Universidade de Aveiro
2021

ANA SOFIA TAVARES DA SILVA MARQUES VENTURA

EXPLORANDO O PROCESSAMENTO DE AMEAÇA INCONSCIENTE USANDO REALIDADE VIRTUAL

EXPLORING UNCONSCIOUS THREAT PROCESSING USING VIRTUAL REALITY

Universidade de Aveiro
2021

ANA SOFIA TAVARES DA SILVA MARQUES VENTURA

EXPLORANDO O PROCESSAMENTO DE AMEAÇA INCONSCIENTE USANDO REALIDADE VIRTUAL

EXPLORING UNCONSCIOUS THREAT PROCESSING USING VIRTUAL REALITY

Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Psicologia da Saúde e Reabilitação Neuropsicológica, realizada sob a orientação científica da Professora Doutora Sandra Cristina de Oliveira Soares, Professora Auxiliar do Departamento de Educação e Psicologia da Universidade de Aveiro e da coorientação do Doutor Samuel de Sousa Silva, Investigador no Instituto de Engenharia Eletrónica e Informática de Aveiro (IEETA) da Universidade de Aveiro

Dedico este trabalho à minha família, de sangue e do coração.

o júri

presidente

Professora Doutora Anabela Maria Sousa Pereira
Professora Associada com Agregação, Universidade de Aveiro

Doutor Pedro Filipe da Silva Rodrigues
Investigador de Pós-Doutoramento, Escola de Psicologia (epsi) - Universidade do Minho

Professora Doutora Sandra Cristina de Oliveira Soares
Professora Auxiliar, Universidade de Aveiro

agradecimentos

Depois de um ano tão diferente para todos, chega ao fim mais uma etapa no caminho do meu sonho. E por isso só tenho a agradecer às pessoas que me ajudaram neste caminho.

À Professora Sandra Soares, pela partilha de conhecimentos, pela boa disposição e por me motivar. Muito obrigada!

Ao Doutor Samuel Silva, pelo apoio, disponibilidade e simpatia. Obrigada!

À minha família, por serem os meus maiores apoiantes, por acreditarem em mim e me proporcionarem tudo para concretizar mais esta etapa. Mãe, pai, irmão, tios e primos, muito obrigada!

Ao António, por estar sempre presente, por ter sempre a palavra certa e por me ajudar a olhar para além das minhas inseguranças. Muito obrigada meu anjo!

Às minhas colegas de casa, Andreia, Sílvia e Catarina, por serem incríveis, por estarem presentes mesmo que à distância, por acreditarem sempre em mim e me alegrarem sempre. Muito obrigada!

Às minhas amigas, que me acompanham há tantos anos e que trago sempre no coração. Eva, Mariana, Rafa, Carolina, Catarina, obrigada!!

À Andreia, por nunca se esquecer de mim e ser um exemplo a seguir, muito obrigada!

À Sara, a minha irmã gémea, por ter os melhores conselhos e me tranquilizar sempre. Muito, muito obrigada!

Ao Francisco, por ter tido muita paciência comigo e me ter ajudado muito, obrigada!

Por fim, a todas as pessoas que se cruzaram comigo durante estes cinco anos e me ajudaram a crescer, evoluir e chegar até aqui. Obrigada!

palavras-chave Medo; Estímulos ameaçadores; Cobras; Acesso à consciência; CFS.

