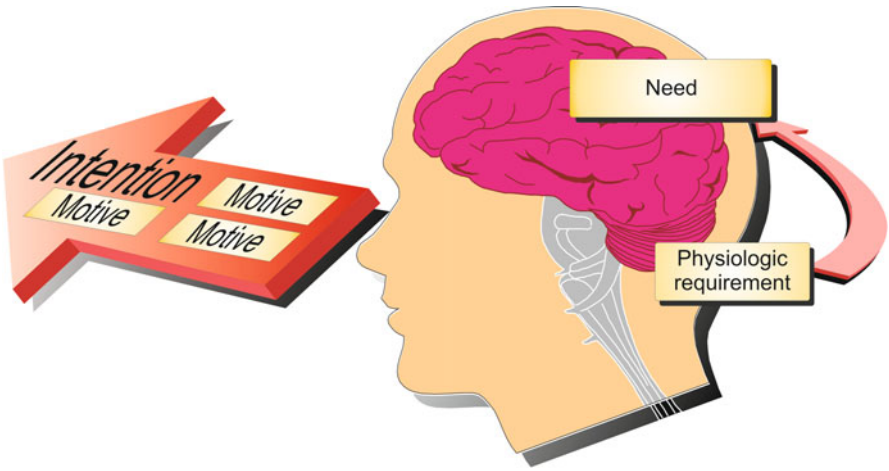

Fig. 4.2 From need to intention

social and informational needs are based on a need for understanding the actual state of the environment. Social needs are driven by the desire for social contact, acceptance by others, and the need to experience a feeling of competence.

A *motive* is a need connected to a goal that seems likely to satisfy a basic need (Bischof 1985). In other words, a motive has a goal connected to satisfying a need. However, for any need there may be several adequate goals or paths to satisfy the need. For instance, one can relieve hunger by choosing to go to the cafeteria or by taking an apple out of one's pocket. People are different – despite having the same basic needs – in how they strive to fulfill needs. Culture, specific previous learning experiences, and the environmental context play crucial roles in the formation of motives.

4.3.1.2 Intentions

Intention is a collective term for all of the various terms used to denote action tendencies, e.g., *wish, aim,* and *intention* (Dörner 1984; Heckhausen and Kuhl 1984). Intentions are a blend of different motives. People tend to meet several needs at the same time, and therefore several motives are active at the same time. For example, if you decide to go to the cafeteria, you could be doing it because you indeed are hungry, but you also might want to go there because you want to meet colleagues, chat, and listen to relevant news. This kind of action goal ("go to the cafeteria") determined by multiple motives is simply called an intention. Thus, an intention is a blend of motives (Fig. 4.2). Intentions are temporal – depending on the actual physiological and psychological state of the organism – and compete with each other (Dörner 1999):

- Humans have physiological and psychological needs.
- Motives arise from a goal that involves satisfying a need.
- Intentions are action-oriented goals that are determined by blending and balancing motives.

4.4 A Solution to the Competition of Intentions

Abraham Maslow (1943) proposed a well-known theory that needs are organized into a hierarchical structure. The structure consisted of five layers of needs. Within this model, depicted as a pyramid, the most basic *physiological* needs lie at the bottom, whereas *psychological* needs (such as self-realization or such things as "concern for others") are higher-order needs. According to Maslow, higher-level needs can only be met when the subordinate-level need is satisfied. When lower-level needs are not met, for example, in the case of a sleep-needy clinician, there is always a danger that the lower need will have a surprisingly stronger influence on decisions than, for example, considerations about patient safety. For instance, it is not uncommon during nighttime anesthesia that anesthesia is started despite the fact that the patient's "NPO time" has not been long enough. The decision "to get on with the operation" is influenced by the anesthesiologist's need to get to bed. Fortunately, this

hierarchy of needs is not completely inflexible (e.g., Zimbardo and Gerrig 2012). We all know of situations where we were very hungry or felt an urgent need to go to the restroom but instead kept on going because the patient needed our full attention.

Obviously, needs compete with each other, and the order of execution is not completely defined by their place in Maslow's hierarchy. What happens is that a complex mediating mechanism comes into play. To understand this mechanism, we turn to some other theories (Dörner 1999; Kuhl 1983). The selection of which needs will be met partly depends on the chance of successfully meeting the need in the context of competing needs. Every intention is weighted by an internal mechanism that considers importance, on one side, and a subjective estimate of the manageability of the intention. This weighting process is further mediated by temporal circumstances. If something is unimportant *or* if there is no chance at all of being successful, no action will be initiated.

On the other hand, if something is important or if it is almost certain that one will succeed, action will be initiated. The expectation of manageability is mainly driven by the subjective assessment of competence and control and is highly influenced on the situation as perceived by the individual (Dörner and Güss 2013).

