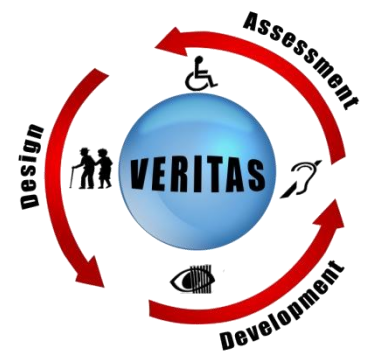




VERITAS project

FP7 247765



Behavioural and Psychological Abstract User Model



ITACA-TSB



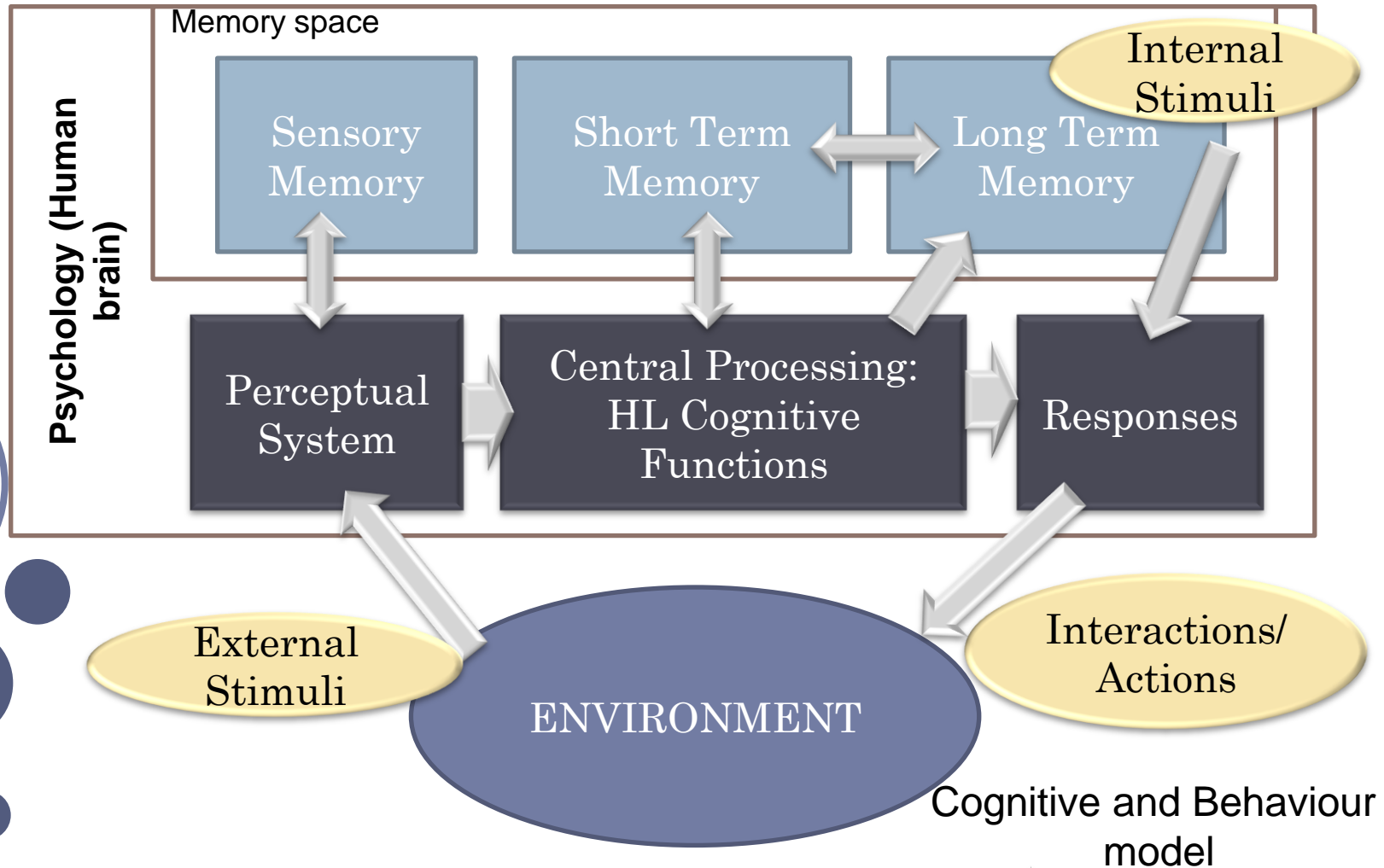
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HUMAN BEHAVIOUR AND PSYCHOLOGY THEORY



