Understanding awareness deficits following brain injury

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The critical role that awareness deficits play in contributing to rehabilitation outcome and independent functioning of brain injured adults is readily acknowledged by rehabilitation professionals. However, there are inconsistencies in the scope of what is included within the concept of awareness and the way in which it is measured within the literature. A comprehensive model of awareness is needed to guide the development of measurement tools and interventions. This paper expands upon concepts originally proposed by Crosson and colleagues [12] and proposes a comprehensive model of awareness that integrates parallel themes in cognitive psychology, social psychology and neuropsychology. It argues that a hierarchical view of awareness does not capture the complexities and subtleties of awareness symptoms and proposes a dynamic relationship between knowledge, beliefs, task demands and context of a situation. A distinction between knowledge and awareness, that one has prior to a task, and that, which is activated during task performance, is emphasized. Suggestions for expanding assessment and intervention methodology are derived from the perspective of research within the areas of metacognition and self-efficacy.

Keywords: Self awareness, brain injury, metacognition, self-efficacy, assessment, rehabilitation

1. Introduction

A significant proportion of individuals with acquired brain injury fail to recognize their cognitive perceptual impairments and the impact of these impairments on daily functioning [2]. Deficits in awareness present major challenges in rehabilitation. The inability to recognize one's deficits interferes with safe and independent functioning [15,60]. Individuals who are unaware of their limitations tend to choose activities beyond their capabilities and do not recognize when they need help. They often exhibit poor judgement and need to be supervised for safety [24]. Awareness deficits also limit motivation for and participation in rehabilitation [17, 60]. An individual who does not recognize his or her functional difficulties is not likely to be motivated for treatment. Incongruence between the unrealistic goals of the patient, the goals of the family, and other members of the rehabilitation team can cause tension and present a dilemma for the rehabilitation professional. Awareness has been found to be related to attainment of rehabilitation goals [45] and employment outcome [52, 60]. The independent use of compensatory strategies requires the individual to recognize that a problem needs to be circumvented. Likewise, participation in remedial activities involves recognizing that there are problem areas that need to be strengthened or improved. Regardless of the treatment approach used, awareness is necessary to sustain the active effort, motivation and persistence required for rehabilitation [60].

2. The Pyramid Model of Awareness

Traditionally, awareness has been defined as knowledge of one's illness or deficits. The Pyramid Model of Awareness, described by Crosson and colleagues [12] for traumatically brain injured adults, expands the scope of awareness to include metacognitive skills such as self-monitoring and anticipation of performance. The Awareness Pyramid consists of three interdependent levels that are hierarchical. Intellectual awareness is at the bottom of the pyramid and provides the foundation for the succeeding levels of emergent and anticipatory awareness. Intellectual awareness is the knowledge that a particular function is impaired. Emergent awareness is the ability to recognize a problem when it occurs. There can be a disassociation between accu-

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rate knowledge (intellectual awareness) and use of this knowledge to monitor ongoing performance (emergent awareness). The patient may acknowledge the existence of a deficit but fail to recognize errors unless someone else points them out. Anticipatory awareness is the ability to realize that a problem is likely to occur as the result of a deficit. Intellectual and emergent awareness are prerequisites for anticipatory awareness [4,12]. Thus, an individual may be able to acknowledge and recognize errors while performing a task but be unable to use this knowledge to predict the consequences of the deficit or anticipate difficulties in advance.

The Awareness Pyramid Model [4,12] also delineates three different types of awareness deficits, and suggests that awareness is not a unitary concept. This model is supported by neuroanatomical models of awareness, which postulate that no single area of the brain is responsible for mediating awareness [41,54]. Although the right hemisphere and prefrontal regions are thought to have special roles in awareness, it has been postulated that awareness is mediated by multiple areas of the brain including the prefrontal areas, inferior parietal lobe, angular gyrus, supramarginal gyrus, and anterior tips of the temporal lobe [41]. This indicates that different clinical symptoms of unawareness may be observed depending on the area of the brain affected. This view is consistent with Crosson and colleagues [12] notion that awareness is multidimensional in nature.

The Pyramid Model of Awareness [4,12] has not been studied empirically, yet it is widely referred to within the rehabilitation literature because it provides direct implications for rehabilitation assessment and treatment. Although the model identifies and describes three different levels of awareness, it does not explain how the different levels work together and why some levels of awareness can be observed in some situations but not in others. In addition, the notion of implicit awareness, or awareness without conscious knowledge, is not addressed. There is a need for a more comprehensive model that takes into consideration the individual's belief system, and explains the way in which different aspects of awareness work together.

3. Denial and awareness

Recently, researchers have provided preliminary guidelines to distinguish the concept of denial from awareness deficits [39]. Denial refers to a psychologically motivated symptom that serves to protect the individual against internal or external stressors [1], whereas awareness deficits reflect a lack of recognition that a once intact function is now impaired [34]. Denial is a coping strategy that is thought to limit the despair that could accompany complete awareness [38]. Some authors have suggested that denial is accompanied by resistance, a tendency to blame external sources, hostility and anger when errors are pointed out, but that individuals with "true self-awareness deficits" respond to feedback with perplexity, surprise or indifference [20,39]. However, what constitutes denial and what constitutes true unawareness due to brain injury is not clear-cut. It is complicated by the fact that some persons with brain injury, by the very nature of the injury, may exhibit rigid thought patterns, an inability to switch perspective in order to understand another person's viewpoint, and disinhibited emotional responses [42]. In addition, some individuals show both types of responses to feedback at different times and in different situations. Awareness deficits and denial reactions may interact in the same individual [30]. The emotional reaction to a partial understanding of one's deficits may compromise self-monitoring skills and complicate the clinical picture [39,43]. A model of awareness is needed that considers the influence of emotional reactions and the response to feedback.