When there are several active intentions, it is always the intention with the highest weighting which will be executed. The result of an internal calculation that determines the strength of a need and the possibility of satisfying that need guides what actions will be manifested. The intention that rises to the top attenuates other intentions. In circumstances where time is limited, the number of intentions also becomes limited. Therefore, less important intentions will not get a chance to manifest into action (Dörner 1999). The fact that relatively less important tasks, such as phone calls, documentation, and other duties, seem to constantly slip the clinician's mind has less to do with forgetting than with the dynamics of intentions. The consequences of competition of intentions in everyday life are usually trivial; for example, you receive a reminder letter to pay a bill. During critical or emergent situations, however, the problem of neglecting an important piece of information or dropping tasks is exacerbated and can become a life-and-death issue. One explanation for this type of error comes from the clinician's strong and unconscious drive to feel competent. Maintaining a sense of competence can interfere with the goal of solving the medical problem. Even though it is difficult to understand or accept because it seems irrational, the drive to maintain a feeling of competence and control is a significant factor in clinical care, especially in acute settings.

4.4.1 "Overall Competence Assessment" and the Need for Control

When an intention is executed, specific motives are acted upon. At the same time, there is another strong and independent need embodied in every intention: the need to experience a feeling of competence. Psychologists sometimes call that the need for control. We have a psychological need to feel able to influence our environment according to the goals we set (e.g., Bandura 1977; Flammer 1990; Dörner 1999).

We want to know with certainty what is happening around us, and we seek clarity of facts and certainty about future developments.

The individual's overall competence assessment tips toward one or another end of a scale: At one end is a feeling of being able to handle the situation, and at the other end is a feeling of helplessness and fear. Another way of stating it is that a difficult situation can be seen as within one's ability to manage (feeling of confidence and competence) or beyond one's ability to manage (feeling of helplessness, frustration, and incompetence). "Helplessness" is the subjectively felt incapability to influence the environment adequately and poses a perceived threat to the human psyche and feeling of well-being (Seligman 1975).

One's current state is routinely perceived as a feeling of competence. For a clinician, once this feeling starts to decrease, for example, when facing a situation wherein one's skills and ability are no longer adequate, the motive of control is activated. Due to its inherent strength, it very often "wins" against other motives. In consequence, behavior is no longer governed by explicit patient-related goals but instead by the subconscious drive for the clinician to regain the feeling of competence.

In summary:

- The concepts of a motive for control and the need for feeling competent describe the need of every human being to achieve clarity about the actual state of the situation, the certainty about future developments, and the capability to influence the environment in accordance with one's own goals.
- The feeling of competence describes the perception of one's own capability to control circumstances.
- The need for competence becomes a driving force in decision-making when the feeling of competence is threatened by circumstances.
- Behavior in complex and dynamic environments is always influenced by reducing uncertainty and gaining control over the situation.
- Emergency situations in high-stakes medical environments are examples of highly dynamic and opaque situations where clinicians may have great difficulties in controlling their environment. As a result, perceived ability to control a situation is reduced and the feeling of competence is at risk. When this is the case, clinicians will attempt to reduce the feeling of inability and try to regain control. These feelings are so strong that the clinician, albeit subconsciously, may have a surprisingly strong intention to regain self-confidence and control. How successful this attempt will be depends on one's ability, the confidence in one's resources, and the quality of the team involved in patient care.

4.4.1.1 Wrong Assessment of Competence

The confidence in our own skills or capability is often misleading. This is especially true in complex situations. For example, if a clinician *overestimates* one's ability to cope with an emergency situation, he or she is more likely to take greater risks because of the (incorrect) feeling of being up to the task. On the other hand, when clinicians *underestimate* their own competence, they have a tendency to act defensively and refrain from taking possibly helpful and necessary steps.

Fig. 4.3 Competence protecting rationality. Normally, safe patient care is the main focus of every healthcare provider (*left*); however, when faced with seemingly unsolvable problems (*right*), healthcare providers will struggle to protect or regain the feeling of competence. As a result, the competence motive, rather than safe patient care, may become the dominant motive

4.4.1.2 "Competence Protecting Rationality"

Complexity in combination with a perceived small prospect of success will diminish the clinician's feeling of competence and activate the need for control. Behavior will be directed at satisfying the competence motive. Normally, the first approach will be to start doing things the clinician knows well or that have proved successful under comparable circumstances. The problem, however, is that the clinician may be subconsciously busier regaining a feeling of competence than actually solving the patient's problem. In such a state, people only want to receive information that does not confuse them or contradict their view of the world and their self-confidence. The unfortunate result may be that only information that confirms the current model of the situation is taken into account and other information is not considered ("confirmation bias"; Chap. 6).

Perceived imminent failure tends to add to uncertainty. The protection of the feeling of competence can then become the dominant motive. Actions are chosen subconsciously not for the patient's sake but for our own defense. The examination of the critical situation on objective grounds becomes secondary. This *competence protecting rationality* (Strohschneider 1999) leads to errors because wrong or less than optimal actions from the patient safety perspective are implemented because of the need to protect a feeling of confidence and control (Fig. 4.3).

4.5 Emotions

In addition to motives, emotions play an important role in regulating human action. While motives determine *what* we do, emotions affect *how* we do it (Dörner and Güss 2013).

