Avoidance Associations with Physiological Arousal in Response to Deep and Shallow Emotion Processing

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Abstract

Avoidance is a powerful risk factor for the development and maintenance of mental health disorders, but much remains to be learned about the specific underlying physiological processes that are implicated. Also, much remains to be learned how can experiential avoidance can be treaded or reduced. The current study examined the relationship between experiential avoidance and indexes of physiological arousal toward an emotional imagery task in different ways of processing emotional materials (deep Vs shallow). Sixty-nine participants performed an emotional imagery task experiment with affective (fear) and neutral stimuli, while autonomic arousal was measured. Participants had to complete processing trials, with shallow and deep instructions. Experiential avoidance was assessed through the Acceptance and Action Questionnaire (AAQ-II), whereas physiological arousal by indexes of heart rate and skin conductance. Also, alexithymia was used as a covariate on all analyses and was assessed by TAS20. Experiential avoidance was used as a continuous variable. No statistically significant results was found, but interesting observations were made. Firstly, were found no associations at all between experiential avoidance and heart rate and skin conductance during deep and shallow processing of fear and neutral stimuli. Experiential avoidance was only associated with alexithymia (positive correlation; as one increases the other also increases). Although findings were not significant, there was a tendency that the individuals with greater levels of experiential avoidance tended to use less skin conductance responses during deep processing of fear stimuli.

Keywords: experiential avoidance, skin conductance, heart rate, alexithymia, physiological arousal, deep and shallow processing.

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Emotion Regulation

Emotions are an integral part of our lives (Eisenberg, 2000). As there are plenty of emotions one might wonder how exactly we manage them. In general, people can adjust and interact more easily with society by regulating their emotions (Brans et al., 2013; Grecucci et al., 2013). Emotion regulation refers to the automatic or controlled, conscious or unconscious processes by which people shape what emotions they have, when they have them, and how these emotions are expressed or experienced (Garnefski et al., 2001; Gross, 1998; Webb et al., 2012). Emotion regulation involves changes in cognitive, behavioral, and physiological functions of emotions, such as their beginning, intensity, duration, maintenance and appearance (Eisenberg et al., 2000; Gross, 1998, 2002; Koole, 2009; Thompson, 1994). The regulation of emotions also involves self-regulation processes so as to achieve one's personal goals and satisfy needs (Tamir, 2016).

Emotion Regulation Strategies and Psychopathology

Emotion regulation strategies have an impact on an individual’s psychological state and health, as they influence how emotions are expressed and experienced (Hu et al., 2014; Koole, 2009). Specifically, the type and magnitude of emotional experience can be adjusted and modified through emotion regulation strategies (Aldao et al., 2010). Through the years, a number of models of emotion regulation have been developed in an attempt to categorize emotion regulation strategies as either adaptive or maladaptive, based on their outcomes on humans’ functioning (Aldao, 2013; Gross, 2013; Schäfer et al., 2017).

Importantly, poor emotion regulation can lead to the development of psychopathological problems, which can begin even in early childhood (Schäfer et al., 2017; Zeman et al., 2006). Ineffective emotion regulation can consist of the inflexible, or chronic reliance on specific strategies that target undesired emotions, instead of aiming to resolve the distressing situation itself. Emotional arousal plays a key role in this process, as high arousal can make it difficult for an individual to manage his/her emotions in effective ways, especially when it comes to negative emotions (Zeman et al., 2006). On other hand, Sheppes and his colleagues (2011), argue that individuals use different emotion regulation strategies, depending on the level of arousal they experience. More explanatory, they argued that when individuals experience emotions with low arousal and intensity they prefer to use cognitive reappraisal strategy to change their affective responses, whereas when they experience high arousal and intensity emotions they select the attention disengagement strategy (a form of attentional avoidance). Many forms of psychopathology (e.g. agoraphobia, social anxiety, other forms of anxiety, eating and mood disorders; Aldao et al., 2010) involve the frequent use of specific types of emotion regulation strategies such as avoidance and escape, to regulate affect, which may contribute to the maintenance of these conditions (Gross & Jazaieri, 2014). Aldao et al., (2010) consider strategies such as avoidance, suppression and rumination as maladaptive and linked to psychopathology.

Avoidance

Avoidance can be seen as a strategy, used by the individual to protect himself/herself from unintended consequences and negative psychological effects (Kashdan et al., 2006). Emotional avoidance aims to control unwanted emotions, especially negative ones, such as anger and sadness (Chawla & Ostafin, 2007), so as to experience less pain and stress (Berking & Wupperman, 2012). For example, my painful experiences prevent me from having a life that fulfills me (AAQ-II). Some authors suggest that emotional avoidance belongs to the larger category of experiential avoidance (Kashdan & Rottenberg 2010), which involves avoiding feelings, physiological sensations, and thoughts, usually with negative valence (Hayes et al., 2004; Leonidou & Panayiotou, 2021; Sloan, 2004). Sometimes experiential avoidance can even entail harmful behaviors such as drug use or excessive alcohol and food consumption, in order to block the person's painful thoughts and feelings and increase feelings of comfort and control (Blackledge & Hayes, 2001; Leonidou & Panayiotou, 2021; Dobson & Dobson, 2018; Sloan, 2004; Lillis & Hayes, 2007).

A study by Levin and colleagues (2018), which examined experiential avoidance in undergraduate students, showed that experiential avoidance can predict more intense negative emotions, fewer positive emotions, and less valued actions. Although this has positive effects in the short-term (e.g. reduction of anxiety; Leonidou & Panayiotou, 2020), in fact in the long-term it may lead to negative outcomes (e.g. unemployment) that prolongs distress rather than alleviate it (Kashdan et al., 2006; Kashdan & Rottenberg, 2010; Panayiotou et al., 2019). It has been found that positive emotions decrease when avoidance is chronic (Chawla & Ostafin, 2007). Also, it seems that the use of avoidance as an inflexible, chronic way of managing discomfort, results in less fulfilled and valued living, as it hinders individuals from engaging in worthwhile activities (Panayiotou et al., 2021) and impairs relationships (Dobson & Dobson, 2018; Sloan, 2004). Ultimately, these effects on daily functioning are implicated in the etiology and maintenance of many mental health conditions involving anxiety, panic, depression and stress (Boulanger et al., 2010; Karekla et al., 2004; Panayiotou et al., 2019; Panayiotou et al., 2017). For example, people with social anxiety disorder tend to avoid eye contact (Schneier et al., 2011) and emotional faces like angry faces (Mansell et al. 1999), something that has been found to contribute in the maintenance of the disorder (Bar-Haim et al., 2007; Cisler & Koster, 2010). In line with this, Andrew and Dulin (2007) found that anxiety and depression in older adults are maintained through avoidance mechanisms. Similar findings exist by Kahn and Garrison (2009) with a sample of college students. On the other hand, when individuals accept their unpleasant emotions like anxiety, instead of avoiding them, even though it is more painful for them in that moment, in the end they are capable to move on and not be stuck emotionally (Kashdan & Rottenberg, 2010; Kivity et al., 2016).