resumo

As emoções têm como efeito primário a ativação do nosso corpo para provocar uma resposta rápida. As respostas de medo criam mecanismos para evitar e escapar de estímulos e eventos ameaçadores. Através da seleção natural, os indivíduos com sistemas defensivos e visuais mais eficazes na resposta e deteção de ameaça, prevaleceram. Esta vantagem de processamento está ainda presente nos seres humanos de hoje, com vários estudos a mostrarem a vantagem das cobras na sua deteção e acesso à consciência. A técnica de CFS (Continuous Flash Supression) permite o estudo do processamento inconsciente. Neste projeto, iremos comparar os resultados usando CFS num monitor de computador e num dispositivo de realidade virtual, medindo tempos de reação, frequência cardíaca e condutância da pele. No olho dominante serão apresentados os estímulos (imagens de cobras e de pássaros) e no outro olho, as máscaras de Mondrian. Iremos manipular a posição dos estímulos através das visões (foveal e periférica). Esperamos uma vantagem dos estímulos de cobras aos dos pássaros, nas duas condições (computador e realidade virtual), e também modulação das medidas fisiológicas com o aparecimento dos estímulos ameaçadores. Esperamos também que a vantagem das cobras seja independente do campo visual. Este projeto pretende contribuir para o estudo do processamento de ameaça no ser humano, assim como avaliar o uso de realidade virtual em psicologia experimental e aumentar a validade ecológica do uso desta em investigação e intervenção psicológica.

keywords

Fear; Threat stimuli; Snakes; Conscious awareness; CFS.

abstract

Emotions have as primary effect the activation of our body to elicite a quick response. Fear responses created mechanisms to avoid or escape threatening stimuli and events. Through natural selection, the individuals with more effective defensive and visual systems in responding and detecting threat, prevailed. This processing advantage is still present in humans as various studies reveal snakes' advantage in accessing awareness. Continuous Flash Suppression (CFS) technique allows the study of unawareness processing. In this project, we will compare the results of using CFS in a computer monitor or in a virtual reality device, accessing reaction times, heart rate and skin conductance. To the dominant eye will been presented the stimuli (snakes' or birds' images) and to the other eye the Mondrian masks. We will manipulate the stimuli position by visions (foveal or peripheral). We expect advantage of snakes' stimuli over birds' images, in both devices, and also modulation of the physiological measures upon appearance of the threat eliciting stimuli. We expect, as well, that snakes' advantage will be independent of the visual field. This project aims to contribute to the study of threat processing in the human being as well as to evaluate the use of virtual reality in experimental psychology and increase the ecological validity of its use in investigation and psychological intervention.

Index

List of figures

Literature Review

Fear, threat and evolution

Emotions are multidimensional, encompassing physiological, behavioural and emotional changes (Tooley, Carmel, Chapman, & Grimshaw, 2017), with the primary function of activating our body in order to quickly respond to significant events in the environment (e.g. predators, natural disasters) (Ekman, 1999; LeDoux, 2012; Öhman & Mineka, 2001). Fear, in particular, is a basic emotion involved in dealing with threat and maximizing the chances of survival of the organism (Maack, Buchanan, & Young, 2015). As a result, complex and multidimensional mechanisms are activated in order to allow faster detection of threatening stimuli and, consequently, faster responses to these through the inhibition of certain types of response and the facilitation of others (Bentz & Schiller, 2015).

Threat responses have an evolutionary nature and are still observed nowadays despite having as genesis the primitive years of the human being. That is, emotions induce adaptive responses according to the past, both the evolutionary and the individual's history. This adaptability has a central role in learning and surviving, that is often related with the emotion of fear that is associated with survival responses (Bentz & Schiller, 2015). According to Seligman (1971), adaptive responses towards events or stimuli that elicit fear, such as snakes or angry faces, have resulted in the survival of the human species throughout its evolution. Additionally, threat detection involves the processing of innate but also learnt threatening stimuli (Bentz & Schiller, 2015). That being said, ecological pressure determined the most successful coping mechanisms to process and detect threat that were passed on through generations. Avoiding dangerous situations by a quick detection of threatening stimuli have then increased survival and consequently reproduction, hence perpetuating the gene pool to future generations (Öhman & Mineka, 2001).

Fear processing

According to Öhman and Mineka (2001), our brains are hardwired with a *Fear Module*, involving a dedicated neuronal circuit implicating fear elicitation, with the amygdala playing a central role. The fear module is favourably elicited by evolutionary-relevant stimuli, and its activation is automatic and not fully controlled by cognition. According to the authors (Öhman & Mineka, 2001, 2003), fear of such stimuli (e.g., snakes) is easier to learn than other stimuli, both through direct or vicarious conditioning, harder to extinguish, and its processing does not need awareness of the threating stimuli for its activation and conditioning.