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B&P RELEVANT STATES DESCRIPTION: STRESS, FATIGUE, EMOTIONS AND MOTIVATION

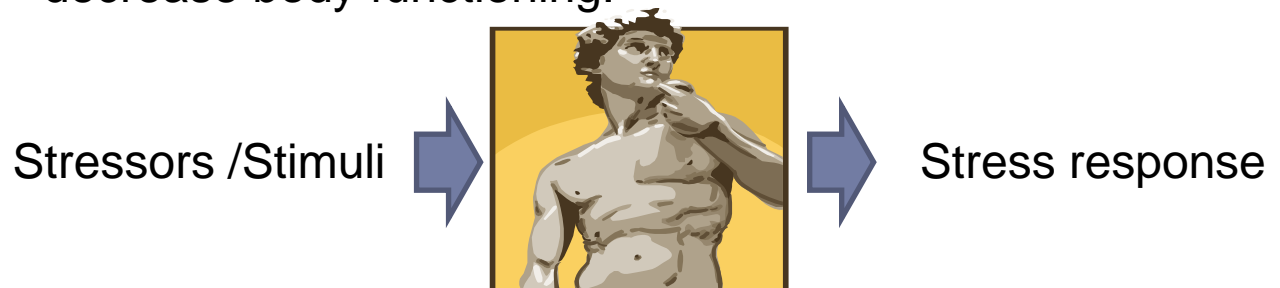
- Elderly and disabled people face multiple life and body changes that lead them to experience different psychological facets during their life. These psychological states can have great impact on the QoL of these groups.
- The most relevant P&B facets that influence elderly and disabled are:
 - Stress
 - Fatigue
 - Motivation
 - Emotional states



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STRESS

- **Stress** is the adaptive response of the body when facing various stressors. Is a body protection against physical & emotional pressure and danger.
- Occurs if there is imbalance between resources and strategies available to handle a situation and resources necessary to achieve the goals.
- Three types of stress taken into account: eustress, acute stress and chronic stress.
- A disability induces stress or increases the stress level of a disabled person in many real-life situations. Elderly users often suffer from chronic stress due to personal losses and decrease body functioning.



FATIGUE

- **Fatigue** is a state of awareness describing a range of afflictions resulting from over-exertion, usually associated with physical and/or mental weakness. *Physical fatigue* is the inability to continue functioning at the level of one's normal abilities. *Mental fatigue*, on the other hand, rather manifests in somnolence.
- The fatigue state can be recovered within a few days (*Acute Fatigue*) otherwise it could turn into Chronic Fatigue.
- Disabled and elderly users may get tired more rapidly. Quantifying the user's fatigue can be useful for maintaining safety and optimal usability when designing new products and services.



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MOTIVATION

- **Motivation** is the impetus that starts, guides and maintains behavior to reach a desired goal or objective.
- Performance at workplace or the success of therapy or rehabilitation is determined to a greater extent by the person's motivation.
- Among other groups, elderly and disabled are specially sensible to this.