Emotional avoidance, and experiential avoidance more broadly, also have negative effects on physical health. For example, it has been found that greater use of emotional avoidance can contribute to the maintenance of fibromyalgia pain and fatigue (health problem that contains musculoskeletal pain, tender points, complaints of fatigue, sleeping problems, and disturbed mood) (Van Middendorp et al., 2008). For these reasons, understanding the mechanisms through which emotion regulation through avoidance affects physiological and psychological systems, can have important implications for health prevention.

Physiological Effects of Avoidance

Some researches support that avoidance is associated with altered autonomic functioning (e.g. Sloan, 2004); something that predisposes individuals who tend to use this strategy to exhibit physical and psychological problems (Appelhans & Luecken, 2006; Dobson & Dobson, 2018; Hayes et al., 1996). The autonomic nervous system (ANS) is closely linked to emotions and plays a primary role in their recognition, expression, experience and generation (Levenson, 2003; 2014). ANS contains two main subsystems, the sympathetic (SNS) and the parasympathetic (PNS), which influence the emotional state of an individual (Silvert et al., 2004). The first one (SNS) is triggered in emergency situations, where heart rate and physiological arousal are increased, while the parasympathetic system (PNS) is activated during rest, sleep and safety, to restore balance in the person's system by reducing heart rate and physiological arousal (Sequeira et al., 2009). ANS's activity can be measured through various physiological indices, including skin conductance responses (SCR), eye startle reflex, heart rate variability (HRV) and heart rate (HR) (Hagemann et al., 2003; Katahira et al., 2014).

Physiological arousal varies from high to low intensity (Hagemann et al., 2003) and it seems to be closely related to emotional states or traits (Herman et al., 2018). For example, increased physiological effect may occur in emotional states such as anger, anxiety, happiness, while decreased physiological arousal occurs in sadness and satisfaction (Herman et al., 2018). Additionally, heart rate (HR) and skin conductance (SCR) can be considered indicators of physiological arousal (Hagemann et al., 2003).

An important measure of the activity of the autonomic nervous system (ANS), which is often used, is heart rate (HR), which is affected by the sympathetic and parasympathetic systems. Leonidou et al., (2021) posed a hypothesis that avoidant emotion regulation may be associated with autonomic hyperarousal, which may indicate that the parasympathetic system is unable or fails to restore calm to the heart during unpleasant emotional situations. Because of their inability to launch appropriate strategies for regulating emotions, in order to truly calm their physiological reactions, individuals who tend to use avoidance may remain in defensive action preparation showing increase autonomic arousal compared to non-avoiders (Gross & John, 2003; Kashdan et al., 2006; Leonidou & Panayiotou, 2021). Löw and colleagues (2015), reached similar conclusions, finding that the use of avoidance in response to threat stimulus (electrical shock) increased heart rate when active avoidance was possible, in a sample of 27 students.

To the contrary, an interesting study by Sloan (2004) investigated the relationship between avoidance and arousal (HR) toward pleasant, unpleasant, and neutral stimuli. Sixty-two participants were divided into two groups: high avoiders and low avoiders based on the Acceptance and Action Questionnaire (Hayes et al., 2004). Participants had to watch affective movie clips and after the end of each movie clip, they had to rate their emotional state during the film. Avoidance was measured through self-report measure; AAQ and physiological measures (Sloan, 2004). High avoiders showed greater avoidance of both pleasant and unpleasant stimuli, and less heart rate activity in response to the unpleasant stimuli compared to low avoiders (Sloan, 2004), suggesting hypoarousal toward such stimuli. Still, other studies about the psychophysiology of avoidant coping, show that there are no significant differences between high and low experiential and emotional avoidance groups in HR (Chawla & Ostafin, 2007; Feldner et al., 2003; Karekla et al., 2004). Thus, findings regarding the relationship between avoidance and HR reactivity toward unpleasant stimuli are mixed, underlying the need for further examination.

Another autonomic measure that only reflects sympathetic function and therefore may be easier to interpret than HR, is SCR, which can be considered as an objective index of physiological arousal (Bernat et al., 2006; Dawson et al., 2007; Mardaga et al., 2006; Mardaga & Hansenne, 2010). Studies using this measure seem more consistent with the hypothesis of hyper-arousal associated with avoidance, than the studies that used HR. Yoshino and colleagues (2005) showed that healthy men with higher harm avoidance (temperamental trait) scores exhibited greater skin conductance responses toward negative, neutral and positive visual stimuli relative to the subjects with low harm avoidance, consistent with the idea of hyper-arousal. Additionally, the study of Löw et al., (2015) has shown that when college students were asked to actively avoid a stressor (an electrical stimulus) skin conductance responses were increased. Similar findings exist by Wendt et al., (2017) with a sample of university students, in a condition that participants had to avoid possible threats. Moreover, Lovibond and colleagues (2009) showed that participants who used avoidance as a protective method in response to unpleasant stimuli exhibited increased skin conductance reactivity toward them. Nevertheless, some studies did not find significant differences between high and low experiential and emotional avoidance groups in skin conductance (Chawla & Ostafin, 2007; Feldner et al., 2003; Karekla et al., 2004) suggesting the need for further research.

