Understanding Resilience by relating Stimuli Optimality to Schema Constructs

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ABSTRACT

We hereby define a novel, two-phase framework which describes the process of elaborating input stimuli of heterogeneous nature into cognitive schemas. For our first phase (PI), we formalize the concept of *stress as the deviation from the optimal stimuli level* of an individual, described as either understimulation or overstimulation. As second phase (PII), we consider retrieval and rating of autobiographical memories on an *importance-positivity scale*, which provides an estimation of the individual's self- and world-schema. The present paper also highlights the novel nonlinear transformation function between the mentioned first (PI) and second phase (PII), in terms of translating over- and under-stimulation to the self- and world-view over time. The described framework, in addition to proposing a novel classification of individuals based on their needs for stimuli, entails representation and potentially diagnosis of multiple psychopathological conditions we have analytically described herein.

INTRODUCTION

Stress is today considered to be one of the major causes of psychological problems, which often reflects on lower work performance and maladaptive behavior in the workplace. This effect is particularly present in high-risk settings and public-safety professions, such as in the army. Military jobs were ranked as the most stressful occupation in U.S. in 2013 (CareerCast, 2013). Combat deployment has led to development of mental disorders in almost 20% among UK soldiers (Fear et al., 2010), while studies on American soldiers showed that 35% of Iraq war veterans accessed mental health services in the year after returning home; out of that, 12% per year were diagnosed with a mental health problem, more than 50% were documented to receive follow-up care, but less than 10% of all service members who received mental health treatment were referred through the screening program (Hoge, Auchterlonie, & Milliken, 2006). Furthermore, stress leads also to severe psychological disorders, amongst which the most common are alcohol- and substance-related disorders, adjustment disorders, mood disorders, and personality disorders (Hoge et al., 2002). Finally, chronic stress can lead to more dramatic outcomes, by enhancing violent behavior and suicidal thoughts (Perrewe, Rosen & Halbesleben, 2013). Such high rates of reported mental health problems after deployments indicate the need for an assessment tool that would evaluate and monitor resilience and its underlying cognitive mechanisms, providing an accurate method for predicting the development of psychological disorders of soldiers.

RELATED WORK

Richardson et al. defined resilience as the adaptation of one's body, mind and spirit to some current life circumstances which are influencing one's "*biopsychospiritual* homeostasis" (Richardson, Neiger, Jensen & Kumpfer, 1990). The military began to embrace the concept of resilience in 2008 in an effort to decrease the number of suicides among soldiers, and since then it has been explored in relation with concepts such as adaptive coping, personal control, hardiness, and social support. Previous work indicates traumatic life events and combat deployments as the most common antecedents of resilience. Consequences of high resilience include decreased mental health symptoms and career success, while low resilience leads to increased mental health symptoms and participating in unnecessary high-risk behaviors (Simmons & Yoder, 2013).

Resilience has been often described as a multi-trait construct; CD-RISC scale of resiliency (Connor & Davidson, 2003) measures characteristics such as commitment, self-efficacy and tolerance of negative affect, while Schok's model of resilience includes self-esteem, sense of control and optimism (Schok, Kleber & Lensvelt-Mulders, 2010). Some authors viewed resilience as cognitive adaptation towards stressful experiences; it has been found that individuals, after experiencing stress trauma, perceive themselves as less worthy and the world as less benevolent (Janoff-Bulman, 1989); same tendencies in self- and work-view have been found in war veterans (Dekel, Solomon, Elklit & 2004). Other authors considered resilience as an emotional adaptation and proposed the tendency to enhance positive emotions during stress as a predictor of successful coping (Waugh & Koster, 2015). In these terms, adaptation of cognitive schemas during stressful periods can be viewed as a form of cognitive resilience to stress, which was found to be a predictor of coping capacities: resilient individuals showed more task focused coping, while non-resilient individuals were more emotion-focused (Campbell-Sills, Cohan & Stein, 2006); in studies on soldiers it has been found that those with cognitive appraisal of stress are also more resilient and less susceptible to post-traumatic disorders (Schaubroeck, Riolli, Peng, & Spain, 2011).