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EMOTIONAL STATES



- **Emotions** are psycho-physiological phenomena that represent modes of adaptation to certain environmental stimuli or to oneself. In humans, emotions fundamentally involve "physiological arousal, expressive behaviours, and conscious experience".
- Emotions are located based on two basic dimensions: *Arousal* (elevated level versus low level) and *valence* (pleasant/positive versus unpleasant/negative).
- Emotional category are negative emotions: fear, sadness, aversion and positive emotions: Joy, surprise
- Elderly and disabled often experience negative emotions: sadness, fear to death, depression due to major life events.



STATE OF ART OF B&P MODELS REGARDING VERITAS USERS AND APPLICATION DOMAINS

Analysis of B&P descriptive and computational models:

- Considering five application domains
 - Automotive
 - Smart living spaces
 - Office workplace
 - Infotainment and games
 - Personal healthcare and wellbeing

- Considering the following VERITAS user groups:
- Blind & low vision impairments
 - Motor impairments
 - Cognitive impairments
 - Hearing impairments
 - Speech impairments
 - Elderly



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STATE OF ART OF B&P MODELS REGARDING VERITAS USERS AND APPLICATION DOMAINS

| Attribute | Sector | Blind & low vision impairments | Motor impairments | Cognitive impairments | Hearing impairments | Speech impairments | Elderly |
|-----------|------------|--|-------------------|-----------------------|---------------------|--------------------|---------|
| Stress | All | <p><i>Stress</i> is the emotional and physical strain caused by our response to pressure from the outside world. Common stress reactions include:</p> <ul style="list-style-type: none"> •tension, •irritability, •inability to concentrate, •a variety of physical symptoms that include headache and a fast heartbeat. <p>(http://www.ehealthmd.com/library/stress/STR_what_is.htm)</p> <p>In order to assess the multiple dimensions of <i>state response in stressful performance environments</i>, Matthews and his colleagues developed the <i>Dundee Stress State Questionnaire</i> (DSSQ; Matthews et al., 1999; Matthews et al., 2002; Helton et al, 2009). The DSSQ samples eleven state constructs within the domains of affect, motivation and cognition. The DSSQ consists of 29 items and is a multidimensional instrument designed to measure workload, mood and motivational cognitions as well as cognitions associated with stress, arousal and fatigue (Schell & Cox-Fuenzalida, 2005).</p> | | | | | |
| | Automotive | <p>Physiological parameters for detecting stress in drivers (Healey & Picard, 2005):</p> <ul style="list-style-type: none"> ECG (heart rate, heart rate variability) EMG (electromyogram) EDA (skin conductivity) respiration <p>Based on these physiological parameters listed, Healey and Picard (2005) proposed a <i>continuous stress metric</i>. A driver stress prediction approach based on ECG and EDA and Bayesian reasoning is proposed in (Rigas et al., 2008).</p> | | | | | |



PHYSIOLOGICAL, COGNITIVE AND BEHAVIOURAL HUMAN RESPONSES TO P&B STATES.

- Analysis of the physiological, cognitive and behavioural responses of each psychological state: stress, fatigue, emotions, motivation.
- For each state, study of the descriptive theories, categories of the P&B facet, physiological and psychological experiences, internal and environmental stimuli that trigger the physiological, cognitive and behavioural responses.