In the *Fear Module* proposed by Öhman and Mineka (2001), the authors claim that there is a special neural pathway through the reptilian brain, mostly involving the limbic system, which is shared with more primitive living beings. The amygdala seems to play a major role in fear control. Moreover, the subcortical pathway amygdala-pulvinar-superior colliculus, the so-called *low road* (LeDoux, 1996), is pointed as the pathway that seems to favour the processing of threatening stimuli, even without its visual awareness (LeDoux, 1996; Öhman & Mineka, 2001). The pulvinar is located in the thalamus and establishes connections with the other thalamic nucleus and it is associated with sensorial integration, whereas the superior colliculus is in the mesencephalon and is implicated on visual reflections and visual stimuli (Seeley, Stephens, & Tate, 2003).

The activation of the *low road* seems to rely on Low Spatial Frequency (LSF), rather than High Spatial Frequency (HSF) information. LSF information implies a coarse, less detailed and out of focus image processing and seems to be processed through this subcortical pathway, while HSF information seems to rely more on the visual cortical areas (Ledoux, 1996; Schiller, Malpeli, & Schein, 1979). The results in the study by Almeida, Soares and Castelo-Branco (2015), using an fMRI event-related design, showed an increased response of the amygdala towards threat stimuli (snake shapes), independently of the visual field of its presentation. It also showed that the pulvinar activated strongly in central presentations of snakes' stimuli. Moreover, Van Le et al. (2013) studied two monkeys born in captivity and that, therefore, have never witnessed a snake, by recording the pulvinar neurons response from the cells in medial and dorsolateral pulvinar. Snakes' images were compared to pictures of monkey faces (angry and neutral faces), monkey hands and geometric shapes (circle, cross, square and star). Pulvinar responses were faster and stronger to the stimuli of snakes compared to the other stimuli, with snakes eliciting the shortest latency responses. The study by Van Le et al. (2014) using Japanese Macaques, also showed that pulvinar neurons both in medial and dorsolateral pulvinar activated strongly with images of snakes in striking positions than with non-threatening positions. These studies seem to suggest the existence of an adaptive system developed to detect snakes in non-human primates.

Snake processing advantage

Snakes have indeed been identified as a prototype of a fear stimulus, one with the deepest evolutionary routes. According to the Snake Detection Theory (SDT), proposed by Lynne Isbell (2006), snakes were probably mammals' first predator, which led to modifications and specialisations of the visual systems to detect snakes quicker, through natural selection. This process resulted in the extinction of individuals who exhibited less effective defence systems because, given the nature of snakes, its quick detection was essential for survival (Isbell, 2006). It is suggested that visual cortical areas are involved in identifying objects and their characteristics in socials environments, and that the subcortical visual system is involved in activating a prompt detector in situations that require a quick response, as to guarantee the survival of the individual (Soares, Maior, Isbell, Tomaz, & Nishijo, 2017).

Consistently, a bulk of behavioural studies have shown that snakes exhibit a privileged pass to our brain even in short exposure periods, peripheric vision, cluttered environments and as distractors, as showed in Soares and colleagues (2014). In one experiment of Soares et al. research, participants completed a visual search task, with stimuli presented for 300, 600 and 1200 ms in a set of four or eight items. These stimuli were images of snakes, spiders, mushrooms and fruit. Snakes' detection was faster comparing to the detection of other stimuli, in particular in the 300 ms exposure time condition (i.e., the shortest exposure duration). The authors also manipulated the location of the target stimuli (fovea, parafovea and periphery), with the results showing that snakes were detected quicker than spiders and mushrooms, especially in peripheric vision. In a further experiment, snakes demonstrated a larger interference in cluttered environments, suggesting that attention was redirected to snakes. In a final experiment, results showed that snakes were more distractive from the central task, compared to other target stimuli, independently of the perceptual load of the task. These studies show the effective detection of snakes under demanding conditions, which are assumed to mimic those that may have been crucial for survival.