Despite the described findings, existing tools for assessing resilience concentrate on stable personality traits, rather than on cognitive schemas which can vary over time, which is the focus of this scope.

With regards to stress, this has been traditionally defined either as a *stimulus*, often referred to as a *stressor* which is experienced by a person, or as a *response* characterized by physiological arousal and its related negative affect, especially anxiety (Folkman, 2013). Before defining stress, it is important to understand sources of stress in military environments; studies exploring stress sources in police officers explored the role of workload and showed that high-load officers are stressed above all by work tasks, while low-load officers are stressed more by relationships. In such low-load officer the quality of relationships had influence on their self-esteem, but not on the self-esteem of high-load officers (Stotland & Pendleton, 1989).

Aforementioned findings (Stotland & Pendleton, 1989) imply that different sources of stimuli can have an impact on individual's self-evaluation, and that individuals who are highly stimulated at work can attribute less importance to other areas, while individuals who don't experience high pressure at work can focus more on non-work areas and on

stressors which come from them. This, however, depends on individual's optimal stimulation level (OSL) which can differ for various kinds of stimuli. Optimal stimulation theory (Hebb, 1955; Leuba, 1955) states that each individual has certain preferred level of arousal, which s/he will try to maintain at the optimum level (Raju, 1980). Other authors found that individuals differ also in preferred type of stimuli; Pearson divides them in categories, based on their sources (self-generated or coming from environment), and nature (cognitive or sensorial).

On the basis of these previous findings, we created a model of *resilience as the process of converting diverse stimulation levels to cognitive schemas*, rather than a set of stable traits, and describe *stress as a consequence of overstimulation and/or deprivation* by any type of needed stimuli.

MODEL

Figure 1: Implementation details of the model in terms of latent variables

In view of approaching resilience as the aforementioned transformation process, we hereby present the overall architecture as illustrated in Figure 1, which describes the transformation of different stimulation levels (namely phase I) into cognitive schemas about the self and the world (namely phase II), by means of a non-linear conversion function: We now describe these more in detail in the paragraphs below.

Phase I: Need for stimuli

In our model observations from the first phase determine the optimal level of stimulation of an individual and the type of stimuli he/she needs the most, in order to capture understimulation and overstimulation. We hereby refer to Pearson's categorization (Pearson, 1970). Furthermore since it has been shown that also social aspect plays role in memory recall (i.e. extraverted individuals were faster to recall pleasant experiences (Lishman, 1974) and recalled more pleasant memories than introverts (Mayo, 1983)), we divided each category into the *orientation towards the self* and *orientation towards other people*. If an individual doesn't receive an adequate level of stimulation (resulting in either overstimulation or understimulation) this entails a given amount of stress, which will consequently reflect on the cognitive schemas.

Phase II: Mental state; self-schema and world-schema

Stressful experiences generated by under- or over-stimulation are memorized and organized into schemas of the self and of the world, which represent the second phase of our model. Self-schema and world-schema function as containers of memories, which represent a semantic and episodic knowledge of an individual of him/herself and people around him/her. The theory underlying Brief Core Schema Scale (Fowler et al., 2006) has analogies to the concept of such phase, but instead of perceptions our model estimates autobiographical memories of an individual in terms of positivity and importance.

In this view, individuals who enhances positive memories and disregard negative ones will have less difficulties in integrating stressful experiences within his/her cognitive schemas, while individuals who focus on negative memories and disregard positive ones are more likely to experience difficulties in adapting to stressful experiences.

Mapping Phase I to Phase II: Conversion function

The two phases are connected with a conversion function which measures how needs for different types of stimuli from the first phase (PI) convert into memories about experiences of stimulations from different types of stimuli in the second phase (PII), and how those memories organize themselves into self-schema and world-schema. One major focus of the present model is the non-linear relationship between two phases, meaning that a given outcome can be the result of multiple configurations: for instance, multiple different values of PI and of the conversion function can entail the same PII value.