4.5.1 What Are Emotions and Feelings?

The general understanding of "emotions" is they are something independent of rational thinking and experienced on a "gut" level. In some circles of academic medicine, it seems to be a worthy goal to strive for "emotion-free" medical management. This is not possible. Emotions can be conceptualized as a piece of one's information-processing system; emotions are a kind of "thinking alongside conscious thinking" (System 1 processes, Chap. 6). Emotions constitute a subconscious, rapid, and holistic assessment of the current situation or event (e.g., Cochran et al. 2006; Evans 2008). This assessment is quick and automated and is able to process much more information than conscious perception (Chap. 5). This "integrated situational assessment" always includes a hedonic component accompanied by physiological activation: We seek to feel pleasure and seek to avoid unpleasantness about a situation (Fig. 4.4; Bach 2009; Scherer and Ekman 1984; Dörner 1999). The situational assessment (with activation and pleasure/displeasure) is experienced as a feeling.

If the emotional and cognitive situation assessments differ from each other, we tend to move toward a sense of confusion, that is, our mind and our gut are telling us different things. But the reason for the confusion is simply that emotions use different and more information than conscious reasoning.

As soon as they are felt, emotions can be further processed just like any other perceived data (Chap. 5). The source of emotions can be analyzed, and their intensity can be changed by means of becoming familiar with their meaning and learning how to incorporate emotional data into guiding action.

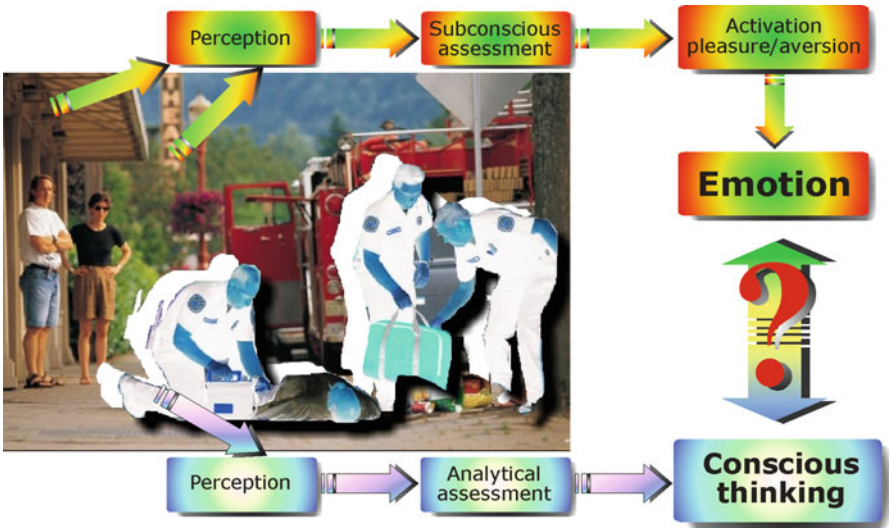

Fig. 4.4 Emotions as integrated situational assessment. Whereas conscious thinking assesses an emergency situation analytically, emotional assessment processes more information and provides the situation with a specific emotional texture that adds significant depth to one's understanding

Feelings accompany behavior and can become a goal of actions. For example, a decision may be delayed because we want to avoid the feeling of failure or an action may be taken because we anticipate the feeling of success.

In situations where cognitive resources are overtaxed or inadequate, humans tend to switch to an emotionally driven style of action (Spering et al. 2005). In this type of situation, emotional assessments are no longer cross-checked with conscious analysis of the situation. On the one hand, swift and risky solutions are taken with no room for reflection. Problems tend to be oversimplified and solutions are considered satisfactory if they "feel right." This can lead to inadequate decisions if the subconscious goal is the maintenance of a feeling of competence or the avoidance of negative emotions. On the other hand, when a highly experienced clinician is following emotionally led actions, it may be the most efficient and correct way of taking action (Zsambok and Klein 1997). The problem, of course, is that the decision-maker/action-taker may "feel right" whether the patient care is simplified and correct or simplified and incorrect.

4.5.2 Emotions and Human Action Regulation

Apart from providing holistic situational assessments, emotions can be further understood as being part of a regulation system that takes two considerations of reality into account: uncertainty because of the *unpredictability* of the environment and the *estimated degree of efficiency* to tackle problems (competence; Belavkin and Ritter 2003). This regulation system modulates parameters that influence the selection of actions (Dörner 1999; Dörner and Güss 2013). Among the parameters influenced by emotions are:

- The general preparedness for action (arousal)
- The thresholds for perceptions and selecting a behavior
- The degree of concurrence between emotional and cognitive processes
- The perceived degree of external factors that release or inhibit correct action

It is an everyday experience that the way a task is performed greatly depends on the emotional state of a person. The execution of a task done angrily can look completely different from the same task done in an even-tempered way. An "angry" mode of action therefore is characterized by an increase in arousal, a decrease in the degree of cognitive checks on action, a little planning, and an incomplete consideration of possible modes of action.