Moreover, in a further study (Soares & Esteves, 2013), both snakes and spiders were detected quicker compared to mushrooms, for short exposure times (150 ms and 300 ms) and high perceptual load condition (4, 6 and 8 items). Snakes were again overall detected more accurately than spiders, with a greater advantage in high perceptual load (many distractors) than low load (few distractors). These studies suggest that snakes have an advantage in reaching awareness even when presented very briefly and in high perceptual load conditions, i.e., among distractors stimuli. Consistent with these results, a study conducted by Kawai and He (2016), using the RISE technique (see Sadr & Sinha, 2004), also revealed an accurate detection of snakes under less discernible settings, hence simulating snakes' camouflage in the wild, while using images interpolated by random noise. That is, this technique generates a continuous sequence, that develop gradually from a random noise to more discernible images. Compared with images of fishes, cats and birds, snakes were detected exceeding 90% of accuracy in images with interpolation of 60%. In this study, participants were able to detect camouflaged snakes quicker than the other animals. In sum, these studies corroborate the notion that faster and accurate detection of snakes most likely have played a very important role in the survival of the human species as the Snake Detection Theory entails.

Furthermore, comparing images of snakes, spiders and birds, Van Strien, Eijlers, Franken, and Huijding (2014), measured early posterior negativity (EPN) amplitudes in a rapid serial presentation of 600 pictures of each animal. EPN is a component of event-related potential that peaks about 225-300 ms after stimulus onset. The results showed a lower EPN amplitude to birds, intermediate to spiders and a larger amplitude to snakes. This result argues in favour of SDT (Isbell, 2006), by further showing the quickness of snake detection. The authors also recorded the Late Positive Potential (LPP), where both snakes and spiders showed a larger amplitude when compared to bird pictures, demonstrating the preparedness to action and a greater level of sustained attention towards fear-relevant stimuli. In addition, in the study by Van Strien, Franken, and Huijding (2014), where EPN was also recorded, snake stimuli also demonstrated a larger amplitude, compared to crocodile and turtle stimuli, but also spider and slug pictures. Additionally, the study by He, Kubo, and Kawai (2014), measuring early posterior negativity (EPN), showed a larger amplitude of EPN when comparing pictures of snakes and birds in a serial presentation of these stimuli. These results provide additional evidence suggesting that snakes hold a preferential attention grabbing.

In order to investigate the effect of curvilinear shapes on EPN of threatening and non-threatening stimuli, Van Strien, Christiaans, Franken, and Huijding (2016) proceeded to a rapid serial visual presentation of pictures of: snakes (threatening and curvilinear), spiders (threatening and non-curvilinear), worms (non-threatening and curvilinear) and beetles (non-threatening and non-curvilinear). The EPN amplitude was larger, i.e. more negative, to snake images compared to spider and beetle pictures. Moreover, it was larger for spiders compared to beetle pictures and worm pictures produced a more negative EPN than beetle images. These results could suggest that curvilinear body shapes are not directly responsible for the enhancement of EPN but can partially lead to that.

A recent research by Bertels and colleagues (2020), studied the electrophysiological/neurophysiological effects on the detection of snakes, compared to frogs, and snakes compared to caterpillars. This study was conducted on infants between their seven and ten months old. By showing the images of these animals, the authors recorded the scalp electrical brain activity and showed a higher activity for snakes, especially in the occipital area of the brain. The authors suggested that this effect could be explain by the coiled body of the snake compared to the frogs (quadrupeds) and the caterpillars (long but not coiled). The coiled body of snakes has been appointed to be a critical aspect of their quick detection, as well as if they are presented in a striking position (Lobue & Deloache, 2011; Masataka, Hayakawa, & Kawai, 2010). The results by Bertels and colleagues (2020) provide further support to the Snake Detection Theory (Isbell, 2006) by evidencing a rapid detection of these stimuli in infants, who have not been expose to snakes before (as informed by the parents) and that humans can indeed exhibit a predisposition to detect these animals quicker and without the need for direct or vicarious learning.