Just as the perceived level of stress changes over time, due to various changes in the environment and in the psychosocial maturation of an individual, also the cognitive adaptation to stress changes over time, by either decreasing or increasing: therefore the parametrization of the conversion function is time-conscious. This is achieved by design of the latent variables, and estimated via repeated observations which provide information about the capability of an individual to adapt such conversion capability over time. Such conversion function will be subject to further investigation. The present work is preliminary and part of a more comprehensive framework, for which we refer to other supporting literature (Kirk & Arbanasić, 2017; Kirk & Arbanasić, 2017).

Implementation

The present model finds its implementation in a specifically designed assessment tool, named the PERSONA test, which implements the two-phase architecture and which provides information about the resilience level of an individual and clinical implications in terms of development of psychopathologies. The present questionnaire offers a novel method of classification of the candidates, based on their needs for stimuli (Phase I) and estimation of their cognitive schemas (Phase II).

The first phase contains a set of 8 items which measures the needs for different stimuli. Stimuli are grouped into four categories, presented in a Table 1 below, whereas each category contains self and social aspects. The overall result estimates the optimal level of stimulation and preferences for each type of stimuli of an individual.

Dimension	Example
External cognitive - self oriented	Need for learning new information
External cognitive - oriented to others	Need for exchanging knowledge with others
External sensorial - self oriented	Need for physical activities
External sensorial - oriented to others	Need for affection from others
Internal cognitive - self oriented	Need for reflection about things, people and events
Internal cognitive - oriented to others	Need for exchanging opinion and ideas with others
Internal sensorial - self oriented	Need for experiencing emotions
Internal sensorial - oriented to others	Need for sharing emotions with others

Table 1: The classification and explanation of different types of stimuli

The second phase consists of two parts, the self-schema and the world-schema. Beliefs about the self and others are examined via items which estimate autobiographical memory retrieval on a continuum of *positivity-negativity* and *importance-unimportance*. Importance of memories are evaluated by set of 16 items which assess how often does the individual reflects about certain experiences. Positivity of memories are evaluated by a set of 16 items which assess how positive does a person feel when s/he thinks about certain experiences. The overall result estimates the prevalence of four different kinds of memories, which are presented in Table 2 below.

Non-important positive memories	Important positive memories
Non-important negative memories	Important negative memories

Table 2: The classification of memories related to self and to others

Diagnosis Possibilities

After having explained the PERSONA test operationalization, we now present the relationships between constructs and their possible implications for clinical diagnosis. We will hereby indicate different types of relationships between Phase I, conversion function, Phase II and expected outcome in terms of resiliency to stress. We then explain how different cognitive schemas are expected to be related to potential psychopathological traits.

Optimal Stimulation Level	Stimulation level	Conversion function	Cognitive schema	Stress-related outcomes as consequence of a given stimulation level, stress level, conversion capability and cognitive schema
arbitrary ¹	optimal ⁴	poor ⁸	positive ¹¹	Absence of stress-related psychopathologies; low level of stress ¹³
arbitrary	inadequate ⁵	good ⁹	positive	Overcoming stress; resilience ¹⁴
arbitrary	inadequate	poor	negative ¹²	Succumbing to stress; Vulnerability ¹⁵
arbitrary	inadequate	good	negative	Succumbing to extreme stress; burnout ¹⁶
high ²	understimulation ⁶	arbitrary ¹⁰	negative	State of deprivation ¹⁷
low ³	overstimulation ⁷	arbitrary	negative	State of burnout ¹⁸

Table 3: Examples of stress-related outcomes, given estimates of the test constructs, i.e. need for stimuli, stimulation level, conversion function and cognitive schemas

¹Arbitrary optimal level for stimulation stands for either distinctively high or distinctively low overall need for stimuli.