4. The interface between self-awareness, metacognition, and self-efficacy

There is a significant degree of similarity and overlap in regard to self-awareness, in the cognitive psychology and neuropsychology literature. Self-awareness is related to the broad concept of metacognition in cognitive psychology and to executive functions within neuropsychology. Similarly, in social psychology, there is an overlap between the concept of awareness and that of self-efficacy or beliefs about one's effectiveness and capabilities. Although the literature and research within these areas is derived from different perspectives and uses different terminology, there are parallel themes that can be integrated to provide a more comprehensive framework for understanding self-awareness following brain injury. The following represents an expansion of the concepts of the Pyramid Model of Awareness [4, 12] and reconceptualizes the nature of awareness based on research and concepts in the areas of metacognition, self-efficacy, and neuropsychology.

5. Metacognition

The concept of metacognition is discussed extensively in the cognitive psychology literature [6,8,10, 16]. Metacognition involves conscious knowledge of cognitive processes as well as the ability to consciously monitor and regulate one's ongoing activities or processes while engaging in a task [25]. The definition of metacognition describes two distinct but interrelated aspects: knowledge and on-line awareness. Metacognitive knowledge includes declarative knowledge or factual knowledge of task characteristics, cognitive processes and strategies that are stored in long term memory. It also includes knowledge of one's own cognitive capabilities [16,27]. Thus, metacognitive knowledge can be thought of as stored knowledge that exists prior to actual task performance [10].

The concept of metacognitive knowledge has been expanded by some researchers to include self-efficacy beliefs or one's sense of mastery regarding the ability to use cognitive skills effectively as needed [6,9]. Social cognitive psychologists emphasize the interrelationship between knowledge of cognitive processes and beliefs about one's own cognitive capabilities [9]. Self-knowledge is viewed as a constructive process that cannot be separated from one's interpretations, beliefs, and subjective perceptions of cognitive experiences [31].

The second aspect of metacognition involves monitoring and self regulation. Metacognitive knowledge is what one brings to a task, whereas monitoring and regulation involve ongoing evaluation of performance within the context of a task [49,54]. Monitoring reflects awareness of performance within the context of a task, whereas self-regulation refers to the ability to change strategies and adjust performance in response to changing task demands. Self-regulatory processes depend on accurate self-monitoring [6,25]. Monitoring and self-regulatory concepts are also inherent within the definition of executive functions described in the neurospychology literature [54,55].

Self-evaluation of experiences involve comparing current performance to one's knowledge and expectations about cognitive functioning. However, this knowledge is mediated and influenced by one's beliefs and feelings about one's capabilities [27]. The distinction between knowledge and beliefs about one's abilities prior to performing a task and the awareness that occurs within the context of a particular situation is a theme which is echoed within the neuropsychology literature [46,55]. It is similar to Crossan and colleagues [12] distinction between intellectual awareness and emergent, and/or anticipatory awareness. As suggested by the Pyramid Model of Awareness [4,12], an individual may have good intellectual awareness of one's deficits but be unable to use this knowledge to monitor and regulate ongoing performance [4]. The integration of self-efficacy concepts within the concept of self-knowledge is also useful. After brain injury, the individual may have beliefs about themselves that are incongruent with performance. As a result, self-efficacy may be significantly altered [29]. Thus, the emergence of awareness can be viewed as a process that involves the restructuring of one's self-knowledge and beliefs.

6. Proposed model

The proposed model of awareness (diagram 1) views awareness following brain injury within a framework that is based on the concept of metacognition. The framework views the relationship between different aspects of metacognition and awareness as a dynamic process rather then as a series of hierarchical levels. It clearly differentiates between knowledge and beliefs related to one' self that are pre-existing or stored within long term memory and knowledge and awareness that is activated during a task. The term on-line awareness is used to describe the ability to monitor performance "on-line" or within the stream of action [26]. Pre-existing knowledge and beliefs are based on repeated experiences over time and are relatively stable [8].

On-line awareness or ongoing monitoring and regulation of actual performance varies with the task and the context of a situation and is relatively unstable [8]. On-line awareness includes the concepts of anticipatory and emergent awareness [12]. However, because on-line awareness is dependent on the task and the situation, this framework implies that anticipatory and/or emergent awareness may be evident on some tasks and situations but not on others. Pre-existing knowledge influences and interacts with self-awareness within the context of a task (on-line awareness) [10]. One's knowledge, beliefs, and affective state influences how task demands are perceived, and they shape expectations and anticipations regarding task outcome [8]. At the same time, the results of self-monitoring activities are compared to expectations based on prior experiences. A discrepancy between what one does and what one expects to do, based on prior knowledge or beliefs, may lead to the adjustment of performance and the selection of a different strategy [16]. Finally, one's assess-