Unconscious processing of threat

One of the premises of the privileged processing of threat stimuli is that it does not require awareness, given the potential hazardous consequences of a slower processing (Öhman & Mineka, 2001, 2003). Different methods have been used to experimentally manipulate awareness, such as backward masking, binocular rivalry and flash suppression. Backward masking entails the suppression of a target stimulus by presenting a masking stimulus immediately after it (Raab, 1963), while binocular rivalry consists of the presentation of one image to one eye and another image to the other eye, alternately (Tsuchiya & Koch, 2005). Flash suppression needs a pre-adapting period and only allows brief time of suppression. However, by combining the last two techniques, i.e., presenting to one eye continuously different images while a static image is presented to the other eye, allows a full suppression of the target stimulus (Tsuchiya & Koch, 2005). That is one of the most recent methods used to study unconscious processing by supressing visual stimuli from awareness, the Continuous Flash Suppression (CFS) (Korisky, Hirschhorn, & Mudrik, 2018). The technique works by presenting different shapes varying at 10 Hz into one eye and another image to the other eye, thus allowing visual suppression for long periods of time, at least ten times greater than the classic methods, such as binocular rivalry (Tsuchiya & Koch, 2005). Moreover, a version of CFS – breaking CFS (b-CFS) – is able to measure the time each stimulus takes to break suppression, which works as a direct measure of the time needed for the stimulus' detection (Stein, Hebart, & Sterzer, 2011).

A study by Gomes, Silva, Silva, and Soares (2017), using the breaking Continuous Flash Suppression (b-CFS), tested the advantage of snakes, compared to spiders and birds, in entering awareness, even under more complex settings. For this, the experiment had two conditions: a less complex condition (stimuli shown to the dominant eye of the participant) and a more demanding condition (stimuli shown to the non-dominant eye). In the first one, both ecological-relevant stimuli (snakes and spiders) took less time to be detected by the participants. However, in the second condition, only snakes showed advantage (shorter response times) to break suppression and reach awareness. This study suggests that, even in a more complex setting and in absence of visual awareness, snakes have a privileged detection. In further study, the same author, again using CFS and now manipulating the spatial frequency of the stimuli, studied the privileged access to awareness of snakes, in order to assess the role of the *low road* in this process (Gomes, Soares, Silva, & Silva, 2017). The stimuli were presented in one of the four quadrants of the screen and the spatial frequency of the images was manipulated LSF information, BSF (unfiltered) and HSF information. The results were consistent in showing that snakes showed an advantage in entering consciousness, compared to birds, preferentially when based on LSF information but also on BSF information. These results corroborate the notion that ecological-relevant stimuli, such as snakes, show a quicker detection and processing based on LSF information, supporting the role of the subcortical pathway to the amygdala.

Virtual reality as a tool to study unconscious processing

Research in threat unconscious processing in the laboratory has been limited to the use as static and low ecologically valid stimuli. Virtual reality (VR) is or can be an important resource in experimental settings, by adding resemblance to more real experiences and events that are part of our life. Hence, it establishes a connection between the computer and the person and can enhance the human senses like vision and audition by simulation (Hayre, Muller, & Scherer, 2020). VR also allows the creation of any environment and the use of different stimuli (e.g., fear-related stimuli), allowing a tailored experience (Botella, Fernández-Álvarez, Guillén, García-Palacios, & Baños, 2017). This technology enables the display of environments or stimuli in three dimensions (3D) while covering all visual field, and also being able to provide real time feedback and to create more immersive experiences (Botella et al., 2017; Hayre, Muller, & Scherer, 2020; Niehorster, Li, & Lappe ,2017). VR advantages also rely on the portability of the gadgets and the relatively easy access to be used in laboratory settings as well as non-laboratory settings. Moreover, it can reach people with impairments and physical disabilities, as shown in the study of Appel and colleagues (2020) where the participants watched a 360º nature video and it was well received with no side effects like disorientation and dizziness.

