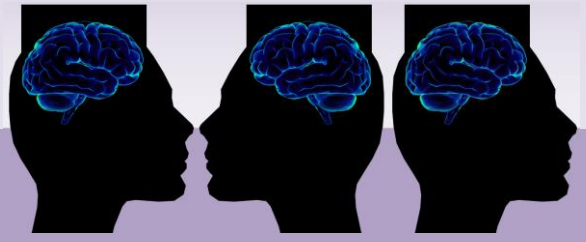
Understanding Stress at Work

Stress types
Examples of stress factors and consecutive effects
Areas of work for stress management



Philippe Fauquet-Alekhine (ed.)

Preface: Prof. Allan V. Kalueff & Prof. Viktor M. Klimenko

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Preface

Stress deeply affects our life. As the International Stress and Behavior Society (ISBS), we are particularly interested in how stress interacts with the brain, and how this interaction shapes human and animal complex behaviors.

The present book, written by an impressive group of international scholars, offers yet another unique angle - the focus on workplace stress. Is this problem important? By all means, yes - simply because we spend more and more time at work, gradually becoming the Planet of Workaholics.

From this point of view, the book offers an updated and well-balanced summary of stress at work, from its neurobiology to clinical psychology and mental health problems. What is also important to understand is the chronic nature of workplace stress in general. This becomes critical, as we now recognize the chronic nature of major stress-related human psychopathologies - anxiety, depression and even psychoses.

As a subset of chronic stress, workplace stress becomes important. Therefore, we can also appreciate the broad spectrum of topics discussed by the authors - beginning with the general overview of stress biology, and including biologically and societally key topic of Stress x Drug interaction. The multi-disciplinary approach taken by the Editor and the book authors logically covers clinical and basic (pre-clinical) topics, such as stress management and geriatrics.

What Ivan Pavlov called neuroses, and Hans Selye later conceptualized as Stress-Distress theory, now enters our today's life, including the workplace. Overall, our ISBS Society welcomes this "biology-meets-psychology" cross-disciplinary effort aiming to reduce, manage and cope with stress at work. The readers will surely enjoy learning more about stress psychobiology from this interesting book.

Prof. Allan V Kalueff, PhD
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Foreword of the Editor

In May 2017, during the 24th Conference on “Stress & Behavior” in St-Petersburg (Russia) organized by my dear and esteemed colleague, Professor Allan Kalueff, I had the honor of chairing a symposium addressing “work stress”.

This allowed some of the participants to initiate exchanges on the subject and also to make some researchers aware of the importance of their research for the promotion of occupational health beyond the characterization of stress. So we found it interesting to capitalize these exchanges in a collection easily accessible online for a better diffusion.

I hope this collective work will contribute to help the scientific community regarding occupational stress: one may find here research questions of interest to be deepened, but also relevant models and practical solutions. Here are ten contributions from twenty authors in four different countries (France, Russia, United Kingdom and USA) categorized in four domains: stress types, stress factors, stress consequences and stress management. Despite the articles are categorized, some of them address several categories.

These articles are written to be used: feel free to circulate the content of this book.

Finally I would like to warmly thank the contributing authors, the reviewer committee, and my dear colleague Allan Kalueff who now knows the importance of his contribution to the success of such a project.

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Executive summary

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Stress Types

Evolution of the Concept of Stress

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Hans Selye (1907-1982) has developed his concept of general adaptation syndrome (GAS) in 1936 as a universal biological mechanism of adaptation to different types of noxious agents like traumatic injuries, pain, infection and inflammation, heat or cold. He focused on the endocrinological processes that take place in the organism confronted by a variety of adverse influences and outlined three stages of the adaptation reaction – initial (alarm) reaction, stage of growing resistance and stage of exhaustion. From his point of view these stages to a certain extend resemble the whole life course of the individual – from restless and a little anxious childhood to more stable and steady adulthood, and then to the older age with inevitable lowering of vitality, tiredness and more frequent diseases (Selye, 1937).

The essence of his theory was a non-specific character of GAS, which was confirmed by observations of the uniformity of pathological changes in the animal organism (adrenal glands hypertrophy, thymus and other lymphoid tissues atrophy and intestinal mucosa ulceration) under different adverse influences (Selye, 1937). On the other hand, when trying to extend the theory to humans, he already distinguished between "good and bad stress" – eustress and distress, thus starting a process of diversification of the concept, which initially was so uniformly and logically described (Selye, 1974). Besides, some authors in opposition to the idea of absolute non-specificity of the stress-reaction started to point on differential pituitary-adrenal cortical responses in animals and humans, especially when such factors as pain and psychological stimuli were involved (Mason, 1971). They have argued that, in physiologist's and biochemist's experiments, these factors often seemed to be negligible in the shadow of such drastic physical variables as trauma, heat, cold, fasting, etc. Analysis of Selye's views shows that his theory overlooked or diminished the role of the nature and severity of the stressor, the importance of its perception, as well as extremely important role of higher cognitive functions and individual variability of the psychological processes involved in stress-reactivity (Sukiasyan et al., 2003).

Further studies of the nature of stress have been mostly influenced by two revolutionizing scientific developments (Sapolsky, 2015). The first was associated with understanding that brain, specifically its hypothalamic part, acts as an endocrine gland, secreting releasing and inhibiting hormones into the hypothalamic-pituitary portal system. When corticotropin-releasing hormone (CRH) was isolated, the hypothalamic-pituitary-adrenal (HPA) axis was fully delineated as a functional and structural system. The second breakthrough was due to the active involvement of psychologists in the stress studies, which promoted such concept as psychological stress. Psychologists have been using different wording trying to conceptualize general understanding that higher cognitive functions, emotions, perceptions, and thoughts are important factors influencing the level of stress experienced by an individual – psychological, subjective, mental, psychic stress, etc. With this the link between different mental states and neuroendocrine mechanisms of stress was established and recognized.

Eventually, several structured models and concepts of stress from the psychological perspective have emerged, including those suggested by behaviorism, interactionism and cognitive studies. The most widely accepted model today is a transactional model of stress. This model, which was developed by Richard Lazarus, foresees that an individual's cognitive appraisal of a situation determines whether the situation is perceived as a stressor that consequently evokes a stress response (Lazarus & Folkman, 1984). More precisely, the "primary appraisal" of a situation as irrelevant, challenging, or threatening together with the "secondary appraisal" assessing the individual's perceived coping abilities, i.e., competences to control and manage the situation, result in the individual's interpretation of the situation as stressful or not. A situation is perceived as stressful if interpreted by the individual as challenging or threatening and at the same time exceeding the individual's perceived coping resources. In its turn, stress perception and induced stress responses can largely differ between individuals depending on a variety of modulating trait and state influences (Lazarus & Folkman, 1984).

This understanding of stress promoted conceptualization of the perceived stress - a "global and comprehensive stress construct that is based on the concept that individuals actively interact with their environment, appraising potentially

threatening or challenging events in the light of available coping resources" (Katsarou et al., 2013). Perceived stress arises when perceived requirements and demands to an individual exceed the behavioral and emotional resources of the personality. Stress-reaction actually emerges when the person realizes inability to cope with a problem, to overcome frustration or to avoid its negative consequences due to the lack of an opportunity to control any event, process or state. In a great majority of situations, stress is the result of intuitive and even unconscious feeling (rather than on cognitive processing) that coping is impossible. Emerging fear, anxiety and depressive thoughts may add to the existing level of internal feeling of danger becoming the basis of perceived stress, i.e. feeling and understanding of how much stress we are experiencing. Perceived stress is measured not by the accumulation of stressors (for instance, negative life events), but by summarizing uncontrollability and unpredictability of one's life, one's ability to deal with problems and difficulties. It is based on a general perception of the stressfulness of one' life and ability to cope, and in such form, it is represented in the most popular Perceived Stress Scale (Cohen et al., 1983).

The collateral result of psychological studies was the conceptualization of the stress reactivity – a variable associated with different levels of cognitive, emotional, behavioral, and physiological responses based on personality variables. Recently important data were obtained proving that stress reactivity is a genetically based trait, which is also dependent on the process of early development of the individual, early adverse effects (including in utero) (Brent & Silverstein, 2013). Early adversities also seem to be the main reason of stress-diathesis, i.e. pathologically enhanced reactivity to stressful stimuli (Brent & Silverstein, 2013).

Another dichotomy was associated with differences between acute and chronic stress and comparison between animal world and humans. For instance, R. Sapolsky indicates that the stress in animals is usually short-term event (though potentially deadly, such as an attack of a predator), but the overwhelming part of the life-time of animals is devoted to nutrition, reproduction, and relaxation (Sapolsky, 2015). What is most important is that animals after each stressful situation do not ruminate what would happen if they couldn't escape from a predator and they are never anxious in advance, expecting new misfortunes or being emotionally disturbed about future. The human being in this sense is an example of the opposite – the most part of our time we stay in tension, while periods of relaxation and rehabilitation are getting shorter and shorter. In a more recent historical perspective, since humanity has shifted towards modern types of labor that demands high mental activity, the possibility to escape from overwhelming thoughts and to relax have been reduced substantially. The majority of our negative emotional experiences are associated with reflections how to cope with the freight of duties and responsibilities. Modern humanity is disturbed by anticipated problems and regrets about unused opportunities or about wrong decisions. Of course, the intensity of these negative feelings and perceptions is the subject of great variability due to personality traits, values, abilities of self-regulation and individual predispositions.

Recognition of the contribution of psychological and personality variables and evaluation of the role of internal experiences was an important step in developing the modern concept of stress. The logical continuation of this process was acknowledging and evaluating the role of social factors. This led to a concept of psychosocial stress. This concept is sometimes referred to as work stress or occupational stress, though psychosocial stress is obviously a more general concept, embracing a variety of social determinants. From this point of view such entities as marital stress, academic stress, job stress, as well as life stress, which also appear from time to time in scientific literature, are also looking rather like special cases of the psychosocial stress.

The fact that the concept of psychosocial stress was growing within the framework of occupational medicine is not surprising. Most types of modern stressors in large cities (it should be noted that urbanization is in progress and already more than 50% of people globally live in cities) are usually generated by living and working conditions. It is considered that work stress occurs when there is a combination of high demands (high output requirements and multiple responsibilities) with the inability to influence or control (low task variety and rigid system to control how the work is done) or when feeling of injustice is dominating based on the imbalance between effort spent and reward (Theorell & Karasek, 1996; Siegrist, 1996). In addition in modern society not only high intensity and growing inequality take place, but also a high variability of activity is observed. Fast changes in the markets, mobility of companies, changing tasks and new challenges demand constant adaptation, while the high level of competitiveness and constant tension together with enormous information flow impose additional requirements (Lundberg, 2006). More generally speaking, Western civilization based on liberalism – free access to information, freedom of entrepreneurship, high level of technologies, and especially following the socially approved behavioral models and consumption strategies – generate constant stress associated with competitiveness, inequalities, psychological tension, high pace of life, information overload, responsibility for decisions

made, instability and uncertainty. It gradually turns into a threat to the well-being of the individual. Prolonged psychosocial stress can give rise to a range of problems that are widespread in the modern humanity (often in comparatively young people), like poor performance, chronic fatigue, disinterest, memory and sleep disturbances, diffuse syndrome or cardiovascular diseases (Danielson et al., 2012).

This again returns us to the comparisons between stress in the animal world and in humans - our body is designed to confront sudden physical threats and to endure protracted physical activity; today, however, we are increasingly exposed to sudden psychological and mental stressors and are captured by chronic hypodynamia. The last is associated with the sedentary lifestyles inevitably imposed by office environment and restricted physical operations, which in association with hectic and mentally taxing work paradoxically lead to constant muscle strain leading to unspecific pain and consequents joints and bone problems (Danielson et al., 2012). In general civilized humanity faces natural biological and physical stressor less and less, while the pressure of psychological factors caused by the work strain, mental fatigue, information overload, hectic work style, interpersonal conflicts and mental stress are becoming increasingly common. It does not mean of course that we cannot experience typical types of stress, like running for our lives to escape a natural disaster or hostile attack. However, a majority of human population, which is currently moving towards 8 billion, experience stress as work overload, loss of control, economic problems, family problems, poverty, unemployment, conflict, and frustrations.

There is a consensus that this "human" stress in which the social component is crucial (work, unemployment, competitiveness, money, society, relations, etc.) is the most common type of stress of modernity. For a human being societies, communities, families, work, relations and higher level life goals like self-realization create the primary context of existence, therefore stress produced by failures, frustrations, break off relations and problems in life are largely dictated by these wide social factors. On the other hand, stress of modern life, being psychosocial by nature, is utilizing quite the same conservative biological mechanisms that are inherent to all mammals (Charmandari et al., 2005). This contradiction, in our opinion, is the main pathological factor of the modernity. It was addressed in many studies, and the most recent development in this field is the conceptualization of the phenomenon of allostasis, which supplements classical understanding of homeostasis, which was in the basement of the initial concept of Hans Selye.

The concept of allostasis appeared to be very relevant for understanding health-damaging effect particularly in case of chronic psychosocial stress when social environment is the main source of stressful experiences (McEwen, 2012). There are many signs that long-term effects of unavoidable and repeated stress lead to “wear and tear” of the biological systems of the organism followed by physiological, emotional, cognitive and behavioral consequences. This “wear and tear” is the results of complex interactions between different parts of the regulatory neuroendocrine system of the body. The essence of a pathological development is that each new steady operating state induced by stressful challenges and demands leads to higher tension in the counterbalancing systems of the organism. As a result in progression of chronic psychosocial stress, balance between systems is achieved on a substantially higher level of their activity. An analogy to this is a see-saw, which is balanced by two heavy weights as compared with the same see-saw balanced with much lower weights. In both cases, the balance is reached, but the energy developed by the weights as well as the strain applied to the fixed support, are very different from one case to another. The strain in the body due to constant ups and downs and huge efforts of regulatory systems to keep the balance is defined by the author of the concept as “allostatic load” (McEwen, 2012). The most serious negative results may follow if one of the counterbalancing systems is compromised or suddenly break.

When speaking about allostatic load, a typical busy workweek is taken. Cyclic type of occupational stress with high demand, low control, and constant pressure is a known risk factor for coronary heart problems and cerebrovascular diseases, associated with atherosclerosis (Kamarck et al., 2004). Actually, working week load is thought to be quite well balanced by week-ends, and it is supported by all human practice. But in fact the problem is deeper; it seems to be imprinted in the biological mechanisms that are confronted by the new type of stress that is inherent to modern life. When one heavy weight is removed from the sew-saw (relief and lowering of stress exposure) organism needs time to adjust for new balance, and in such situations different problems with seemingly unconnected systems may evolve. For instance, it is well known that after a period of serious strain long-awaited resolving of the situation and obvious relief are often followed by an unexpected health problem, like infectious disease or depression. Really, colds and other infections in modern life often manifest themselves on week-ends or on vacations after a prolonged period of intense demand, while depression can become most evident shortly after the holiday, etc. (Kamarck et al., 2004).

These models of stress, especially psychosocial and perceived stress to a great extent explain how "social factors get under the skin". Within this context, the ability to cope with psychosocial stress, in fact, means the ability to restrict biological responses of the body. This ability is not only the result of previous experiences, memories, and strategies one have used to solve problems and to overcome obstacles and problem situations, but also a more a conscious strategy protecting one's physical and mental health, based on the psychology and attitudes to healthy lifestyles. Cortisol peaks are not only stimulated by outcomes of cognitive and emotional transactions, but also contribute both to emotional and cognitive features that may result in stress-vulnerability and stress-resilience based on coping strategies (McVikar et al., 2013). On the other hand as recent studies have proved, stress-vulnerability and stress-resilience are dependent on previous experience and are largely determined by early life conditions, up to puberty and even later (Sapolsky, 2015; King, 2016). This "biological embedding" of the reactivity to stress is largely dependent on epigenetic events which take place during development as a result of stressful experiences, starting from in utero (Herbison et al., 2015). Epigenetic events (molecular modifications of DNA and chromatin, as well as some regulatory RNAs dynamics), which are induced by stress hormones, have been recently identified as a potent mechanism of programming long-lasting changes of the biological systems of stress-reactivity, thus designing them for living in low-stress or high-stress conditions (King, 2016; Herbison et al., 2015; Rozanov, 2017).

Subjective stress as a personal feeling of the pressure of surrounding psychosocial triggers can be differentially perceived by representatives of different cultures, can be influenced by mentality, local traditions and attitudes to diseases and life in general. In a recent study, biological responses to stress were measured in representatives of three big cities – New York, Moscow and Taiwan with regards to sex differences (Glei et al., 2013). Several markers including standard cardiovascular/metabolic risk factors as well as markers of inflammation and neuroendocrine activity were measured. Subjective psychological stress was measured by the perceived stress scale (Cohen et al., 1983). Only Moscow sample demonstrated positive association with overall dysregulation for both sexes. In the US, there was an association for women but not for men. Among the Taiwanese who reported the lowest perceived stress, there was no association for women but an unexpected inverse relationship for men. The association with perceived stress was most consistent for standard cardiovascular/metabolic factors, a little less with inflammation and neuroendocrine activity for some samples. Although the evidence that perceived stress is the primary source of physiological dysregulation is generally modest, it was stronger in Russia where the level of perceived stress was particularly high (Glei et al., 2013). Thus, ethno-cultural component plays an important role possibly moderating biological responses to psychosocial stress. It is also interesting to mention that talking about stress is rather common nowadays; the word "stress" becomes a part of a common discourse, which is also dependent on the cultural context. Talking about stress, claiming high level of stress or complaining about stressful life both help to explain one's own state and, possibly, help to cope with it due to the evoked social support (Pietilä & Rytkönen, 2008). On the other hand, in some cases, it may lead to enhancement of internal feeling of stress if social support is scarce.

This short essay gives an impression how the concept of stress has been the subject of evolution – from general adaptation syndrome considering mostly endocrinological regulation in animals to psychological perceived stress concept, based on deep internal feelings, emotions and cognitions interaction, so characteristic for a human being. On the other hand the initial idea of Selye which was putting forward the uniformity of stress as an internal reaction is still valid and widely recognized. Each type of stress, including one tightly associated with social and personality factors, utilizes the same neuroendocrinological mechanisms of the human body, known today almost in details due to animal studies. Moreover, the concept of stress seems to become a part of a cultural context and is influenced by mentality, attitudes and values. It is quite possible that the concept will be developed further and will be filled with new content.

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Stress Types

The Pathological Cycle of Stress: Insights of Psychological, Biological and Genetic Aspects

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Abstract

Stress is a psycho-physiological process that should be considered from these two perspectives: the psychological aspect of stress has been shown to have an impact on the physiology of the body that might lead to increase sensitivity to stress in the individual; the physiological aspect of stress may increase or diminish the individual sensitiveness to stress and thus impacts the psychological aspect. Due to the context and to the psychological or physiological state of the individual, they may combine and result in a sort of pathological cycle of stress from which it may become difficult to escape. In addition, both aspects may be favored by genetic and epigenetic characteristics. An insight is given here suggesting how one may fall into such a cycle. It warns about the erroneous belief that indirect general approaches to stress permit to avoid considering individual cases. As the work environment may be considered as a multi-stressor context, scientific contributions to improve understanding of occupational stress are obviously welcome to help workers to avoid getting into this pathological cycle.

1-Introduction

"Stress" was first defined as "the non-specific response of the body to any demand for change" (Selye, 1936) and later as "a state manifested by a specific syndrome which consists of all the non specifically induced changes within the biological system" (Selye, 1976: 64). Selye introduced the general adaptation syndrome (GAS) to depict the stress process including threat and the subjects' reactions to it. However, this was to approach stress without taking into account certain psychological aspects such as cognition and perception. This was taken into account later (see for example French, 1973; French et al., 1982) within a dynamic approach (Lazarus and Folkman, 1984; Folkman et al., 1986) suggesting that stress occurs when subjects perceive that external demands exceed their capacity of response, thus endangering their well-being; this gave rise to the transactional model (see Rozanov, 2017: 17).

Bearing in mind what is summarized here, exposure to stress is clearly "inevitable, and it may occur, to varying degrees, at different phases throughout the lifespan" (Maniam & Morris, 2012): any external demand triggers a state of stress to a greater or lesser degree and the state of stress might not even be perceived by the subject when its degree is very low. To illustrate this, a simple experiment may be carried out; it must first be acknowledged that an increase in heart rate is an indicator of increased stress. This has been demonstrated in many experiments (see for example: Kudielka et al., 2004; Spierer et al., 2009; Petrowski et al., 2010; Cinaz et al., 2010; Fauquet-Alekhine et al., 2016). Anyone may lie down and relax on the sofa at home, in a quiet environment. Should their heart rate be recorded at this moment, it should be relatively low. Then someone enters the room, calmly and asks a neutral question with a quiet voice such as "how are you?". The person lying on the sofa does not move, does not answer, just hears the question. A priori there is nothing to stress the person lying on the sofa. However, this experiment was undertaken ten times with a subject (healthy male, 47 years old): the heart rate after ten minutes rest was 55bpm and it rose up to 65bpm as soon as the question was heard, before any answer or movement. The person did not report any perceived stress after experiencing the situation, but the heart rate variation illustrated that this quiet demand generated a physiological answer associated with the stress response to an external demand. Similar results were obtained with subjects reading and answering a questionnaire (Fauquet-Alekhine et al., 2012: Fig. 1). This experiment illustrates that any external demand may generate a state of stress which is not necessarily perceived as such by the subject, and that any external demand is a kind of stressor. This is why, when using a polygraph (popularly referred to as a "lie detector") which is in fact a stress detector, analysts calibrate the device by measuring the normal reactions of the subject under examination with innocuous questions: they measure several physiological variables in real time such as blood pressure, heart rate, respiration, pupil size and skin conductivity. However; heart rate may rise differently depending on the stressor and the consecutive stress may take different forms.

2- Stress types

The four main types of mental stress recognized to date are acute stress, episodic acute stress, chronic stress and traumatic stress. They were described in detail by Taylor (1995). Each of them gave rise to numerous and specific studies.

Acute stress, also referred to as "short-term stress" or "microstress", relates to a short event (several milliseconds to a few hours) and that event, most of the time, is identified as the source of stress by the subject (i.e. the stress is perceived as such). It could be taking an exam, having a minor accident, being scared when facing a dangerous animal for example. The stress disappears with the event.

Episodic acute stress is associated with multiple stressful events or situations occurring repeatedly, though subjects might not necessarily be aware of it, thus creating periodic episodes of acute stress.