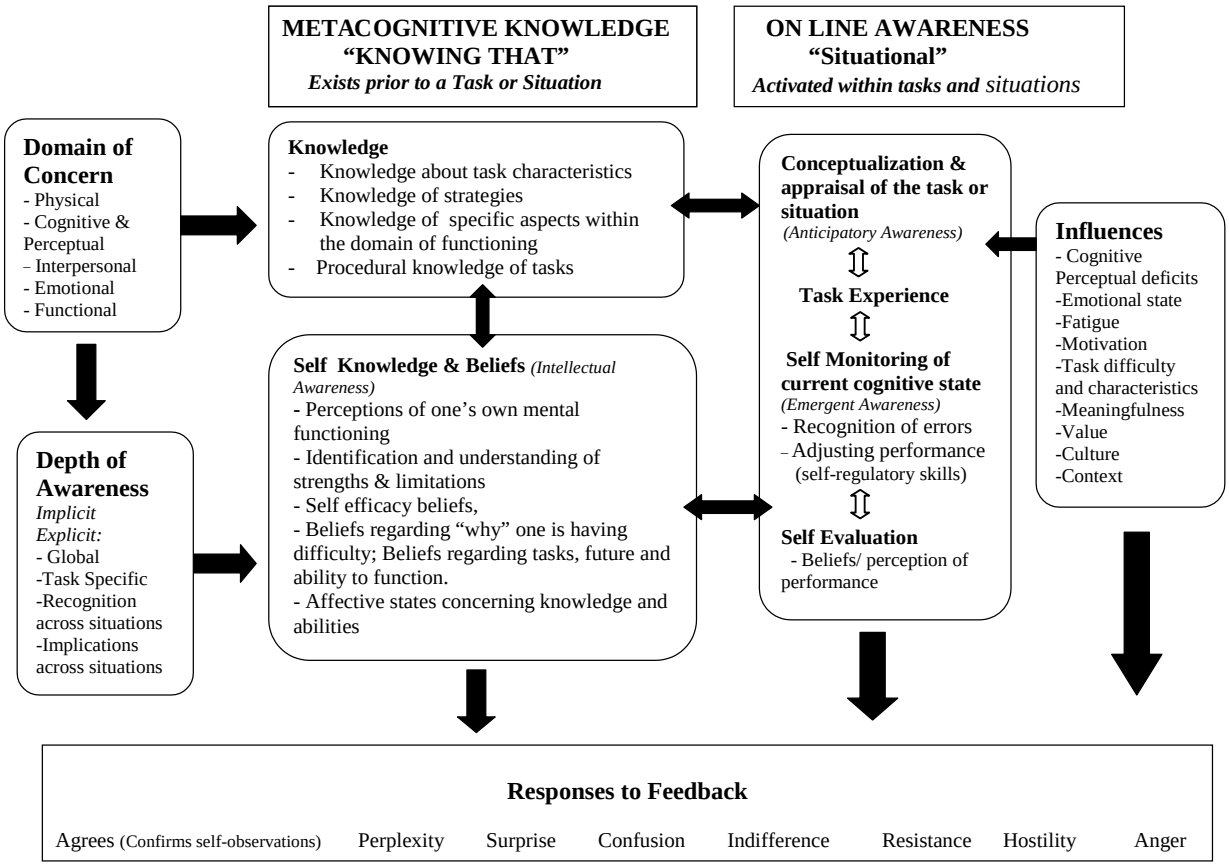

Fig. 1. A proposed model of awareness.

ment and perceptions about the outcome of task performance, within the context of a particular situation, can restructure and shape stored knowledge and beliefs about one's abilities [3,16]. Thus, there are constant interactions between stored knowledge, beliefs, affective state, and on-line awareness. Other factors can also influence on-line awareness and self-monitoring abilities such as: cognitive perceptual deficits, motivation, fatigue, task demands and context [6,8].

This model provides an explanation of how perceptions of one's capabilities interact with task performance across and within separate domains. It includes considerations of self-efficacy and conceptualizes the process of gaining awareness as the process of re-structuring self-knowledge. Variations can occur in the depth of awareness as well as in the domain of concern. The individual may show more or less awareness in some areas but not in others [47]. Response to feedback is also affected by many factors including one's beliefs and personality, as well as the meaningfulness and value of the task. Awareness of one's abilities and limitations can be characterized by the different aspects of awareness (self knowledge or intellectual awareness, on-line awareness or emergent and anticipatory awareness), degree of depth or specificity, domain of concern, and response to feedback [4,20,47]. Each aspect of the proposed model (Fig. 1) will be discussed in more detail below.

6.1. Domain of concern

Self-awareness can differ in various areas of function: physical, cognitive, perceptual, interpersonal, emotional and functional domains [17,28]. An individual may recognize memory problems and show anticipatory and emergent awareness within the memory domain but at the same time be unaware of deficits in everyday problem solving or social situations. Thus, individuals may exhibit "blind spots". They may be aware of certain deficits but may be unable to appreciate the full picture [17]. Hibbard and Gordon [28] found that awareness was inconsistent across domains in individuals with cerebrovascular accident (CVA).

One year post stroke, the majority of persons with CVA were aware of their physical deficits, 50% were aware of memory and language deficits, but only one-third were aware of deficits in abstraction [28]. A number of studies have demonstrated that awareness for motor deficits and sensory problems are better than awareness for cognitive deficits [2,20,36]. Awareness of the ability to perform basic self care tasks such as dressing and personal hygiene was better than awareness for Instrumental Activities of Daily Living (IADL) tasks, such as meal preparation, work, and scheduling daily activities. In general, self-awareness was most impaired on activities with a large cognitive and social-emotional component and least impaired on tasks involving a physical or concrete, observable stimuli [17]. This suggests that awareness is not a unitary concept. Aspects of awareness can be differentiated and linked to different areas of functioning. This view of awareness is similar to the concept of self-efficacy. Self-efficacy views the belief system not as an overall trait but as a differentiated set of beliefs that varies across different domains [3].

A number of investigators have proposed different frameworks to explain the variations in awareness across domains. For example, McGlynn and Schacter [34,46], proposed a Conscious Awareness System (CAS) that detects changes in separate cognitive domains. Unawareness within a domain occurs when there is a disconnection between the conscious awareness system and a specific cognitive domain. Berti et al. [5] modified the CAS model and proposed several different modality specific monitoring systems rather than a central conscious awareness system.

6.2. Depth of awareness

Within each domain of function (e.g. physical, cognitive, social), the level of specificity or depth of awareness can vary [47]. At one end of the continuum, awareness and knowledge may operate at a subconscious or pre-conscious level. For example, individuals with severe memory deficits may not recall learning a series of words but when the list of words is repeated, there is an advantage or superiority for lists previously studied. Even though the patients do not recall having learned the previous list, they showed some knowledge of the word list that they were not consciously aware of [29]. Similar observations have been reported across different domains. For example, patients with blindsight have reported that they were unable to see but then responded appropriately to visual stimuli [29]. These observations have been described as implicit expressions of knowledge about one's deficits [34].