4.5.2.1 Arousal

Certain emotions (e.g., anger, joy, fear) can serve to activate people. This phenomenon, also known as unspecific sympathetic syndrome, increases readiness to explore the environment and to prepare for action. The senses are heightened, muscle tone is increased, and heart rate, blood pressure, and breathing tend to increase

(Chap. 9). Other emotions, such as mourning or hopelessness, reduce arousal. Normally, the chaos of an emergency situation is associated with arousal.

4.5.2.2 Degree of Resolution

In a heightened emotional situation, a cognitive process (e.g., perception, thinking) will run with a different degree of resolution than under normal circumstances and hence with varying accuracy. By "degree of resolution," we mean the level of differentiation and discrimination among dimensions of perception or cognition. "Judging the facts" can happen in a detailed, scrutinizing way or by simply taking in the most salient features of the situation. How well the environmental factors are resolved and considered in making decisions is partly dependent on emotions (via arousal), the importance of the situation, and (subjectively assessed) time pressure. The consequence for the clinician lies in the varying influence our feelings provide. On the extremes, we can develop either a too superficial or a too inclusive, detailed picture of the situation. For example, if one has an aversion for a task, it will reduce the degree of resolution, and the perception of objective reality will be "coarse grained," and the execution tends to be superficial.

4.5.2.3 Selection of Behavior: Concentration

Emotions influence the frequency of changes in intention and the intensity of action. A strong arousal raises the threshold of selecting an alternative motive to replace a leading motive. Thus, the action-guiding motive tends to predominate. If the threshold for selection is high, people will much more likely stick to a task even if the task is not preferred for the patient. If the threshold increases further, it can reach a point where people no longer are able to react to external triggers. Indeed, sometimes neither monitor alarms nor requests from team members can penetrate this "wall of attention." The result, as can be seen in our case report: "The doc goes solo." As long as his concern for the police officer was high, the emergency physician may have considered only the policewoman and "forgot" the second patient for some time. As stated previously, however, it's likely that this was not an issue of a faulty memory but of competing intentions. In contrast, when people feel helpless or have the impression that they are not competent to tackle a problem, the selection threshold for action is decreased. In the hope to bring about positive change, even if it has a small chance of success, they may try whatever comes to mind.

4.5.2.4 Externalization of Behavior

Emotions influence the extent to which attention focuses on external events or on internal cognitive processes (reflection, planning). Thus, emotions have a major impact on the balance between how much a person is driven by perceived events and driven by cognitive processes. For example, angry or scared persons will focus on the stimulus and how to get rid of or control it rather than focus their thinking on the true problem: Shouting at people instead of asking questions may be a result of externalization.

4.6 Knowledge, Memory, and Learning

4.6.1 Knowledge and Schemata

Our knowledge is composed of what we learn and experience. Knowledge is not stored in unrelated bits of information but instead in small meaningful entities, so-called schemata (Selz 1913; Bartlett 1932). Schemata are a cluster of structured data that are stored in the neuronal network of the brain. Schemata contain information that is based on the perceived regularity of the world and one's personal experiences with the environment (Cohen 1989). Schemata underlie every aspect of human knowledge and skills: They give structure to sensory impression (*sensory knowledge*), encode the generic information about our dealings with the environment (know-how; *procedural knowledge*), and represent concepts for the description of objects, facts, and procedures ("know what"; *declarative knowledge*, see Anderson 2005). Schemata are high-order, generic cognitive structures that underlie and organize all aspects of knowledge and skill.

In addition, schemata contain expectations about regularities or changes in the environment: We perceive a situation not only on the basis of momentary stimulus patterns but also based on our expectations about the possible developments of the situation (*horizon of expectations*; Chap. 8). Expectations can be so strong that sometimes we even "see" or "hear" things that we expect but do not happen, such as a confirmation of an order, just because we expect to see or hear it. Because schemata have this interpretative and inferential function, predictable biases in remembering occur. There is a strong tendency to organize our view of the world or a situation in accordance with the general character of previous personal experiences. This characteristic feature of schemata plays a vital role in the way human perception works (Chap. 5).

Procedural knowledge encoded in schemata is the basis for behavior. It consists of "if-then" cycles that are repeatedly compared with expectations about the situation and the outcome of actions (action schemata). The internal logic goes like this: "Given situation A, action B is taken and situation C will be the outcome." When many action schemata are strung together, the result is called a behavioral program or script (Schank and Abelson 1977). People store a range of successful cognitive and behavioral routines as behavioral programs. These are sequences of perception, classification, assessment, decision, and action. The whole chain of a behavioral program can be initiated with relative ease in a familiar and highly practiced situation, or the sequence of steps can be adapted and modified according to situational demands. Among typical behavioral programs common to clinicians, nurses, and paramedics are CPR, the placement of IV lines, and endotracheal intubation.

4.6.2 Memory

With this rough sketch of schemata, we have described a simple model of the human memory (overview in Anderson 2005; Dörner 1984, 1999): Knowledge always

consists of schemata stored in neuronal networks. It operates through the interrelation of sensory perception with motor programs and motivation as a behavioral program. The memory items are connected in an associative way that allows for quick and efficient retrieval of relevant information.