Chronic stress relates to long-term stress. It is usually due to sustained and continuous pressure over a long period (several months or years).

Traumatic stress is a particular type in that it may be considered as a combination of an acute stress of very high intensity (e.g. sexual assault, violent accident, earthquake) prolonged by long-term stress resulting from the traumatic situation experienced sometimes involving post traumatic stress disorders.

As we can see, the frequency and the duration of stress may help to define its type, but its intensity in terms of effects produced on the subject must be taken into account too: usually, episodic/acute stress is more intensive than chronic stress.

Another way to categorize stress can be according to its source or environment: for instance, pregnancy may induce specific stress for the mother (see for example Cole-Lewis et al., 2014) or for the fetus (Abbott et al., 2018); work environment induces stress, which has been referred to as occupational stress for many years (see Frideman et al., 1958), as work environment may provide stressful contexts. It includes the four aforementioned types of stress. We shall not list all the possible categories of stress here.

3- Occupational stress

In the introduction of his article, Milbourn (2012) reviewed different proposals to define occupational stress, also said job stress: "Sager (1991) defined job stress as a psychological state perceived by individuals when faced with demands, constraints, and opportunities that have important but uncertain outcomes. Chen & Silverthorne (2008) concludes that job stress is an individual reaction, and differs from general stress as it is also organizational-and-job related. Wu and Shih (2010, 74), state that job stress is associated with adverse consequences for both the individual and the firm 'since it has the effect of lowering motivation levels and performance, and increases turnover intentions'. Likewise, Conway et al. (2008) concluded that job stress is one of the most important issues in health care because it has a negative effect on the safety and health of personnel." However, Legeron (2008: 811) noted that stress response must not be understood as pathological but as an indispensable process of adaptation (both biological and psychological) for subjects to their environment when facing higher levels of strains. In some cases of acute stress with low intensity, stress may even be beneficial (see for example Yerkes & Dodson, 1908; Staal, 2004; Fauquet-Alekhine et al., 2014).

Beyond the health issue, another way to objectify that occupational stress is an actual issue is its financial dimension: in West Europe, the cost of work-related depression was estimated to be 617 billion€ per year (Hassard et al., 2014: 7).

All these elements explain why so many studies address occupational stress and why psychosocial risks (PSR) are now taken into account as professional risks. For some countries, analyzing and preventing PSR at work has become mandatory.

4- Biology of mental stress

All types of mental stress are concerned by psychological and physiological changes (McLean, 1974; Beehr & Newman, 1978; Karasek & Theorell, 1990; Palmer et al., 2003). We propose here a short recall of the biological process associated with mental stress, not in details but in the main lines (details in Kemeny, 2003).

When an individual is submitted to psychological pressure, the autonomic nervous system (ANS) is called upon, involving mainly:

- the sympathetic nervous system,
- the parasympathetic nervous system.

The sympathetic nervous system is made up of two axis:

- the adrenergic axis,
- the corticotropic or HPA axis.

The first one has short term effects, mainly concerning a rise in blood glucose, heart and ventilation rate, i.e. involuntary processes driving the "fight or flight" response, by releasing norepinephrine and epinephrine (or adrenaline). The short-term stress or acute stress is thus mainly concerned by the sympathetic nervous system and its effects (see for example Kemeny, 2003; Davezies, 2008; Montano et al., 2009; Keitel et al., 2011).

The second one has a long term effect (at least tens of minutes to several hours), mainly related to the

production of corticotropes and cortisol into blood, saliva and urine, having a moderating effect as opposed to adrenaline. This relates to return processes maintaining homeostasis. This increase of hormone cortisol comes from the hypothalamic-pituitary-adrenal axis activation (HPA axis): the hypothalamus releases corticotropin-releasing hormone (CRH) that stimulates the pituitary gland producing thus adrenocorticotropic hormone stimulating adrenal gland through blood circulation resulting in cortisol release (see for example Dickerson & Kemeny, 2004).

This description depicts very briefly the biological response of the ANS to stressors and how it comes back to a non-stressed state. It is thus an adaptative and transient process.

The problem arises when the exposure to stressors is repeated at a high frequency or when the stressor has a high intensity (case of traumatic stress type). One of the problematic factors comes from cortisol that inhibits the production of certain chemical mediators called cytokines involved in the regulation of immune cells. This reduces some immune functions but, at the same time, this may result in an increased circulating level of cytokines promoting inflammations (Miller et al., 2002). This impact on the immune system is not without consequences on the brain (sensitive to chemical imbalance) and subsequently on the psychological state, sometimes in a lasting way.

At the same time, it may influence diet: experiments proved that HPA axis reactivity to pharmacological stimulation predicts subsequent food intake with a major role of cortisol that stimulate food consumption (George et al., 2010). However, stress impact on food intake is bidirectional: it may lead to either increase or decrease food intake (see for example Maniam & Morris, 2012; Razzoli & Bartolomucci, 2016).

5- Genetics and stress

Despite the statistical evidence for the heritability character of the stress response, the number of significant relationships between genetics and stress is small. Ising & Hoelsboer (2006) summarized findings in Table I, p.436 of their article. Significant associations for stress responses were found with: Glucocorticoid receptor (GR) gene, γ-aminobutyric acid (GABA) A 6 receptor subunit gene, micro-opioid receptor 1 (MOR) gene (see also Merikangas & Pine, 2002). More recently, Cousijn et al. (2010) showed that the sensitivity to acute stress was determined by α2b-adrenoreceptor (ADRA2B) gene, and Judge et al. (2012), after Caspi et al.'s work (2003), showed that "the mediated relationships via job satisfaction and work stress are explained by genetic factors", hypothesizing that the serotonin receptor (5-HTTLPR) gene is involved in stress response but not yet clearly confirmed according to some others (Ancelin & Ryan, 2017). In fact, "abnormal properties of the personality, behavioral disorders, and mental pathologies, such as depression, pathological anxiety, disorders of adaptation, antisocial manifestations, aggression, risky behavior, propensity to suicide, propensity to addictions, and many others result, to a considerable extent, from gene-determined influences" (Rozanov, 2012: 332).

In addition or regardless these predispositions, epigenetic phenomena may occur, resulting from stress exposure and then contributing to favor stress sensitivity. "Epigenetic" was coined by Waddington (1942) "to describe the class of internal and external interactions between the environment and the genes leading to the development of phenotype" (Tronick & Hunter, 2016). "The phenotype in a psychological/ psychiatric meaning is the result of development of a genetic program preset as a unique combination of the parents' genes, but under the influence of the environment in a broad sense of the term, namely, conditions of prenatal development, a stage of early maturation, upbringing, various positive and negative physical, chemical, and social effects and influences acting within different life periods" (Rozanov, 2012: 333). In other words, phenotype may be produced by hormones released under stress that induced "molecular modifications of DNA and chromatin, as well as some regulatory RNAs dynamics" (Rozanov, 2017: 20). The related mechanisms are DNA methylation, histone modifications and microRNA activity (Stankiewicz et al., 2013). This has an influence on gene expression and may be transmitted through cellular division but does not alter gene sequences. This means that, to some extent, exposure to stress may generate epigenetic processes that result in changes of gene expression. That may appear in "early stages of development" and may "form stable morphological, physiological, biochemical, and […] behavioral patterns. […] These changes force the genes to work in a new modified mode, to become 'silent' for a long time or to be activated" (Rozanov, 2012: 334), thus shaping stress-vulnerability and/or stress-resilience (Rozanov, 2017: 20). Maniam & Morris (2012) discussed how changes in gene expression of neuropeptides regulating stress through epigenetic modifications can occur after long-term stress. Rozanov (2012, 2017) illustrated and discussed the way daily life in "modern society" provides conditions for epigenetic events and the link with stress.

6- Conclusion

Exposure to stress (whatever its type) may lead to sustained chemical imbalance that will favor sensitivity to stress and to some pathologies. The later may also make the subject more sensitive to stress. This means that a dangerous pathological cycle may be engaged: an exposure to stress that

leads to chemical imbalance favors pathologies increasing sensitivity to stress that leads to higher chemical imbalance creating new pathologies increasing again sensitivity to stress and so on. Another possibility that might trigger this sort of cycle might come from genetics: some genes expression creates chemical imbalance favoring pathologies increasing sensitivity to stress that leads to higher chemical imbalance creating new pathologies increasing again sensitivity to stress and so on. Epigenetic events may also contribute to start and maintain the cycle. All this advocates for the necessity to deal with stress very early and avoid the installation of a prolonged and pathogenic chemical imbalance, that is to help the individual to maintain the homeostasis necessary for optimal functioning for the organism. The world of work being the source of many stressors, all studies aiming at promoting health at work or at coping with stressors are welcome. This might contribute to avoid workers falling into the pathological cycle of stress.

However, nowadays, it is common for companies to spend energy promoting well-being at work through the promotion of sport, parenting support or the organization of debates on topics of social interest for example. Our observations in the field have shown that it contributes to spread the erroneous belief that such indirect global approach of stress might cope with stress issues; in fact it may lead the management to forget considering individual cases. Any stress cannot be treated in the same way, even when the symptomatology seems to be the same. This sort of approach nevertheless may help but cannot be fully efficient and produce lasting results.

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Stress factors

Leadership Styles: Employee Stress, Well-being, Productivity, Turnover and Absenteeism

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Abstract

The present review examines some of the most widely accepted leadership styles (Transactional leadership, Laissez-faire leadership, Autocratic / Dissonant / Authoritarian and Transformational leadership) and how and whether these impact on employee outcomes such as employee stress, well-being, productivity, turnover and absenteeism.

The review shows consistent advantages in terms of reduced stress, turnover, absenteeism and better well-being and productivity for leadership styles that are more relational such as transformational leadership. Poorer outcomes are demonstrated for laissez-faire, autocratic and transactional leadership. This review suggests that employees will benefit from leadership environments where relational styles are present where employees feel their leaders have strong values and act in accordance with these, where the leaders communicate clearly and inspirationally attracting employees to follow their vision, where employees are encouraged to use their full capacity, are intellectually challenged and where they feel the leader individually supports them and considers them, or at a minimum knows them. In short, valued employees are healthier, perform better and take less time off.

1- Introduction

The concept of stress needs no real introduction. Scientific definitions suggest that stress occurs when the individual appraises a situation as a threat to something of value to them, which exceeds their ability to cope given their current resources and typically reduces their psychological and physical well-being (Harms et al., 2017; French et al., 1982; Lazarus & Folkman, 1984). In simple terms, stress is felt when the situation demands more from us than we feel able to give.

In terms of well-being, its definition is perhaps more difficult and often is conceptualised as the absence of "dis-ease" or mental disturbance. However, according to the World Health Organisation this definition by absence is incomplete, and they suggest well-being to be the most significant aspect of mental health, thus "Mental health is defined as a state of well-being in which every individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (WHO, 2014). Psychological conceptualisations of well-being have suggested it is primarily comprised of two components, 1. Hedonic well-being defined as maximising pleasure and minimising pain and 2. Eudaimonic well-being defined as moving towards one's full potential and experiencing life as personally meaningful. However, it is worth noting that large scale studies of well-being have reported these two factors to be highly inter-correlated (Disabato, Goodman, Kashdan, Short, & Jarden, 2016). Stress is a factor that will consistently reduce reported well-being.

One obvious potential source of stress in the modern world concerns work. Several characteristics of work make it a major potential cause of stress, chiefly: 1. The sheer amount of time spent at work relative to other life activities (e.g. sleeping, home, travel); 2. Consistent demands to perform and produce results; 3. Managing relationships with other individuals in the workplace; 4. Reduced autonomy; 5. Financial imperative to work irrespective of desire; 6. Usually a hierarchical power structure; 7. Career aspirations and wage discrepancy awareness; 8. Potential for bullying, victimisation, harassment and inequality; 9. Managing work life balance; 10. Job security; 11. Unmanageable workloads, deadlines and expectations; 12. Lack of training or support.

Given the potential for work to be such a compelling source of stress, one aspect that has increasingly received attention in the literature concerns whether the particular type of manager, leader or supervisor in the organisation and their style of leadership can affect the level of stress and well-being experienced by individual employees / followers.

Before the effects of leadership style can be examined, it is necessary to delineate differences between management and leadership. Understanding the similarities and differences between management and leadership has long been explored within management theories and research paradigms. Debate over the precise differences continues to the present day, with many suggesting

that arriving at a precise definition of either management or leadership remains an elusive goal (Morrill, 2007). Despite this, several key differences have been systematically distilled from a range of authors.

The attributes and activities of managers versus leaders have been documented by various authors (see Bennis, 1989; Diffen LLC, 2017; Kotter, 1990) and show clearly that there are marked differences between their roles. Typically, managers are seen as high-level administrators, chiefly concerned with the day to day running of an organisation, and therefore with structures, processes and ensuring optimal functioning. In contrast, leaders are more visionary and long term focused, attempting to define and generate organisational commitment to a shared vision and associated values (Bush, 2000). A famous quote, that echoes similar ideas, suggests that "management is doing things right; leadership is doing the right things" (attributed to both Peter Drucker and Warren Bennis).

The focus of this chapter will be on leadership styles and how these influence employee outcomes including stress and well-being. Having said this it is important to realise that in practice managers and leaders are frequently the same individual. Despite this, organisational structure frequently allocates positions in a hierarchical manner to allow people employed at the very pinnacle, for example the Chief Executive Officer (CEO), a leadership role, with several ancillary managers sitting just below them, for example CTO (Chief Technical Officer), CFO (Chief Financial Officer), COO (Chief Operating Officer), CMO (Chief Marketing Officer) to deal with the more practical aspects of running the organisation and reporting directly to the overall CEO.

Even though there is considerable overlap between leadership and management, this chapter will concentrate on leadership rather than management. Leadership has been defined as "a process whereby an individual influences a group of individuals to achieve a common goal" (Northous, 2004).

2- Method

This article represents a review of the available evidence linking leadership styles in an organisational context with outcomes of relevance to employee health – chiefly: Employee Stress, Well-being, Productivity, Turnover and Absenteeism.

The method employed initially was to use a literature search on PsychInfo and Google Scholar for papers directly linking leadership styles to employee / health outcomes. The search terms used included "leadership styles" and derivatives such as "management styles", and "employee stress, well-being, productivity, turnover and absenteeism" some relevant derived terms such as "burnout" were also used. The abstracts of all papers arising out of these searchers were examined for inclusion. Included papers represented ones where they provided actual data regarding the links between leadership styles and the particular health outcomes of interest. Previous review articles were also included as these led to the identification of further experimental literature that was not present in the online searches.

3- Leadership styles

The historical literature has identified a myriad of distinct leadership styles of unknown number and has frequently evidenced disagreement regarding taxonomy, overlap, hierarchy and critical distinctions. However, there is some broad agreement regarding the existence of four styles which although not exhaustive (Anderson & Sun, 2015) have the widest evidence base with regards to impact on employee outcomes. These are:

3-1-Transactional leadership

Focuses on transaction and exchange of resources in order to accomplish necessary work, rewards are contingent on measureable performance, in addition to taking corrective action when tasks are being undertaken poorly e.g. punishments (Bass, 1990; Bass & Avolio, 1994).

Transactional leadership is seen as encompassing three dimensions:

I. Contingent reward – the leader makes transactions in a constructive way, rewarding good performance and making explicit expectations.
II. Management by exception active – the leader takes corrective action regarding leader / follower exchanges e.g. punishing poor performance – active leaders monitor behaviour and take corrective actions quickly.
III. Management by exception passive – these leaders wait until problems manifest before taking action.

3-2-Laissez-faire leadership

These leaders are characterised by the absence of transactions and provide employees with a great deal of freedom regarding how they manage and run their day to day work. The leaders can be supportive but are often uninvolved. They passively avoid issues and decision making. This can backfire if the employees do not effectively manage themselves (Avolio, Bass & Jung, 1999; Lewin & Lippitt, 1938). Often described as the avoidance of leadership. These leaders are avoidant, often hesitant and difficult to contact.

3-3-Autocratic / Dissonant / Authoritarian

These leaders are autocratic and order others to do certain tasks, which depends on their positon in the

hierarchy, authority and punitive measures. They make decisions without consulting others. The advantages are that decisions are made very quickly and can be implemented swiftly. However, employees feel uninvolved and can become complacent (Coleman et al., 2002; Lewin & Lippitt, 1938).

3-4-Transformational leadership

Involves establishing oneself as a role model by inspiring employees to follow them, gaining trust and employee confidence. These leaders are charismatic and attract respect and trust from colleagues, they are inspiring, motivating and seen as collaborative and fair. They model useful organisational behaviours they wish employees to adopt. They respect staff and challenge employees to follow them (Bass, 1990; 1998; Eagly et al., 2003).

As Judge and Piccolo (2004) state "Transformational leaders offer a purpose that transcends short term goals and focuses on higher order intrinsic needs" (p. 755).
Transformational leadership is said to encompass four sub domains (Arnold & Connelly, 2013; Bass & Riggio, 2006), which are:

I. Idealised influence – these leaders have strong consistent values and act in accordance with those values.
II. Inspirational motivation – communicate clearly, often inspirational and convey a vision of the path to take, convincing others to follow and share in this vision.
III. Intellectual stimulation – they encourage followers to think in alternative and different ways, solving problems by using their full capacity.
IV. Individual consideration – supporting employees individually and helping them to develop their potential.

The leadership styles noted above are not exhaustive and other styles debated in the literature include: charismatic; servant; authentic; ethical; as well as destructive forms of leadership e.g. abusive, tyrannical, derailed etc., and models such as Full-range Leadership Theory (FRLT) and Leader-Member Exchange theory (LMX), among others. The focus of this chapter will examine how the style of leadership impacts on a range of employee outcomes, chiefly: well-being; stress and burnout; performance and absenteeism / sickness.

It is worth noting at this juncture that leadership styles are not mutually exclusive, and some have suggested that optimal leadership might be best conceptualised as a combination of the transformational and transactional styles, e.g. Bass (1999) states "the best leaders are both transformational and transactional" (p. 21). However, others suggest sensitivity to context is key and that all styles are necessary to flexibly apply as the situation or the type of organisation demands (Goleman, 2000).

4-The impact of leadership styles on employee wellbeing and productivity

The following sections will examine research regarding employee outcomes under distinct headings representing possible effects of leadership style.

4-1-Sickness, absence and staff turnover

Sickness and absence are clearly undesirable outcomes for any organisation. They will affect productivity, morale and stress levels of other employees. Furthermore, they are poor outcomes for employees.

Research has shown that higher level support provided by leaders and supervisors are associated with reductions in turnover (Thomas & Ganster, 1995) and absenteeism (Kuoppala et al., 2008; Stansfeld et al., 1997). However not all studies support this (Clumeck et al., 2009). Furthermore, long term absence due to sickness has been found to be related to lower levels of work based support from leaders and supervisors (Labriola et al., 2006; Nielsen et al., 2006).

There is also evidence that it is not only the provision of support per se that results in greater presenteeism but also the quality of the support. Thus, leadership quality assessed as providing good developmental opportunities, work satisfaction, and good conflict solving relationships is associated with lower levels of sickness absence (Munir et al., 2011). In a rare longitudinal study, Dellve and colleagues demonstrated in 3275 employees that high quality leadership that carefully used rewards and recognition cultivated greater respect and was associated with presenteeism (Dellve et al., 2007).

Studies that have examined discrete leadership styles have consistently found that relational leadership styles (e.g. transformative and charismatic / inspirational) where employees feel valued and have a say in decision making are invariably associated with less absenteeism including sickness and lower staff turnover (Boyle et al., 1999; Nyberg et al., 2008; Schreuder et al., 2011; Volk & Lucas, 1991). Importantly Schreuder et al. (2011) report task-oriented leadership behaviours are related to more absenteeism in the short term. Nyberg et al. (2008) found autocratic leadership to be associated with more sick leave for men.

Some research has examined the leadership behaviour and its relationship with intent to stay in the role by employees. With consistent findings being reported regarding the fact that employees report more intent to stay in roles where leadership

styles are more relational, employees are satisfied and feel their behaviour is rewarded (Manion, 2004; Boyle et al., 1999; Kramer & Schmalenberg, 2003; Upenieks, 2003). Transformational leadership has been specifically examined in the field of nursing and has been shown to relate to greater job satisfaction, commitment to the organisation, self-efficacy and empowerment, while simultaneously relating to lower staff turnover, (Failla & Stichler, 2008; Neilson et al., 2009).

4-2-Stress and Burnout

The effect of leadership on stress and burnout has been examined in multiple studies. For the purpose of this chapter burnout is defined as a cluster of psychological factors best represented by emotional exhaustion, depersonalisation (seeing others as more like objects than people) and reduced personal accomplishment (Van Dierendonck, Schaufeli, & Sixma, 1994).

In line with the evidence reviewed above regarding absence and turnover, studies have consistently demonstrated that more relational forms of leadership such as transformational and charismatic, where leaders are perceived to be individually considerate and effective communicators are associated with less stress and burnout in employees (Gill, Flaschner, & Shachar, 2006; Leithwood et al., 1996; Seltzer, Numerof & Bass, 1989; Sosik & Godshalk, 2000; Sparks et al., 2001). Furthermore, higher levels of employee support have been associated with reduced stress and burnout (Schaufeli & Enzmann, 1998). Importantly in some studies the beneficial effects of leadership style are stronger than the effects of demographic and personality factors, however they are not as strong as job demands and social / organisational support (Leithwood et al., 1996). Lyons and Schneider (2009) report that transformational leadership was associated with higher perceived social support, increased self-efficacy, less threat appraisal when simultaneously under stress, and less negative affect again in stressful conditions.

Corrigan and colleagues examined the subcomponents of transformational leadership (idealised influence, inspirational motivation, individual consideration and intellectual stimulation) the first three components were negatively related to burnout. However intellectual stimulation was not related to emotional exhaustion and was positively related to personal accomplishment (Corrigan et al., 2002). This is similar to Seltzer et al. (1989) who found that intellectual stimulation was positively related to stress and burnout.

Research has started to investigate processes that may moderate the relationships between relational leadership styles, stress and burnout. One suggested factor is personality. Thus, Hetland et al. (2007) found transformational leadership was not associated with emotional exhaustion but positively associated with efficacy. Yet the personality dimension of neuroticism was more strongly associated with burnout and its sub-dimensions. Liu et al. (2010) found that another potential mediator was the degree of trust in the leader. Thus, leader trust and self-efficacy mediated the relationship between transformational leadership and stress.