According to Kihlstrom [29], "Just because something is not registered in consciousness does not mean that it is not registered at all or that it cannot influence ongoing experience" (p. 217). An individual, who demonstrates poor intellectual awareness at a verbal level, may have some awareness of a deficit that can be observed during task performance. McGlynn and Schacter [34] observed that anosognostic patients indicate that they appreciate their deficits at some level of awareness even though they do not explicitly acknowledge them. For example, an individual may not acknowledge a memory problem, but when asked to remember something, automatically writes everything down within the context of that situation. Clinicians need to be alert to observations that suggest implicit awareness. Areas of implicit knowledge can be capitalized on in treatment by either training tasks at a nonverbal or procedural level or by trying to make implicit knowledge accessible to consciousness.

The degree of specificity of awareness can vary considerably at a conscious level. For example, problems in memory may be generally acknowledged, but the individual may be unable to provide specific examples. During the course of a task, an individual may have a vague sense that something is wrong but be unable to localize or specify what is wrong [47]. An individual may be able to recognize and identify memory problems on some tasks or situations but not on others [27]. The ability to recognize and describe specific problems across and within a variety of different tasks and situations represents a higher degree of awareness than task specific awareness. Finally, the ability to understand the implications of problems across different tasks represents the highest degree of awareness [4,15].

It must be kept in mind that the ability to acknowledge the implications and consequences of deficits verbally may not correspond to actual behavior [15,54]. Differences in awareness may be observed within different contexts. Thus, the degrees of specificity and depth of awareness needs to be considered across a variety of situations [47].

6.3. Metacognitive knowledge and beliefs. Expanding the concept of intellectual awareness

Metacognitive knowledge, which exists prior to an actual task or situation, consists of two interrelated aspects: knowledge of specific aspects of cognitive processes, task characteristics, and strategies in

different areas of functioning; self-understanding of one's capabilities and limitations [16,25]. This self-understanding cannot be easily separated from self-efficacy beliefs [13]. Self-efficacy in relation to cognitive skills involves judgements and beliefs about one's own ability to use cognitive skills such as memory effectively. Self-efficacy can be conceptualized as having two aspects: judgements and perception of one's capabilities; a sense of control in achieving desired outcomes [3]. One's belief in the ability to do a task is shaped by an understanding of one's own abilities and limitations [3]. When understanding of one's abilities is distorted, judgements and beliefs will be distorted as well. In addition, the individual may experience a loss of control. Thus, the concepts of self-awareness and self-efficacy are closely interrelated.

Knowledge and beliefs about ones capabilities are based on past experiences in similar situations. Although self-knowledge and beliefs are relatively stable, they also change over time and are influenced by ongoing evaluations and perceptions of successes and failures. Subjective beliefs and perceptions of situations interact and influence the development of knowledge. Beliefs regarding one's self are the products of experience, but they are also involved in the construction of experiences [3]. Beliefs and perceptions of one's capabilities can create biases in the processing and interpretation of information that can enhance or impede cognitive functioning [3]. They can influence activities one chooses to engage in, selection of strategies, what is monitored, the degree of effort and persistence, and commitment to goals. They can also affect the appraisal of task difficulty level [7,13,27]. Thus, inaccurate beliefs regarding one's capabilities can limit cognitive performance by their disrupting effects on self-monitoring and self-regulatory processes [6,27].

6.4. On-line awareness

On-line awareness is activated within the context of a specific situation or task and involves judgements about one's abilities and limitations in relation to the current situation. On-line awareness has been subdivided into self-monitoring and self-regulatory processes [25,54]. Self-monitoring involves appraisal of current task demands (anticipatory awareness) and recognition of errors (emergent awareness). Although self-monitoring is influenced by pre-existing knowledge and beliefs about one's abilities, it is dynamic in nature [8,49]. Anticipation and recognition of errors varies depending on the nature of the task itself, the complexity of the task, its familiarity, perceived consequences of failure, the meaningfulness and value of the task, motivation or drive, depression, fatigue, and anxiety [8].

Studies in cognitive psychology have found that prediction accuracy or the ability to anticipate and recognize errors varies as a function of familiarity and/or the complexity of the task [27,49]. For example, in a study with children, Schneider [48] found that when a memory task was simple, there was little difference in self-monitoring skills between younger and older children, but as complexity and difficulty level of the task increased, differences were observed in the ability to self-monitor performance. This suggests, representing anticipatory and emergent awareness as hierarchical levels, may be an oversimplification as self-monitoring skills may be highly dependent on task characteristics such as familiarity and difficulty level [27]. On one task, an individual may show good anticipatory and emergent awareness whereas on another task within the same domain, the individual may show limited anticipatory or emergent awareness. Thus, the ability to monitor performance varies as a function of task characteristics.

Self-monitoring depends on ongoing integration of cognitive perceptual information. Attention, visual perception and cognitive integration of all aspects of a task are necessary for accurate task appraisal and error recognition. Deficits in self-monitoring may be related to a variety of different cognitive and perceptual problems including impulsivity, distractibility, inability to attend to all aspects of space, decreased visual discrimination, a tendency to focus on particular aspects of a task or situation or to misinterpret the overall goal, and inability to keep track of information or keep the expected outcomes in mind [4,15,22,27]. Deficits in self-monitoring may also be related to a lack of interest in the task, an attitude of indifference or unconcern, and false beliefs regarding one's capabilities [22,35]. Table 1 lists problems that can contribute to deficits in self awareness.

Accurate task appraisal or judgement of task difficulty level is related to recognition of the need for strategies and self-monitoring. If a task is perceived as easy, an individual is not likely to initiate strategy use, or pay close attention to what he or she is doing. Overestimation of abilities can affect the speed and intensity of task performance as well as allocation of resources and strategy use [3,25].