Taken together, some studies support that greater avoidance use is associated with hyperarousal toward unpleasant stimuli (Leonidou & Panayiotou, 2021; Lovibond et al., 2009; Löw et al., 2015; Mantantzis et al., 2018; Wendt et al., 2017), whereas others support either the presence of hypoarousal (Sloan, 2004) or no associations at all (Feldner et al., 2003; Karekla et al., 2004). Such conflicting findings underline that more research on the relationship between avoidance strategy and autonomic arousal toward unpleasant stimuli is needed; which is the goal of the current study.

Based on the above hypotheses and majority of findings, we theoretically expect that in the present study, greater avoidance levels will be associated with increased physiological reactions, such as heart rate and skin conductance; suggesting hyperarousal. In addition we aim to propose a mechanism through which these atypical patterns of responses may occur. We suggest that individuals who use avoidance as a regulation strategy may process emotional situation by not engaging with their behavioral and physiological aspects, but much more superficially and concretely. We hypothesize that guiding individuals into deeper engagement or processing of emotional situations, by helping them direct their attention on behavioral and physiological aspects can reduce the effects of avoidance, and contribute to more typical and context-appropriate physiological responses.

Depth of Processing

Memory networks, which include all aspects of emotional responses, physiological, behavioral and subjective, can be activated through affective imagery (Lang, 1979). In order to engage physiological and behavioral aspects of the emotional response to a greater degree, Constantinou et al. (2014), use a depth of emotional processing manipulation, during an emotional imagery task, with high alexithymic individuals who are believed to show very superficial and concrete responses to emotions, which seemed to normalize their physiological responses. According to this manipulation, the shallow processing task gives more emphasis to the semantic aspects of emotions, while deep processing aimed to activate more behavioral, subjective and physiological responses (Constantinou et al., 2014). This experimental procedure was inspired by the work of Craik & Lockhart (1972) study, which supported that deep processing focuses more on cognitive and semantic analysis (Craik & Lockhart, 1972). Deep and shallow emotional processing has not been applied previously to experiential avoidance, to examine if it can produce more typical responses. Studies of this method in relation to alexithymia (where it appeared to be related to avoidance), found that deep processing provoked more emotional responses in people with alexithymia in relation to controls (Panayiotou et al., 2007; Vermeulen et al., 2011); something that needs to be explored in relation to experiential avoidance.

Aim of the current study

All in all, emotions are crucial and necessary in our lives. A large body of research has tried to examine which emotion regulation strategies are adaptive or maladaptive in the regulation of negative emotions. Many of them have supported that avoidance is a maladaptive emotion regulation strategy and contributes in the development and maintenance of several psychopathological conditions (Dobson & Dobson, 2018; Panayiotou et al., 2019; 2021). The purpose of the current study is to examine whether greater use of experiential avoidance (as reported on self-report questionnaires about how individuals usually regulate their emotions) is associated with greater levels of physiological arousal as indexed by HR and SCR during an emotional imagery task, and whether different ways of processing emotional materials (deep Vs shallow) moderate the aforementioned relationships. Findings will inform us whether different types of affective processing are effective in alleviating the emotional deficits that have been previously reported in individuals using, to a greater extent, experiential avoidance.

Hypotheses

Based on the existing literature we hypothesize that:

1) Greater levels of experiential avoidance will be associated with increased autonomic arousal (SCR, HR) during the shallow emotional imagery of negative stimuli, whereas no associations will be observed with SCR and HR responses during the shallow processing of neutral stimuli. Although, conflicting findings exist in this area with some studies supporting hypo-arousal, others hyperarousal or no associations at all, due to the similar population of this research to the research of Leonidou and Panayiotou (2021), we expected similar results supporting hyperarousal.
2) During deep processing, it is expected that the association between avoidance and increased autonomic arousal will be reduced or eliminated.
3) Greater levels of avoidance are expected to show stronger associations with HR and SCR responses during shallow processing of unpleasant stimuli than during the deep

processing of unpleasant stimuli, indicating more appropriate reactivity to positive valent emotion, which do not trigger the motivation to avoid. Such findings are expected, as similar findings were found in individuals scoring high on alexithymia, which is characterized by high avoidance levels (Constantinou et al., 2014).

Method

Participants

Around 69 participants (female=81.7%; male=12.7%) were recruited from a large student sample from the University of Cyprus (N≥1500). They were between the ages of 18-30 years old (M= 21.16 and SD= 2.65) and speak fluently Greek. Individuals who meet the Psychiatric Diagnostic Screening Questionnaire criteria for substance use/ alcohol abuse or psychosis were excluded for the current study, as well as individuals having cardiovascular problems. Participants received a small monetary compensation (20 Euros) or extra credit for a course in the University for their participation in the research. Undoubtedly, the safety and well-being of participants was a priority throughout the research. The current study has received approval from the Cyprus National Bioethics Committee.

Experimental Design

The experiment was conducted as a 2 × 2 design with emotion (negative/neutral) and depth of processing (shallow/deep) as within-subject variables. Because these individuals also took part in another study on alexithymia, which as a trait may be related to greater avoidance tendencies, alexithymia (measured with total score on the Toronto Alexithymia Scale-20) was used as covariate in all analyses.

Each participant completed 12 imagery trials, which included scenes related to negative and neutral emotions. Participants were asked to process each type of scene either under deep or shallow processing instructions. The dependent variable in this study was avoidance, while the independent variables were the physiological indices (i.e. heart rate, skin conductance) and alexithymia as a covariate during the 2 types of emotional imagery.