In terms of negative leadership styles, abusive supervision and bullying have both been linked to increased stress and burnout (Sparks et al., 2001; Tepper, 2000). In line with this, research has examined a range of factors that are associated with increased stress the main contenders have been shown to be: role ambiguity, lack of autonomy, difficult interpersonal relationships and workload (Dolan & Renaud, 1992; O'Driscoll & Beehr, 1994; Schaubroeck, Cotton & Jennings, 1989; Sullivan, 1993). Importantly given the literature these are all likely to be reduced where leaders are transformational. Thus, studies have shown that having increased control over one's work results in significant mental health benefits and reduces absenteeism (Stansfeld et al., 2000). Furthermore, there is evidence that these same factors not only affect stress and well-being but may have detrimental effects on physical health. Thus, high workload, low autonomy and lack of sensitivity to reward balance have been found to be related to increased coronary heart disease (Head et al., 2002).

These issues appear to be exacerbated where work stress becomes chronic. Therefore, chronic stress at work has been demonstrated both cross-sectionally and longitudinally to be linked to many negative outcomes including depression, anxiety, cardiovascular disease and emotional exhaustion (Michie & Williams, 2003; Sapolsky, 2003). Furthermore, work stress itself relates to negative organisational outcomes such as increased staff turnover and absenteeism while simultaneously lowering performance (Dollard et al., 2000).

One feature of transformational leadership that lends itself to enhanced positive outcomes particularly regarding work stress is social support and individual consideration of employees. To investigate the effects of social support, Viswesvaran and colleagues conducted a meta-analysis which demonstrated that social support had beneficial effects on stress via three pathways. These were: reducing experienced strain, altering employee's perception of stressful situations whereby previously stressful situations come to be seen as easier to deal with, and moderating the relationship between stressors and strain (Viswesvaran, Sanchez & Fisher, 1999).

In a review of the literature on stress and burnout in correctional officers, Schaufeli and Peters (2000) conclude that while stress levels and burnout are high in this occupation the situation could be helped by improving human resources management and the social work environment. Importantly both of these strategies are more likely with relational and transformational leadership styles.

4-3-Well-being / health

Studies have investigated the effects of leadership behaviours and styles on well-being. It is important to realise that as a concept well-being is seen as having both psychological and physical qualities (Liu et al., 2010). Therefore, the present section will review the literature in terms of effects on both mental and physical health broadly.

In line with the previous research examining outcomes on absenteeism and stress / burnout, studies on well-being have broadly shown that once again leadership styles that are relational, charismatic and transformational consistently demonstrate better employee outcomes in terms of well-being (Cummings, 2004). Specifically, transformational leadership has been associated with less depression at multiple time points, better general health, lower anxiety and less stress (Cummings, 2004; Munir, Nielsen & Carneiro, 2010; Stordeur et al., 2001). One rare longitudinal study is particularly instructive (Nielsen et al., 2008) which demonstrated, over 18-months, that there was no direct relationship between transformational leadership at time 1 and affective well-being at time 2. However, transformational leadership did show positive effects on affective well-being that were shown to be mediated by increasing experience of meaning in work, greater role clarity, improved developmental opportunities and more self-efficacy. Of relevance to well-being, transformational leadership was associated with less depression both at time 1 and over the 18-month period.

In terms of the mechanisms through which transformational and relational leadership may exert effects, research has shown that charismatic leadership (a sub component of transformational leadership) seems to evoke more positive emotions in employees with benefits to well-being (Bono & Ilies, 2006; Cherulnik et al., 2001). Thus, it seems charismatic and transformational leaders are viewed as more positive and these emotions can be transmitted to employees. This is important as positive emotions are one consistent hallmark of mental health and well-being (Arnold & Connelly, 2013). Furthermore, there is also some evidence that transformational leadership can simultaneously reduce negative emotions in followers (Rowold & Rohmann, 2009). In addition to evoking more positive emotions the increased support likely to be in evidence with transformative and relational leadership styles may also lead to independent benefits. Thus, higher levels of employee support have been associated with increased well-being and satisfaction (Amick & Celantano, 1991; Donaldson-Feilder, Munir, & Lewis, 2013; Moyle & Parks, 1999). Another factor that appears related to employee well-being and leadership is job satisfaction. Meta-analysis indicates that job satisfaction is related to improved employee health – both mental and physical (Faragher & Cooper, 2005). As transformational leadership styles have been consistently related to increased job satisfaction this suggests one route to improving well-being.

In view of the findings demonstrating consistent benefits of transformational styles on well-being, a range of studies have investigated whether these styles can be developed in leaders and the benefits that may result. The main findings indicate that training programs designed to develop effective leader behaviours show good outcomes particularly with respect to employee well-being. Thus, Theorell et al. (2001) examined the effectiveness of a program designed to improve managers psychosocial competence with the training covering the social psychology of groups, individual functioning (psychologically & medically), and the design of workloads. Leaders participating had bi-weekly sessions for a year. Results indicated that employees with managers that had undergone the training showed evidence of increased autonomy, and critically demonstrated lower serum cortisol levels compared to employees whose managers did not participate. This is an important finding as serum cortisol is seen as a robust marker of general stress.

In a similar study, Barling et al. (1996) examined a program designed to develop transformational leadership styles. Results indicated that employees of managers who underwent the training had enhanced perceptions of their managers transformational style. Most importantly the employees of managers that completed the training also showed evidence of increased organisational commitment and financial performance. In terms of the general effectiveness of stress management interventions, Richardson and Rothstein (2008) report consistent positive overall effects in a meta-analysis, especially beneficial were cognitive behavioural interventions.

In a well-designed study avoiding some of the pitfalls of an overreliance on self-report measures, Bono et al. (2007) used experience sampling procedures where employees were randomly stopped throughout the day and had to report their current emotions. Results indicated that employees with transformational leaders reported more positive emotions at work but not less negative emotions.

Studies have also investigated the converse i.e. leadership factors that appear detrimental to well-being. Thus, Skogstad et al. (2007) found that laissez-faire leadership was associated with increased role conflict, ambiguity and greater conflict and bullying. In turn, abusive supervision has consistently been linked to increased anxiety (Harris & Kacmar, 2005) and depression (Tepper, 2000). Unsurprisingly, forms of destructive leadership (e.g. harassment, bullying abusive practices, power abuse, and undermining among many other destructive practices) have consistently been demonstrated to harm employees, particularly with respect to well-being (Bowling & Beehr, 2006). Furthermore, a meta-analysis of destructive leadership by Schyns and Schilling (2013) suggests that employee outcomes are negative including worse perceptions of management and counterproductive work practices.

4-4-Employee engagement

Studies have also investigated the effect of leadership styles on employee engagement. Employee engagement refers to "individual's involvement and satisfaction with as well as enthusiasm for work" (Harter, Schmidt & Hayes, 2002, p. 269). While this concept shares overlap with organisational commitment it is not viewed as identical (Robinson, Perryman, & Hayday, 2004). Thus, organisational commitment is seen as referring to a person's attitude towards their organisation but engagement is not seen as an attitude but the extent to which an individual is focused and attentive to their employment role (Saks, 2006). What is clear is the literature on employee engagement agrees that the concept has developed mainly from organisational departments and human resource based organisations not from academic researchers who have been slow to start researching employee engagement, which has led to terminological confusion (Macey & Schneider, 2008). Although a modern definition has emerged suggesting that employee engagement is a state of mind relating to feelings of fulfilment, enthusiasm and dedication to work (Eldor & Vigoda-Gadot, 2017).

Once again relational forms of leadership where leaders are effective communicators are seen to be positively related to greater employee engagement, job satisfaction and organisational commitment (Keegan & den Hartog, 2004; Myers & Kassing, 1998). In line with this, Schaufeli & Peeters (2002) found engagement is linked to charismatic leadership which is often seen as one component of transformational leadership.

Factors shown in various studies to be linked to greater employee engagement include positive leader interactions and communications (Bakker, Schaufeli, Leiter, & Taris, 2008; Madlock, 2008; Madlock, & Booth-Butterfield, 2012; Madlock & Horan, 2009), involvement of employees in decision making (Bakker, Demerouti & Schaufeli, 2003), and greater control over day to day running of one's own work tasks (Hakanen, Bakker & Schaufeli 2006). Indeed, Madlock and Horan (2009) found that almost 18% of the variance in job satisfaction was accounted for by supervisor effective communication. Importantly studies indicate that greater engagement is linked to higher productivity and work performance, customer satisfaction, loyalty, profit, turnover and safety (Harter et al., 2002**;** Towers Watson, 2008).

Studies have also examined factors associated with greater estrangement. Thus, Sarros and colleagues report that authoritarian, inflexible, less empowering leadership leads to employee estrangement and alienation. They also suggest that transformational styles of leadership avoid these losses by providing workers with the support they need to handle complex job demands effectively (Sarros et al., 2002). Furthermore, Sarros found that transformational leadership lessened the degree of work alienation, whereas transactional leadership increased alienation. In line with this, the degree of centralised control, more formal rules, codified practice and strict authority have all been found to predict the degree of work alienation (Gaziel & Weiss, 1990; Zeffane, 1993). It is suggested that inflexible bureaucracy contributes to alienation by constraining employee autonomy and the extent to which they control their own activities (Kakabadse, 1986; Zeffane, 1993). This led MacLeod & Clark (2009) to suggest that, to enhance employee engagement, leaders need to provide autonomy, empowerment, developmental opportunities, be clear regarding expectations, respect and fair treatment, offer coaching, feedback and training to ensure work is effectively and efficiently designed and allocated fairly.

In terms of discrete leadership styles the evidence is clear, transformational leadership is a driver of employee engagement (Macey & Schneider, 2008). Furthermore, Shamir et al. (1993) found that transformational leadership resulted in increased employee involvement, commitment, performance and relatedness. Importantly, leadership satisfaction appears negatively related to laissez-faire leadership, and positively related to inspirational leadership (Andrews et al., 2012). However, there is some evidence that employees report even greater satisfaction where leaders display both relational and task-oriented behaviours (Castenada & Nahavandi, 1991).

4-5-Productivity

Research examining work productivity has again demonstrated advantages for transformational forms of leadership, thus transformational leaders have been found to be more productive, both in terms of their own performance and that of their

employees, regardless of the level at which the output is measured e.g. individual, team or company (Barrick et al., 2015; Bass et al., 2003; Hater & Bass, 1988).

Ng (2017) investigated the mechanisms through which transformational leadership might give rise to better performance by conducting a large scale meta-analysis. The results demonstrated that five separate factors could explain some of the effects of transformational leadership on performance. The first factor was labelled affective experience, being led by a transformational leader enhanced the number of positive emotions experienced by followers and thereby led to improved performance. The second factor, labelled motivation, concerned the fact that transformational leadership resulted in greater confidence in followers and excitement regarding their work resulting in performance increments. The third factor was labelled identification mechanism and demonstrated the influence of transformational leadership on employees whereby they would identify with the leader and emulate them as a source of inspiration. The fourth factor was labelled social exchange and suggested that transformational leadership improved the quality of social exchanges between leaders and followers which in turn meant the follower was motivated to reciprocate by performing their job to a higher standard. The fifth and final factor was labelled justice enhancement and suggested to followers that resources would be allocated in a fair way, motivating followers to expend more effort on tasks. These overall results indicate that in the final analysis it was the quality of the relationship that improved performance.

Related to performance increments, Judge, Piccolo and Kosalka (2009) comment "even among leaders, we believe charismatic, intelligent, conscientious leaders perform better (i.e. have higher subjective and objective effectiveness)" (p. 864). Furthermore, they make the critical point that stable characteristics, i.e. personality or leadership style, are unlikely to show utility in all situations. For example, collaborative leadership where decisions are jointly made is likely to be effective in normal circumstances but ineffective in times of crisis or war. By the same token they suggest some socially "dark" or undesirable traits can sometimes be necessary and useful. The same authors conducted a meta-analysis examining the effects of leadership styles on performance. Results indicated that transformational leadership was consistently related to enhanced performance. Contingent reward was also related to better performance and transformational and contingent reward were themselves positively related. Importantly passive leadership and laissez-faire leadership were consistently related to reduced performance (Judge & Piccolo, 2004).

4-6-Effects of transformational leadership on leader stress and well being

While most studies have focused on the effects of leadership style and behaviours on employee outcomes, a few have investigated the impact of leadership style on stress and well-being in the leaders themselves. These studies report that transformational leadership and its sub-dimensions are positively related to personal accomplishment in the leader (Corrigan et al., 2002). Furthermore, there is some evidence that charismatic leadership is associated with reductions in one component of burnout - emotional exhaustion. A similar study also reported benefits of transformational leadership on well-being in the leader. Thus, transformational leadership was negatively correlated with emotional exhaustion, depersonalisation and positively correlated with personal accomplishment (Zopiatis & Constanti, 2010).

4-7-Gender differences in leadership style

Research has now demonstrated that there may be gender differences in preferences for leadership style, particularly in Western cultures. Specifically, women have been shown to lead more democratically, preferring participation from other members of the organisation whereas men tend to lead more autocratically (Johnson & Eagly, 1990). A further meta-analysis from Eagly and colleagues (2003) has also shown that female leaders are often more transformational than males. In addition, women were shown to be more consistent in rewarding useful behaviours, thereby being more transactional. In contrast, they found male leaders to be more laissez-faire. However, it is worth noting that the effects were small.

5-Conclusions

The research linking leadership styles with a range of outcomes linked to health, well-being and productivity show a remarkable degree of consistency. Relational and transformational leadership styles show consistent benefits to both the leader themselves and employees in terms of increased well-being, health, and productivity coupled with reduced absenteeism and sickness absence. In contrast, transactional leadership sometimes shows benefits albeit only for contingent reward and some studies report a positive correlation between transformational and contingent reward transactional leadership. However, it is worth noting that even for contingent rewards the outcomes are not always positive and management by exception whether active or passive demonstrated poor outcomes. The outcomes for Laissez-faire and authoritarian leadership are easier to distil. These have been related consistently to poor outcomes in terms of less productivity and workplace engagement

coupled with negative impacts on health and well-being.

However, despite the consistencies reported, a few critical points need to be raised at this juncture. Firstly, the quality of the evidence, while improving has on the whole been limited, with the vast majority of studies being correlational and associative making it impossible to make causal inferences (Arnold & Connelly, 2013). Furthermore, although this chapter has focused on four widely accepted leadership types, these are far from all of the suggested leadership styles (see end of section 3) and there is ongoing debate regarding the number of styles that exist. In addition, the literature is rife with inconsistent use of terminology and simplistic research designs. For example, data is typically collected via self-report and often assessed retrospectively, is often cross sectional and correlational so no causal ascriptions or causal direction can be argued. One critical issue within the literature is the fact that leadership style is rarely objectively verified and mapped onto actual leader behaviour, creating a dichotomy in the literature between perceived leadership style against objective leadership style (Behrendt, Matz & Goritz, 2017; Dinh, et al., 2014). Therefore, although tempting, it is too premature to suggest that transformational leadership leads to the enhanced outcomes.

What is clear is that work environments have changed dramatically in the 21st Century and employees are now more educated and intelligent than previously. Some have argued these shifts mean it is now necessary for leaders to be more collaborative and transformational to engage their employees (Salacuse, 2013). Towards this end, research indicates that satisfaction with supervisors is related to the leaders perceived competence as an effective communicator (Berman & Hellweg, 1989). Perhaps most important in view of the consistent association with improved employee outcomes, there is good evidence that transformational leadership can be taught (Barling, Weber & Kelloway, 1996; Kelloway, Barling & Helleur, 2000).

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Stress Factors and Options for helping Students to Cope with Stress in UK Universities

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Abstract

Students' stress may be considered as a form of occupational stress. Recent studies have shown that UK students' stress has significantly increases the past years. Based on a review of recent articles (after 2015) addressing this issue in UK universities, we highlighted the main factors of stress for students, the implications regarding their performance and the solutions that were considered to deal with this issue.

We found that the main factor of stress related to financial concerns: due to the government disengagement in funding universities since the 90s, tuitions fees have raised significantly, forcing students to engage themselves in loans or to have a side employment at the expense of the time needed to study with a direct impact on students' health. This is amplified in a general manner by the students' disappointments associated with the academic reality compared with what they expected from the institutions. The amplification is even higher during examination periods with obvious additional factors of stress. Studies have shown that, during these periods, many students reverse their eating habits, provoking an imbalance and a decline in quality of the usual diet with a negative impact on academic performance.

Several studies identified students' resilience to stress as an antecedent of students' wellbeing which could be reinforced through developing optimism. A current experiment undertaken at the University of Cambridge aims at assessing how mindfulness training may help in this perspective.

1-Introduction

Occupational stress does not appear when people enter the world of work. Before that, people are usually engaged in an academic curriculum that provides its specific stress factors. The students' "job" being to study, stress induced by studies may be considered as a form of occupational stress. This form of stress is not negligible and requires specialists' attention.

In British universities, students' stress increases since several years. This is especially seen in terms of numbers of individuals concerned: in 2004, Andrews & Wilding noted an issue of growing concern regarding "the increase in the number of seriously disturbed students consulting student health services in the UK" (p.509) "with an increase in the proportion of students seeking help in recent years" (Galante et al., 2016: 1) recently confirmed for example by Laidlaw et al. (2016: 2157) or Denovan & Macaskill (2017: 506).

This is partly due to changes in the British educational policy at the end of the 90s (Denovan & Macaskill, 2017) and due to intrinsic characteristics of academic studies. Regarding British educational policy, allowances given by the government progressively disappeared increasing students' fees from about £1000 in 1998 to £9000 to date, forcing students to engage themselves in loans or to have a side employment at the expense of the time needed to study.

Subsequent implications for students' health and performance have become an essential issue to deal with: identifying the factors increasing or lessening students' stress may help education professionals to develop methods that might help them to cope with this issue.

2-Method

A bibliographic review has been undertaken, focusing on recent studies (after 2015) addressing students' stress in British universities. Main factors increasing or lessening students' stress are listed, consequences on students' health and performance are analyzed and authors' remedial proposals are discussed.

3-Results

Studies reviewed here had statistical approach. They thus emphasized the main factors of stress for UK students, reported and discussed in the following. However this does not mean that other factors might not be of interest although not presented in this short paper as being less significant overall.

2-1-The main factors of stress

Financial concerns: Students' stress increases with time during school year in UK universities (Andrews & Wilding, 2004; Denovan & Macaskill, 2017) with a significant contribution of financial difficulties (Andrews & Wilding, 2004; Richardson et al., 2017) due to a progressive disengagement of the British government well described by Denovan & Macaskill (2017: 506). Financial difficulties lead to lower the level of mental health for students (see for example the recent longitudinal study of Richardson et al., 2017) with a significant negative contribution to exam performance (Andrews & Wilding, 2004).

Examination periods: Students' stress increases during examination periods and have significant effect on students' diet and subsequently on mental health. Recently, Barker et al. (2015) analyzed nutrient intake for university students (N=20, male) during an examination period compared with an outside examination period. They found that, for almost half students, dietary habits were reversed associated with amplified hypo/hyperphagia; this reversal of eating habits caused an imbalance and a decline in quality of the usual diet of students. Indeed it has been shown that stress impact on food intake is bidirectional: it may lead to either increase or decrease food intake (Maniam & Morris, 2012: 1). This should have been avoided in examination periods because numerous studies have demonstrated the positive influence of diet quality on academic performance. These results concurred with previous studies regarding stress and hypo/hyperphagia (Oliver et al., 2000; Torres et al., 2007).

Erroneous academic expectations: Another source of stress for students is the mismatch between their expectations and what they are offered at the university: Blair (2017) undertook a pilot study with first-year students (N=51) and found that "while the majority of students considered that workloads, nature of assessment, level of independent reading, and learning were broadly in line with their expectations, they were less satisfied with the support provided in terms of contact time with tutors and feedback on performance" (p.215). A Russian study is worth to be presented here as it points out an issue that has not yet been analyzed in the literature for UK students. The authors, Maloshonok & Terentev (2017), examined students' expectations, undertaking a deeper analysis of first-year students' mismatch expectations in a Russian university (N=283) and highlighted, among 30 criteria, that three dimensions affected significantly students' academic outcomes: i) expected vs real grades, ii) expected vs real levels of interest in studying, iii) expected vs real time for extracurricular activities. Despite no similar study is available to date for West-European students, from our own experience, we suggest these points might be less significant in UK but quite up-to-date in France (especially the second point) and that their significance might depend on the discipline (Laidlaw et al., 2016: 2157). From their results, Maloshonok & Terentev (2017) pointed out the importance "to form high expectations and self-confidence among first-year students regarding future academic performance, […] to track the level of student interest in study and determine the possible reasons for its decrease" and that "universities should provide resources on the optimal balance between curricular and extracurricular activities for students" (p.15). The authors suggested thus an organizational approach of the issue rather than focusing on individuals' stress.

2-2-The proposed solutions

Reed (2016) undertook a study with undergraduate students (N=95) in UK. Applying a structural equation modeling data, he found that optimism mediated coping flexibility with life satisfaction and perceived stress, giving thus elements of understanding how optimism is important for mental health. He also pointed out that "optimism is assumed to predict resilience against stressful life events" (p.73).

In the line of Reed (2016), Denovan & Macaskill (2017) emphasized the importance of optimism (defined as "a generalized positive outcome expectancy", p.508) for students in UK (N=192), "helping to buffer the impact of stress on subjective well-being" (p.508), where "subjective well-being" is not defined by the authors but characterized by "three components; emotional reactions to events (positive affect and negative affect), and cognitive appraisal of fulfillment and satisfaction" (p.507). Subjective wellbeing "is generally defined as how people think and feel about their lives" (White & Dolan, 2009). For Denovan & Macaskill (2017), optimism, as well as resilience (personal qualities that facilitate recovery from adversity, p.509), are covitality factors, part of the subjects' psychological capital as positive attributes that subjects bring to deal with adversity. Similarly, in Australia, in a recent study addressing wellbeing at university (N=410), Turner et al. (2017) emphasized the role of resilience for students' mental health and wellbeing. They identified factors contributing to students' resilience (from the highest to the lowest: building networks, staying healthy, interacting cooperatively, living authentically, and maintaining perspective). They identified that resilience is an antecedent of students' wellbeing. They also noted that training students to develop resilience would help them being "work-ready" for entering the world of work known as a stressful environment. According to the authors, this could be achieved on the basis of the identified factors, suggesting in their conclusions

that factors could be worked differently from one individual to another.