The consequences of overestimating one's capabilities on a task can be detrimental. For example, individuals may believe that they can drive when it is unsafe

Table 1
Problems that contribute to deficits in self-awareness

Self knowledge – outside the context of a task
Loss of the ability to access knowledge about task characteristics and strategies
False judgements and beliefs about one's capabilities
Lack of acceptance of deficits
On-line awareness prior to performing a task: Overestimation of task performance
Task demands are unfamiliar or ambiguous
Failure to recognize, integrate or perceive all aspects of the task or task demands
Inaccurate assessment dues to false beliefs about one's skills
Tendency to judge task based on prior experiences, beliefs and knowledge, without regard to current level of abilities
Jumps into task without planning or assessing, or selecting goals
Bases judgements on what one like to do rather than what one is capable of
Failure to access previous task and strategic knowledge
Task performance
Does not recognize errors Failure to perceive and integrate all aspects of ongoing performance
Unable to simultaneously attend to the task and one's own performance
Overfocuses on irrelevant information
Does not initiate self checking
Does not adjust speed when errors are made
Receives inaccurate feedback
Lack of interest; unconcern – lack of motivation to monitor
False beliefs about task difficulty level and one's capabilities
Looses track of the goal, expected level of performance
Does not compare ongoing performance with expectations based on previous experience
Lack of knowledge about what the correct response should be
Failure to recognize need to use task strategies
Able to recognize problems but cannot adjust performance
Unable to use feedback – involves initiation
Unable to access strategy knowledge when needed within the context of a situation (unable to choose the correct solution or response; Inappropriate response to acknowledged error)
Lack of recognition trigger to apply strategy
Lack of flexibility in changing strategy
Lack of ability to initiate use of strategies
Self evaluation
Does not initiate self checking of work
Does not compare results with previous experiences or with goals
Unable to grasp implications; recognize reasons; abstract – see beyond the here and now
False beliefs about capabilities
Lack of knowledge regarding the correct outcome or unable to access a representation of desired performance
Difficulty reflecting back and connecting one's actions or performance to the outcome
Failure to integrate
Does not retain the new experience over time

to do so, putting themselves and others at risk. However, even when the immediate consequences of overestimation are not obvious, a pattern of overestimation of one's capabilities can ultimately lower a sense of self-efficacy (Fig. 2) [3,19].

Overestimation of performance can lead to unexpected results or outcomes which produces insecurity in knowing if things will turn out right or out wrong. In some instances, the individual may be taken by surprise as the result of his or her efforts. This can shake their sense of confidence and heighten anxiety. In other instances, external causes may be blamed for the unanticipated outcomes. In either situation, the individual may experience decreased self-efficacy or a loss of a sense of inner control. This can have psychological and emotional consequences that can create a cycle that is difficult to break. For example, the individual who perceives a loss of control, is at high risk for depression [3]. Depression further inhibits cognitive processing and decreases attention and memory [28]. On the other hand, individuals who blame other people or things for difficulties also experience a loss of control. They refuse to acknowledge obvious difficulties and expose themselves to negative social feedback and sanctions. The individual may begin to mistrust others and become increasingly angry and hostile. This can result in isolation and alienation from close family and friends [11]. This too has negative emotional consequences and decreases self-efficacy. In either case, brain injury can have significant effects on perceived

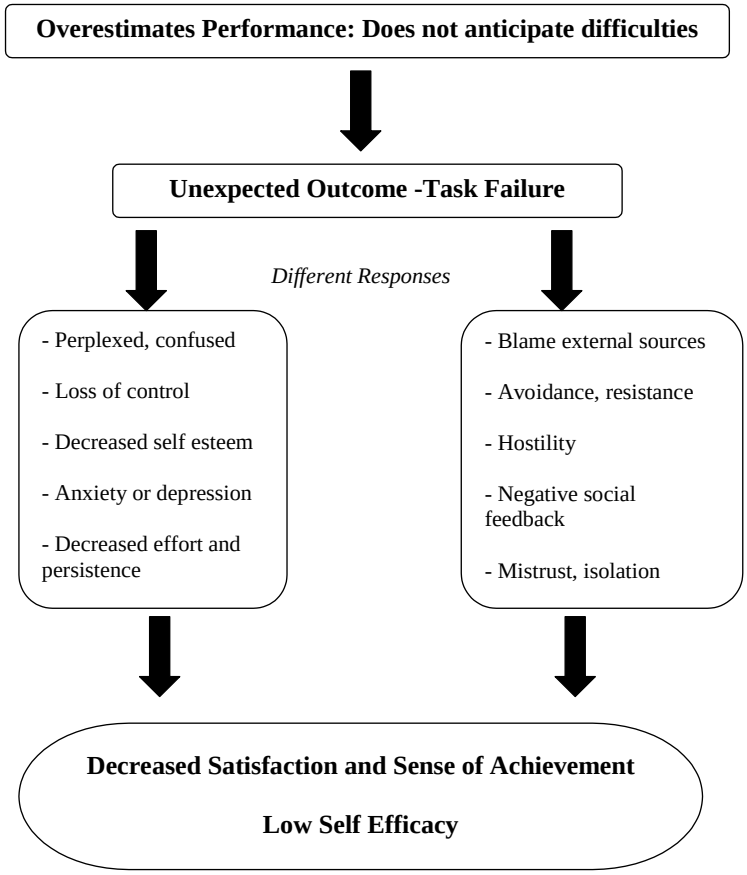

Fig. 2. Overestimation of performance lowers self-efficacy.

self-efficacy. People who lack self-efficacy believe that tasks or events are beyond their control. Low self-efficacy is associated with decreased motivation, lack of persistence, vulnerability to stress, poor coping skills and emotional distress [3]. As individuals with brain injury gain awareness, they are at increased risk for emotional problems [21]. At the same time, individuals who continue to deny deficits 2 years post injury also have deficits in psychosocial adjustment [33].