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PHYSIOLOGICAL, COGNITIVE AND BEHAVIOURAL HUMAN RESPONSES TO STRESS

| Psychological state Category | Short description | Type | Stressors-Stimuli | Response | | |
|------------------------------|--|--------------------------------------|---|---|---|---|
| | | | | Physiological Response | Cognitive Response | Behavioural/Emotional Response |
| Stress | The adaptive response of the body when facing various stressors. Is a body protection against physical & emotional pressure and danger | Eustress: Positive Short Term Stress | Experienced right before you have the need to exert physical force: big game, competition | <ul style="list-style-type: none"> • Adrenaline release. • Heart rate increases (Heart beats faster) • Small arteries contraction. (Thickens blood) • Pumping blood into muscles and organs. • Blood pressure increases • Interrupts functioning of digestive system. • Sweating • Muscle tension • Rapid breathing • Voice changes | <ul style="list-style-type: none"> • Alertness increases. • Senses heighten. (Perception) • Increase processing information. • Increases search of information. | <ul style="list-style-type: none"> • Favours selection of appropriate behaviour • Exciting mood. • Improves performance. • Pleasant anxiety |
| | | Long Term Stress | | <ul style="list-style-type: none"> • Decalcification of bones (calcareous deposits) • Negative action on immune system. | <ul style="list-style-type: none"> • Decreases concentration • Affects memory: declarative, spatial, etc • Post-traumatic stress decreases memory task-dependent on hippocampus • Deteriorates declarative verbal memory • Facilitates procedural memory learning (ie: fear) | <ul style="list-style-type: none"> • Anxiety, nervous • Depression (loneliness, frustration..) • Fear • Worried • Pacing • Increase of alcohol taking |



PHYSIOLOGICAL, COGNITIVE AND BEHAVIOURAL HUMAN RESPONSES TO FATIGUE

| Psychological state Category | Short description | Type | Stressors - Stimuli | Response | | |
|------------------------------|---|------------------|---|---|---|---|
| | | | | Physiological Response | Cognitive Response | Behavioural/Emotional Response |
| Fatigue | Body and mind exhaustion that occurs as a result of work or effort. It is characterized by the inability to perform physical tasks with the usual force and a reduced speed in the rational processes which may cause memory failure. | Physical fatigue | Sleep disturbance Lifestyle alterations (increased activity, nutritional deficiencies, increased need for energy). | <ul style="list-style-type: none"> Concentration of ATP in nerve cells decreases [10] The speed of processing signals from the chemoreceptors slows down [10] | <ul style="list-style-type: none"> Deterioration of sustained attention level Deterioration of complex information processing Slower Reaction time Deterioration of Procedural Memory | <ul style="list-style-type: none"> Labour force decreases Performance drops (longer response time, longer lapses) |



PHYSIOLOGICAL, COGNITIVE AND BEHAVIOURAL HUMAN RESPONSES TO STRESS

| Psychological state Category | Short description | Type | Stressors-Stimuli | Response | | |
|------------------------------|--|------|--|---|--|--|
| | | | | Physiological Response | Cognitive Response | Behavioural/Emotional Response |
| Emotion | psycho-physiological phenomena that represent modes of adaptation to certain environmental stimuli or to oneself. In humans, emotions fundamentally involve "physiological arousal, expressive behaviours, and conscious experience" | Fear | Anticipation of a threat or danger that causes anxiety, uncertainty or insecurity. | <ul style="list-style-type: none"> • Migraines • Stomach Pains • Trembling • High blood pressure • Temperature changes | <ul style="list-style-type: none"> • Raise of attention • Raise of perception <p>Because the visual system has limited capacity, emotions such as fear may play an important role in guiding the selection of relevant input (LeDoux, 2000; Öhman & Mineka, 2001). So, fear can guide the organism by influencing: (I) attention processes, (II) awareness of the visual input, and (III) affective processing independent of awareness.</p> | <ul style="list-style-type: none"> • Stress • Depression • Anxiety • Insomnia • Panic |



PHYSIOLOGICAL, COGNITIVE AND BEHAVIOURAL HUMAN RESPONSES TO MOTIVATION

| Psychological state Category | Short description | Type | Stressors-Stimuli | Response | | |
|------------------------------|--|--|-------------------|---|---|--------------------------------|
| | | | | Physiological Response | Cognitive Response | Behavioural/Emotional Response |
| Motivation | The impetus that starts, guides and maintains behavior to reach a desired goal or objective. | Intrinsic motivation (internal motivators) | | Sympathetic Nervous System: <ul style="list-style-type: none"> • Heart rate (HR) • Systolic Blood Pressure (SBP) • Diastolic Blood Pressure (DBP) • Cardiovascular Response (CVR) • Electrodermal activity (EDA) • Skin Conductance Response Rate (SRR) | <ul style="list-style-type: none"> • Expectancies and value attributed to behaviors. • Definition of which behaviors comply with functional purposes and which not. • Cognitive Dissonance • Self perception of self-efficacy | |
| | | Extrinsic motivation (external motivators) | | | | |