Instruments

Action and Acceptance Questionnaire (AAQ-II). Participants completed the Acceptance and Action Questionnaire (AAQ-II) that was developed by Bond et al. (2011). It is a newer version of AAQ, created by Hayes and colleagues (2004). AAQ-II is a measure of experiential avoidance and in particular it measures avoidance of negative experiences by the individual (Karekla & Panayiotou, 2011; Tyndall et al., 2018). In more detail, the AAQ-II is a 10-item self-report questionnaire (e.g. ‘’I’m afraid of my feelings‘’, ‘’I worry about not being able to control my worries and feelings‘’) (Rochefort et al., 2018), with a 7- point Likert scale ranging from 1 (‘’never true‘’) to 7 (‘’always true‘’) (Bond et al., 2011; Fledderus et al., 2012; Tyndall et al., 2018; Wolgast, 2014). There is a range of scores between 10 and 70, where greater scores indicate more psychological flexibility and lower scores more experiential avoidance (Karekla & Panayiotou, 2011). Prior studies have shown that AAQ-II exhibits satisfactory test-retest reliability (r = .81 and .79), high internal consistency (Cronbach’s alpha = .84) and good content validity (Bond et al., 2011). Karekla and Michaelides (2017) found that the AAQ-II Greek translation has appropriate psychometric properties in a sample of 274 Greek-speaking participants in Cyprus as indexed by test-retest reliability with r =.78, p < .001, high internal consistency with Cronbach's alpha at .92 , high correlations with similar constructs at .78 or higher, and a unifactorial structure (Karekla & Michaelides, 2017). In the present study, the Cronbach’s Alpha for the AAQ scale was 0.92 (M= 3.08, SD= 0.15).

Toronto Alexithymia Scale-20 (TAS20). This tool (TAS20; Bagby et al., 1994) is a twenty item self-report measure assessing the levels of alexithymia, with a 5-point Likert scale. It contains three subscales: difficulty identifying feelings (DIF: seven items), difficulty describing feelings (DDF: five items), and externally oriented thinking (EOT: eight items) (Bagby et al., 2020; Leising et al., 2009). The total score of the three subscales is used as a measure of the total levels of alexithymia, with a higher score on TAS-20 indicating higher levels of alexithymia (Constantinou et al., 2014). This tool has satisfactory psychometric properties; prior studies have shown that TAS-20 exhibits satisfactory internal consistency (Cronbach's alpha = .80 and .83) and test-retest reliability (r = .74) (Michael et al., 2020). There is a Greek version of TAS-20 by Anagnostopoulou and Kossieoglou (2007), with good reliabilities for most scales (total α = .79, DDF α = .79, DIF α = .74, EOT α = .58). This was used to assess participants' trait level of alexithymia, which was a covariate in the present analyses.

Imagery Materials. The material used to evoke emotional imagery, are derived from Panayiotou, 2008. They represent standard emotional imagery scripts as used by Witvliet & Vrana, (1995) that went through the process of translation and validation in a Greek-Cypriot sample (Panayiotou, 2008). Twelve scripts representing sadness, fear and neutral content were selected (four for sadness, four for fear and four for neutral) from the pool of normed materials, based on their normative valence and arousal scores. In particular, scripts of sadness and fear were selected so that they are different in arousal but not valence, as they respectively represent a low and a high arousal negative emotion. Neutral scripts are expected to be significantly lower in both negative valence and arousal from all other categories. The scripts were written in the first person and included references to subjective, physiological and behavioral emotional responses. They consisted of two sentences, with an average of 22 words. A sample of sad scripts are ‘’ I sit listening to the stranger next to me tell me that she lost her job and has to turn to social care to feed her children.'', '' I hear on the radio the story of an unmarried mother who has no money to feed her child.'', a sample of a fear script is ''A strange man is following me through a bad part of town; Sweat pours down my face as I listen to his footsteps getting closer'' and a sample of a neutral script is '' I lean against the wall, watching people passing by as I wait for a friend before class''.

Procedure

At first, participants provided their written consent to participate in the experiment. The research consisted of two phases. During the first phase participants completed a series of questionnaires online through the platform LimeSurvey, including the Acceptance and Action Questionnaire (AAQ-II), and the TAS-20. In the second phase participants performed the imagery experiment at the Clinical Psychology and Psychophysiology Laboratory of the University of Cyprus.

Experiment

Once participants arrived at the lab, provided consent and are given instructions, they were fitted with physiological monitors and will be allowed to relax for a few minutes. Then the experiment will begin. Participants completed 12 imagery processing trials, six with shallow instructions and the other six with deep instructions. To achieve this, they memorized the imagery scripts, aiming to induce sadness, fear and neutral emotions, which were given to them written on an index card, before the start of each trial. Participants started to imagine the memorized script when they were listening a tone cue and stopped when a different tone was heard, cue the end of imagery. At the end of each trial and before the beginning of the next one, participants were asked to write down elements they recall from their previous imagery, depending on the depth of processing that pertained to the particular trial. For the shallow processing, participants were required to imagine the specific scene in an active and intense way so as to be able to note various elements of the imagery environment, such as animals, objects, and people. Regarding deep processing, participants were asked to focus on emotional reactions and other subjective experiences during the processing of the imagery script, so that they could describe them to an actor who would want to impersonate them as they participate in the scene. All participants should actively participate and imagine the scene as vividly as possible, as though it is actually happening to them. After each imagery trial, they wrote down a) their thoughts, feelings, reactions, physical changes and behaviors, or whatever else they consider important to report, so that an actor could impersonate them, in the case of deep imagery, or b) semantic aspects of the imagery, specifically the numbers of people, animals or objects they imagined, in the case of shallow imagery, as in Constantinou et al., (2014).

Presentation order of deep vs shallow processing was counterbalanced between trials.

HR and SCR Recording and Data Analyses

Physiological measurements of heart rate and skin conductance were recorded during each imagery processing. BIOPAC MP150 for Windows bioamplifiers and transducers and Acq3.9 data acquisition software (Biopac Systems Inc., Santa Barbara, CA) were used for psychophysiological signals recording and data analysis respectively. To measure skin conductance level, two electrodes with a NaCl paste were used on the surface of the palm of the non-dominant hand. Additionally, for the measurement of heart rate, EKG Lead I electrodes were applied to the arms (on each inner forearm) of each participant.

A data reduction process was implemented to estimate heart rate and skin conductance responses during imagery processing. For each measurement and for each individual, extreme values above ± 2.5 SD were subtracted. Then, through Excel software, average scores for SCR responses and HR for each condition respectively (negative and neutral). Mean HR was later computed for each imagery period and each 20 s baseline "count-one" period prior to imagery onset. Mean SCLs were off-line computed for imagery and 20 s baseline periods.