In addition to accurate task appraisal and error recognition, on-line awareness includes self-regulatory and self-evaluation skills. Self-regulatory or control processes involve the ability to shift sets or plans as needed, which depends on accurate monitoring [6,25, 49]. Sometimes an individual is able to recognize problems but cannot shift strategies or adjust performance. In other cases, an individual is unable to access knowledge of strategies when needed or chooses an ineffective strategy. Self evaluation or appraisal of one's performance following a task requires initiation of self-checking and the ability to compare responses and recognize discrepancies between performance and expected outcome [62]. It involves integrating new experiences with previous experiences. Self evaluation also involves the process of self reflection; the ability to go beyond the here and now, and think back on performance, as well as to look ahead and see the implications of difficulties [15,54]. Persons with brain injury often demonstrate concrete thinking and have considerable difficulty going beyond the "here and now". Goldstein [23] found that impairment in the "abstract attitude" could influence the ability to understand how one has been affected as well as the consequences of one's deficits.

Cognitive perceptual deficits and the skills needed for on-line monitoring appear to be related, suggesting that severity of cognitive perceptual deficits and awareness deficits are related. A review of the literature on awareness indicates that the majority of studies have not found a relationship between awareness and severity of cognitive deficits [36,44,51]. For example, individuals with subtle cognitive deficits may fail to rec-

ognize their problems, whereas individuals with severe cognitive deficits may readily recognize their difficulties. However, most of these studies used measures that examined intellectual awareness or general perceptions of one's capabilities outside the context of an actual task [36,44]. As stated earlier, there can be a disassociation between knowledge that a skill is impaired, and the ability to use that knowledge to monitor and regulate performance [4,54]. Although knowledge and understanding of one's deficits may not be related to severity of cognitive perceptual deficits, the ability to anticipate, recognize and self correct errors within the context of current task performance may be related to the severity of cognitive perceptual deficits.

Stuss and Benson [55] proposed a model, that attributes general self-monitoring and self-reflective abilities, including the ability to understand the implications of deficits, to frontal systems. The frontal lobe is viewed as a central monitoring system. Conscious direction or self-monitoring skills mediated by the frontal lobe are required for non-routine or novel activities. Once activities become routine, less conscious self-monitoring skills are needed. Other areas of the brain can mediate these activities. Damage to prefrontal regions results in general self-awareness deficits. General self-awareness deficits are different from focal deficits in awareness which are more related to knowledge that is associated with a particular domain [54,55]. Stuss and Benson's [55] model supports the disassociation of knowledge or fact from self-monitoring skills. The model suggests that the knowledge of specific deficits is associated with posterior brain functions, whereas the frontal systems play a general role in self reflective and monitoring behaviors. The model also suggests that cognitive deficits associated with frontal lobe functioning such as reasoning, judgement, selective attention, and flexibility are most likely to influence general on-line monitoring skills [54].

6.5. Implications for rehabilitation

Immediately following a brain injury, an individual continues to have knowledge and beliefs of one's strengths and limitations based on preinjury experiences. Changes in knowledge and beliefs occur over time, as one has the opportunity to experience and learn from repeated difficulties and successes. Individuals who have suffered a brain injury describe a feeling of a "loss of a sense of self" [62]. The process of recovery and rehabilitation involves adjusting and getting to know about the cognitive changes that have occurred. It involves "getting to know oneself" again [58]. This requires a restructuring of one's knowledge and beliefs about ones strengths and limitations. Repeated discrepancies between one's evaluation of performance and pre-existing beliefs, knowledge, and expectations can modify one's belief and knowledge structure [3]. However, brain injury may also affect the ability to experience problems accurately. Cognitive perceptual deficits may prevent the individual from recognizing the mismatch between what one should be able to do, based on past experiences, and what one actually does within the context of a task. Even when this mismatch is recognized, the experience may not be retained over time [15,22,29].

Individuals derive knowledge and beliefs about themselves from many sources, including feedback from others. However, the most important source of self-beliefs is a person's history of "mastery experiences" or "enactive experiences" [3]. Bandura [3] discusses the concept of "guided mastery" as the principle vehicle in strengthening and restructuring self-efficacy beliefs. Guided mastery involves structuring experiences in ways that allow the individual to monitor their functioning and exercise some control. "Powerful mastery experiences can produce a transformational restructuring of efficacy beliefs that is manifested across diverse realms of functioning" (p. 53) [3].

Bandura's [3] concepts suggest that familiar tasks may be more effective in facilitating awareness than remedial or unfamiliar tasks because they provide a basis for evaluating current experiences [18]. However, familiar tasks may need to be simplified and structured so that they match the individual's information processing abilities. Tasks that are beyond the individual's capabilities can lead to a failure to integrate and assimilate the experience. Although it may seem easiest to see one's problems, in a situation where a person is making a significant number of errors, it is suggested that this may not be the case. Self-monitoring skills, such as error recognition and error correction, are most likely to emerge on tasks that are at a level of "just right challenge". Restructuring of knowledge and beliefs is most likely to occur when the individual can recognize or discover errors themselves [3]. Awareness training techniques, which are geared towards helping patients self-discover their own errors, may be more effective in enhancing awareness than verbal feedback.

Structured methods of self-questioning and self-evaluation that help patients discover errors themselves, have been described [53,62]. Videotape feedback, in which individuals are asked to evaluate themselves on

specific behaviors, may also assist them to identify their errors and to re-experience their performance [53,56, 62]. A study of patients with hemineglect found that videotape feedback, which allowed patients to evaluate their own performance, was more effective in enhancing awareness than verbal feedback during task performance [56]. When the therapist is the one who continually points out errors through direct feedback, the therapist is the one who has all the "control". A major part of awareness training should be directed toward helping the individual to gain control of his or her cognitive symptoms [62].