As a result of these interrelations, human memory is *active* and adaptive. Memory is not like a computer, where information is stored on a hard disk and retrieved complete and unchanged whenever needed. Instead, concepts stored in memory are constantly rearranged and reorganized depending on the actual needs and the general circumstances; therefore, memories are a reconstruction rather than factual recall. When and in which form information is recollected depends largely on past interactions with the world, emotions, and the current situation. Habits, too, can influence memory. Schemata that are activated more often are more readily available and can be more quickly reactivated.

Human memory is not an entity that can be precisely located in the brain. Most scientists agree that there are different memory functions and they take place in different parts of the brain (see Fig. 5.4; overview in Anderson 2005; Wickens 1992). For example, sensory input (see Chap. 5) is stored for a very short time. However, the contents of this sensory information can be further processed and become meaningful perceptions that can be transferred to immediate working memory and also to long-term memory. Chapter 5 provides a more detailed description of the structure of memory.

Thinking is only possible if people can compare their current experiences with previous ones. We have to be able to access both the long-lasting information in long-term memory and sensory perception that is only momentarily available. The memory items active at a certain moment are the "working memory." The working memory is not a distinct functional entity but instead the description of the momentarily active schemata. There are many complex interactions that occur in the brain on the way from a situational clue (stimulus) to a behavioral response. Chapter 5 provides a more detailed discussion of the interactions between knowledge stored in long-term memory, perception derived from sensory stimuli, and thinking using working memory.

In order to encode experiences into long-term memory, humans are endowed with a "protocol feature" of the events. Protocol memory (Dörner 1999) keeps track of the ongoing mental operations and filters important and relevant details from unimportant and irrelevant "noise." What might be surprising is that among the main criteria for something to be viewed as "important and relevant" are things that lead to success or pleasure. These things tend to find their way into long-term memory. On the other hand, those things assessed as likely to lead to lack of success and to pain tend to be viewed as unimportant or less relevant. Therefore, things viewed as lacking success or painful tend not to be retained in long-term memory. With these main selection criteria, one can see that memory does not function in a machine-logic way but rather "psycho-logically."

4.6.3 Intentions and Memory: Prospective Memory

Totally immersed in the treatment of the traumatized patient, the physician realizes only shortly before arrival at the hospital that he had wanted the team in the ED to

call for a thoracic surgeon. He intended to do something, but then forgot his intention. It is only when he imagines his arrival at the emergency room and the people awaiting him that he suddenly realizes that the thoracic surgeon is missing. His *prospective memory* had let him down.

While academic research on different types of memory has a long tradition, research on prospective memory ("intentional memory") is a rather young field of research in the cognitive sciences (Brandimonte et al. 1996). Prospective memory is defined as a psychological process that enables humans to execute previously formed intentions during an appropriate but delayed "window of opportunity" (Harris and Wilkins 1982) or more succinctly "remembering to do things later." In contrast to retrospective remembering, prospective remembering is typically self-initiated and not stimulated by an explicit request to remember. A prospective memory cue is an integral part of ongoing activity and can be missed without the person realizing it (Rothen and Meier 2013). In a strict sense, the term *prospective memory* is misleading, as prospective memory is based on many different cognitive functions and not confined to memory alone. These cognitive functions are:

- Goal formation
- Planning
- Task management
- Attentional control mechanisms

Daily life is filled with prospective memory demands, from remembering where to meet a friend to remembering to take one's medication. As an estimated 50–80 % of all everyday memories are, at least in part, related to prospective memory, it is not surprising that prospective memory failure (colloquially "forgetfulness") makes up more than half of our daily memory problems (Kliegel and Martin 2010): We intend to do something, but then forget to carry out our intentions. Prospective memory failures often give us the vague feeling that we wanted to do something, but have not the faintest clue what that something was. Prospective memory is often initiated during an ongoing activity, and the time between intention and the window of opportunity for implementing what was planned is likely full of unrelated activities. Because prospective memory means self-initiated retrieval of an intention, a person cannot count on help from others but instead must "remember to remember."

Acute patient care is filled with tasks requiring some form of prospective memory: remembering to give antibiotics before operative incision or heparin before transitioning to cardiopulmonary bypass, repeatedly checking serum potassium levels when a syringe pump with potassium is running, or remembering to continue provision of the correct level of anesthesia for a trauma patient when there is an unrelated respirator malfunction immediately after intubation. These memory tasks can be accomplished via monitoring processes, in which people expend attentional resources to either keeping the intention activated while performing ongoing activity or by searching the environment for a prospective memory cue (Harrison et al. 2014). Unfortunately, the ability to remember to execute future tasks can be seriously impaired by many factors inherent to acute patient care: interruptions, distractions, fatigue, cognitive demands of problem solving, multiple task demands, time

delays, etc. Intensive care units and emergency departments are busy, interruption-prone clinical environments making them especially susceptible to prospective memory failures. If interrupted, almost 20 % of clinicians may delay or fail to return to a significant portion of interrupted tasks (Westbrook et al. 2010). In addition, task shortening may occur because interrupted tasks are truncated to "catch up" for lost time that may contribute to unsafe acts or errors.