Plan of Analyses

SPSS 21 for Windows statistical package was used to tabulate and pre-process the data. First of all, data were screened for the presence of missing and invalid data. Subsequently, Pearson's r correlations performed among experiential avoidance HR during the deep processing of unpleasant stimuli, HR during the deep processing of neutral stimuli, HR during the shallow processing of unpleasant stimuli, HR during the shallow processing of neutral stimuli, SCR during the deep processing of unpleasant stimuli, SCR during the deep processing of neutral stimuli, SCR during the shallow processing of unpleasant stimuli, and SCR during the shallow processing of neutral stimuli in order to observe any relationships among experiential avoidance and physiological arousal at different levels of processing. After that in order to examine hypothesis 1, we ran a multiple linear regression with experiential avoidance as the outcome and HR and SCR during shallow processing of unpleasant stimuli and neutral stimuli as the predictors in order to examine whether experiential avoidance is associated with increased physiological arousal during the processing of unpleasant stimuli relative to neutral stimuli, while alexithymia (TAS-20) was used as a covariate. In addition, for the second and third hypothesis, a multiple linear regression performed with HR and SCR during deep processing of unpleasant stimuli and neutral stimuli as the predictors in order to examine whether experiential avoidance shows less strong associations with physiological arousal during the deep processing of unpleasant stimuli compared to the shallow processing of unpleasant stimuli supporting more appropriate reactivity, while alexithymia (TAS-20) was used as a covariate.

Results

Pearson's r correlations

Firstly, we performed Pearson's r correlations analysis among experiential avoidance HR during the deep processing of unpleasant stimuli, HR during the deep processing of neutral stimuli, HR during the shallow processing of unpleasant stimuli, HR during the shallow processing of neutral stimuli, SCR during the deep processing of unpleasant stimuli, SCR during the deep processing of neutral stimuli, SCR during the shallow processing of unpleasant stimuli, and SCR during the shallow processing of neutral stimuli in order to observe any relationships among experiential avoidance and physiological arousal at different levels of processing. Finally we performed the same analyses, simply in place of avoidance, the variable of alexithymia was placed, in order to examine whether the close association between avoidance and alexithymia moderates the effects of the other variables.

Heart Rate

Pearson's r correlations showed that experiential avoidance was not significantly associated with heart rate during deep processing of fear stimuli (r = -.055, p = .667) and during shallow processing of fear stimuli (r = -.095, p = .454). Also, Pearson's r correlations showed that experiential avoidance was not significantly associated with heart rate during deep processing of neutral stimuli (r = -.054, p = .676) and during shallow processing of neutral stimuli (r = -.041, p = .752). Therefore, our findings did not support any significantly associations between experiential avoidance and heart rate during deep and shallow of fear and neutral stimuli (see table 02). Finally, no significant associations between alexithymia and heart rate during deep and shallow of fear and neutral stimuli were found (see table 03).

Skin Conductance

Pearson's r correlations showed that experiential avoidance was not significantly associated with skin conductance during deep processing of fear stimuli (r = -.207, p = .101) and during shallow processing of fear stimuli (r = -.105, p = .409). Also, Pearson's r correlations showed that experiential avoidance was not significantly associated with skin conductance during deep processing of neutral stimuli (r = -.168, p = .188) and during shallow processing of neutral stimuli (r = -.213, p = .094). Therefore, our findings did not support any significant associations between experiential avoidance and skin conductance during deep and shallow of fear and neutral stimuli (see table 02). Finally, no significant associations between alexithymia and skin conductance during deep and shallow of fear and neutral stimuli were found (see table 03).

Although the findings are not statistically significant, however there seems to appear a tendency for a negative association, suggesting that individuals with greater avoidance scores tended to show less skin conductance responses during deep processing of fear stimuli. This shows that when they perform deep processing, they have less sympathetic arousal. Also, there seems to appear a tendency for a negative association, suggesting that individuals with greater levels of experiential avoidance tended to have lower skin conductance responses during shallow processing of neutral stimuli (see table 02 & 05).

Multiple Linear Regression

We performed a multiple linear regression with experiential avoidance as the outcome and HR and SCR during deep and shallow processing of unpleasant stimuli (fear) and neutral stimuli as the predictors, while alexithymia (TAS-20) was used as a covariate. This analysis was performed to show if experiential avoidance is associated with increased physiological arousal during the processing of unpleasant stimuli relative to neutral stimuli (first hypothesis). Also, it would show if experiential avoidance shows less strong associations with physiological arousal during the deep processing of unpleasant stimuli compared to the shallow processing of unpleasant stimuli supporting more appropriate reactivity (second and third hypothesis). Separate analyzes were performed for heart rate and skin conductance, respectively.

Heart Rate

Firstly, we used the experiential avoidance as the outcome, heart rate during deep and shallow processing of unpleasant stimuli (fear) and neutral stimuli as the predictors and alexithymia (TAS-20) and baseline heart rate as a covariates. Table 04 present the associations between experiential avoidance and heart rate responses during deep and shallow fear and neutral stimuli. Contrary to our expectations, no significant associations were observed between experiential avoidance with heart rate during deep and shallow processing of fear and neutral stimuli and baseline (see table 04). Experiential avoidance was only significantly associated with alexithymia (positive correlation; as one increases the other also increases) at both Step 1 (p = <.001) and Step 2 (p = <.001), while the whole model explained 39.3 % of the variance of experiential avoidance.

Skin Conductance

We used the experiential avoidance as the outcome, skin conductance during deep and shallow processing of unpleasant stimuli (fear) and neutral stimuli as the predictors and alexithymia (TAS-20) as a covariate and baseline heart rate as controlling. Table 05 present the associations between experiential avoidance and skin conductance responses during deep and shallow fear and neutral stimuli. Contrary to our expectations, no significant associations were observed between experiential avoidance with skin conductance during deep and shallow processing of fear and neutral stimuli and baseline (see table 05). Experiential avoidance was only significantly associated with alexithymia (positive correlation; as one increases the other also increases) at both Step 1 (p = <.001) and Step 2 (p = <.001), while the whole model explained 42 % of the variance of experiential avoidance.