Within the area of self-efficacy, Bandura [3] found that verbal persuasion is the least effective method of attempting to change one's beliefs. Telling someone that they have problems over and over does not usually influence performance [3]. Knowledge and beliefs are modified through integration of direct and personal experiences. Thus, treatment needs to be directed towards creating structured experiences where individuals can experience and recognize errors themselves, and at the same time, achieve a sense of control and mastery over performance [53,62]. Increased awareness without a sense of self-efficacy may increase risk of emotional dysfunction and limit functional performance.

6.6. Response to feedback

Response to feedback can range from agreement to indifference, perplexity, resistance, or hostility [20,39]. Response to feedback may vary depending on a number of factors including culture, personality, value and meaningfulness of the task, context of the situation and the way the feedback is provided [11,40,42,61].

Culture: The extent to which feedback is accepted and deficits are acknowledged can be influenced by one's culture. Although individuals with brain injury have decreased insight across cultures, the behaviors that are minimized may differ. For example, Northern Italians showed less "denial" than Swiss persons with brain-injury [42]. In addition, a cross cultural study [40] found that Japanese patients with traumatic brain injury (TBI) did not overestimate social or emotional control problems, but they did overestimate self care abilities. As Prigatano [40] points out, these behaviors are contrary to the behaviors of persons with TBI within the United States who overestimated social-emotional skills and underestimated self care skills. Prigatano [40] explains that in the Japanese culture, self-care activities and the ability to be independent are highly valued. The need to rely on others may be considered a personal disgrace, so it may be more threatening to admit difficulty in this area. In contrast, social-emotional skills are not usually discussed openly. Individuals may be modest when asked about social-emotional skills because modesty is an important value in the Japanese culture [40].

Personality: Premorbid personality factors are considered major determinants that influence the development and nature of the denial [30,42,61]. Thus, some premorbid personalities are more prone to denial reactions than others. An individual who never liked to admit mistakes; never admitted to failures, unless the world was collapsing around him; never asked for help; did things his or her own way; was always in control, is an individual who will have more difficulty when errors are pointed out directly. Other personality characteristics that are typical of individuals who are prone to denial, include, overfocus on work; compulsive tendencies, need for prestige and esteem from others, history of denying perceived inadequacies [61].

Use of denial as a coping strategy does not fully account for the problems of unawareness, but it may interact with awareness deficits and create additional challenges for treatment [30]. The clinician needs to understand what the individual's personality and life was like, what he valued, what activities he enjoyed, what he was successful at, how he or she coped with previous adversities and what he or she believes has been lost. This information can be used to overcome resistance and help the individual re-connect and rediscover the strengths within themselves [42,62].

Value and meaningfulness: It is important to keep in mind that acknowledgement of cognitive deficits is threatening to an individual's sense of self and place in society. Deficits in cognitive abilities have a negative social stigma [11]. For example, admitting that one cannot drive, manage one's finances, or work indicates a need to rely on others and a loss of independence. For many individuals, work and independence represent a part of who they are. People tend to resist changing their views of themselves in situations where they are highly invested and have firm beliefs and values. The stronger the value and belief, the harder it is to "let go of it" [3]. It is not easy to recognize or accept changes in the ability to do things that were so much a part of one's life. Individuals are not as likely not to admit impairments that they perceive as socially threatening. Fleming and Strong [17] found that at 12 months post injury, persons with TBI overestimated IADL skills. The 3 items that were most frequently overestimated included: managing finances, driving a car, and recog-

nizing if something one said or did upset someone else. These tasks represent key areas of personal control, independence and self-esteem [17].

In addition, cognitive skills are often associated with one's identity. For example, an individual may be described as a good problem solver; learns quickly; thinks on her feet, well organized; follows through with tasks. Admitting to cognitive deficits can be threatening to one's self identify and self-esteem. It can threaten the individual's sense of self [11].

The ability to recognize errors is harder in tasks that are highly valued, meaningful and closer to one's self identify. This implies that treatment may need to begin with tasks that are emotionally "neutral". Although familiar tasks provide a basis of comparison, tasks that are highly valued may need to be avoided in the early stages of treatment. Awareness is most likely to emerge within a safe and non-threatening atmosphere. The power of a close therapeutic alliance cannot be underestimated in helping persons with brain injury to recognize and accept their difficulties [53,62].

Methods of interaction: The manner in which questions are asked, and in which feedback is provided can influence the individuals response. Direct confrontation tends to elicit defensive reactions particularly in individuals who are prone to use of denial as a coping strategy [62]. The sandwich method of feedback whereby negative comments are "sandwiched" between positive comments, which are given first and last, may decrease the probability of resistance and hostility [53]. In addition, the way in which questions are asked may influence responses. Feher [14] observed that the willingness of patients to admit impairments depended on how the question was phrased, and how the issues were addressed.

7. Assessment of awareness

The most common method of assessing awareness is to compare a person's self-ratings with either ratings by a relative or a clinician, or by performance on neuropsychological tests. The discrepancy between self-ratings and test performance or ratings by others is considered to be a measure of the degree of unawareness [51]. Interpretation of such discrepancies is limited, however, because it is unclear that this method actually measures awareness [59]. There is considerable variability in relatives' judgement and objectivity concerning the patient's functioning [36]. Likewise, clinician ratings may be biased and influenced by patient characteristics such as likeability [32]. In addition, there is some indication that measuring awareness by comparing patients self-ratings to clinicians ratings produces different results from patient self ratings as compared to relative's reports [51]. Comparison to neuropsychological test performance is problematic because individuals may not be rating themselves on the same type of things as those measured by specific neuropsychological tests [59].