Denovan & Macaskill (2017) suggested that "offering interventions to develop optimism may significantly improve new students' ability to cope with stress at university and lead to reductions in negative affect" (p.521).

Galante et al. (2016) promote mindfulness training: "Mindfulness interventions have been shown to reduce stress and prevent depression in clinical and non-clinical populations. Secular mindfulness training involves paying attention to the present moment on purpose and non-judgmentally. It is popular among students and increasingly used to support them in the UK" (p.2). To support their claim, they refer to the systematic review of Gotink et al. (2015). However, Galante et al. (2016) note that its effectiveness at university has not yet been ascertained. They thus currently implement a pragmatic randomized controlled trial in a UK university fully described in their paper (results being expected soon). Their hypotheses are, that "a preventative mindfulness intervention could reduce students' psychological distress during the examination period (primary outcome), improve their resilience to stress up to at least 1 year later, reduce their use of mental health support services and improve academic performance" (p.1).

4-Concluding discussion

Students' stress in the UK appears mainly to come from or be amplified by financial context and examination periods.

Students' stress clearly lessens students' performance and this effect is amplified when stress has a negative impact on students' diet.

For some authors (Reed; 2016; Denovan & Macaskill, 2017) optimism seems to be a key characteristic as remedial response to students' stress. However, this proposal yields two issues: How optimism may be developed when it is a personality trait and thus remains rather stable (Reed, 2016)? How can this suggestion be effective with subjects whose personality traits include neuroticism ("enduring tendencies to think and react in anxious and maladaptive ways and feel more negative emotions"; Weiting, 2015) instead of optimism, knowing that, similarly to optimism, neuroticism remains rather stable itself? A German study integrating neuroticism concerns even concluded that students' stress had to be explained by organizational conditions rather than personality (Schmidt et al., 2015). Nevertheless, recent researches have proposed that neuroticism was more malleable than originally believed (Weiting, 2015; Sauer-Zavala et al., 2017) being possibly lessened through cognitive treatment.

Another area for improvement appears being students' resilience toward stress, closely linked to optimism ("optimism is assumed to predict resilience against stressful life events"; Reed, 2016: 73). Optimism may thus be reinforced indirectly through resilience. In addition, resilience has a significant influence on students' mental health and wellbeing (Turner et al., 2017). However, Turner et al. (2017) did not differentiated mental health and wellbeing while Laidlaw et al. (2016) emphasized this difference on the basis of previous studies of several researchers confirmed by their own analysis of students (N=20) enrolled in either medicine, psychology, biology, physics or English undergraduate degree programs at the university in UK: "dual factor model [Tudor, 1995] defines mental health and mental well-being as being two distinct concepts, each of which has a spectrum of potential levels […] mental health refers to whether an individual is experiencing mental illness, with severe mental illness at one end of the spectrum and no mental illness at the other end. Mental well-being within the model could be described as emotionally flourishing and resilient at the optimal end of the spectrum and languishing at the other end. In other words, someone may have good mental well-being but poor mental health […] this model of mental health and mental well-being requires differing approaches to treat mental illness or prevent poor mental well-being" (p.2157). The issue is thus to determine whether it is necessary to privilege one or the other if both cannot be worked at the same time, or to consider they may not be disconnected, implying that working one implies working the other. Reading considerations of the literature, the latter option seems this to be chosen: working resilience against stress will positively influence mental health and wellbeing.

This means that the most potential successful solutions to reduce students' stress remain in developing students' resilience and improving organizational conditions of students' life in universities (see for example what is undertaken at the London School of Economics & Political and Science:https://info.lse.ac.uk/current-students/student-wellbeing), especially before and during examination periods.

Mindfulness training may respond to this need according to Galante et al. (2016). However, this must respect certain rules: Hülsheger (2015) warned about possible misuses of Mindfulness trainings. One of the issues is to transform training into "quick fix", with program reductions, reductions in duration of group meetings and reductions in duration of daily individual practice (p.675). Another issue comes from the subjects' values and ideals that training might bring back to mind: some practitioners then report subjects willing to make radical life-changes: changing their professional orientation or leaving their partner. The last issue is to restrain mindfulness at the level of the individual because, doing so, the intervention

would be restricted to offering training to participants with limited effects whereas integrating training within organizational policies and practices would be more effective. A related analysis, prior to training, might address the aspects of the organization that would promote individual mindfulness (see for example Sutcliffe et al., 2016). Students' stress must not be thought only as an individual issue but also as an overall concern in universities that organizational psychology has to address.

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Stress consequences

Assessment of Psychological and Endocrine Human Reactions in Experimental Microstress at Work

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Abstract

Daily hassles have been modeled by two types of experimental situations commonly encountered at work: "public speaking stress" and "communication with opposite sex unknown interviewer". Cortisol level, 10 psychometric and 4 physiological measures were used for pre- and post-experiment assessments and evaluation of stress reactivity. This was undertaken for both experiments involving 151 healthy participants, male and females, age range from 19 to 34 y.o. Complex correlations between types of stress reactivity and self-assessment of mental state and used coping-strategies were identified. Important findings were discovered through correlation between adverse childhood experience, health risk behaviors and level of stress reactivity. Assessment of cortisol level was confirmed as an objective parameter of stress level evaluation.

Key words: experimental microstress, physiological human reactions, psychological human reactions.

1-Introduction

1-1-Background

Stress and its negative consequences and disorders are considered as one of the major problem for health, especially at work, by different sciences and applied areas in medicine, psychology, sociology. The empirical data shows that the most dangerous consequences associated with the experience of stress are cardiovascular disorders and mental disorders such as depression, anxiety, learned helplessness, health risk behaviors (Shafirkin, 2003; Shaboltas & Zhukov, 2011; Trifonova, 2012). The actual trends in international and national stress research are associated with the investigation of the mechanisms which are responsible for appearing stress reactions and the identification of the hierarchy of their determinants. This type of knowledge could lead to finding new effective medical and psychological treatments.

The theoretical and methodological basis of our experimental method was built on cognitive-phenomenological approach of R. Lazarus and his understanding of stress as transactional process. Lazarus and Launier (1981) definition of stress includes psychological and physiological reactions. Everyday life events (among which those related to job representing 30% of our life) are considered as stressors which could be systematized by the level of negative effect and time for post adaptation. The following classification includes everyday stressors or daily hassles (microstressors), traumatic life events (macrostressors) and chronic stressors (Perrez et al., 1998). In the present experimental research, daily hassles have been modeled by two types of experimental situations commonly encountered at work: "public speaking stress" and "communication with opposite sex unknown interviewer".

1-2-Objective and aims

The study objective was to identify psychological and endocrine human reactions in response to different everyday stresses in healthy males and females. The following study aims were defined: to identify emotional, cognitive and behavioral reactions and gender specific in response to experimental stressors; to investigate stress reactivity of hypothalamic-pituitary-adrenal axis in two modeled stress situations assessing the cortisol level in saliva; to evaluate the psycho-physiological reactions in response to experimental stresses.

2-Method

2-1-Design, Subjects & Ethics

Two experimental stress inducing situations were developed in order to address study objective and aims:

1. Public speaking stress. To model this type of stress situation we used the version of classic Trier Social Stress Test in Halpern's modification (Kirschbaum et al., 1993; Halpern et al., 2002).
2. Stress in response to the communication with opposite sex unknown interviewer (sexual behavior). To model this type of stress we used modified experimental situation based on dating interview (Halpern et al., 2002).

The modification and tailoring of Halpern's experimental procedures were important to address cultural, ethical and economical specific of the Russian population. The study protocol, informed consent forms and procedures were reviewed and approved by the Institutional Review Board of St-Petersburg State University. The inclusion criteria

included the willingness to participate in two days experiments, age range 18 - 34 years old (young adults), no medical condition requiring hormonal therapy, no psychiatric or psychological conditions identified as difficulties for understanding informed consent. The total sample size was 151 participants, male and females, students, officials and people working in business. The recruitment was conducted using two approaches: face-to-face recruiting at the educational settings and recruiting through Internet social networks.

Each participant took part in two-day experimental procedures with no longer than one week interval in-between. The scheduled times for the experiments were the same to avoid the influence of daily cortisol level variations.

2-2-First study visit – modeling experiment "Public speaking stress"

After signing the informed consent, the participant was asked to provide pre-test saliva sample, fill in pre-test psychometric surveys and take pre-test psycho-physiological express-exam. Prior to experiment, the following instruction was provided to the participant: "Today you will participate in the experimental procedure to evaluate your abilities and achievement level in public speaking. You will be presented with the task concerning a speech to be prepared about a proposed topic with issues to discuss. For the speech preparation, you will have 10 minutes and you will be provided the list of facts you should use to support your arguments. During the speech you need to present the opposite arguments and position on the proposed topic. Your speech will last 5 minutes and will be videotaped for future scientific analysis".

To model public speaking stress situation, we have used the stressful and not well-known topic devoted to the fictional project of "law on the prohibition of export to Russia of specific species of mollusc 'Conus family' ".

After 10 minutes of preparation, the participant was led to another room for public speaking and videotaping. The participant had to start his/her presentation following a beep and finish it in 5 minutes marked with a second beep. In case of early finishing, the participant was instructed to keep standing until the final time.

The saliva collection for cortisol level detection for all study participants was conducted using the following protocol:

a) the saliva samples collection happened during time period between 2 PM – 8 PM;

b) 1 hour prior to the saliva collection time (scheduled experiment time) the participants were not allowed to eat, smoke and drink other beverages except water;

c) three samples of saliva were collected for each participant at each of two-day experiments: pre-test before experimental procedure, first post-test right after experiment and second post-test 10 - 20 minutes after the experimental procedure.

For quantitative detection of the free cortisol concentration level in saliva (as marker of stress reactivity) we used rapid test kits "Cortisol in Saliva - Immune-Enzyme Assay ("XEMA" production, Russia). Saliva measurement was conducted according to the required algorithm of these test kits. 0,2 - 1,0 ml of saliva samples were collected using sterile disposable SaliCap supplies (IBL production, Germany). Minimally detected free cortisol concentration in saliva for this test was 0,3 ng/ml, standard cortisol concentration as stress marker was 0,5 — 3,0 mg/ml (7,5 — 8,5 hours after morning awakening); 2,8 — 7,7 mg/ml (3,5 — 4,5 hours after morning awakening).

After experiments and short debriefing, the participants were asked to fill out post-test psychometric surveys and take post-test psycho-physiological express-exams (detailed description is provided in section 2-3). At the end of the first study visit, the second study visit was scheduled and short description of the second experiment was provided.

2-3-Second study visit – modeling experiment "Stress in communication with opposite sex unknown interviewer"

In the first part of the experiment, after filling out pre-test surveys, first saliva test and pre-test psycho-physiological exams, the following instruction was provided to each participant prior to the experiment: "The experimental situation will consist of two parts today. The first part will last 5 minutes. During this time 10 photos of opposite sex people will be shown to you on the computer screen (the duration of exposition for each photo is 30 s.). You will need to evaluate each person by answering two questions: 1) How attractive this person seems to you? 2) How attractive you seem to be to this person? To select your answers, please, use the cursor under the photo on the computer screen". Among the pictures, there was no picture of the interviewer.

In the second part of the experiment, the interview with opposite sex interviewer was focused on questions related to participant's choices and sexual behavior. The following instruction was provided to the participant: "After finishing the first part of the experiment, you will meet the interviewer who will talk with you approximately for 15 minutes asking questions about your impressions and evaluations of presented people and associations with your actual life experience. The interviewer will assess your ability to speak out and to provide arguments freely and assertively". During the interview, two or

three sensitive sexually oriented questions were asked by the interviewer to provoke the participant's stress reaction (for example: could you tell me about your problems in sex?).

After the experiment, last saliva sample collection and short debriefing was carried out with the participants. Then, they were asked again to fill in post-test psychometric surveys and take post-test psycho-physiological express-exams (the same as after first experiment).

2-4-Pre/Post tests

The 10 psychometric and 4 physiological measures were used for pre- and post-experiment assessments and evaluation of stress reactivity for both experiments. So many tests were used in order to obtain a complex system evaluation of processes of experimental stress.

2-4-1. Survey for Stress Reactions Self-assessment. The short version was developed based on the family stress survey (Ababkov & Perrez, 2004) and self-assessment survey of emotional states (Safonov & Prosvirnin, 2009) and include the list of stressors, the dynamic of self-evaluations of emotional states, feelings, casual attribution's, the level of self-control, used coping strategies in stress.

2-4-2. State-Trait Anxiety Inventory (STAI) developed by J.D. Spielberger and adapted by Y. Hanin for usage in Russia (Speilberger et al., 1970; Hanin & Spielberger, 1980).

2-4-3. Health Risk Behaviors Survey developed by A. Shaboltas with colleagues from St-Petersburg State University at the Department of Behavioral Psychology and Prevention of Behavioral Deviations, including questions on demographic and different health risk behaviors (substance use, sexual behaviors, deviant behaviors, suicidal tendencies, violence experience, etc.) (Nikitenko & Shaboltas, 2011).

2-4-4. Short version of "Adverse Childhood Experiences Questionnaires" (ACE) developed as a part of long-term research study on adverse childhood experiences by Center of Disease Control (http://www.cdc.gov/NCCDPHP/ACE). Original version of the questionnaire included 200 items (Felitti et al., 1998). In current study later developed, short version eligible for international settings was used which allows to identify the traumatic experiences in childhood (http://acestudy.org).

2-4-5. Russian version of "Dissociation Experiences Scale (DES)" developed and adapted by N. Tarabrina (Tarabrina, 2001). This scale measures types of dissociation, including problematic and normal dissociative experiences dissociative experiences (e.g., day-dreaming).

2-4-6. Short version of Personality Traits Inventory "Big five" developed by J. Gerris with colleagues. This instrument allows to evaluate the level of five basic personality factors: extraversion, agreeableness, conscientiousness, emotional stability and openness/resourcefulness which are considered as transcultural and universal (Gerris et al., 1993).

2-4-7. Sensation Seeking Scale. The most worldwide used version was developed by Zukerman as instrument to diagnose the need in sensation seeking in 1964 and consists of 16 pairs of statements (Zukerman, 2007). In our study we have used the modern version of the instrument with 40 questions which is considered as a part (scale) of five-factor personality traits inventory developed by Zukerman (Alujia et al., 2010).

2-4-8. Achievement Motivation Survey. The modified version of the survey was developed by A. Mehrabian and adapted by M. Mahomed-Eminov for Russia. Survey was presented in two forms for male participants (form A) and female participants (form B) (Weiner et al., 1968, Il'in, 2002). It assesses participants' achievement motivation in context**.**

2-4-9. Brief Symptom Inventory (BSI) – short version of SCL-R-90 developed by L. R. Derogatis with the main purpose to identify clinical symptoms. BSI consists of 53 items related to 9 factors: somatization, obsessive-compulsive disorder, interpersonal anxiety, depression, general anxiety, hostility, anxious-phobic thoughts, paranoiac thoughts and psychotism. The measure was adapted to Russian culture by N.V. Tarabrina (Derogatis & Melisaratos 1983, Tarabrina, 2001).

2-4-10. Observation of Emotional Arousal. Technical and observational algorithm were developed by A.T. Puni in 1977 in order to observe and evaluate the dynamic of visual emotional arousal symptoms (Puni, 1977). The algorithm includes the evaluation of the dynamic of following behavioral parameters: attention, mimics, pantomimic, physical movements, static poses, speech and vegetative characteristics (Regush, 2008).

2-4-11. Express-diagnostics of psycho-physiological and mental state dynamics. In order to get the quick complex assessment of state parameters before and after modeling stress experiments without long difficult instructions for participants, the following tests were selected (test procedures were the same for pre- and post-experiment assessments):

- Tensometry – computer based assessment of spatial-dynamic characteristics during keeping the physical balance (equilibrium) using strain measurement platform connected with the computer ("Platform – ST-150",

BIOMERA, Russia) (Skvortcov, 2010).

- Bio-power-potentiometric (BPP) – assessment of own electric potential (which depends on the moisture) on the hand skin with special copper handle. To evaluate the functional asymmetry, the assessment was conducted for left and right hands.
- Dynamometry – assessment of static physical efforts with hand dynamometer (which measure a muscular strength).
- Subjective Time Counting – subjective calculation of 10-second time interval using the stopwatch timer with covered face.

For the analysis of the data, the following statistical procedures and methods were used: descriptive statistics, dispersion and regression analysis (SPSS, version 18)**.**

3-Main results & Discussion

3-1-The types of stress reactivity in response to experimental stressors

Developed experimental model of human stress allowed to identify the significant association between the types of stress reactivity based on the level of cortisol and the self-esteem specific in subjective evaluation of emotional states and coping strategies used in modeled stress situations. The objective significant stress reactivity in cortisol level in saliva after the experimental stress was considered as 30% increasing of cortisol level in one post-test sample or 30% summarized increasing in two post-test samples. The following considerations were based on the analysis of the literature on cortisol stress reactivity research in human (Halpern et al., 2002). The positive cortisol stress reactivity after two experiments is presented in Table 1.

Table 1. Cortisol reactivity in response to different experimental stress (% of participants).Table 1: Characteristics of selected studies

Experimental situation	Gender	Significant reactivity	No significant reactivity
Public speaking	Males	61,1	38,9
	Females	53,1	46,9
Interview	Males	55,6	44,4
	Females	67,2	32,8

In the first experiment (public speaking stress), significant positive stress reactivity was found for 53.1% female participants and 61.1% for males ($\chi 2 = 1{,}680$, $p > 0{,}05$); in the second experiment, 67,2% females demonstrated significant cortisol reaction and 55,6% for males ($\chi 2 = 0{,}767$, $p > 0{,}05$). The gender differences were not statistically significant.

Four types of cortisol stress reactivity were identified (Table 2).

Table 2. Cortisol stress reactivity types (%).

Gender	SR(*): both experiments	SR: after first experiment	SR: after second experiment	No reactivity in both experiments
Males	37,0	24,1	18,5	20,4
Females	37,5	15,6	29,7	17,2

(*)SR=Significant Reactivity

The significant stress reactivity in cortisol level after first and second experiments was found for 37,0% males and 37,5% females, after first experiment only 24,1% and 15,6%,and after second experiment only 18,% and 29,7% correspondingly. 20,4% males and 17,2% females did not demonstrate any significant increasing cortisol level after both experiments. The significant correlation between cortisol level and previous experience of public speaking was not found.

In terms of subjective evaluation, data showed that, after both experiments, participants in general felt themselves more tense when compared with data obtained before experiments. This was not always associated with increasing cortisol level. The coping strategies were in general characterized by complexity and included several coping actions. The active adaptive actions were used more often ("I have been thinking how to resolve experimental tasks"). The passive less adaptive actions were also used by the participants but in less amount of cases. It is concluded that subjective perception of everyday stress could differ significantly from its physiological correlates (levels of cortisol).

3-2-Correlations between psychological and biological determinants in social stress situations

The research data on endocrine, physiological and psychological reactions in response to modeled situations led to the following statistically significant conclusions:

1. Modeled situations of everyday stressors did not induce significant stress reactions in all registered parameters. It was found that automatic (involuntary) characteristics of mental states were the most sensitive parameters demonstrating significant dynamics in experimental situations.

2. Monitoring the levels of subjective feelings such as *active, fresh, tension* could be considered as informative indicators of psychological stress and could be utilized in diagnostic and correction. These subjective feelings as a complex system accompanying with the feelings *calm, brave, satisfied* could be

considered as functional mobilizing manifestation in stress situations.

3-3-Personality factors, coping-strategies and cortisol reactivity in experimental stresses

The results of two-factor dispersion analysis did not highlight any significant correlation between gender, cortisol stress reactivity in both experiments and personality traits: extraversion, benevolence, openness to experience. A significant correlation was found between gender and cortisol stress reactivity in the second experiment and with conscientiousness (p=0.050). Cortisol stress reactivity in response to communication with opposite sex person was more significant for males with low and females with high level of conscientiousness. A significant correlation was also found between gender and emotional stability (p=0.006 in first experiment and p=0.004 in second experiment). The emotional stability for female subjects participants was lower than for male subjects.

It was found influence of extraversion on the frequency of using personal coping strategy: "I was trying to hold my emotions" in both experiments. High level of extraversion reduced frequency of using such coping.

Negative influence of conscientiousness on the frequency of using coping expressed as "I was hoping on the miracle to help me to resolve the tasks" was detected in the first experiment: the high level of conscientiousness reduced the frequency of using this coping. In the second experiment, the high level of conscientiousness reduced the frequency of using coping: "I was criticizing the investigator in my mind".

Positive correlation was found for benevolence and frequency of using coping "I have reduced the significance of the experiment" in first experiment: the high level of benevolence reduced the frequency of using this coping.

Negative correlation was found for emotional stability and frequency of using coping "I was criticizing myself" in second experiment: the high level of this personality trait reduced using this coping.

In the second experiment it was also found that the openness to new experience reduced the frequency of using coping "I have reduced the significance of the experiment".

Combined correlation was detected in the first experiment for conscientiousness and emotional stability and the frequency of using coping "I was trying to see the positive aspects for myself in experimental situations": the high level of conscientiousness increased the frequency of using this coping and, at the same time, high level of emotional stability reduced it.

3-4-Cortisol level, adverse childhood experience, dissociations, sensation seeking and achievement motivation

Negative significant correlations were found between levels of dissociation and achievement motivation for the participants who demonstrated significant cortisol level increasing after first experiment (p=0,014) and after second experiment (p=0,002).

Positive correlations were found between sensation seeking and achievement motivation (p= 0,013) and between dissociation and sensation seeking (p=0,009) for the participants with significant cortisol reaction after the second experiment.

The gender differences were found in adverse childhood experience. Female participants declared about the experience of sexual violence significantly more often (p=0,007); male participants more often declared about the alcohol or drug abuse of adults living with them (p = 0,035). Participants who had experience of living with adults with substance abuse more often demonstrated significant stress reactivity in response to public speaking task (p = 0,008).

3-5-Health risk behaviors

Relatively high prevalence of health risk behaviors was detected in the study sample without significant gender differences: active smoking (27,78% males and 21,88% females); alcohol use (72,22% males and 90,63% females); experience of drug use (66,67% males and 56,25% females); experience of sexually transmitted diseases (14,81% males and 18,75% females). The only statistically significant difference was found in the frequency of alcohol use. Unexpectedly, female participants were drinking alcohol more often than males (p = 0,021).