The presentation of stimuli with virtual reality, compared to such presentation in computer screen, provides a richer immersion experience and has been presented as a valuable tool to research and treatment purposes of fear-related disorders, such as specific phobias: spider phobia (Miloff et al., 2019), dental phobia (Gujjar, Van Wijk, Kumar, & Jongh, 2019), fear of heights (Freeman et al., 2018), fear of flying (Mühlberger, Weik, Pauli, & Wiedemann, 2006), as well as post-traumatic stress disorder (Nelson, 2013). Indeed, as a dysfunctional processing of threat and fear play a critical role in various psychopathologies, it is also important to note the clinical application of virtual reality in psychological intervention, for example in specific phobias (e.g., spider phobia), by using exposure therapy – Virtual Reality Exposure Therapy (VRET). Exposure therapy can be expensive, dangerous or too intense, which difficult its application, but virtual reality can work as a therapeutic resource and an intermediate technique in this case (Botella et al., 2017). For example, implementing VRET showed a decrease of anxiety levels in patients with dental phobia (Gujjar et al., 2019). Virtual reality, in this kind of intervention, can induce a sense of control by the user and create a safe space because it allows the creation of artificial environments (Botella et al., 2017).

The development of technology in the past decades has induced reliability on this tool (Brookes, Warburton, Alghadier, Mon-Williams, & Mushtaq, 2019) and several studies have compared different equipment's, stimuli and experimental settings, as to provide the most valuable solutions for researchers. For instance, in a study of Foerster, Poth, Behler, Botsch, and Schneider (2016), the authors compared Oculus Rift (head-mounted virtual reality device) and Cathode Ray Tube (CRT) computer performance evaluating the threshold of conscious perception, the capacity of visual working memory and the processing speed. For this, the authors used a modified version of the standard TVA-based assessment (See Vangkilde, Bundesen, & Coull, 2011) where six red letters appear around the fixation cross. Then, each letter was followed by a red-blue mask. Subsequently the participants had to report the letters they remember from the array. The test-retest reliability of the first two did not differ significantly between the two devices. However, the reliability of the processing speed was higher for Oculus Rift than for CRT. These results suggest that Oculus Rift can evaluate visual processing components at least as reliably as CRT.

In a further study by Foerster, Poth, Behler, Botsch, and Schneider (2019), the authors compared HTC Vive and Cathode Ray Tube (CRT) computer performance evaluating the threshold of conscious perception, the capacity of visual working memory and the processing speed, as well as top-down controlled selectivity and lateral attentional bias. These components of visual processing were evaluated by a modified version of the CombiTVA assessment (see Vangkilde et al., 2011), that consists on the presentation of letters that vary in colour (red or red and blue) and time exposure (11, 22, 56, 78, 144 or 200 ms) that then were masked by patterns. After that, the participants had to verbally report all letters that they could remember without a time limit. This paradigm assesses visual capacities and visual selective attention in an unspeeded way. Results showed that test-retest reliability were significant and did not differ significantly between the two devices. Therefore, results suggested that the five components of visual processing can be measured by HTC Vive as reliably as by CRT (Foerster et al., 2019).

Moreover, Olk, and colleagues (2018) compared the use of virtual reality and a computer monitor, using daily life objects on a virtual kitchen. This experiment evaluated attention and distraction by assessing reaction times. In the task, the participants had to search a target stimulus (red/white yoghurt or red soda can) among five distractors, where this discriminability was varied. On one condition the distractors were the same colour of the target (low discriminability) and on the other condition the distractors were of a different colour (e.g. green and green/white distractors and red and red/white target) (high discriminability). Additionally, the participants had to ignore flanker items that could be congruent or incongruent to the target stimulus. In total there were four conditions. The results showed a bigger reaction time when the flanker was incongruent and when the discriminability between target and distractors was low, with similar results in both virtual reality and computer monitor. This study adds relevant insight on the efficient use of virtual reality in laboratory settings.