²High optimal level of stimulation stands for distinctively high overall need for stimuli

³Low optimal level of stimulation stands for distinctively low overall need for stimuli

⁴Optimal stimulation condition indicates that the individual is neither understimulated nor overstimulated

⁵Inadequate stimulation condition indicates that the individual is exposed to either excessive or insufficient level of stimuli, according to his/her optimal level of stimulation

⁶Understimulation condition indicates that the individual receives an insufficient amount of stimuli regarding his/her optimal level of stimulation, resulting in a feeling of deprivation

⁷Overstimulation condition indicates that the individual receives an excessive amount of stimuli regarding his/her optimal level of stimulation, resulting in an overwhelming feeling

⁸Poor conversion function indicates scarce capacity of a person to disregard negative experiences of understimulation or overstimulation and to promote positive experiences, transforming them in negative perceptions of self and others

⁹Good conversion function indicates a high capacity of an individual to disregard negative experiences of understimulation or overstimulation and to promote positive experiences, transforming them in positive perceptions of self and others

¹⁰Arbitrary conversion function indicates that the capacity of an individual to disregard negative experiences and to promote positive ones can be either poor or good

¹¹Positive cognitive schemas refer to positive self-beliefs and positive beliefs about others

¹²Negative negative schemas refer to negative self-beliefs and negative beliefs about others

¹³Absence of stress-related psychopathologies in case of absence of stressor

¹⁴Resilience to stress; capability to transform inadequate stimulation inputs into positive cognitive schemas

¹⁵Vulnerability to stress; lack of capability to transform inadequate stimulation inputs into positive cognitive schemas

¹⁶Burnout; incapacity to transform extremely inadequate stimulation input into positive cognitive schemas despite the good conversion function

¹⁷State of deprivation as a result of having high need for stimulation and receiving insufficient amount of stimuli

¹⁸State of burnout as a result of having low need for stimulation and receiving excessive amount of stimuli

Examples of extreme psychological profiles in Table 3 show the non-linearity of the relationship between the need for stimuli (PI) and mental state (PII), which is mediated by a stress level (either understimulation or overstimulation) and the capability of maintaining high self-esteem and positive world view (i.e. the conversion function). As the table shows, when an individual is optimally stimulated, he/she should be in a positive mental state, regardless of the conversion function. In the cases of high stress, the capability of an individual to convert bad experiences into a positive mental state should indicate whether an individual is vulnerable or resilient to stress. Of course, in cases of extreme stress, not even a good conversion function can lead to positive mental state. With regards to need for stimuli, individuals with high needs for stimuli will more likely suffer from understimulation and deprivation, while individuals with low level of stimuli will more likely feel overstimulated, which in extreme cases could lead to burnout.

Self-schema	World-schema	Psychopathological manifestations
Positive ¹	Positive ³	Excessive optimism, lack of critical thinking, denial (in extreme cases) ⁵
Negative	Positive ⁴	Extreme dependent behaviour ⁶ , avoidance of social contact and activity ⁷
Positive ²	Negative	Exaggerated feelings of self-importance and grandiosity ⁸ , antagonism towards others and disinhibition of impulses (APD) ⁹
Negative	Negative	depressive mood, anhedonia, recurrent thoughts of death ¹⁰ , substance-related addiction ¹¹ , violent behavior, avoidance of social contact and activity

Table 4: Examples of combinations of extreme cognitive schema cases and possible psychopathological manifestation consequences

¹Positive self-view; high presence of self-related positive memories about stressful experiences which have a major impact on self-beliefs and low presence of self-related negative memories which have minor impact on self-beliefs

²Negative self-view; high presence of self-related negative memories about stressful experiences which have a major impact on self-beliefs and low presence of self-related positive memories which have minor impact on self-beliefs

³Positive world-view; high presence of positive memories related to others about stressful experiences which have major impact on self-beliefs and low presence of negative memories related to others which have minor impact on

self-beliefs

⁴Negative world-view; high presence of negative memories related to others about stressful experiences which have major impact on self-beliefs and low presence of positive memories related to others which have minor impact on self-beliefs

⁵Extreme positive self- and world-view can lead to neglect of negative aspects of the individual's context; in cases of extreme stress this can imply denial and hesitation of the individual to acknowledge and confront the stressor