3-6-Non-verbal stress reactions in public speaking stress experiment

The technique and protocol developed by Puni (see § 2-4-10) to observe emotional states were used for observational data collection. Statistically significant increasing in the breathing frequency and sweatiness appeared during the second minute of speaking which was combined with tension in face muscles (eyes squeezing, winking etc.). The mimics were becoming more tense during 4 minutes. At the end of experiment, all participants demonstrated a decreasing of stress expressions in the voice (p=0,014).

Participants without cortisol stress reactivity significantly more often looked towards to the right side from the observer in comparison with the participants with cortisol stress reactivity (p=0,012). Participants with cortisol stress reactivity more often fixed the direction of their gaze ("look in one point") during public speaking. Female participants more often changed the

direction of their gaze in comparison with males. Head movements directed towards the video camera during speaking were observed for the majority of the participants. Head movements towards opposite direction were observed only in males. Arms movements towards opposite direction were observed only in males. Female participants were moving more often their arms away from their bodies. Males participants in general and specifically those with stress reactivity were characterized by abrupt pose changes (p=0,042). Arms movements were more monotonous for females, especially for those with stress reactions (p=0,028).

Male participants without cortisol stress reactivity less often widely open their eyes (p=0,031) and wrinkled the noses. Females with stress reactivity were more often raising the eyebrows and were less often drawing them together. The sighs were more common for the participants with stress reactivity (p=0,016).

A correlation between gender, stress reactivity and voice key was detected. Females without stress reactivity demonstrated higher voice key during public speaking (p=0,042). Results of two-factor dispersion analysis highlighted the gender influence on the level of speech characteristics expression. Statistically significant gender differences were found in all registered parameters except general behavioral characteristic and the frequency of changing static poses. Females were speaking louder, with more variety in intonations, with more clear articulation and high voice. Statistically significant gender differences were also highlighted for frequency of pose changes during the third minute of speaking: males were changing poses more often than females (p=0,008). Males with stress reactivity demonstrated more expressive dynamics in the intensity of nonverbal reactions. Females without stress reactivity during public speaking demonstrated smooth increasing in characteristics of mimic and pantomimic: the muscles were becoming more tense (p=0,022). The expressions of the emotional arousal in the voice at the same time were decreasing (p=0,007). Females with stress reactivity were coming back to comfortable pose up to 3 minutes later. (p=0,014), the speed and the volume of the voice smoothly were going down and the clearness was increasing during between 2^{ND} to 5^{TH} minute (p=0,004).

3-7-Limits

The main limits of this research concern fragmentary investigation of physiological parameters. They consist of express-diagnostics. Cortisol was the only neurochemical substance of stress used in the present study (for example, is well known hypothalamo-pituitary-adrenic system).

4-Conclusion

The proposed model of experimental stress is based on complex investigation of the cortisol level, psycho-physiological and mental parameters. The analysis of our experimental data supports the general consideration that stress reactivity is a characteristic stable enough to be manifested constantly in different stressful situations. Complex correlations between types of stress reactivity and self-assessment of mental state and used coping-strategies were identified. Important findings were discovered through the correlation between adverse childhood experience, health risk behaviors and level of stress reactivity. Assessment of cortisol level was confirmed as an objective parameter of stress level evaluation. Psychological and mental parameters were found much more subjective and mediated comprehensively. However, developing experimental model of human's micro stress and piloted methods for assessment were the main results of the present study (described in section 2). We also emphasized that the choice of psychometric tests and methods should be based on the specificity of the evaluation related to the experimental situations.

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Stress consequences

Sex Differences in Acute Stress Effects on Spatial Memory and Hippocampal Synaptic Neurochemicals

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Abstract

We determined whether sex differences are present in cognitive responses to acute stress. Adult male and female rats received 6 h of restraint stress and were tested on the spatial memory task, "object placement," 30 min. following restraint. Levels of PKMξ and GluR2, important for synaptic plasticity and maintenance of memory and for mediating synaptic activity, respectively, were measured in the hippocampus immediately following testing. Stressed males were impaired as compared to control males, but stress did not alter female performance. Levels of cytosolic, but not post synaptic density PKMξ, were highest in stressed females, and levels of PKMξ positively correlated with memory performance in stressed males. PSD GluR2 levels were not different among groups. These results show that females, but not males, exhibit cognitive resilience to an acute stress, and the pattern is similar to results of cognitive testing following chronic stress. Further research is necessary, but results suggest that a better understanding of sex differences in stress responses may inform the development of novel and more effective therapies for brain disorders which are precipitated by or related to stress and for dealing with stress in the workplace. They also advocate for the introduction of female members in teams operating complex technical systems (e.g. aircraft, space shuttles or nuclear reactors) to increase resilience to acute stress and thus their level of safety.

1- Introduction

Information is accumulating that stress does not elicit identical neural and behavioral responses in the sexes (Luine et al, 2007, 2016). These sex differences range from alterations in basic cellular responses to changes in higher order neural responses such as learning and memory abilities and mood. Including females as well as males in stress research is important because there are well-documented sex differences in humans for coping with chronic stress and in the incidence of stress-related diseases. For example, females have a higher incidence of anxiety disorders, post-traumatic stress disorder (PTSD) and major depression than males while males show greater levels of conduct disorders and substance abuse than females (Bangasser and Valentino, 2014; Weinberger et al, 2009).

In male rodents, chronic stress, as for example daily restraint or different daily stressors, generally impairs learning and memory. Following 1- 3 weeks of daily restraint stress, impairments are found in spatial memory tasks like the Morris water maze (Kitraki et al, 2004), eight arm radial maze (Luine et al, 1994), object placement (Beck and Luine, 1999; 2002; Gomez et al, 2012) and Y-maze (Conrad et al, 2003; Wright and Conrad, 2005; Gomez et al, 2013) and in non-spatial tasks such as object recognition (Beck and Luine, 1999; 2002; Bowman et al, 2009, Gomez et al, 2013) and temporal order recognition memory (Wei et al, 2014). Surprisingly, females show resilience to stress in some domains. When female rats or mice are given the same chronic stressors for the same period of time as males, they are not impaired, and performance on some tasks is enhanced. For example, on the Morris water maze (Kitraki et al, 2004), eight arm radial maze (Bowman, 2001), object placement (Beck and Luine, 1999, 2002; Bowman et al, 2009 and Y-maze (Conrad et al, 2003; McLaughlin et al, 2005) tasks, stressed females show better performance than control females. Female rodent performance is not affected by stress on object recognition (Beck and Luine, 199, 2002; Bowman et al, 2009; Gomez and Luine, 2014) or temporal order recognition memory tasks (Wei et al, 2014). Though few studies have included females, chronic stress is also associated with sex-specific alterations in brain areas important for learning and memory like the hippocampus and prefrontal cortex. Neural differences include morphological changes and expression of neurochemicals in glutamatergic and monoaminergic neurons (Luine et al, 2016; Sunanda et al, 2000).

Few studies have assessed the effects of acute stress on cognition, and most were conducted in males. Baker and Kim (2002) showed that inescapable restraint-tail shock stress for 1 h to males impaired object recognition when testing began 30 min post stress, a result similar to effects of chronic stress in males. Acute predator stress also impaired male rats on a radial arm water maze (Diamond et al, 1999).

Conrad et al (2004) investigated effects of 1 h of restraint stress on the spatial memory task, Y-maze, at 5 h post stress in both sexes. This acute stress, like chronic stress, produced opposite effects on the sexes with memory being impaired in males and improved in females. However, further research is necessary to verify whether acute stress is associated with different cognitive responses in the sexes.

The current study assessed the effect of an acute stress, 6 h of restraint in a plastic restrainer, on spatial memory using the object placement task. We also measured levels of protein kinase M zeta (PKMξ) and GluA2 (AMPAr subunit), in the hippocampus in order to determine whether changes in these proteins might underlie effects of stress on memory (Shao et al, 2012). PKMξ is important for synaptic plasticity and maintenance of memory, and GLuR2 is an important mediator of synaptic activity (Sacktor, 2011) and is altered following some stressors (Sebastian et al, 2013).

2- Material and methods

Young adult, male (N=16) and female (N=16), Sprague Dawley rats were randomly assigned to control or restraint, 6 h. They were housed in two/cage on a 12/12 light/dark cycle and received food and water *ad libitum.*

The stress group received 6 h of restraint in a plastic restrainer where they were not immobilized but had limited movement of heads and extremities (Bowman et al, 2009). Following a 30 min recovery period, subjects were tested on the object placement task (see below).

The object placement task assesses spatial memory (See Bowman et al, 2009 for details of testing). In the training trial (T1), rats explore two objects for 3 min. Following a 2 h inter-trial delay, one object is moved to a new location, and rats explore for 3 min, retention trial (T2). The exploration time is reported in sec for T1, and the exploration ratio, time at new location/total exploration time, is reported for T2. Exploration ratios of 0.5 indicate chance performance while ratios greater than 0.5 indicate that subjects discriminate between old and new locations and have established a memory for the old location.

Brains and sera were collected immediately following the memory test. Hippocampal tissue was homogenized and centrifuged to obtain cytosol and post-synaptic density (PSD) fractions, and western blot analysis measured protein levels of PKMξ and GLuR2 (Sebastian et al, 2013). Data was analyzed by two-way ANOVA and appropriate post hoc tests applied.

All procedures were approved by the Hunter College Institutional Animal Care and Use Committee.

3- Results

Fig. 1 shows results of object placement testing. No differences between groups in the training trial (T1) were present. In the retention trial (T2), control males significantly discriminated between the old and the new location, exploration ratios greater than 0.50, while control females did not, as has been found in previous studies (Luine et al, 2016). Acute restraint stress decreased male discrimination ratios but did not affect females, ratios of both control and stressed females were approximately 0.55. Control male ratios, 0.74±0.08, were significantly higher than stressed males, control females and stressed females.

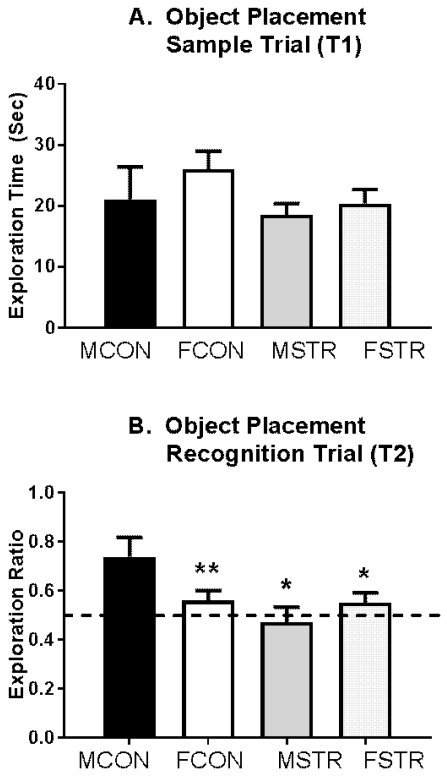

Figure 1: Effect of acute stress and sex on object placement performance.
Male and female rats were given 6 h of restraint stress and then at 30 min following the stress, they received a recognition memory training trial followed by retention tests 2 h later.
A. Total time exploring in the training trial (T1). No group differences were observed.
B. Mean exploration ratio in the retention trial (T2). Control males significantly discriminated, exploration ratio greater than 0.50, and ratios were significantly different from control females, stress females and stress males. Two-way ANOVA: Stress $p < 0.02$, stress x sex $P < 0.001$; LSD * $p < 0.02$, ** $p < 0.001$.

Levels of PKMξ zeta were measured in cytosol and post synaptic density fractions from the whole hippocampus of subjects immediately upon

completion of behavioral testing. In the cytosol fraction, stressed females had significantly higher levels of PKMξ than other groups, $p < 0.01$, but no differences between groups were found in the PSD fraction (Fig. 2). GLuR2 levels in the PSD fraction were not different between groups (Fig. 3). Correlations between the exploration ratio of all groups and neurochemicals were run. Only PKMξ in stressed males showed a significant correlation with higher PKMξ levels associated with better performance (higher exploration ratios), Fig. 4.

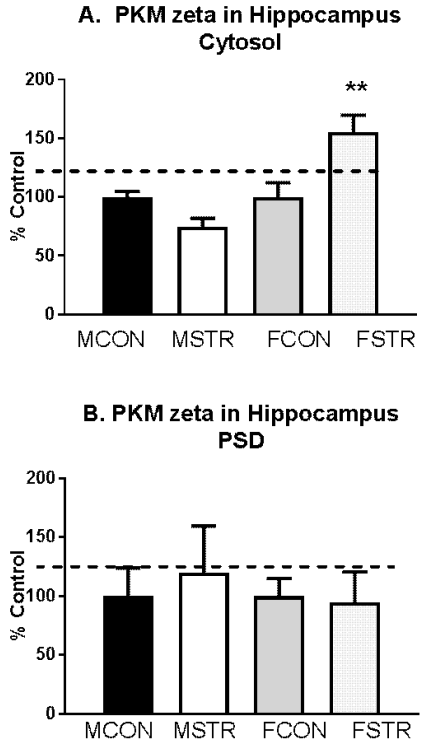

Figure 2: Effect of acute stress and sex on hippocampal PKMξ levels.
A. PKMξ levels in cytosol fraction was significantly higher in stress females as compared to other groups, $p < 0.01$, Student's t-test.
B. PKM zeta levels in PSD were not different between groups

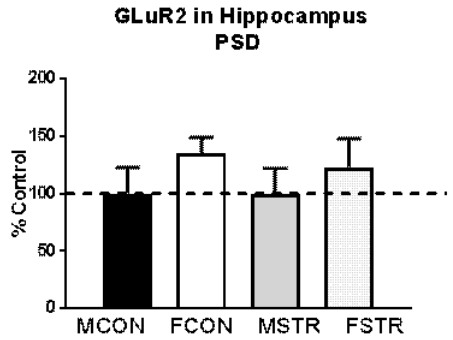

Figure 3: Effect of acute stress and sex on GLuR2 levels in hippocampus
GLuR2 levels were not different between groups.

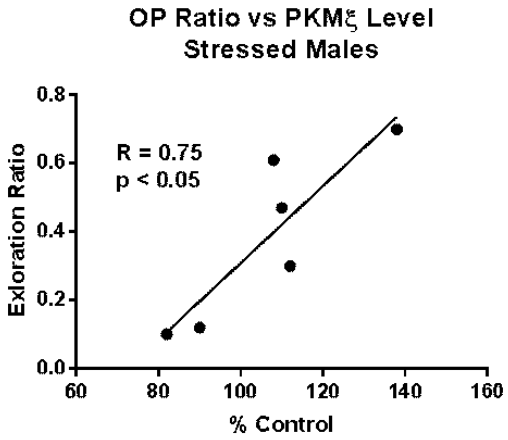

Figure 4: Relationship between object placement and hippocampal PKMξ.
In the stressed male group, a significant correlation between object placement exploration ratios and % control PKMξ was found, $p < 0.05$.

4- Discussion

Results show the novel finding that an acute stress is associated with an impairment in object placement memory in male but not female rats. Thus, females appear to show resilience to acute stress, similar to findings following chronic stress. When rats receive daily restraint for three weeks, males are impaired in object placement as compared to controls while stressed females show enhanced performance (Beck and Luine, 1999; 2002). This pattern of chronic stress induced cognitive impairments in males and resilience in females is found in other spatial memory tasks including the radial arm (Bowman et al, 2001; Luine et al, 1994), water (Kitraki et al, 2004) and Y-maze (Conrad et al, 2003; Wright and Conrad, 2005; McLaughlin et al, 2005) tasks. While current results are the first demonstration of a sex difference following acute stress in object placement memory, Conrad et al (2004) reported that effects on another spatial memory task were similar to results reported here: acute restraint impaired male and improved female Y-maze performance. In contrast, Wood and Shors (1998) found sex differences in eye-blink conditioning following acute stress, but males were facilitated and females were impaired. A few other studies have shown impaired memory in males on memory tasks following acute stressors (Baker and Kim, 2002; Diamond et al, 1999), but females were not investigated. Thus, further research is necessary to determine whether sex differences are present in cognitive responses to acute stress.

We focused on measuring PKMζ and GluA2 as they are important synaptic markers involved in the consolidation of memory and can be modulated by stress (Sebastian et al, 2013). As the trafficking of the GluA2 receptor subunit to the PSD95 increases during episodes of synaptic plasticity and memory,

clusters of PKMζ/GluA2/PSD95 proteins have been identified (Shao et al, 2012), which prevent the AMPA receptors from undergoing endocytosis and contribute to memory consolidation (Sacktor et al, 2011). Current results showed no differences between groups in PKMζ in the PSD, but stressed females had higher levels of PKMζ in the hippocampal cytosol than control females, control males and stressed males. Increased PKMζ in stressed females may contribute to maintenance of memory in this group. The positive correlation between exploration ratios and PKMζ levels in stressed males also suggests that higher PKMζ levels promote memory. In contrast, no differences in PSD GluA2 levels among the groups were found suggesting that differences in trafficking of this receptor to the PSD may not contribute to stress-induced changes in spatial memory immediately following stress.

Whether current results translate to humans is currently unclear since few students have assessed effects of acute stress on cognition in humans. Wolf (2011), in reviewing this literature, concluded that for episodic memory some evidence exists that women compared to men are sometimes less susceptible to stress or cortisol treatment, a pattern similar to the current results. In contrast, stress impaired eye blink conditioning performance in both sexes (Wolf et al, 2009) which is a different pattern from rats (Woods and Shors,1998). Recently, Guenzel et al (2014) examined the effect of a socially evaluated cold pressor test on stimulus-response learning and memory and on spatial memory in humans. This acute stress impaired stimulus-response memory performance in men but not in women. Conversely, spatial memory was impaired by stress in women but not in men. Thus, as in animal studies, further studies are needed to determine the extent to which sex differences in cognitive responses to stress are present in humans. Such studies are important for understanding and treating stress related diseases which show sex differences in incidence such as anxiety disorders, PTSD, major depression, conduct disorders and substance abuse (Weinberger, 2009).

If the present results are confirmed, such studies may also advocate the introduction of female members in teams piloting complex technical systems such as aircraft, space shuttles or nuclear reactors. In other words, while to date such systems are operated by teams with, on average in US, fewer than 12% of its members being female (Landivar, 2013), increasing this proportion might increase team resilience to acute stress and subsequently increase the level of safety of the systems. Moreover, with increased incidences in workplace stress and social violence, determining whether sex contributes to stress responses is even more critical.

5- Conclusions

The current study showed that following an acute stressor, 6 h of restraint, object placement memory decreased in stressed as compared to control male rats while no effect of stress was noted in female rats. Elevated levels of PKMζ may contribute to maintenance of spatial memory in both sexes. Further experiments in both sexes are necessary to confirm and extend results of this study, but they may be important for understanding the etiology and treatment of stress-related mental disorders and for dealing with stress in the workplace. They also advocate the introduction of female members in teams operating complex technical systems (e.g. aircraft, space shuttles or nuclear reactors) to increase resilience to acute stress and thus safety levels.

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Stress consequences

Association of Perceived Stress, Opioid Craving, Anxiety and Depression with Retention in Naltrexone Treatment with and without Guanfacine among Opioid Users

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Abstract

Psychosocial stress at work may induce drugs addiction as well as stress induced by unemployment. Many countries7 are concerned with this issue. In Russia, opioid use disorders are a major public health problem, the main difficulty related to treatments being relapse risk. Relapse risk is associated with increased stress- and drug cue-induced craving. The preliminary clinical trial of α-2 receptor agonist guanfacine on relapse risk showed reduction of stress-induced and cue-induced drug craving and arousal. The current study evaluated the impact of stress, opioid craving, anxiety and depression on retention in addiction treatment (oral naltrexone with or without guanfacine) among opioid users. Participants (n=301) were randomly assigned to 4 treatment group: oral naltrexone 50 mg/day + guanfacine 1 mg/day (N/G), naltrexone+ guanfacine placebo (N/P), naltrexone placebo + guanfacine (P/G) and double placebo (P/P). The active treatment period was 6 months and includes visits every 2 weeks. All participants were assessed repeatedly during the study course for perceived stress, opioid craving, alcohol use, anxiety and depression. We compare the psychometric variables in the last visit before drop out in non-retainers and matching visit in retainers. Mixed ANOVA was utilized that considered of two treatment groups (N/G+P/G and N/P+P/P) and time point of the drop out as independent variables, and psychometric data as dependent variable. No differences in depression and craving were observed between those who dropout and retained in both treatment groups. However small effects on retention were observed in anxiety and perceived stress scores at 2 month time point of treatment period. Interestingly, there was no correlation between stress and craving after 2 months. Taking together, data suggested the effect of anxiety and stress on retention in the addiction treatment at the later time points in treatment.

1-Introduction

Psychosocial stress at work may induce drugs addiction especially when subjects' profession provides ready access to substances of abuse as in healthcare environment, furthermore contributing to a greater risk of relapse (Earley et al., 2017). If workers under stress are concerned by this issue, jobless people are also affected. Many studies have demonstrated the influence of unemployment on drug use, mainly through increase psychosocial distress while the subsequent decreased income does not decrease drug use. The recent review of Nagelhout et al. (2017) showed that this phenomenon affects many countries.

In Russia, opioid use disorders (OUD) are a major public health problem. In 2016 the prevalence rate of hospitalization for OUD was 18.2 per 100.000 persons (Kirzhanova et al., 2017). The most important problem in the treatment of opioid drug users is high relapse rate after detoxification probably due to the lack of interest, poor compliance with prescribed treatment (Krupitsky et al., 2004, 2016), limitation in capability to provide full range of evidence-based practice including ban of opioid agonist therapy (OAT) as a maintenance therapy and need of patients to pay for medications out of their pocket. Thus, all these factors may lead to relapse in early abstinent period after hospitalization.

The nature of addiction may also explain the lack of efficacy of existing treatment. It is well known that addiction is a chronic relapsing disease. Neurobiological studies have shown that repeated drug exposure modulated dopaminergic neurotransmission in the brain reward pathways and stress reactivity, and then lead to "sensitization" to the drug and stress exposures which represented as a key elements of compulsive drug seeking (Koob & Mason, 2016). Animal models of drug reward have shown that drug seeking and consumption behavior can be triggered by a stressor (Nair et al., 2009). Moreover, Sinha et al. (2001) in the literature review suggested that the dysregulated stress responsivity on the stress exposure during abstinent period lead to drug relapse through

following mechanisms: enhanced conditioned emotional responding, drug craving and lack of coping. Taking together, stress response and negative emotional state could be reasons for relapse and therefore should be considered as potential targets for the pharmacological treatment of addiction.