Discussion

The present study examined whether greater use of experiential avoidance is associated with greater levels of physiological arousal as indexed by HR and SCR during an emotional imagery task (fear and neutral items), and whether different ways of processing emotional materials (deep Vs shallow) moderate the aforementioned relationships. As expected, experiential avoidance was not significantly associated with heart rate during deep processing of fear and neutral stimuli, whereas similar findings were found for skin conductance. However, contrary to our expectations experiential avoidance was also not significantly associated with skin conductance and heart rate responses during shallow processing of fear and neutral stimuli. Finally, experiential avoidance was only strongly associated with alexithymia.

Although, we did not observe any significant associations between experiential avoidance and autonomic reactivity toward fear and neutral stimuli, our results appear to be consistent with those of previous research supporting no significant differences between experiential avoidance and physiological arousal during the processing of emotional stimuli (Feldner et al., 2003; Karekla et al., 2004). The study of Feldner and collaborators (2003) claimed that one possible explanation for this could be that the levels of emotional avoidance appear to be related to the way physical and bodily arousal is experienced, rather than to the perceived or actual appearance of the senses. This explanation can be related to the literature on emotional disorders, especially panic attack disorder, where these individuals tend to experience their physical sensations as dangerous and unmanageable, rather than experiencing physiologically different their senses (Barlow et al., 2016; Bouton et al., 2001). In addition, Karekla and collaborators (2004) argued that individuals with panic disorder do not experience more physiological arousal than individuals without the disorder, something that seems to be in line with individuals with greater avoidance or no tendency of avoidance. Also according to the first hypothesis, indeed no associations observed with SCR and HR responses during the shallow processing of neutral stimuli.

Of note, some interesting observations were made. More explanatory, it seems that there was a tendency for a negative association, suggesting that individuals with greater experiential avoidance scores tended to show less skin conductance responses during deep processing of fear stimuli. This shows that when individuals perform deep processing, they have less sympathetic arousal (as indexed by less skin conductance levels), suggesting that guiding individuals with greater levels of experiential avoidance being exposed to their feelings may lead in associated changes in physiological reactivity. Thus, processing feelings more deeply could reduce their anxiety, perhaps due to a better emotional management (Constantinou et al. 2014; Leonidou & Panayiotou, 2021). Also, it seems that deep processing provoked lower emotional responses (less skin conductance responses; less physiological arousal) in relation with more experiential avoidance in contrast with people with alexithymia for whom deep processing provoked more intense emotional responses (Constantinou et al. 2014). A possible explanation is that people with avoidance usually have heightened physiological responses; heart rate (Leonidou et al., 2021), so probably when they perform deep processing and are therefore encouraged to be exposed to their feelings, they have lower sympathetic arousal because of processing their feelings better and having more appropriate emotional management. Whereas, in the study on alexithymia it was expected that alexithymic individuals typically have reduced physiological responses to emotion, so deep processing would normalize this in the opposite direction (increased physiological response; increased heart rate), showing a more appropriate reactive and emotional behavior (Constantinou et al., 2014).

Also, we found a tendency for a negative association, suggesting that individuals with greater experiential avoidance scores tended to show lower skin conductance responses during shallow processing of neutral stimuli, although the effect was not significant. This could mean that if the neutral stimuli were treated more superficially, lower physiological arousal was produced. This can be explained by the fact that participants may not have resorted to deeper processing to feel their emotions, but processed them more superficially, causing them less sympathetic arousal. Vrana and Gross (2004) argued that neutral expressions are hard decoded and may require more attention and concentration to stimuli, elicit increased physiological responses (e.g. heart rate, skin conductance). Maybe this can explain the tendency toward less physiological arousal during shallow processing of neutral stimuli. The study of Gasper and partners (2019), examine the belief that people always feel something, so it is not possible to feel neutral (Damasio, 2003; Izard, 2007). Also, there is the belief that emotions are negative or positive, so there is no neutral emotional state (Condon et al., 2014; Colombetti 2005; Gasper et al., 2019). In addition, there is a belief that neutral affect is not important, because it cannot affect any behavior or cognition (Cohen and Andrade 2004; Gasper, 2018; Gasper et al., 2019). Therefore, individuals' physiological arousal may have been reduced due to the fact that neutral stimuli could not elicit a response in the shallow processing (Gasper, 2018). Additionally, individuals' physiological arousal may have been reduced as a strategy; if these stimuli were processed deeper by participants (Vrana & Gross, 2004), they could have led to more negative emotions that would affect their behavior and cognition (Gasper et al., 2019), thus causing them greater skin conductance responses and consequently greater physiological arousal.

It is important to discuss the finding that experiential avoidance was only significantly associated with alexithymia, which was used as a covariate at model analysis. It showed a positive association with the outcome variable, experiential avoidance. Alexithymia was first introduced in 1973 by Sifneos and can be described as the difficulty of individuals in expressing their feelings and inner states verbally (Sifneos, 1973). The most recent literature report that people with alexithymic characteristics, not only have difficulty in verbal expression of their emotions, but also in the description of emotions, in daydreaming, in distinguishing emotional arousal from other bodily senses and in the imagination (Lane et al., 1996; Wagner & Lee, 2008). Alexithymia is associated and predicts the development of various psychological and physical health problems, such as depression, cardiovascular and other medical problems (Manninen et al., 2011; Rief & Broadbent, 2007; Vanheule et al., 2011).

Through the research that has been done so far, it seems that alexithymia is related to experiential avoidance and the use of inappropriate ways of regulating emotions (Panayiotou et al., 2015; Venta et al., 2013). The study of Panayiotou and partners (2015) found a strong correlation between alexithymia and experiential avoidance, where avoidance used as a mediator between the relationship of alexithymia and depression. Similar findings were found in the study of Venta and collaborators (2013), where avoidance functioned as a mediator in the relationship of alexithymia and emotion regulation problems. It is also important to note that the clinical improvement in depression was associated with a reduction in alexithymic characteristics and consequently a reduction in experiential avoidance (Panayiotou et al., 2015). In conclusion, it appears that alexithymia and avoidance are strongly linked (Panayiotou et al., 2015; Venta et al., 2013), suggesting that the feeling that emotions are uncontrollable and unwanted is associated with some of the emotional difficulties that arise in alexithymia (Constantinou et al., 2014). Therefore, it is useful to study them in parallel, so that it is clearer how one affects the other, as well as which are the net effects of alexithymia and which are the net effects of avoidance. Also, because of the strong association with the alexithymia (covariate) and experiential avoidance, any effects of other variables may were lost.