⁶Main symptom of (DPD) which involves someone's dependent behaviour from others expressed with a "clingy insecurity" and in case of intense, rigid and pervasive dependency it can negatively affect social and personal functioning (Bornstein, 2010)

⁷Characteristic of Avoidant Personality Disorder (AvPD), along with low self-esteem, sensitivity to criticism or rejection, anhedonia, intimacy avoidance and anxiousness (American Psychiatric Association, 2013)

⁸Main symptomatology for Narcissistic personality disorder (NPD). The typical narcissistic patient experiences an excessive need for admiration and a lack of understanding of others' feelings (Caligor et al., 2015)

⁹Typical characteristics of the Antisocial personality disorder (APD) which also includes egocentrism, self-direction, lack of empathy and incapacity to form mutually intimate relationships (American Psychiatric Association, 2013)

¹⁰Characterizing Major Depressive Disorder along with feelings of worthlessness, loss of energy every day, significant weight loss, insomnia or hypersomnia, psychomotor agitation or retardation (American Psychiatric Association, 2013)

¹¹Substance addiction refers to substance-related disorders and includes symptoms such as craving for psychoactive substances, increased tolerance to the effects of substances, withdrawal symptoms in case of attempt to decrease or stop the use of substances, etc. (American Psychiatric Association, 2013)

While Table 3 provides a better understanding of the relationships between the two phases, Table 4 offers examples of possible clinical implications from the outcomes of the second phase, which can be useful in prevention, diagnosis and treatment of various psychological disorders. Again, extreme cases are here described for explanatory purposes, by showing possible combinations of two cognitive schemas. For instance, the hypothetically optimal condition of an individual would be high self-esteem and a positive world view, although in cases of extreme optimism this can lead to denial. Conversely if the self-schema is extremely low and the world-schema extremely low, this could imply narcissistic and grandiosity disorders, which in worst cases can manifest in sociopathic behavior. On the other hand high world-schema, but low self-schema can lead to extreme dependence on other people. Among all these exemplifications, it is important to highlight the central role of the conversion function, which shows the actual level of resilience of an individual, by measuring his/her capability to maintain positive cognitive schemas even during very stressful periods and to improve that capability over time.

EVALUATION

The novel model of resilience presented in this work has been developed with the objective of understanding better how individual stimulation levels relate to cognitive schemas about oneself and about the world. In order to demonstrate the effectiveness of PERSONA to differ resilient from non-resilient individuals, scientific validation will be conducted on three different populations. The *general population* sample will be tested in order to collect general norms of measured variables from individuals in low-risk professions. The *clinical population* sample includes patients from the psychiatric wards of Italian hospitals and serves to collect norms from individuals with diagnosis of certain psychological disorders, who show maladaptive patterns of feelings, thoughts and behaviors. Results from this validation should prove that the PERSONA test can detect mentioned maladaptive patterns in individuals in work settings. The *high-risk population*

sample conversely will include individuals employed in high-risk professions, who experience short and/or long periods of intense stress. Norms gathered during clinical validation will be used in order to detect non-resilient individuals on the high-risk sample, in order to prove the *criterion validity*.

Samples will be retested after three weeks, in order to provide information about test-retest reliability and again after three months, in order to provide information about change in time-conscious variables measured in the test (i.e. mental state and conversion function). Tested participants from the high-risk population will be retested during the following 12 months and their data regarding hospitalizations for stress-related sickness will be gathered, in order to relate the change in resilience over time with work-related events and the severity of experienced psychological symptoms.

CONCLUSIONS

Employing individuals who are resilient to a variety of stress sources is fundamental to minimize risk of operations, above all in military and safety contexts. Towards this, we developed a framework to estimate resilience as the extent to which a person can recall subjectively important memories in a positive way while being affected as little as possible by under and over stimulation. The framework is also time-conscious, enabling the detection of resilience change over time. The presented preliminary work also provided insights regarding what is the clinical diagnosis capability of the framework, which will be subject of future work.

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