Importantly, Rosén, Kastrati, Reppling, Bergkvist, and Åhs (2019) studied innate and learnt threat using virtual reality (and a computer monitor as a comparison setting), while recording skin conductance responses (SCRs), as the physiological marker of the fear response. The innate threat condition was tested with the appearance of a sudden character and compared to a distant character appearance. The learnt threat condition involved the conditioning of two characters (one proximal and one distant) with electric shocks and the comparison with two other characters with no electric shock conditioning. The participants were divided in two groups, one using virtual reality and the other using the computer monitor. The results showed that virtual reality enhanced SCRs on proximal threat cues but not in learnt threat cues. These results showed that virtual reality can be successfully used in the research of threat processing, mainly in innate threat.

The present study

In this project, we aim at taking the use of VR a step further in experimental settings, by testing its ability to present threat-related stimuli under unaware conditions, by the use of the CFS technique. Given the pivotal role of snakes in eliciting fear-related responses, and in order to allow direct comparisons with previous studies from our lab (e.g., Gomes et al., 2017), snake stimuli will be used and the b-CFS will be tested with VR and compared with a typical experimental setting (computer screen).

We will also manipulate the visual presentation of the stimuli – foveal or peripheral vision – as to assess whether the snake advantage is dependent on the perceptually demanding conditions of its presentation, given the results from previous studies (e.g., Soares et al., 2014) and the relevance of defining the best conditions for the threat processing advantage to emerge under VR conditions.

As emotions involve a multitude of dimensions, it is important to assess not only behavioural measures but also physiological ones to serve as an additional threat processing marker. This aspect is important as typically these responses are increased or modulated in threat processing settings (Öhman & Soares, 1994; Peira, Golkar, Öhman, Anders, & Wiens, 2012). Therefore, in this project, will be measure both heart rate and skin conductance, that will be recorded using Biopac MP160. Importantly, in this project we intend to create a foundation structure to facilitate future implementations of protocols using the same concept, i.e., to increase ecological validity by the use of technology and virtual reality in experimental psychology.

We hypothesize that snakes will exhibit an advantage to break suppression (compared to birds, a neutral stimulus) in both virtual reality and standard conditions, reflected in shorter reaction times and larger physiological activity, hence suggesting that virtual reality may indeed be used to provide more ecologically valid protocols in study threat processing. Finally, we also predict that the snake advantage will be independent of the visual field in which the stimuli is presented, based on the results by Almeida et al. (2015).

Research Plan and Methods

Participants

This study will count with thirty participants, all university students and with a minimum of age 18 years old.

All participants must have normal or corrected to normal eyesight, no medication intake at the time of the experiment nor diagnosis of mental or neurological disorder (See instruments and Appendix 1).

Participants using glasses and with an epilepsy diagnosis cannot participate in this experiment, given the potential interference with the virtual reality equipment.

Stimuli

Stimuli will include five images of snakes as the threatening stimuli, and five images of birds, as the neutral stimuli. These images were chosen from the ones used in Gomes, Silva, Silva and Soares (2017), in order to provide comparable results with previous studies.