COGNITIVE ATTRIBUTES AFFECTED BY PSYCHOLOGICAL STATES: PARAMETERS, METRICS AND MEASUREMENTS METHODOLOGY

- Analysis of the effect of each psychological state on a cognitive attribute when performing cognitive tasks.
- Study of high number of clinical and psychological studies: few studies with disabled found.
- **For each cognitive attribute** and subcategories: memory (working memory, LT memory, attention types, perception, cognitive flexibility, etc) analysis of the stress, fatigue, emotions and motivation (when possible) **influence** (physiological and psychological): ie: how stress affects working memory when doing a specific task.
- The relevant parameters (times, performance rate, etc), metrics (quantitative/qualitative) and measurements methodology have been analysed.
- Specific information about a VERITAS user or domain is also included.



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COGNITIVE ATTRIBUTES AFFECTED BY STRESS: PARAMETERS, METRICS AND MEASUREMENTS METHODOLOGY

- Type of Stress: Acute Stress: Negative Short Term Stress: (Degree depending on arousal)
- Affected cognitive attribute: Working memory
 - Stress being induced by the Trier Social Stress Test (TSST): pronounced working memory deficit was associated with exposure to stress.
 - Lower performance in **arithmetic problem-solving, reading and reading comprehension. (TASKS)**
- Type of Stress: Acute Stress: Negative Short Term Stress: (Degree depending on arousal)
- Affected cognitive attribute: Long Term Memory (Episodic)
 - Episodic memory: If stressor (TSST test) is present, enhances memory for emotional information and impairs memory for neutral information. Stress allows retrieving emotional memories but impairs the neutral ones.
 - Episodic memory in **elderly**: stress exacerbates age-related decline on episodic memory. **(VERITAS users)**



P&B ABSTRACT USER MODEL

- P&B Abstract User Model merges the information from
 - State of the art: theoretical and computational models
 - Physiological, cognitive and behavioural human responses to P&B states.
 - Cognitive attributes affected by P&B states:
Parameters, metrics and measurements methodology



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| P&B STATE | Cognitive Response | | | | |
|---|-------------------------------|--|--|--|--|
| | Affected cognitive attributes | Existent Metrics (Qualitative or Quantitative) (Value, range values (specify if values change for a specific user), rules) | Computational (ACT-R) Rules/Metrics | | Other methodology to measure them |
| | | | Rules (specify if rules change for a specific user) Bibliography. | Metric (Found params, wanted params, ACT-R params) | |
| Acute Stress: Negative Short Term Stress: (Degree depending on arousal) | Working memory | Deterioration of hippocampal-dependent memory. Negative acute stress negatively affects performance in arithmetic problem-solving, reading and reading comprehension. | | | Stress being induced by the Trier Social Stress Test (TSST): pronounced working memory deficit was associated with exposure to stress. |
| | Attention | Decrease: Hancock (1986), Wickens et al. (1998) | Rule 1: Wickens- WM overlay. Rule 2: Another way to implement an overlay that decreases attention to the task is to create a secondary task. This secondary task simulates worry. The rules that create this secondary task might be seen as architectural productions. This overlay decreases performance rate on the serial subtraction task. | Performance rate decreases | |



CONCLUSIONS

- Analysis of the P&B models difficult due to early stage in knowledge about how human mind is affected by internal and external stimuli.
- In most cases, limited evidence suggests the influence of P&B states on cognitive attributes , but the degree to which they might affect the processes **requires more extensive analysis.**
- Qualitative rather than quantitative analysis.
- Parameters analysed are based on times and accuracy (performancerate).
- Generalising is difficult: each state affects differently in each individual since it depends on uncountable life circumstances and traits.



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