Clinical trial of the alpha-2 adrenoreceptor agonist guanfacine among cocaine drug users shown effectiveness in decreasing cue-induced cocaine craving, anxiety and arousal (Fox et al., 2012). An open trial of guanfacine shown improvement of control-related processes in patients with attention-deficit hyperactivity disorder (Hunt et al., 1995). Preliminary results from the clinical trial of the alpha-2 adrenoreceptor agonist lofexidine used as an adjunct medication to naltrexone in opioid addicts have suggested potential anticraving effect of lofexidine and have shown lower relapse rates compared to naltrexone only group (Sinha et al., 2007).

The goal of this study is to evaluate the influence of perceived stress, anxiety, depression and craving on the treatment dropout in a double-blind, double-dummy, placebo-controlled clinical trial of naltrexone (50 mg/day) and guanfacine (1 g/day) (Krupitsky et al., 2013) .

2-Methods

2-1-Study design

This was a longitudinal, secondary data analysis using baseline and follow-up data from a double-blind, double-dummy, placebo-controlled 24-week study (NIH Grants #5R01DA018863-04 "Heroin Addiction Treatment: Naltrexone and Adrenergic Agents" (Krupitsky et al., 2013)) in which patients were randomly assigned into 4 treatment groups: naltrexone 50 mg/day and guanfacine 1 mg/day (N/G); naltrexone placebo and guanfacine (P/G); naltrexone and guanfacine placebo (N/P) and double placebo group (P/P).

2-2-Participants

Patients (male and female) were eligible to participate in the study if they were: 1) meet criteria for opioid dependence based on DSM-IV for at least a year; 2) demonstrated the abstinence from any psychoactive substances for at least one week (confirmed by alcohol breath test and urine drug tests); 3) at least one relative willing to participate in treatment and monitor medication adherence and assist in follow-up; 4) a stable address within the St. Petersburg/Leningrad Region; 5) a home telephone number at which he/she could be reached; 6) if female, a negative pregnancy test and willingness to use adequate contraception; 7) demonstrated ability to give informed consent and 8) 18-50 years of age. Potential participants were excluded from the study if they had a current major axis I psychopathology other than opioid dependence; had a primary diagnosis of any advanced somatic disorders; had a significant abnormality in blood laboratory tests. Current participation in another treatment study or concurrent treatment in another substance abuse program also was exclusionary.

Recruitment, data collection and treatment details are described in the primary outcome paper (Krupitsky et al., 2013).

2-3-Measures

For the present analysis, perceived stress were assessed with the Perceived Stress Scale (PSS; range 0-56) (Cohen et al., 2016). Opiate craving was assessed with 10-point visual analog scale (VASC). Anxiety assessment was made with the Spielberger State-Trait Anxiety Test (SSTAT) (Hanin & Spielberger, 1983). Depression assessment was made with the Beck Depression Inventory (BDI) (Beck et al., 1961).

2-4-Data analyses

The data were double entered and analyzed with SPSS (version 17). For the present analysis, we used a subset of the dependent variables collecting during the study because of our focused interest in the effect of perceived stress, craving, anxiety and depression on dropout during 24 weeks of guanfacine (N/G and P/G) and guanfacine placebo (N/P and P/P) treatment period. All variables were tested for normal distribution using the Kormogolov-Smirnov criteria. Preliminary analyses were performed to endure no violation of the assumptions of normality, linearity and homoscedasticity. We perform descriptive statistical analysis of the treatment engagement (% of participants who completed study visit and % of dropouts), mean scores of PSS, craving, anxiety and depression in 4 treatment groups at each visit. To assess the possibility that the PSS might act as a proxy for psychological variable, we conducted Pearson correlation to examine the association between perceived stress, depression, anxiety and craving. The analyses examine the relations between changes in retention status from one follow up visit to the next and changes in stress, anxiety, depression and craving as dependent variables in the same lag. Continuous data were examined by mixed model analysis of variance, Mixed ANOVA: main group (e.g. treatment guanfacine versus guanfacine placebo), main endpoint (e.g. retention or dropout) and Group X Endpoint interaction. We conduct analyses with psychometric variable on initial visit as the covariate, retention status as the independent variable, and psychometric variable at the latter visit as the dependent variable. We use this approach to explore the impact of the dropout on the psychometric differences between the groups during the lag time. The lag time is the time between completion of a questionnaire and the relapse event which followed it (2 weeks). Therefore, in our analysis we observe 12 lag time

periods since baseline to 24 weeks. Tests were considered significant at $p<0.05$.

3-Results

Of 301 participants, 82.4 % were male. The average age was 28.26 (SD=4.36) years old with an overall range between 19 and 40. There were no statistically significant differences between the treatment groups in the gender, age, employment status and baseline scores of PSS, craving, anxiety and depression.

There were not significant differences between four treatment groups in treatment engagement as determined by the percentage of participants who had completed treatment appointment through the 24-week study period (Figure. 1).

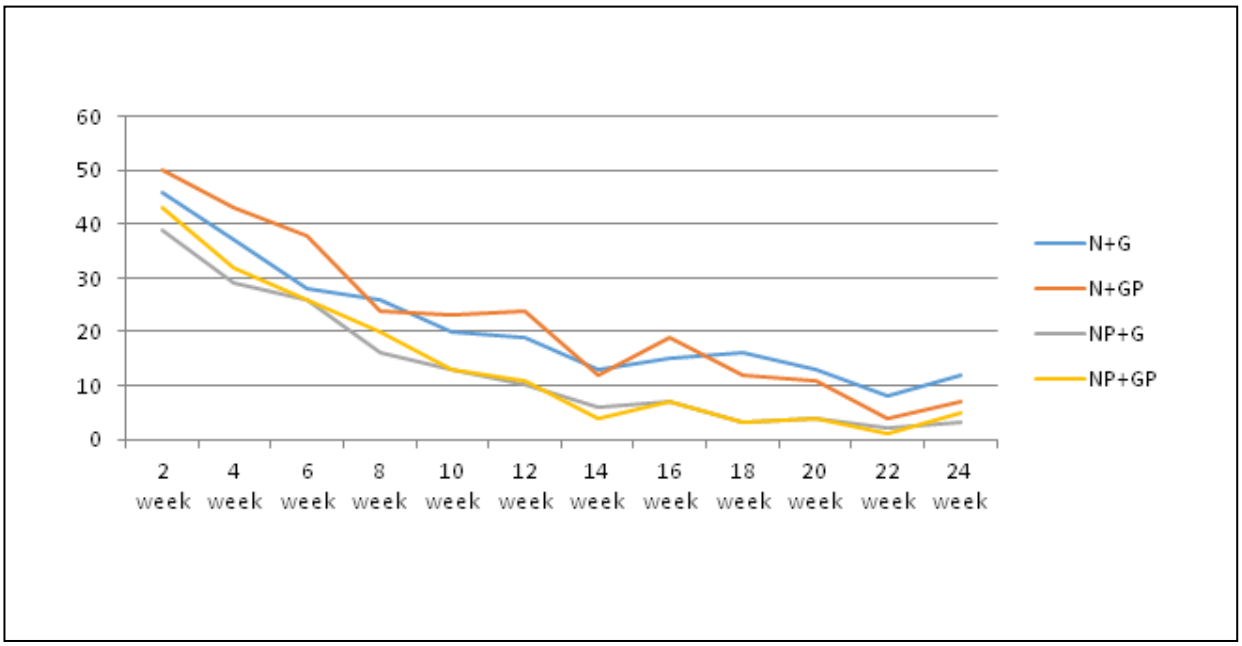
Data analysis revealed the correlations between PSS score and psychological variables on each study visit (Table 1).

Table 1. Correlations between perceived stress and psychometric variables in total sample during the study periods.

	PSS-BDI	PSS-state anxiety	PSS-trait anxiety	PSS-craving
Baseline, n=301	0.409**	0.405**	0.336**	0.125*
2 week, n=178	0.572**	0.595**	0.546**	0.310**
4 week, n=141	0.529**	0.648**	0.566**	0.318**
6 week, n=118	0.567**	0.716**	0.711**	0.353**
8 week, n=86	0.566**	0.751**	0.766**	NS
10 week, n=69	0.623**	0.756**	0.797**	NS
12 week, n=64	0.474**	0.588**	0.623**	NS
24 week, n=27	0.519**	0.537**	0.665**	NS

Note: PSS – perceived stress score, BDI – Beck Depression Inventory. NS – not significant. * $p<0.05$, ** $p<0.01$

Figure 1. Treatment engagement in treatment groups on each study visit.



Overall, BDI (depression), STATI (personal or trait anxiety) and STATA (state anxiety) scores were significantly related to PSS score during the study (higher score of depression and anxiety associated with higher score of perceived stress), however craving was associated with PSS only in the beginning of the study (baseline, 2-, 4- and 6- week visits).

There were correlations between PSS and anxiety, depression and craving scores separately in groups treated with guanfacine (N/G and P/G) and with guanfacine placebo (N/P and P/P). Interestingly, on the baseline and on 6-week visits craving was significantly correlated with PSS in guanfacine group, but not in guanfacine placebo group. Trait anxiety was correlated with PSS on each study visit in both treatment groups with one exception; there was no correlation of PSS and trait anxiety on week 12 in guanfacine group (Table 2).

ANOVA significant differences were (Table 3):

- In PSS on 8 weeks between those who dropped out of visit 10 weeks and those who remained in study in guanfacine group and in the similar categories in guanfacine placebo group (mean±SD, 24.9±6.5 vs. 18.3±6.3 vs. 19.4±8.5 vs. 21.2±8.2, $p<0.05$); between guanfacine and guanfacine placebo groups on week 10 (18.5±6.9 vs. 23.3±7.4; $p<0.05$); and in PSS on 14 weeks between those who dropped out of visit 16 weeks and those who remained in study in guanfacine group and in the similar categories in guanfacine placebo group (mean±SD, 19.0±4.1 vs. 19.0±4.1 vs. 21.6±8.5 vs. 20.5±5.8, $p<0.001$);
- In STATI (personal or trait anxiety) and STATA (state anxiety) on 8 week between those who dropped out of visit 10 weeks and those who remained in study in guanfacine group and in the similar categories in guanfacine placebo group (STATI: 45.7±9.4 vs. 36.7±7.4 vs. 40.82±9.0 vs. 41.38±11.3; $p=0.05$ and STATA: 10.2±8.6 vs. 5.7±8.0 vs. 6.9±7.5 vs. 6.5±7.8; $p=0.05$);
- In STATA on 10 week between guanfacine and guanfacine placebo groups ($p<0.05$) and STATA on week 8 between those who dropped out of visit 10 weeks and those who remained in study ($p<0.05$).

Table 2. Correlations between perceived stress and psychometric variables during the study periods in 2 treatment groups: guanfacine (N/G and P/G) and placebo guanfacine (N/P and P/P).

		PSS-state anxiety	**PSS-trait anxiety**	**PSS-BDI**	**PSS-craving**
Baseline	N/G+P/G, n=150	0.471**	0.376**	0.371**	0.163*
	N/P+P/P, n=150	0.361**	0.306**	0.450**	NS
2 week	N/G+P/G, n=85	0.558**	0.445**	0.487**	0.336**
	N/P+P/P, n=93	0.627**	0.634**	0.641**	0.287**
4 week	N/G+P/G, n=66	0.650**	0.589**	0.518**	0.323**
	N/P+P/P, n=75	0.647**	0.560**	0.535**	0.299**
6 week	N/G+P/G, n=54	0.752**	0.665**	0.622**	NS
	N/P+P/P, n=64	0.689**	0.743**	0.526**	0.415**
8 week	N/G+P/G, n=42	0.778**	0.697**	0.455**	NS
	N/P+P/P, n=44	0.733**	0.812**	0.669**	NS
10 week	N/G+P/G, n=33	0.748**	0.779**	0.580**	NS
	N/P+P/P, n=36	0.721**	0.807**	0.626**	NS
12 week	N/G+P/G, n=29	0.417*	NS	0.313	NS
	N/P+P/P, n=35	0.698**	0.773**	0.587**	NS
24 week	N/G+P/G, n=15	0.520*	0.777**	0.620*	NS
	N/P+P/P, n=12	0.582*	0.631*	0.474	NS

Note: PSS – perceived stress score, BDI – Beck Depression Inventory. NS – not significant. * $p<0.05$, ** $p<0.01$

Table 3. Comparisons of BDI, STATA, STATI, craving and PSS scores between groups: continuing treatment vs. last measure before dropout.

Time point	Group	Endpoint						ANOVA	
		before dropout			continued treatment				
BDI		N	Mean	SD	N	Mean	SD		F
baseline	N/G+P/G	65	17,35	7,81	85	18,94	8,80	endpoint	1,50
	N/P+P/P	57	19,18	9,38	93	20,12	09,03	group	2,10
								groupXendpoint	0,10
2 week	N/G+P/G	23	12,70	9,27	59	12,32	7,74	endpoint	0,09
	N/P+P/P	14	13,14	7,37	72	12,53	8,83	group	0,04
								groupXendpoint	0,01
4 week	N/G+P/G	10	9,00	6,48	51	8,43	7,82	endpoint	2,05
	N/P+P/P	13	14,08	7,83	58	9,50	7,93	group	2,92
								groupXendpoint	1,24
6 week	N/G+P/G	11	8,27	11,36	37	5,95	5,42	endpoint	0,01
	N/P+P/P	12	5,25	5,21	40	7,25	8,49	group	0,23
								groupXendpoint	1,45
8 week	N/G+P/G	10	10,20	8,57	27	5,70	7,98	endpoint	1,42
	N/P+P/P	11	6,91	7,45	24	6,50	7,82	group	0,37
								groupXendpoint	0,98
10 week	N/G+P/G	6	3,00	2,37	24	6,63	9,60	endpoint	0,07
	N/P+P/P	11	10,27	12,38	25	8,04	6,97	group	2,84
								groupXendpoint	1,29
STATA									
baseline	N/G+P/G	65	49,31	8,72	85	48,01	8,24	endpoint	0,15
	N/P+P/P	58	48,55	11,04	93	49,00	9,88	group	0,01
								groupXendpoint	0,62
2 week	N/G+P/G	23	45,57	11,45	59	44,36	10,18	endpoint	0,09
	N/P+P/P	14	44,57	9,35	72	44,61	10,48	group	0,03
								groupXendpoint	0,10
4 week	N/G+P/G	10	40,00	6,58	51	38,49	10,26	endpoint	0,94
	N/P+P/P	13	45,00	7,94	58	42,00	10,73	group	3,34
								groupXendpoint	0,10
6 week	N/G+P/G	11	43,27	11,28	37	38,43	10,66	endpoint	0,26
	N/P+P/P	12	38,25	8,38	40	40,43	11,77	group	0,34
								groupXendpoint	1,81
8 week	N/G+P/G	10	10,20	8,57	27	5,70	7,98	endpoint	5,29*
	N/P+P/P	11	6,91	7,45	24	6,50	7,82	group	0,02
								groupXendpoint	3,98*
10 week	N/G+P/G	6	31,67	8,82	24	38,67	10,33	endpoint	0,38
	N/P+P/P	11	45,18	16,81	25	42,36	10,46	group	6,53**
14 week	N/G+P/G	17	0,41	0,71	17	0,41	0,71	endpoint	0,56
	N/P+P/P	15	0,87	2,17	17	0,76	2,05	group	0,69

Table 3 (continuation)

Time point	Group	Endpoint						ANOVA	
		before dropout			continued treatment				
STATI									
baseline	N/G+P/G	65	48,68	8,65	85	47,06	9,22	endpoint	0,20
	N/P+P/P	58	47,95	9,47	93	48,60	9,14	group	0,14
								groupXendpoint	1,12
2 week	N/G+P/G	23	43,74	10,60	59	43,56	8,47	endpoint	0,09
	N/P+P/P	14	43,93	9,01	72	45,15	9,35	group	0,26
								groupXendpoint	0,16
4 week	N/G+P/G	10	40,20	4,10	51	41,35	7,94	endpoint	0,31
	N/P+P/P	13	45,31	8,32	58	41,88	10,27	group	1,87
								groupXendpoint	1,24
6 week	N/G+P/G	11	44,45	12,86	37	40,05	7,07	endpoint	1,07
	N/P+P/P	12	40,92	7,17	40	40,83	10,10	group	0,41
								groupXendpoint	0,98
8 week	N/G+P/G	10	45,70	9,37	27	36,70	7,39	endpoint	3,02
	N/P+P/P	11	40,82	9,00	24	41,38	11,30	group	0,00
								groupXendpoint	3,86*
10 week	N/G+P/G	6	36,67	6,44	24	40,00	7,18	endpoint	0,06
	N/P+P/P	11	43,64	12,50	25	41,52	8,84	group	2,73
								groupXendpoint	1,12
Craving									
baseline	N/G+P/G	65	3,70	2,69	84	2,74	2,74	endpoint	1,34
	N/P+P/P	58	3,31	2,76	93	3,53	2,66	group	0,40
								groupXendpoint	3,44
2 week	N/G+P/G	23	2,46	2,62	59	1,56	2,14	endpoint	1,23
	N/P+P/P	14	1,86	2,63	72	1,78	2,27	group	0,19
								groupXendpoint	0,86
4 week	N/G+P/G	10	1,10	1,52	51	1,08	2,01	endpoint	3,24
	N/P+P/P	13	2,73	2,39	58	1,12	1,89	group	3,38
								groupXendpoint	3,07
6 week	N/G+P/G	11	1,51	2,99	37	0,82	1,86	endpoint	0,49
	N/P+P/P	12	1,11	1,87	39	1,10	2,07	group	0,02
								groupXendpoint	0,46
8 week	N/G+P/G	10	1,45	2,01	27	0,81	2,02	endpoint	2,56
	N/P+P/P	11	1,88	2,77	22	0,79	1,71	group	0,14
								groupXendpoint	0,18
10 week	N/G+P/G	6	0,00	0,00	23	1,11	2,31	endpoint	0,33
	N/P+P/P	11	1,45	2,58	25	1,02	1,65	group	1,34
								groupXendpoint	1,71
14 week	N/G+P/G	17	0,41	0,71	17	0,41	0,71	endpoint	0,56
	N/P+P/P	15	0,87	2,17	17	0,76	2,05	group	0,69
								groupXendpoint	0,00***

Table 3 (continuation)

Time point	Group	Endpoint						ANOVA	
		before dropout			continued treatment				
PSS									
baseline	N/G+P/G	65	28,02	5,74	85	27,85	5,97	endpoint	0,42
	N/P+P/P	58	27,88	6,80	92	27,08	6,79	group	0,37
								groupXendpoint	0,18
2 week	N/G+P/G	23	24,09	7,28	59	23,03	7,16	endpoint	0,81
	N/P+P/P	14	24,71	6,24	72	23,26	7,55	group	0,10
								groupXendpoint	0,02
4 week	N/G+P/G	10	21,20	5,03	51	20,08	6,20	endpoint	1,02
	N/P+P/P	13	24,69	5,20	58	22,64	7,77	group	3,71
								groupXendpoint	0,09
6 week	N/G+P/G	11	19,27	9,21	37	19,70	6,39	endpoint	1,02
	N/P+P/P	12	21,17	4,57	40	19,50	8,51	group	3,71
								groupXendpoint	0,09
8 week	N/G+P/G	10	24,90	6,47	27	18,33	6,34	endpoint	1,56
	N/P+P/P	11	19,36	8,45	24	21,17	8,18	group	0,50
								groupXendpoint	4,81*
10 week	N/G+P/G	6	17,67	6,15	24	19,25	7,40	endpoint	0,71
	N/P+P/P	11	21,91	8,61	25	23,92	6,90	group	4,35*
								groupXendpoint	0,01
14 week	N/G+P/G	17	19,00	4,11	17	19,00	4,11	endpoint	6,90**
	N/P+P/P	14	21,64	5,12	16	20,50	5,84	group	2,53
								groupXendpoint	0,00***

4-Concluding discussion

Overall, the data provide no support the hypothesis that anxiety, depression or craving scores have an influence on the retention in both treatment arms: guanfacine (N/G and P/G) and placebo guanfacine (N/P and P/P). However, the results suggested the negative role of state and personal anxiety at 8 week and perceived stress at 8 and 14 weeks on retention, but the effects were small.

In addition, guanfacine and guanfacine/naltrexone maintenance demonstrated a moderate positive impact on stress on week 10. Previous study by Sinha et al (2007) in opioid addicts demonstrated that lofexidine/ naltrexone treatment is effective at increasing abstinence rates and reducing stress-induced craving response. Data from our study showed no evidence to efficacy of guanfacine as an adjunct treatment of opiate dependence. However, further research should address understanding of guanfacine effect on the long-term remission which we could not evaluate due to high rates of dropouts.

Finding supports the suggestion that perceived stress is significantly correlated with state and trait anxiety and depression. However for the later stages of the treatment period the correlation strength was moderate between PSS and personality traits in both guanfacine and guanfacine placebo treatment groups. No significant correlations were found between PSS and craving since the 2-month time point that might be explained by the high dropout rates due to the high craving score.

The strengths of the study are the within-subjects, repeated-measures design of randomized placebo-controlled study included several in-person visits and the assessment battery of validated scales. Despite the advantages of a longitudinal controlled study design, a major drawback is the high dropout rate. The missing data due to dropout considered as a main issue for the detection important interaction due to small numbers in the comparison groups. Future research should actively use the strategies to achieve the higher participation rate in order to cope with missing data, especially on the initial period of the treatment.

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Stress Management

Modeling Heart Rate Vs Short Term Mental Stress Indicators

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Abstract

A model describing heart rate versus stress indicators was developed for healthy adult subjects under short term mental stress, whatever the type of stress indicator chosen to give account for the level of stress. The model was validated when applied to six different stress indicators (EMG, GSR, Work Load, multiquestionnaire, STAI-S and ALES) widely used by the scientific community. The validation method was based on data from 8 different studies involving 295 healthy adult subjects. The model was then used to test the consistency of a new stress indicator recently developed for short term mental stress. This showed that, beyond modeling heart rate versus stress indicators, it can be used as a assessment tool for stress indicators.