Findings showed that experiential avoidance was only significantly associated with alexithymia, indicating a close relation between them. Also, no significantly associations between alexithymia and heart rate and skin conductance during deep and shallow of fear and neutral stimuli were found; suggesting that eventually alexithymia does not moderate the effects of the other variables with experiential avoidance. However, it is important to note that avoidance and alexithymia are two different (distinct) meanings (Luminet et al., 2021). The study of Constantinou and collaborators (2014) tried to examine whether deep processing can work as a method that can reduce the alexithymic characteristics, causing these individuals to express their emotions and physiological reactions, reducing the strategy of avoid. The results showed that during deep processing the heart rate was higher in fear stimuli for high alexithymic individuals, whereas no significant differences during shallow processing and between depth of processing and skin conductance (Constantinou et al., 2014). In our study there are no statistically significant findings, however there has been a tendency for less skin conductance responses during deep processing of fear stimuli in relation with experiential avoidance; supporting the hypoarousal hypothesis. The hypoarousal hypothesis is in line with findings on study of Constantinou et al, 2014, who argue that in relation with autonomic and startle reactivity to emotions, individuals with high alexithymia (who also tend to be high avoiders) tended to have lower reactivity during high arousing emotion; suggesting hypoarousal. These findings suggest that there is a tendency for individuals with alexithymia to use less sensory-motor preparation and active emotion-related mobilization (Bradley, 2009; Bradley & Lang, 2007). Therefore, these individuals need more attentional resources and more time to process threatening stimuli (Grynberg et al., 2013). In line with this, the hypoarousal hypothesis was also supported by Sloan (2004), in relation to avoidance and arousal (HR) toward pleasant, unpleasant, and neutral stimuli. The findings showed less heart rate activity in response to the unpleasant stimuli in individual with greater avoidance; suggesting hypoarousal toward such stimuli (Sloan, 2004). In general, we conclude that people who use experiential avoidance more, have higher heart rate, which could be normalized (reduced heart rate) by instructions towards during deep processing. In alexithymia, individuals have a reduced heart rate, so during deep processing are expected to show an increased heart rate, thus responding better (Constantinou et al., 2014). Nevertheless, it is important to take into account that none of the aforementioned outcomes were statistically significant.

Contribution and Limitations

It seems that individuals tend to use the strategy of avoidance in relation to situations that cause them stress or other negative emotions, negatively affecting their daily lives and functionality (Berking & Wupperman, 2012; Kashdan et al., 2006). Avoiding their emotions does not allow them to manage the various situations properly. This results in the maintenance of stress and negative emotions and in the long run the frequent use of avoidance to cause discomfort and affect the functioning of individuals, contributing to the development of mental health problems (Dobson & Dobson, 2018; Sloan, 2004). The present study aimed to contribute to a better understanding of the underlying physiological processes (physiological arousal) linking experiential avoidance with health problems and factors that may moderate this relationship e.g. deep and shallow emotion processing. In this way, it informed us about how different treatment modalities (deep or shallow emotion processing) can contribute to reducing the adverse physiological effects of experiential avoidance during the processing of aversing emotional information and specifically whether deep emotional processing is effective in relieving the emotional deficits that previously reported in people with high avoidance.

These findings suggest that the deep processing can help reduce arousal and consequently reduce anxiety (Constantinou et al., 2014). Therefore, interventions such as behavior therapy, cognitive behavior therapy and acceptance and commitment therapy, appear to be effective in managing stress (Regehr et al., 2013). Also, reducing avoidance through cognitive behavioral therapy has been shown to help improve psychological symptoms in people with alexithymia (Panayiotou et al., 2014). This suggests that it is very important for people to know and express their feelings, as this leads to improved mental health and connected emotion response systems (Panayiotou et al., 2014).

Beyond the important contribution that can be provided by this study, it is reasonable to note some limitations of the research. Initially, an important limitation was the sample number, which could be larger so that the results reflect a larger portion of the population and statistically significant results. However, due to the time consuming process of obtaining the physiological effects, but also the current state of the coronavirus, the number of participants is limited. Also, the number of females was much more as the number of males. Furthermore, the participants were selected by completing in their own time a package of questionnaires, which contained the self-report questionnaire Acceptance and Action Questionnaire (AAQ-II), but they did not complete again the AAQ-II on the day they came to the laboratory to perform the second part of the research (the practical-laboratory part). Additionally, an event that could affect the results is the detailed and extensive instructions that given to the participants (for deep or shallow emotion processing) and especially in the process of deep emotional processing, something that "deprives" the participants of the freedom to express themselves as they wish, since guidance may lead to an improvement in their emotional reactions. Also, because of the strong association with the alexithymia (that was used as a covariate) and experiential avoidance, any effects of other variables may have been lost. Finally, it would be useful to have a questionnaire about deep and shallow emotion processing, in order to evaluate the subjective reports of individuals about it. However, there is no such thing in the literature yet.

It is important to mention some of the strengths of the present study. Firstly, it is an innovative study, as it examined the relationship between avoidance and physiological arousal, through different processing methods (deep Vs shallow). In addition, alexithymia was used as a covariate, as a result of which its association with avoidance became apparent. This indicates that it is important for future studies to consider both of these variables in their research, as they are closely related. Finally, the present study suggests a coping mechanism to reduce avoidance, through deep processing, and thus states that interventions such as behavior therapy, cognitive behavior therapy and acceptance and commitment therapy, could help reduce anxiety and arousal.

Conclusion

To sum up, to our knowledge this is the first study to investigate the association between experiential avoidance and physiological arousal, during emotional imagery task using different ways of processing emotional materials (deep Vs shallow). So far there is no clear picture of how autonomous regulation is related to the use of avoidance and how this leads to the development of psychological problems. Although no significant statistical results were found, considerable and interesting observations were made. There was a tendency for a negative association, suggesting that individuals with greater experiential avoidance scores tended to use less skin conductance responses during deep processing of fear stimuli, reflecting less sympathetic arousal and thus better emotional management. A noteworthy remark is the fact that experiential avoidance was strongly associated with alexithymia, suggesting that future studies should take into account this association (Luminet et al., 2021). More research is needed to delineate more clearly the role of the aforementioned mechanisms, in the trajectory that links avoidance to the development and maintenance of psychopathological symptoms and how experiential avoidance can be treated or reduced.