In contrast to civil aviation, where the close connection between accidents and prospective memory failure have been acknowledged (overview in Dismukes (2008)), few researchers have investigated prospective memory and its relevance for patient safety in the acute care setting (e.g., Antoniadis et al. 2014; Dieckman et al. 2009; Glavin 2011; Grundgeiger and Sanderson 2009; Grundgeiger et al. 2013). Of special relevance seem those aspects of work in acute care that have negative effects on prospective memory, e.g., frequent distractions, multiple tasks, delay, fatigue, and interruptions. Frequent interruptions show how the organization of work can influence safety: In one study, repeated interruptions (four during one surgical case or up to ten interruptions per hour) increased the likelihood of prospective memory errors (Antoniadis et al. 2014).

4.6.4 Learning

Learning is inseparable from memory. In everyday experience, learning describes the acquisition of knowledge, skills, and expertise. Different schools within the psychology of learning come from two basic concepts: learning as behavioral change and learning as information processing. The first position looks at learning as a result of personal experience or training (e.g., Zimbardo and Gerrig 2012): *Behavior changes* or *behavioral options* are acquired. The perspective of cognitive psychology understands learning as *information processing that results in a change of thinking and consequently acting*. This change occurs through an increase of our procedural and declarative schemata, in which our behavioral options and our knowledge are organized (e.g., Piaget 1950; Anderson 2005). Learning occurred if information is stored in the memory (deliberately or involuntarily) and can be retrieved. Learning therefore means to expand our repertoire of schemata, i.e., our behavioral options and our knowledge. We constantly learn – every action or every observation that is "relevant" or "pleasant" is stored in our memory and refines the quality and adds to the range of our schemata.

There are many theories on learning (for an overview, see Lefrancois (2005)), but when it comes to learning new behavior, one feature is most prominent and agreed upon by virtually all research groups: *Experience* determines our motivation and behavior. The consequences of actions impact subsequent actions.

When a certain behavior is successful or if it generates pleasant feelings, we will try to repeat it when relevant circumstances appear again. Psychologists refer to this positive feedback as *reinforcement*. In a similar way, actions with an unsuccessful or unpleasant outcome will be avoided. Thus, a close relationship between learning and motivation exists. Other important motivations for learning are the

need for a feeling of competence and the need for psychological safety. If actions don't lead to the intended outcome, two possible ways of learning may occur: Either the ineffective behavior is altered or the mental models or goals, which form the basis of the action, are changed. These two processes, which are also called "single-loop learning" and "double-loop learning" (Argyris & Schön 1996), are discussed in more detail in Chap. 16, which focuses on learning within organizations.

Because humans are social beings, we are capable of learning by simply observing other peoples' actions and related consequences. In healthcare, novices learn by observing their more experienced colleagues and by listening to peers and coworkers. In addition to learning medical facts and procedures, novices also become acculturated into the organizational culture. Learning "how things are done around here" means learning how to integrate into that culture (see Chap. 15).

What then do people have to learn to be able to handle critical situations adequately?

Relevant for the acute care setting are:

- *Knowledge*: e.g., pathophysiology, pharmacotherapy, indications, and contraindications of interventions
- *Skills*: e.g., airway management, emergency procedures, communication, teamwork, decision-making, etc.
- *Metacognition*: the ability to analyze and assess one's own thought process and to recognize the impact of "psycho-logic" of human behavior, heuristics, and cognitive distortions
- *Attitudes and values:* e.g., the willingness to ask for help or to learn from mistakes

The above-stated difference between behavioral options and actual behavior has practical implications for the acute care setting. A participant may learn during a team exercise that calling for help early in a critical situation will improve patient safety. "Call for help early!" as a catchy phrase may then be stored as knowledge (extension of schemata), and as a result, the person's attitude toward team support may change. However, whether or not this same person will actually call for help during a critical situation will depend on many factors independent of the learning experience: his or her actual stress level, risk assessment, expected consequences, and the organizational culture (Chap. 15), to name but a few.

Several human factors are not amenable to learning, at least not to learning in the classical sense. These are:

- Functional features of perception (Chap. 5)
- Principles of information processing (Chap. 6)
- Characteristics of human memory
- Characteristics of attention (Chap. 8)
- Basic motives
- Physiological limitations

Nevertheless some of these factors change over the span of life (e.g., deterioration of perceptional threshold and attentional span with increasing age, increased need for sleep in the elderly, etc). Patient safety interventions that take these unchangeable human factors into account will not focus on learning interventions but rather will try to change upstream systemic factors such as changes in workplace setting and routine processes.

Finally, it is important to keep in mind that it is always easier to learn something new from scratch than to unlearn deeply ingrained knowledge and habits and replace those with something new. Habits can become so solidified that people will find great difficulty in changing them or forgetting them altogether (Quinn et al. 2010).