1-Introduction

Many fields of research have identified and studied mental stress as a crucial factor of influence or consequence: for example mental stress may affect performance or social interaction, may cause or be a consequence of pathologies; it is also studied when combined with tiredness or related to sleepiness. Different kinds of mental stress were identified, mainly chronic stress and short term stress (or acute stress). Both are encountered in the world of work, the former being sometimes the consequence of a repeated exposure to the latter. Understanding how occupational stress occurs has become a crucial challenge. At the same time and consequently, measuring levels of stress is a necessity.

Two ways have mainly been developed for stress state assessment: subjective through questionnaires or objective through physiological measurements. Considering studies available in the literature, we found that the response of healthy subject in terms of average heart rate presented a typical power curve shape varying with increasing stress, stress being objectified by an indicator such as the difficulty of the context or an indicator such as the workload or the assessment of a perceived stress; in case of short-term mental stress, the shape of the curve between the average heart rate HR (Heart Rate) and the stressor indicator S could be seen as $HR \propto S^a$ where a was a positive number smaller than 1 in case of healthy subjects under short term mental stress. This finding let us thought that, in case of healthy adult subjects submitted to short term mental stress, there might be a generalized relationship between the average heart rate considered as a physiological response to the stress, relationship independent from the kind of stressor but depending on its intensity. Such a correlation was already assumed by Levy et al. (1998) but did not give rise to a model. If such a relationship could be found, this might contribute to the assessment of new stress indicator for short-term mental stress.

2-Methods

The method consisted in working the hypothesis of pattern by gathering data providing HR and ratio of frequency power of HRV (Heart Rate Variability) for different conditions of short term mental stress. To develop the model, 10 studies were found, involving 202 subjects and providing N=32 points. Among these studies, only those regarding healthy subjects were considered, implying sometimes to select only data of the control group of the study.

The resulting correlation was then used to formulate a mathematical expression of the hypothesis of pattern shaping the model. The model was then assessed by testing its reliability when applied to HR variation versus different types of stress indicators widely used by the scientific community. To assess the model, 8 studies providing HR vs different types of stress indicators (EMG, GSR, Work Load, questionnaires such as STAI-S, ALES) with data respecting the conditions for applying the model (healthy subjects, short term mental stress) providing 24 points spread into 8 samples of subjects (one per study) and gathering altogether 295 healthy adult subjects; when studies considered two cohorts of subjects, one made up of healthy subjects and the other made up of subjects with pathologies or psychological problems, only the healthy cohort was considered.

The six different stress indicators over eight different studies were:

- The Work Load (Nahlinder, 2009; Cinaz et al., 2010), self-assessed by subjects through the NASA Task Load Index (TLX) (Hart & Stavenland, 1988),
- The stress of muscles measured through EMG (Fallali et al., 2016; Lundberg et al., 1994),
- The skin resistivity measured through GSR (Sun et al., 2010),
- The stress state self-assessed through a multiquestionnaire developed by the authors (Lundberg et al., 1994),
- The stress state self-assessed through the STAI-S (Berger et al., 2016) of Spielberger (1983),
- The Appraisal Life Event Scale (Berton et al., 2015).

After validation, the model was used to test the consistency of a new stress indicator recently developed for short term mental stress and based on physiological considerations. In a previous study (Fauquet-Alekhine et al., 2012), it was considered that, as the mean heart rate as well as the maximum heart rate increase under stress, a relevant indicator of the level of short term mental stress could be the product of the mean heart rate HR_{mean} and the difference between the maximum and the mean heart rate, $HR_{max} - HR_{mean}$. The new stress indicator was thus:

$$K = HR_{mean}\ (HR_{max} - HR_{mean}) \qquad (1)$$

The assumption was that if the stress indication expressed in (1) was not matched by the model conversely to other stress indicators widely used in the scientific community, then this indicator was not adapted to give account for short term mental stress. For this aim, cardiac variables were measured for healthy adult subjects (N=46, 48% male, mean age 28.6 years old) in stressful conditions using a Polar FS2c (accuracy for time measurement: better than ±2.0s/24h; accuracy for heart rate measurement: ±1% or ±1bpm, whichever larger; measuring range: 15-240 bpm). Subjects were divided in two cohorts: anesthetists (N_a=28, 46% male, age range: 24 to 35 years old) involved in different simulation training situations as described by Berton et al. (2015) and nuclear engineers (N_n=18, 50% male, age range: 23 to 36 years old) taking a psychotechnical test as described by Fauquet-Alekhine et al. (2012). The values calculated for K ranged from 350 to 4760, the higher value of K the higher level of stress.

3-Results

With N=32 points from 10 studies, the power curve shape was characterized and a value for the exponent was found (Fig. 1).

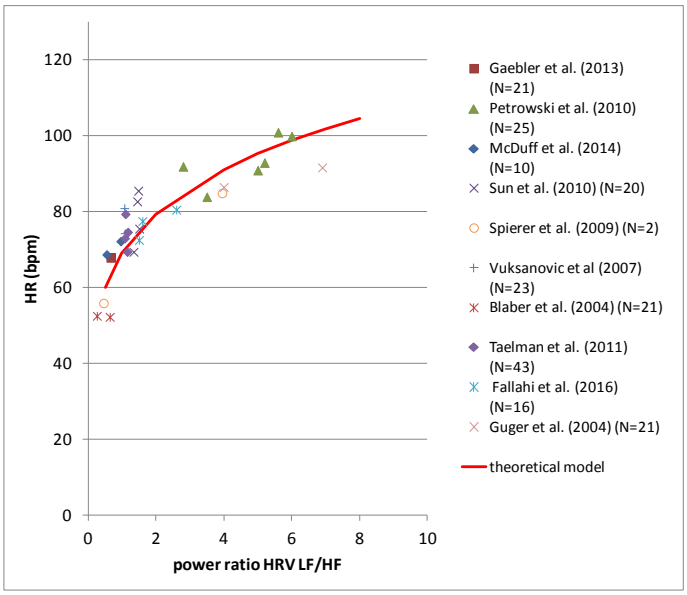

Fig. 1. Power curve between HR and HRV.

The correlation obtained gave $r(N=32)=0.88$ ($p<0.0001$) for a=0.2. Mathematical developments (see details in Fauquet-Alekhine et al., 2016) led to the model:

$$HR = kS^a + c \qquad (2)$$

with:

$$k = {}^{\alpha}\!/_{a\ S_1^{(a-1)}} \qquad (3)$$

and:

- α is the slope of the linear approximation when S tends to zero
- a = 0.2 is the coefficient obtained through the shaping correlation
- S_1 is a constant to be adjusted regarding the range of experimental data covered by the linear approximation when S tends to zero. Further tests with experimental data led to consider that S_1 was to be adjusted to 15% of the range of experimental data covered by the linear approximation when S tends to zero.

The 8 studies providing HR vs different types of stress indicators (EMG, GSR, Work Load, questionnaires such as STAI-S, ALES) gave measured HR which were compared with calculated HR when applying the model (eq. 2 & 3). The correlation obtained between measured and calculated data (Fig. 2) gave r=0.95 ($p<0.0001$) which allowed us to validate the model.

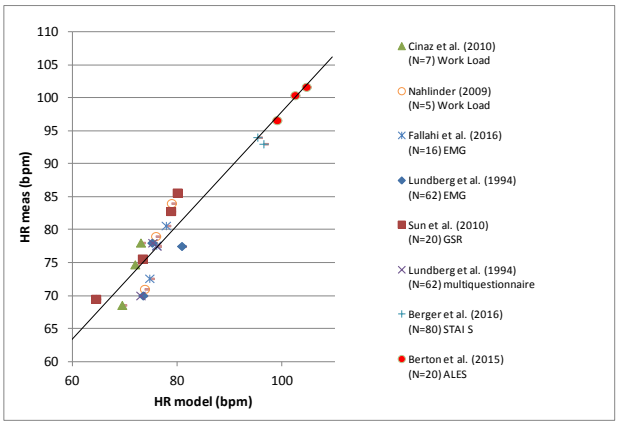

Fig. 2. Measured values of HR (*HRmeas*) provided by the literature vs the calculated values of HR (*HRmodel*) applying the model (r=0.95; p<0.0001).

The model was then applied to the new stress indicator expressed through equation (1). The two cohorts (N=46) participating to the experiment gave *HR* versus *K*, the stress indicator defined in eq. 1.

Following the advice of Berton et al. (2015), the data was treated per segment: an average stress indicator *K* was calculated for intervals of width equal to 500 and the associated average *HR* was also calculated.

The resulting data was fitted by a curve (Fig. 3) which equation is given in (4) respecting the model given in (2) and (3).

$$HR = 20\,K^{0.2} + 4 \qquad (4)$$

The correlation coefficient was r=0.94 (p<0.00004).

Fig. 3. The model fitting *HR* versus *K* where *HRmean* was obtained from measured values and *HRth* was calculated through the model (r=0.94; p<0.00004).

4-Concluding discussion

We developed and validated a mathematical model for heart rate versus stress indicators for healthy adult subjects under short-term mental stress. The model showed good consistency through the validation process. It also showed how it could be used to validate the relevancy and the appropriateness of indicators regarding short-term mental stress: this was achieved for a stress indicator recently developed (see equation 1), based on cardiac measurements quickly accessible through a small heart rate monitor which can be easily implemented on subjects, with the advantage of not requiring any heavy software for post treatment. This stress indicator gives thus immediate and objective information regarding the level of stress.

Regarding the model, we showed that, beyond modeling heart rate versus stress indicators, it can be used as an assessment tool for stress indicators. One of the two limits discussed in a previous study (Fauquet-Alekhine et al., 2016) was improved: the model was here applied with HR measured up to 125bpm while it did not exceed 101bpm in the previous study. The remaining limit is that the model was tested and used for healthy adults only. However, we assume that, for other types of subjects (e.g. with a given pathology), the power *a* (eq. 2) might take a specific value.

In terms of perspective, trying to model HR for subjects with a given pathology or under substance influence might be of interest. Regarding the new stress indicator tested in the present study, further considerations might explain how, from a mathematical standpoint, this stress indicator matched the model.

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Assessment of Mental Stress Induced by Bad News Interview: Standardized Patient's Relative Simulation vs Real Patient's Relative Situation for Anesthetists

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http//hayka-kultura.org/larsen.html

Abstract

Whereas mental stress induced by patient-physician interactions in simulation training of critical medical situations is widely studied, interactions between patients' relatives and physician have been few analyzed. Applying stress assessment questionnaire STAI-S, we showed in a previous study that scenarios for simulation training of "bad news" interview (implying interactions between patients' family members and physician) could be elaborated so that generating mental stress for physicians' training through standardized patient technique, as in the real medical situation. The present study complemented these results by comparing the previous results with real patient's relative situations. It showed that, for novice physicians, the perceived stress during simulation training has the same level than in real patient's relative situation while, for seniors, the perceived stress during the latter was quite lower than during the former. These results show that training physicians with standardized patient's relative simulations actually help them to have a better management of these situations by tackling more often these situations. Doing so, occupational stress might be significantly reduced for anesthetists during real patient's relative situations.

1-Introduction

A kind of interactions appears to be complex in Intensive Care Units (ICU), these between the physician and the patients' relatives, especially when bad news must be communicated.

This type of interviews with a family member can be simulated with minimal equipment investment by the standardized patient technique. For this kind of simulation, an actor or an actress plays the role of a patient's family member according to a given scenario "standardizing" the patient's relative (here, the family member). The simulated situation may be therefore undertaken in the real premises of the ICU.

In a previous study (Bouhours et al., 2015), we investigated this kind of professional simulated situation under the angle of trainees' stress state assessed through STAI-S questionnaire (State-Trait Anxiety Inventory, state part STAI-S; Spielberger, 1983) scored on a scale [0-80] and compared to other stress assessment techniques. We showed that, for both novice and experienced trainees, perceived mental stress was actual. We concluded that the simulation could be realistic by generating mental stress as during real patient's relative situations. More specifically, results (Table 1) showed that:

- residents perceived significantly a higher level of stress than physicians ($p<0.007$),
- for residents, mean stress score *Sr* was within the scale range corresponding to a low level of anxiety: [36-45] (see the manual *Sp* for STAI test in French: Schweitzer & Paulhan, 1990),
- for physicians, mean stress score was within the scale range corresponding to a minimal level of anxiety: [0-35].

Table 1: STAI-S scores for anesthetists after standardized patient's relative simulation

	STAI-S scores: standardized patient's relative simulation
Sr (residents, *N*=7)	37
Sp (physicians, *N*=5)	31

However, the question arose regarding the representativeness of the levels of stress measured in simulated situations when compared with those of real medical situations: to which extend the simulation could reproduce a realistic level of stress considered as an important component influencing the management of the professional situation? (see for example Fauquet-Alekhine et al., 2014).

We formed the hypothesis that H1) stress on simulator might be lower than in real patient's relative situation and H2) stress discrepancy between junior and senior physicians in simulated and non simulated situations might be different.

2-Method

2-1-Protocol

Anesthetists were contacted in a French hospital in order to fill in a STAI-S questionnaire (20 items). The instruction for the questionnaire was "tick, among the 4 proposals, this best corresponding to what you feel when you tackle a situation of communication of bad news to one parent of a hospitalized child."

Answers consistency was assessed through a Cronbach coefficient. The significance of the difference between mean scores was evaluated though a t-test of Student. The distribution of the question scores was evaluated by calculating a Spearman's rank correlation. Pearson's correlation coefficients were calculated between stress score, gender, age and experience.

Results of the present study were compared with those of the previous study (Bouhours et al., 2015).

2-2-Subjects

Anesthesiologists (N=15, 73% male, age range: 21-60 years old), all volunteers, participated to the survey. Those with an occupational experience less or equal to 2 years where considered as juniors (N=4; experience 0-2 years) and the others as seniors (N=11; experience 4-40 years).

3-Results

The mean STAI-S scores are reported in Table 2.

Table 2: STAI-S scores for anesthetists after real patient's relative situation.

	STAI-S scores: real patient's relative situation
Sj (juniors, N=4)	38.5
Ss (seniors, N=11)	36.4

The consistency of the answers was found good with α=0.84.

No significant correlation was found between stress score and gender, age or experience.

Mean stress scores for both samples (juniors and seniors) were within the scale range corresponding to a low level of anxiety: [36-45] (see the manual for STAI test in French: Schweitzer & Paulhan, 1990).

The difference between juniors and seniors' mean scores was found not significant (p>0.4) conversely to mean scores obtained in simulated situations (Table 1).

The difference between simulated and real patient's relative situations was found:

- not significant for juniors' mean scores (p>0.45)
- significant for seniors' mean scores (p<0.03).

Distributions of positive items of the STAI-S questionnaire (describing perception of no stress; e.g. "I feel relax") were ranked per samples (juniors and seniors) and compared (juniors vs seniors). The same was undertaken for negative items (describing perception of stress; e.g. "I feel nervous"). For both cases, Spearman's rank correlation coefficient showed similarity, resp. 0,72 (p<0,015) and 0.88 (p<0.001). All items were perceived with higher intensity by seniors except two equal and one lower "I feel tense". Items contributing to the distribution difference were:

- for the positive items: "I feel relax", "I feel at ease", "I feel satisfied",
- for the negatives items: "I am presently worrying over possible misfortunes", "I am nervous".

This showed that, for seniors, perception of negative items was compensated by this of positive items.

4-Discussion

Hypothesis H1 "stress on simulator might be lower than in real patient's relative situation" was verified for seniors only: for seniors, while the level of perceived stress during simulations was within the minimal anxiety range, it was positioned within the range of low anxiety range during real patient's relative situations. This finding also validated hypothesis H2 "stress discrepancy between junior and senior physicians in simulated and non simulated situations might be different": while juniors experienced a similar level of stress in both conditions, seniors were significantly less stressed during simulations. In other words, during their career, physicians move from a low level of anxiety when junior to a minimal level when senior. This might be due to the fact that experienced physicians, with time, become less sensitive to simulations than juniors. This might also be due to the skills developed by seniors with time to cope with such situations. But if so, then the seniors' level of stress in real patient's relative situations should have to be significantly lower than this of juniors: it seems to be the case when considering the values of scores (*Sj*=38.6 and *Ss*=36.4) but statistical test leads to a lack of significance (p>0.4). This might be due to the low number of juniors: with ten more junior participants, for the same values of mean scores and associated variances, the significance would be p<0.02.

The analysis of the items distribution allows forming assumptions regarding what helped seniors with time to cope with this sort of situations: compared to juniors, they are more relax, at ease and satisfied even though they feel more nervous

and worry about possible misfortunes; this might relate to the habituation to the situations, having encountered more of them with time than juniors have. Therefore, with time, experiencing such situations several times, seniors might have become familiar with these situations and feel more relax and at ease, probably having developed some strategies to manage them. This lead to a proposal for training: mixing junior and senior trainees for the seniors to advise juniors during collective debriefing.

The present results also help us to moderate outcomes of a previous study (Lehousse et al., 2013), concluding that the realism of the simulation was perceived satisfactory by the trainees (close to the real operating situation) and that lack of realism could not be contributors of absence of perceived stress during the simulated situation. Our results suggest that however something is missing for seniors to perceive the same level of stress in simulated situation and real patient's relative situation. If it is not a lack of realism, then it might be associated with the perceived stakes of the situations by the physicians: it was already mentioned that in simulated situation, even though trainees show a similar level of stress when compared with real operating situations (Fauquet-Alekhine, 2011: 27), the stressors in the two conditions may be quite different.

Limits of this pilot study were mainly due to the low number of participants by the side of junior physicians. We make the assumption that additional data would lead to the same conclusions and would increase their significance.

5-Conclusion

Assessment through STAI-S questionnaire of physicians' stress state, both juniors and seniors, showed that simulation training of "bad news" interview could be realistic by generating mental stress for the physicians involved in the simulated situation. However, our results showed that seniors perceived lower level of stress than juniors especially in simulated situations. This might be due to experience of a higher number of situations by the side of seniors.

These results lead to the main conclusion that training physicians with standardized patient's relative simulations actually help them to have a better management of these situations by tackling more often these situations. Especially, when junior and senior trainees are mixed, the former may have benefits from the latter when exchanging about the strategies developed to manage these situations.

A final remark is worth to be noted: the fact that the levels of stress are not very high during training sessions contributes to the efficiency of learning and skills development during simulations: it was demonstrated that high levels of stress in simulation training could hinder these processes (Fauquet-Alekhine et al., 2014).

Further investigations would be worth to be undertaken in order to analyze the kind of strategies are developed by senior anesthetists to cope with these situations. This would help to improving training.

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Considering Care Employees' Stress in Geriatrics: a Clinical Psychology Approach

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Abstract

In the Dependent Elderly Care Facility (EHPAD, France), caregivers are regularly confronted with loss of physical and psychic autonomy. In a national context characterized by an increased of aging population and dependency, the workload in EHPAD is intensified.

Indeed, the resources in material and in human have considerably decreased because of the decrease of governmental allocations (HAS, Haute Autorité de Santé) and restrictions in human resource assigned to this type of residences. In the meantime, the government increases recommendations for a better care of dependant people. This leads to trying doing better with less.

This environment makes caregivers vulnerable to stress factors. As a clinical and work psychologist in an EHPAD, I would like to emphasize here the stress of these caregivers and depict the method applied to access it.

In first, I present the context of my experience whilst working in an EHPAD. I then describe briefly who the caregivers are and present my works with them, promoting the clinical interview (individual and collective) to highlight the factors and symptoms of stress. I finally try to emphasize the benefits of discussion groups in the specific context of EHPADs.

1-Introduction

As a clinical and work psychologist, I worked in a French institution named EHPAD (*Établissement d'Hébergement pour Personnes Agées Dépendantes*, Dependent Elderly Care Facility) which is an accommodation facility for elderly and dependent people. This branch of an associative institution, specialized in the care giving of dependent people, accommodated 60 residents, distributed over four floors of apartments. People who came in this residence were suffering from physical or mental dependences due to cardiac accidents such as strokes, or suffering from diseases like Alzheimer, Parkinson, or cancer... or came here because they needed a constant supervision due to heart trouble or breathing trouble or simply because of no family to take care of them. Among the residents, 80% suffered from an Alzheimer disease.

Most of the employees of the residence were mostly people in charge of the residents, like care assistant (AS), auxiliary of social life (AVS), psychological medical aid (AMP), hospital service agent (ASH) or nurse. The four first ones were in charge of taking care of the residents in their everyday life in accordance with their dependencies. They helped for washing, to get dressed, to move them, pushing wheel chairs, to serve and help eating, …to clean and order the rooms, but also to help them breaking their isolation. They were people mostly in relations with the residents and their family. Nurses were mostly in charge of the medical aspect, but could also help for daily needs. The number of employees and working hours assigned to each task were determined by the government, fixed by a tripartite convention *Conseil général - EHPAD - Agence Régionale de Santé*. In this residence, there were around 29 employees in shift teams to take day and night cares in charge.

The other employees are the persons in charge of the maintenance, one person for animation, a secretary, one person for the laundry, a coordinating nurse, a psychologist, a coordinating doctor and a director.

The context of the residence was difficult with a regular frequency of reorganization due to frequent changes of the top management (ten times in ten years). According to the head office, most of these changes were due to illness or personal reasons. During my three years as an employee, I met three different head managers. That was a little confusing because of a high frequency of changes of objectives for all employees and each time a reorganization of the EHPAD.

As a psychologist of this residence, my patients were the residents and their family but I was also psychologist for the caring staff.

That is a part of this latter experience that I want to tell about here, my work with this people who are mostly in the daily care of the residents, and more precisely the two teams of the day. I thus refer here to my work with the Care Assistants (AS), the Auxiliaries of Social Life (AVS), the Psychological Medical Aids (AMP), the Hospital Service Agents (ASH) and the nurses. These employees were working in two day-shift teams.

I chose to relate the work with these two teams because I had the opportunity to work with them in groups on their demands, every two weeks with each team. Before my arrival, they had a time of discussion groups from 16h30 to 17h15, and they asked to continue in order to exchange and work on the different organizational changes and the difficulties associated with their jobs. Their demands addressed mainly stress suffering, the most important and actual complain in geriatrics' residences. This was our main subject; it took the entire discussion time.