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Appendixes

Table 01. *Means, Standard Deviations, Minimum and Maximum Scores for HR, SCR, Baseline HR and Baseline SCR*

Physiological Measurements	M	SD	Minimum	Maximum
Baseline HR	77.62	9.46	61.19	98.94
Baseline SCR	12.94	5.96	2.67	32.73
HR during Deep Processing of Fear Stimuli	77.39	10.25	58.15	101.19
HR during Deep Processing of Neutral Stimuli	77.58	9.99	58.99	101.13
HR during Shallow Processing of Fear Stimuli	76.40	9.73	58.99	97.92
HR during Shallow Processing of Neutral Stimuli	77.43	10.18	53.72	106.95
SCR during Deep Processing of Fear Stimuli	12.18	5.62	2.03	35.59
SCR during Deep Processing of Neutral Stimuli	11.82	6.26	1.94	36.36
SCR during Shallow Processing of Fear Stimuli	12.02	6.29	1.85	35.25
SCR during Shallow Processing of Neutral Stimuli	11.53	6.03	2.64	33.66

Notes. HR = Heart Rate Responses; SCR = Skin Conductance Responses; M = Mean; SD = Standard Deviation.

Table 02. *Summary of Pearson's r Correlations Analysis for the Associations between Experiential Avoidance with HR Responses during Deep and Shallow processing of Fear and Neutral Stimuli.*

Variables	1	2	3	4	5	6	7	8	9
1. AAQTOTAL	-	-.21	-.10	-.17	-.21	-.05	-.09	-.05	-.04
2. SCR during Deep Processing of Fear Stimuli		-	.87**	.93**	.83**	.14	.20	.15	.17
3. SCR during Shallow Processing of Fear Stimuli			-	.83**	.91**	.03	.13	.09	.12
4. SCR during Deep Processing of Neutral Stimuli				-	.78**	.07**	.15	.09	.13
5. SCR during Shallow Processing of Neutral Stimuli					-	.01	.10	.04	.09
6. HR during Deep Processing of Fear Stimuli						-	.93**	.96**	.90**
7. HR during Shallow Processing of Fear Stimuli							-	.94**	.95**
8. HR during Deep Processing of Neutral Stimuli								-	.93**
9. HR during Shallow Processing of Neutral Stimuli									-

Notes. **p < .001. * p < .005; N=69

Table 03. *Summary of Pearson's r Correlations Analysis for the Associations between Alexithymia with HR Responses during Deep and Shallow processing of Fear and Neutral Stimuli.*

Variables	1	2	3	4	5	6	7	8	9
1. TAS20SUM	-	-.14	-.03	-.05	-.11	-.12	-.13	-.13	-.07
2. SCR during Deep Processing of Fear Stimuli		-	.87**	.93**	.83**	.14	.20	.15	.17
3. SCR during Shallow Processing of Fear Stimuli			-	.83**	.91**	.03	.13	.09	.12
4. SCR during Deep Processing of Neutral Stimuli				-	.78**	.07**	.15	.09	.13
5. SCR during Shallow Processing of Neutral Stimuli					-	.01	.10	.04	.09
6. HR during Deep Processing of Fear Stimuli						-	.93**	.96**	.90**
7. HR during Shallow Processing of Fear Stimuli							-	.94**	.95**
8. HR during Deep Processing of Neutral Stimuli								-	.93**
9. HR during Shallow Processing of Neutral Stimuli									-

Notes. **p < .001. * p < .005; N=69

Table 04. *Summary of Multiple Regression Analysis for the Associations between Experiential Avoidance with HR Responses during Deep and Shallow processing of Fear and Neutral Stimuli.*

	Experiential Avoidance				
Variables	*B*	*SE B*	*Beta*	*t*	*P*
Step 1					
TAS20SUM	.517	. 087	.610	5.959	<.001
Baseline HR	.002	.107	.001	.014	.988
Step 2					
TAS20SUM	.527	.093	.622	5.639	<.001
Baseline HR	.103	.547	.099	.188	.851
HR during Deep Processing of Fear Stimuli	-.046	.406	-.047	-.112	.911
HR during Deep Processing of Neutral Stimuli	-.520	.479	-.509	-1.087	.281
HR during Shallow Processing of Fear Stimuli	.397	.504	.403	.788	.434
HR during Shallow Processing of Neutral Stimuli	.057	.368	.059	.156	.877
Step 1					
R^2	.372				
Step 2					
R^2	.393				
Step 1					
F	17.80				
Step 2					
F	6.05				
Step 1					
p	<.001				
Step 2					
p	<.001				

Notes. HR = Heart Rate Responses; B = Unstandardized regression coefficient; SE = Standard error; Beta = Standardized regression coefficient.

Table 05. *Summary of Multiple Regression Analysis for the Associations between Experiential Avoidance with SCR Responses during Deep and Shallow processing of Fear and Neutral Stimuli.*

	Experiential Avoidance				
Variables	*B*	*SE B*	*Beta*	*t*	*P*
Step 1					
TAS20SUM	.505	.086	.597	5.882	<.001
Baseline SCR	-.214	.172	-.126	-1.243	.219
Step 2					
TAS20SUM	.488	.091	.577	5.370	<.001
Baseline SCR	-.570	1.143	-.337	-.499	.620
SCR during Deep Processing of Fear Stimuli	.265	.684	.149	.388	.700
SCR during Deep Processing of Neutral Stimuli	.818	.598	.517	1.368	.177
SCR during Shallow Processing of Fear Stimuli	-.216	.500	-.134	-.431	.668
SCR during Shallow Processing of Neutral Stimuli	-.545	.454	-.330	-1.199	.235
Step 1					
R^2	.388				
Step 2					
R^2	.420				
Step 1					
F	19.03				
Step 2					
F	6.76				
Step 1					
p	<.001				
Step 2					
p	<.001				

Notes. SCR = Skin Conductance Responses; B = Unstandardized regression coefficient; SE = Standard error; Beta = Standardized regression coefficient.