Many existing questionnaires use a mixture of both generally worded and specifically worded items [51]. Generally worded items are less useful because individuals may rate themselves on different benchmarks. For example if the individual is asked to rate the extent to which they have problems in preparing meals, the individual could think of a meal as heating a can of soup or frozen food dinner, or the individual may think of preparing dinner for six people. The rating depends on the particular context(s) that the individual uses to make his or her judgement [3]. Recently, it has been found that persons with brain injury are more accurate (agreeing with family members) when self-ratings used specifically worded questions [50,51].

It has been suggested that generally worded items tend to be more sensitive to awareness deficits [51]. However, awareness deficits, that are measured by a discrepancy between self ratings and ratings of a significant other, could be due to the general items, which are more ambiguous and leave more room for different interpretations. Thus, generally worded items are more likely to produce discrepant ratings because of ambiguities in interpretation. In addition, general questions may be harder for persons with brain injury because of cognitive perceptual limitations [51]. Specific questioning may provide more cues that enable the individual to access the knowledge that they have.

Assessment in the area of self-efficacy provides some guidance for measures in self-awareness. Specific self-efficacy beliefs are measured in terms of judgements of capabilities. The questions usually ask the individual to rate the extent that they are certain or confident that they can perform a specific task. Thus, ratings are thought to reflect the individual's strength or conviction of their belief [3]. In contrast, awareness questionnaires ask the individual to rate the degree of assistance needed or the perceived magnitude of the problem. It has been suggested that conviction ratings can provide information on the depth of unawareness. In other words, it provides an index of the degree to which an erroneous belief is "fixed", even for those who verbally deny deficits during questioning [20].

In the measurement of self-efficacy, it has been found that global measures of self-efficacy have little predictive value. Global measures mask the multidimensionality of the concept of self-efficacy and are not reliable. Specific self-efficacy measurements are most predictive of performance in a given situation and most sensitive to change. Bandura [3] states that measures of self-efficacy "must be tailored to domains of functioning and represent gradations within those domains" (p. 42). He found that measures of self-efficacy across different task demands and domains surpassed global measures in explanatory and predictive power. These issues need to be investigated within the area of self-awareness.

Bandura [3] identified three levels of assessment for self-efficacy. The first level includes global ratings of self-efficacy where the activities or conditions under which they are performed are not specified. The second, or intermediate level, includes measures of self-efficacy beliefs within the same activity or domain. The third level involves specific measures of self-efficacy or beliefs that are related to a particular task or context. These three levels can be used as a guide in examining differences in awareness. Awareness measures could also be categorized into global, intermediate and specific measures.

Experimental methods used to evaluate paradigms of metacognition and metamemory could be used to estimate different aspects of awareness. For example, monitoring abilities can be measured using, Judgements of learning (JOL); Ease of learning (EOL); allocation of study or effort, and Feeling of Knowing (FOK). JOL ask individuals to estimate or judge their performance or knowledge about whether an item has been learned after a task. EOL asks individuals to make predictions about memory span or task performance prior to performing an actual task. Comparison of the predicted score with the actual recall score is thought to be an indicator of metamemory monitoring [37,49]. In allocation of study or effort paradigms, individuals are asked to estimate the amount of time or effort needed to study items to be recalled. In some experiments, the time allocated to a task is directly manipulated. For example, individuals are given easy items and hard items and the allocation of time chosen for study within each type of task or stimulus is pre-determined. In other experiments, the individual is asked to take as much time as they need to study a list of words so they can recall the items perfectly (knowledge of readiness recall). The amount of time that they choose to allocate to study is recorded [49]. FOK experiments require individuals to predict the likelihood of recognizing items that they have failed to recall [37,49].

Each of these methods could provide useful insights into self-awareness and monitoring skills in adults with brain injury and could be extended beyond the area of memory. There are only a few studies in the literature that have documented use of some of these methods with adults with brain injury [46]. In addition, one standardized assessment, the Contextual Memory Test [57] has incorporated memory prediction and estimation questions within a recall test. Normative data on prediction and estimation for adults within this task is provided. Although prediction methods are useful, it is not clear whether over-prediction is based on failure to recognize the full demands of the task or based on false beliefs regarding one's abilities. It has been suggested that asking a person with brain injury to predict a relative or caregivers score as well as their own could help differentiate whether the problem is in judging task demands or a deficit in self-awareness [59].

8. Conclusion

This paper proposed a comprehensive model of awareness, derived from the literature on metacognition, self-efficacy and neuropsychology. The distinction between self-knowledge and beliefs that one brings to a situation and that, which is activated within the context of a task, was discussed. The complex and multidimensional nature of awareness is reflected within the proposed model and suggests that assessment of awareness needs to be expanded in scope. Measures of awareness that characterize awareness by an overall score, which does not consider the multidimensionality of awareness, are too broad to be useful. Assessment of awareness needs to include systematic methods for examining perception of abilities within the context of a task or situation. With the exception of Hart and colleagues [26], there has been little to no attempt to measure awareness within the context of naturalistic action. The proposed model also implies, that assessment of awareness, include both global and specific estimation measures across different tasks and levels of difficulty. It was suggested that assessment methodologies, such as those used in the study of self-efficacy and metacognition, could be useful to the measurement of awareness. Assessment should aim at identifying the task conditions under which the individual shows the highest levels of emergent and anticipatory awareness. This type of information will provide a solid foundation for intervention.

The proposed model describes how response to feedback can be influenced by personality characteristics, task meaningfulness and culture. These influences need to be taken into consideration when planning treatment. Implications for intervention strategies were discussed with a focus on increasing the individual's sense of mastery and control while simultaneously facilitating error recognition within structured experiences. The use of treatment activities that are familiar, emotionally "neutral" and within a "just right challenge" level was suggested. Although many unanswered questions were raised, this model provides a conceptual framework of awareness that can be used to guide evaluation, treatment and subsequent research.

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