2-Having access to stress factors & symptoms

As a psychologist for employees, I was available to help them in feeling better in their job. For time and economical reasons, I organized discussion groups for them with their agreement. They could discuss about their everyday stress or problems. At the same time, we worked together on a better understanding of residents' illness, behavior and acting.

Regarding discussion groups, I refer here to the Balint groups (Roberts, 2012; see also https://balint.co.uk/about/the-balint-method/) with the exploration of the relational dynamics in the links between caregiver and resident. This was underpinned by the function of listening for helping employees in their everyday work. Discussion groups for each team were spaces where they could speak freely of any subjects linked with their job.

The discussion group offered the possibility to express their real experience and feelings, without any hierarchy. It offered them a place where their subjectivity was central, and the possibility to take a distance with job suffering.

The discussion group also offered the possibility to put painful affects into representations. It was a question of allowing the recognition of individual subjectivities to release the weight of inhibition in the group. The group, as a third party function, helped to take distance from their work and to suffer as little as possible because of work.

An individual approach was possible in certain case, but for time and economical reasons, it was not possible to generalize it (it was only a part of my job).

Discussion groups provided another advantage: Kaes (1999) showed that the group mobilizes psychological process and subjectivity dimension in a different way or intensity compared to individual.

Discussion groups took place each two weeks, for each team. This time was during their day work and considering as working time. The appointment lasted 45 minutes, and began after the afternoon tea for residents, from 16h30 to 17h15. This time slot was the quietest one during the day for the caregivers. This slot was chosen by the management, order-giver of this intervention. It was agreed with the management and the employees that it was a confidential time for them: nothing would be reported to the management except when they wanted to. It was a very important point in order to make the group working: the confidentiality.

We had a specific room for it, with tables in square and chairs around. The room was quiet and no resident came there, so we were not disturbed.

The employees were free to participate, and groups remained open. But in fact, it was always the same participants who came in, groups being almost stable, around 6 people for each team. These people were employees with a permanent job or a long term contract, from each function of caregivers, representative for the staff.

Free speaking, crucial feature of the discussion groups, was one of the two rules defined by Anzieu (1975) as essential and structuring. Caregivers could evoke everything they wanted, their livings, their feelings, their difficulties and their sufferings, freely, with nobody judging them, respecting each other. This rule of free speaking makes revival in the unconscious of each one both the repressed desire and the anguish of transgressing the forbidden. The second rule defined by Anzieu was abstinence in the sense of confidentiality: all what was said in a group remained in the group. As a psychologist, my role was essentially to stimulate the discussion in case of repetitions or to emphasize keywords for example. I could also encourage someone to express him/herself. My goal was to help them to think and to make emerge the meaning, in order to analyze them collectively.

3-Effect of the discussion group's method

The first real important function of the group was to contain the group. As Marc and Bonnal (2014) wrote, this containing effect came from an addition of different theories: the theory of the holding from Winnicott, the containing function of Bion and the psychic envelops from Anzieu. The containing function allowed participants to express freely and in confidence. They could here express very deep emotion. Employees could express here their difficulty with a resident who was always aggressive due to illness. They could express feelings without any hindrance: "it stressed me", "I'm fed up with him", "I cannot support him anymore". The group contained the feelings, the suffering, shared between each of them, like a mother could do with her children. This containing function permitted a free speaking, with less holding. In groups, we could have access to real in-depth feelings.

The group transformed the words in something less painful. The containing function of the group permitted to express more things than in individuals. We could have access to their actual

perceived stress or anguish, when facing the dependencies for example. The group was "good" enough, in the sense of Winnicott, in order to contain and to regulate emotions. In the group, issuing feelings was not a weakness but a chance to express oneself.

The other effect of the free discussion was to take distance with the events and the feelings. They could reexamine an event, personal or collective events, and talked about the stress they had perceived. Each of them could express his/her own feelings and take a distance with it whilst discussing it collectively. I could relate here, for example, a case of a caregiver taking care of a dying person, diagnosed by the coordinator doctor. It was very hard for this AS to support the stress related to seeing this person dying. The AS was afraid of entering in the room. Other participants (AS) could also expressed their own symptoms of stress when they had to enter in the room where a resident was diagnosed as dying. Beyond expressing their feelings, their fear and stress and exchanging on it, sharing it, the function of the group also allowed everyone to identify oneself with the others speaking. They were more confident in their feelings. The possibilities to tell their feelings, their fears in the groups with the help of the group, helped them to admit their feeling and permitted them to take distance with it and to overpass it. Feelings were put in consciousness and they could be overcome and supported.

Putting these feelings in words in groups also contributed to a socialization of the feelings through "social expression of emotions" (see farther), clarifying suffering and understanding the reactions of each other. It helped the team to understand why a person was avoiding a resident who was dying. In accordance with Castra (2004), it also allowed a collective management of feelings, with an explicit and official recognition of the central dimension of the emotional work in the caregiver's activity.

The group could hear difficulties of caregivers and helped them to relieve from their feelings before they went in a mechanical way of working, as a coping strategy, with the resident (see also Lhuillier & Litim, 2009).

Working in EHPAD confronted employees to high relational demands, in quantity and quality. They could not answer all of them. The difference between what they gave and what they wanted to contributed to stress symptoms. They could not do their job with the quality especially in terms of relationship with residents, because of the increasing workload and the time constraints. It was one of the most stress complaints. Doing a good job was not only the care of the body, but also to take a moment to listen to and speak with the elderly person.

The subjectivity of caregivers was explicitly taken into account and worked in the group by the collective. As showed by Castra (2004), it became possible for them to signify, in the group, without fear of judgment the extreme difficulty to face certain situations, to explain how one could be deeply shaken or upset by the dramatic character of an end of life for example.

The effect of putting feelings together conducted also to a better understanding of residents' pain or families' words or actions and colleagues' words and actions. It improved the understanding and the communication in each team, and reduced stress due to misunderstanding. I could relate the example of a resident, who was very aggressive with some caregivers, leading them to develop symptoms of stress. Putting their meanings, feelings and way of feeling it in the groups, permitted the group to better understand the reaction of caregivers confronted to this person and to support them when they were confronted to it. This also have for consequences less bad care giving, as for example less contention or offensive words that could be said to the person. We could observe more cooperation in teams in order to help colleagues under stress.

The social expression of emotions led to the construction of a space of collective intimacy with reinforcement of group identity as described by Castra (2004). The group carried values, standards and rules which structured the perception, the feelings and the behavior of the members as defined by Marc (2005), and its own dynamic. As a result, I could observe more understanding in the residence, more mutual assistance in the team, a common search for solution, and fewer conflicts. The group also helped to reinforce the internal cohesion and solidarity. When an employee had a problem with a difficult resident, s/he could ask for help, even if s/he had to ask someone from another floor, when s/he knew that this colleague could be helpful with this resident, as a result from the group's effect. This was not done before.

When the group was well contained, members could also evoke their personal history. They were working with humans and families and that could evoke their personal family story, in echo. In geriatrics, their own history was constantly reactivated and questioned. We could hear in the group that "if it is my mother", but the group permitted to take a distance with this identification.

Geriatrics confronted also employees to the death and the meaning of their lives, in mirror. The discussion group allowed teams to contain and think about it and express it, in order to take the distance.

The groups helped them to support this environment of death, taking care of the resident who was going to die and of the family, expressing

the feelings and difficulty with it. The team was confronted to their own decline, to their own mortality. Putting it together helped caregivers to face it, because they could speak about it and overpass it. The groups recognized and reduced caregivers' anguish and stress related to death as mentioned by Lhuillier & Litim (2009). They could face it and work with it and not deny situations of stress related to death.

The effect of the group was also beneficial for individuals. As in Rogers' group (1973), each member of the group could have a higher acceptation of oneself in his/her affect being, intellectual being or psychical one as well as his/her potential. This was due to groups' effect that contributed to the development of the person and his/her self-acceptation.

The group allowed people to change in their relation with the others and with his/her life as shown by Marc and Bonnal (2014). As they explained, groups stimulated the self-consciousness, increased the self-esteemed and the evolution of the person with the understanding of their self representations: Who am I for the others? What do they see about me? What image I seek to give and which one is returned to me? They were facing their image sent back by the others.

4-Discussion

4-1-Discussion about stress at work

4-1-1-The analyst's standpoint

One of the most evoked ailments in discussion groups was words on stress and symptoms of stress. I could also observe it when I watched team's working. But behind the words, we had to see the symptoms of it, the meanings of them and the causes.

Seyle (1984) described three bodily-stages in response to stress: the first one is alarm, the second is resistance and the third one is exhaustion.

Lazarus and Folkman presented a stress model, where stress is seen as a relationship between individuals and their environment. Psychological stress refers to a relationship with the environment that the person appraises as significant for his or her well being and in which the demands tax or exceed available coping resources (Lazarus and Folkman 1986:63). This definition points out to two processes as central mediators within the person/environment transaction: cognitive appraisal and coping. When a caregiver judged a situation too stressful for him/her, with his/her own resources, s/he could avoid the situation for example.

It was also important to make the difference between short-term stress disappearing quickly and long-term stress (like chronic stress) known to be a risk factor for health, leading to the exhaustion of the organism after long exposure to hyper stimulation resulting in fatigue of compassion (see for example: Thomas, Barruche & Hazif-Thomas, 2012) or, to the extreme, in "burn-out". The professional burn-out is the issue when professionals cannot manage stress (Bader-Rodriguez, 2012). The burn-out was first conceptualized by Freudenberger (1975) and then described by Maslach (1976) who created the MBI-test. Shauferli and Greenglass (2001) described the burn-out as the process through which employees' energy or capacity to work can diminish over time while the work environment does not provide resources in a context of high demand. In a terminal physical stage; emotional and mental exhaustions will occur due to difficulties to recover.

All authors agree now with the fact that burn-out is a response to a chronic emotional stress with three dimensions, as shown by Maslach, Jackson & Leiter (1996:4): a syndrome of emotional exhaustion, reduced personal accomplishment and depersonalization.

In the institution, as I could see, the syndrome of emotional exhaustion could be an energy reduction, a feeling of tiredness, but it could also be irritability or impulsivity with a possible somatic repercussion against which subjects developed various avoidance strategies such as disinvestment, hyperactivity, withdrawal, secondary stiffening ...

The staff reduction accomplishment could result in demobilization including a decrease in cognitive efficiency (problems of concentration, memory, errors in complex tasks, indecision, ...), demotivation, loss of creativity (reduction of mental flexibility), …

Depersonalization could be a reduction of the commitment towards the residents but also towards the family, a certain affective coldness, a loss of empathy, a superficiality of emotional life, a certain indifference, a loss of hobbies, a boredom, a cynical and sometimes violent projection on others ...

The stress state is commonly described in the psychosocial risk literature, as well as in the Framework Agreement on Work-Related Stress (2004), as a state combining physical, psychological or social complains or dysfunctions, resulting from individual feeling that there is an imbalance between the perception of the imposed constraints versus this of the own resources.

4-1-2- The caregivers' standpoint

What did caregivers say collectively or individually that could be relevant in stress diagnosis, from their physical, emotional, intellectual and behavioral symptoms?

- Physical or somatic symptoms :

  Most complains were about back pain, which caregivers explained by moving the residents so many times a day, but having difficulty to see a symptom of stress behind it.

Some complains related to digestive distracts with stomach‘s pain or stomach ulcer or persistent headache.

The quality of sleeping was also many times mentioned, with a lack of sleep, a bad quality or difficulty to fall asleep or difficulty to stay asleep.

Tachycardia, oppression feelings or difficulty in breathing could be also mentioned.

That made everyday works very difficult and led to a high level of sick leave.

- Emotional symptoms :

  The caregivers could also speak on an increasing of sensitivity and nervousness, crises of tears or increased of anxiety, sadness, anger feelings or despair feelings.

  The symptoms could actually damage the quality of their relationship with the resident, the family and the colleagues. An old people, with Alzheimer would be very receptive to these feelings and could be more nervous with more agitations or tears.

- Intellectual or cognitive symptoms :

  Most of cognitive symptoms were disturbance of the concentration necessary to the task leading to errors and omissions, difficulties in taking initiatives or making decisions. Ruminative thoughts were also often mentioned.

- Behavioral symptoms :

  Practitioners said that they had increased their use of different products in the last months such as anxiolytics to able to rest because of their incapacity to relax. We observed an increase of the use of stimulating products such as tobacco or coffee to help them in their job. Some evocated the fact that they were more agitated and could not stop moving, doing thing, incapable to relax.

Social withdrawals were also mentioned with a loss of social activities, as well as a loss of motivation and difficulties to keep on working in this environment, perceived aggressive and leading to escape strategies.

4-2-Discussion about main factors of stress

In the line of Courty, Bouisson and Compagnone (2004), stress symptoms appeared in geriatrics when there was a gap between the employees’ ideal expectation and the reality. It was at this moment that I heard complaints from employees resulting from this gap and as the result of their inability to do their work as they attempt to. This gap may be analyzed according to the framework of Legeron (2008): the workload, the change, the frustration and the relationships.

4-2-1-The workload

The dependency of residents increased while, at the same time, a decrease of human and material resource was objectified. The job became more complex and needed more manipulations due to the increase of the dependency of people. Nevertheless, the job had to be done with the same quality and the same humanism in less time due to staff reduction. That led caregivers to ethical suffering due to a conflict of values (Fauquet-Alekhine & Rouillac, 2016:5): providing best cares according to institutional requirements versus doing faster with less resource resulting in the fear to hurt or do a bad job.

Employees mentioned the lack of time for doing a toilet, the lack of time to discuss with the residents, to have a real relation with them. They evoked a work as in supply chains with only technical care.

This resulted in having to favor certain activities to the expense of others, as not cleaning the room every day for example, for having a short time to discuss with residents. It was essential for them to humanize the relationship and not making a mechanical care. But this led to stress.

They also suffered from frequent interruptions by the residents’ calls, their cries for attention or pain (as observed by Salicru (2012) for example), one of the most stressful factors. The choice was difficult to make: interrupt their care and deal with the call or continue their care. Whatever their choice, they would feel guilty, would suffer from it and would be stressed.

4-2-2-The change

Change was also one of stressful factors. Practitioners explained that changing the top-management and subsequently the strategy (or way of doing things) ten times in ten years was disturbing. No stability in the top management produced a lack of stability in teams. The unknown future was cause of stress.

Change also came from new incomer residents increasing the workload too as they had to discover and to know them and their dependencies. They had to adapt themselves.

Change also related to new colleagues, the geriatric sector being famous for its short time contracts, a high turnover and a high level of absence for sickness. This was the consequence of the aforementioned difficulties and stress factors.

Timetables were changing too, from early in the morning to late in the evening. It was difficult to manage it with a family and young children. It induced a lot of stress for the employees, mainly women.

4-2-3-The frustration

Legeron (2008) suggested three aspects for frustration can: financial frustration, social frustration and symbolic frustration.

In the present case, financial frustration was very high (typical in this professional sector) with no real salary evolution and bonus or career evolution (the professions respected the collective convention CCN51). The top management changes reinforced this point with no long term strategy.

The social frustration was a lack of social recognition of their job. Caring is an invisible job in the society, but also from the standpoint of the residents' families. Nobody could imagine all the work they did: it is not only taking care by applying technical gesture, but it includes everything around, the words, attention, smile ... It is only visible when it is no more done.

The symbolic frustration came from the meaning giving to their job. The employees were seeking a job with technical, but also with relational, and this last point was disappearing due to the lack of time and the increase of the workload.

4-2-4-The relationships

The relationships were also high causes of stress. First of all, relationships between colleagues were deteriorated with a lack of team spirit and a lack of mutual aids in team.

The relationship with the resident could also be stressful, depending on their pathologies. Some could be very physical or aggressive speaking, due to their cognitive disorder as seen elsewhere (Courty, Bouisson, & Compagnone, 2004).

Relationships with residents' families feeling guilty because perceiving themselves "abandoning" their mother or father could also be very difficult. They could always be negatives and sometimes aggressive with the caregivers. Relationships were also more complex when caregivers identified themselves with the resident or the family (also showed by Courty, Bouisson, & Compagnone, 2004).

4-3-Specific causes of stress in geriatrics works

Other causes of stress were here identified in geriatrics: confrontation to the old age and the death and dependency.

As Courty, Bouisson, & Compagnone (2004) observed, there are specific stressful factors in geriatrics as the confrontation to the view of the elderly refers to one's own aging, and the inevitably confrontation to the death and the support in the palliative care (dependency). The stress for some of them discovering a death people confronted them with their own mortality and could be a source of a traumatic stress.

4-4-Coping strategies

Facing stress, the employees developed coping strategies in order to protect them from emotional adversity (Cramer, 1998).

The term "coping" comes from the CBT (cognitive and behavioral therapy) defined by Lazarus and Folkman (1984) as all the efforts, in cognition and behavior, undertaken by an individual to manage specific internal or external requirements which are evaluated as exceeding the resources. At the difference with the defensive strategy, defined by the psychoanalyst Freud earlier in 1894, the coping strategy are conscious.

Cramer (1998) depicted the main differences as follows:

- the conscious/unconscious status
- the intentional / non intentional nature of the processes
- the conception of defense mechanisms are characterized by a hierarchy, based on psychological maturity, or complexity, or in association with chronological age
- situational or dispositional constructs
- normality / pathology

Several coping strategies were here observed: resignation, avoidance, withdrawal or isolation, negation of the events or denial. Some of them elaborated strategies to avoid an aggressive resident or a resident about to die. These coping strategies protected them but, sometimes, they became less effective and the employees were deeply affected psychologically. In this case, when it was possible, I met the employee in individual interview. Sometimes they came directly to me. Sometimes I applied an informal method to speak with them and persuade them that they needed help, or sometimes the top management sent them to me. In the latter case, I only undertook an individual interview, with their agreement. And sometimes, there was no time for this and the employee felt ill and went for a sick leave.

4-5-The possible psychometric approach

In my practice, the free discussion remained the main tool to help people to get better and to understand their symptoms and feelings in context. The psychologist only helped them to express themselves and to have access to their actual feelings.

The discussion permitted to have access to the entire person, and not to a simple symptom written on a sheet of paper. It gave access to the entire person, with the associated personality, defense and history. The discussion also allowed anticipating: I knew all members of the groups as I saw them each two weeks, and I could anticipate the moment they would not go well. A psychometric approach would

not have given access to this. This matches Gautier & Husser's point of view (2013), when they argued:

- The questionnaires show a state and are not anticipating the future that can make a free speaking. With questionnaires, it is not possible to anticipate the moment when the patient go from a positive stress to a negative one, and helping him before going throw.
- The questionnaires give a level, at which you go throw the normal to the pathologic, there is no sign of a possible evolution during the time, a continuum, where the subject evaluate in time. It is only a picture of the stress state at one moment.
- The questionnaires are relevant to quantify intensity of stress, and causes, but there are not helpful to understand most of the psychological key symptoms which people can feel.
- Questionnaires and scales have also a limit in terms of in-depth stress analysis. Most of the scales are quoting stress on one week or one month for a few; it is difficult to give differential diagnosis or severity of trouble.

In addition, the group maintains people in an active way, with a capacity of thinking, putting words on it and acting on it. It gives them an acting energy or power. It leads them to find the resources, in themselves with the others, in order to go throw it.

However, I could use psychometrics approach before the first groups took place in order to access their level of stress at the beginning of our works. But for the same reason given above, I did not find them helpful.

To illustrate my purpose, here is an example of a specific work we have done with both teams. It happened the residence accommodated very dependant people, with Alzheimer's disease. They needed a lot of technical cares because they were incapable to walk or wash themselves or eat by themselves. Moreover, they needed a presence. They did not stand to be alone. This period was extremely difficult for the teams and caregivers exhibited stress symptoms or and developed defensive strategies. We worked in each team on the feeling of each one, to take a distance with that. They felt very bad because they perceived themselves doing a bad job since they could not respond to the demand of each one, for the toilet, for eating, for talking….. We worked in each team in order to find solutions and I also worked with the top management as it would change the way of doing things. We found some arrangements in each team, that they wanted to share with the others; I was their spokesperson. This specific work, shared between the two teams and the top management, allowed the teams to overpass this period of high stress and probably avoided sick leaves.

4-6-Limits

The limit of the method of discussion group is the group itself. At the beginning, it was difficult to have enough people participating; they avoid it, and me. In the first weeks, there could be nobody or only one person. I had to convince them to try and gain their confidence with other practices such as the analysis of their professional practices or through discussions on residents' life project. The fact that the group was "open" was also helping: they felt free to participate or to leave. They also wanted to be sure that it was confidential with neither feedback nor reporting to the management. At the beginning, they were afraid of saying things that could be damageable for their career.

The difficulty was also to go further than a simple complains, and they felt free to express their actual feelings and factors of stress and difficulty. The confidence and the containing function of the group was helpful after a few sessions of releasing complaints that they need to say.

4-7-Quality of the results

In my practice, I can say that this approach gave some good results, in the sense of getting and being better, particularly with a new team spirit. The group allowed people to meet each other in their deep feelings, and real difficulty. They showed their real feelings to others who discovered "other people", with sometimes the same feelings for themselves. They could have a real relation with each other and with themselves, with a better understanding of themselves.

We also observed more understanding, more verbal exchanges and more mutual aids, which conducted to less stress symptoms evocated above, in the groups and in other informal place, as soon as the groups worked as a discussion group with confidence and real exchange.

I also noted more demands from them, they asked more help with some difficult subjects, like death in particular. They allowed themselves to talk more freely. For example, they had asked to be trained to take care of a dying or dead person. Therefore, for each case of death, a special moment during the discussion groups was dedicated to relate this case, like a work on death, to contribute to their mourning job.

I also observed less aggressive reactions (physical or verbal), or nervousness in their relationship with residents, families or colleagues. The institution was less confronted to team conflict or colleges' conflict. As I also watched the families and the residents and I could notice better relationship, and less complaint.

All of this contributed to a higher motivation and a better social climate.

5-Conclusion

To conclude, as a psychologist for caregivers in an EHPAD, I will recommend the discussion groups in order to help the employees to spot their symptoms of stress and to help them to go throw it. This method is for me the best one for the practitioners to better understand their state and work on it in order to feel better in this particularly stressful professional sector. Ideally, the frequency of meetings is every two weeks, lasting for a minimum of 45 minutes (knowing that it is difficult to have 1 hour). A group must summon less than 10 people and attending every meeting for the group to work better.

I strongly recommend this group-based approach with regular meetings for a team, permitting members to take a distance from their stressful work.

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