4.6.5 Thinking

"Thinking" encompasses all higher cognitive functions that govern human behavior at the level of planning, expectations, and decision-making. Although very powerful in its operations, thinking is a limited resource because it relies on language processing and thus operates in a sequential mode. People can only think one thought at a time.

Thinking involves interpreting and ordering how information is processed (Selz 1913; Guilford 1967; Klix 1971; Dörner 1976, 1999). Interpreting and prioritizing information is a part of recognition and identification (Chap. 5) including assessment, conceptualization, drawing conclusions, planning, and decision-making. Generally stated, interpreting and prioritizing is problem solving. All these cognitive operations are done with the help of schemata that are constructed, rearranged, amended, and brought to mind in a way that helps us make sense of the world around us.

Thinking without language is possible. It consists of associating schemata according to their emotional match to the situation and to already activated schemata. Analytical thinking, however, is dependent on language. As a consequence, analytical thinking is a relatively slow, sequential working mode as only one thought at a time can be brought to mind (Chap. 6). In addition, attention is required (Chap. 8). Attention, too, is limited. This is certainly clear during a medical emergency; there never seems enough of it to tend to everything! One thing that helps us analyze events quicker is the fact that knowledge is broken down into higher-order and lower-order structures. Organization of knowledge is an essential component of its usefulness (Klix 1971). Associative (emotional-based) and analytical (language-based) thinking works hand in hand to solve complex problems. An idea can emerge from an association and is then analyzed for its meaning.

4.6.6 Metacognition: Thinking About Thinking

Thinking can be applied to itself. We can analyze and assess our own thought process. The concept that individuals are able to see inside their own thought processes,

to stand apart, and to "think about their thinking" is called metacognition. The concept was initially developed in the context of educational psychology in the 1970s by John Flavell (1979). It refers to higher-order thinking that involves active control over and regulation of the cognitive processes engaged in learning. As soon as the emergency physician in our case report arrived at the incident site, he likely started reflecting on what he experienced. He started with the situational clues that were readily available and then began searching for additional information. "Do I already know enough about the situation and the patient? Is there anything I still need to know to come to good conclusions?" Metacognition plays a crucial role in the successful generation of situation awareness. If in the aftermath of his mission, our emergency physician asks himself, "How did I reach my decisions? Why did I manage the patient that way? Why didn't I think about a certain issue earlier?" He is engaging in metacognitive activity and has the chance to clarify some of the motives for his actions. This might help him to gain insight into his "psycho-logic" of decision-making and examine the efficacy of his actions. If he reflects on the strategy he applied to the management of the multiple-injured patient, he might be able to identify successful and unwanted behavioral patterns. Metacognition has been described as one of the distinguishing hallmarks of adult human intelligence. It distinguishes adult from child thinking and the thinking of experts from that of novices. Table 4.1 summarizes the components of metacognition that mark an expert.

Table 4.1 Metacognition by experts is characterized by several core features

Metacognition enables people…	
… to have the big picture	Experts excel at forming situation awareness and at detecting when they are starting to lose the big picture. Experts sense decay in situation awareness early and make necessary adaptations. They possess the ability to step back from the immediate problem and reflect on the entire situation with all its ramifications
… to select an adequate strategy	Clinicians are confronted with a wide range of clinical problems and a multitude of possible options to react. Experts can reflect upon their own thinking and select different and novel strategies. These strategies include how decisions are made, where to focus attention, how to improve teamwork, and ways to reduce workload. In addition, experts work to manage their cognitive biases
… to be sensitive to memory limitation	Experts are sensitive to their working and long-term memory limitations and maintain awareness of managing cognitive load. Experts can assess the impact of their level of alertness and their ability to sustain concentration, both of which affect memory. Limitations to memory can be overcome by external cognitive aids that lessen the burden on memory
… to engage in self-critique	Experts know that overconfidence can lead to serious errors. Experts cultivate a capacity for reflection on their decisions and a willingness to reexamine decisions in light of new information or input from team members Expert performance is less variable than that of novices. They can analyze how variations may cause poor performance. In addition, experience allows experts to assess where a plan might have been weak or wrong

Based on Klein (1998)

4.7 Hazardous Attitudes

One of the patterns repeatedly found when accidents are analyzed for root causes is a person's inadequate attitude toward safety and risk. The concurrence of a risky or dangerous situation with an inadequate attitude is often a contributing factor in aviation accidents and healthcare mishaps. These attitudes illustrate the abovementioned "psycho-logic" of human behavior with its interaction of cognition, emotion, and motivation. Attitudes can be seen as a blend of situation assessment (cognition), emotional response (emotion), and an impulse for action (motivation; Hovland and Rosenberg 1960). The cognitions in an attitude have powerful emotional features. Because of the strong emotional component, it is difficult for people to verbalize these cognitions and therefore difficult to bring to one's level of awareness and ability to reflect (metacognition). Furthermore, hazardous attitudes are driven by motives. Attitudes are developed and refined to fit our motives. Five typical hazardous attitudes have been described that account for unsafe response patterns (Jensen 1995). Each of them emphasizes a different motive:

- The *macho attitude*: Courageous actions are supposed to strengthen one's own feeling of competence, especially when team members watch.
- An *antiauthoritarian attitude* is adopted: People want to defy regulations or authority because they cannot stand the feeling of being controlled by other people.
- *Impulsivity* is grounded in the inability to consider options before taking action. To impulsive persons, "just do something, quick" seems superior to leaving any time for reflection.
- *Invulnerability* comes into play when people regard themselves as basically invulnerable. Such people believe mishaps do not happen to themselves; instead mishaps happen to other people who are not as smart or capable. This attitude is especially prevalent in those who have never experienced a major mishap.
- *Resignation* makes people give up quickly when faced with a difficult situation. These persons feel that they have little control to affect an outcome of a difficult situation. Often they take no action whatsoever. Help is expected from others.

These attitudes jeopardize safety in all organizational and industrial sectors. When working with patients, another set of attitudes can impact safety: deprecating and condescending attitudes toward the patient and family. If a nurse says "It's absolutely normal that he's not feeling well after his major GI surgery. Don't worry, I've seen that many times before!" in a belittling reply to a wife's comment about the deteriorating health condition of her husband, it may lead to a delayed detection of an anastomotic leak. Similarly, disrespectful attitudes of senior physicians may impair teamwork with young and unexperienced team members (Chap. 11): "Listen, son, I've been doin' this for over 30 years. I know what I'm doing. Your job is to keep your mouth shut and follow my directions" dismisses the attempt of a medical student who had noticed that the nurse had swabbed a

Table 4.2 The five hazardous attitudes and their antidote

Attitude	Thoughts in emergency situation	"Antidote"
Macho	I can do it, I'll show you!	Showing off is foolish
Antiauthority	Don't tell me what I'm supposed to do	Stick to the rules; they are meant for everybody and the rules can help me
Impulsivity	I have to act now – there's no time	Not so fast – think first. A little thinking before I act will be a worthwhile investment of time
Invulnerability	Nothing will ever happen to me	It can happen to me. Others, just like me, can have a mishap
Resignation	What's the use of even trying?	I can always make a difference; I'm never helpless

From Jensen (1995)

different site from the one written in the OR schedule. Had the senior physician respected the medical student and encouraged airing concerns, wrong-site surgery could have been prevented.

Finally, some physicians tend to over- or underestimate the degree of influence and responsibility they actually have. These attitudes have been termed *responsibility hubris* ("Everything depends on me!") and *responsibility despondence* ("Only others can make a difference!"; Wehner 2014).

Table 4.2 shows the hazardous attitudes and some "antidote thoughts" meant to counteract them by introducing positive mental responses to each situation. Once people discover that they are having hazardous thoughts, they should bring to mind the antidote (Jensen 1995). The main limitation of trying to change hazardous attitudes is that it demands self-reflection ingrained through training or, even more difficult, during action. When hazardous attitudes persist, patient safety can be improved when other team members are in a position that allows for constructive criticism (Chap. 11). A team member's comments may serve as an external trigger for reflection. Because the attitude component of human judgment does respond well to training intervention, training and reflection on action during training should become part of a safety-oriented organizational culture (Chap. 15).

4.8 "Principles of Human Behavior" in a Nutshell

- Human behavior does not strictly follow logical arguments but instead follows an idiosyncratic "psycho-logic."
- "Psycho-logic" implies that a person's interaction with the environment is an interplay of cognition, emotion, and motivation.
- Action regulation is partly autonomous; it's a process without conscious decisions.

- Every action is motivated and is meant to meet one or several needs. Apart from basic needs that secure existence (physiological needs, safety), there are social (proximity, affiliation) and informational (competence, curiosity, aesthetic) motives for action.
- Emotions are an important component of one's integrated situation assessment. Emotions are not language based and are experienced as feelings. Emotions can be described as a modulation of the parameters of action regulation (arousal, selection, resolution level, and degree of externalization).
- Cognition is language based and operates with memory contents organized in schemata.
- Memory is more than passive data storage. Memory is our mental "workbench," the place where our conscious awareness arises. It plays an essential role in our conscious interaction with our environment.
- Prospective memory is a psychological process that enables humans to execute previously formed intentions during an appropriate and later "window of opportunity." Prospective remembering is self-initiated and not stimulated by an explicit request to remember.
- Prospective memory can be impaired by factors present in acute patient care: interruptions, distractions, fatigue, cognitive demands of problem solving, multiple task and patient demands, time delays, etc.
- Learning enlarges our procedural and declarative schemata, that is, our knowledge and behavioral options.
- Among the most salient principles of learning are the following: If the result of an action feels good, we tend to repeat it. If it does not, we will try to avoid it.
- Metacognition describes the concept that individuals are able to examine their own thought processes, to stand apart, and to "think about their thinking."
- Metacognition is a distinguishing hallmark of adult human intelligence and distinguishes adult from child thinking and the thinking of experts from that of novices.
- Safety-relevant attitudes originate from an interaction of cognition, emotion, motivation, and training.

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