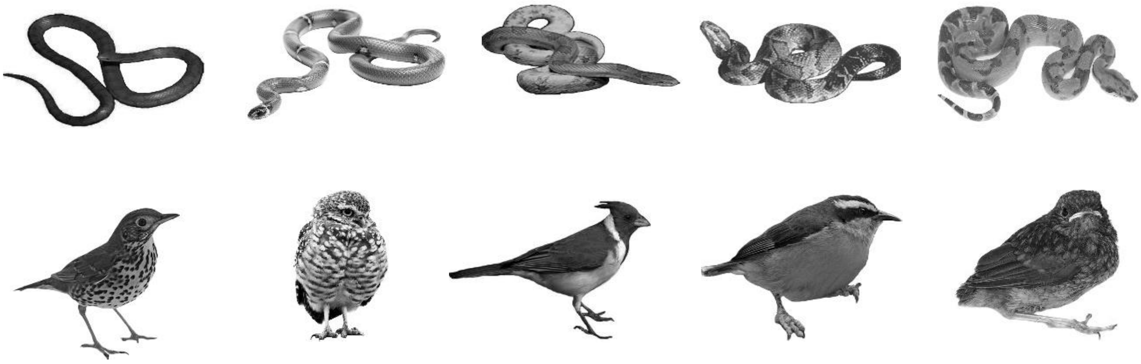

Figure 1: Five images of snakes and five images of birds used in the experimental task.

CFS Masks

In order to implement CFS, we generated Mondrian patterns composed of randomly arranged greyscale circles, with diameters between 0.39º and 1.4º and animated at 10 Hz. To enable CFS using “red-blue anaglyph glasses”, the stimuli will be presented using the blue RGB channel and the CFS masks using the red RGB channel. Despite the overlapping of the stimuli and masks, each eye is only able to see what is presented in the same colour of the corresponding lens of the glasses (Figure 2). In this experiment, the stimuli will always be presented to the dominant eye and the CFS masks presented to the other eye.

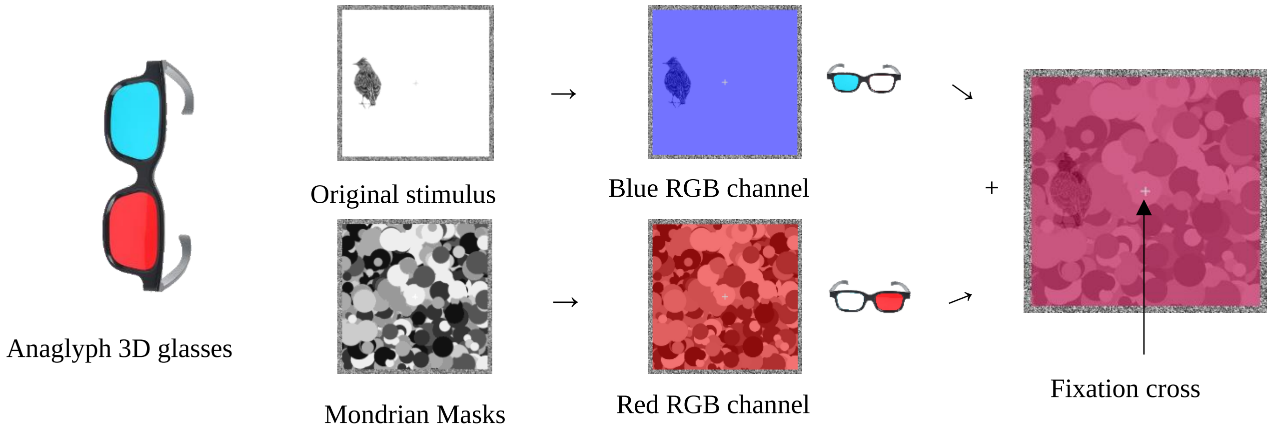

Figure 2: The process of creating each of the frames. The original greyscale stimulus was included in the blue RGB channel and the original greyscale Mondrian mask in the red RGB channel, resulting in the overlap image.

Stimuli presentation

The experimental task encompasses an 16º×16º frame with a 0.5º border presenting a white noise pattern inside of which the mask and the stimulus overlap (Figures 3 and 4). The stimuli will be presented in the right side or the left side according to the centre of the frame. Stimuli will be randomly presented at a distance of 1º and 6º to the fixation cross located in the centre of the frame, respectively for foveal and peripheral stimuli presentation.

The stimuli will be presented on a computer screen, while the participant uses anaglyph glasses. And for the virtual reality presentation, it will be used the HTC Vive device.

The results in the study by Foerster et al. (2019), showed that HTC Vive can be used as reliable as CRT computer in a visual processing task.

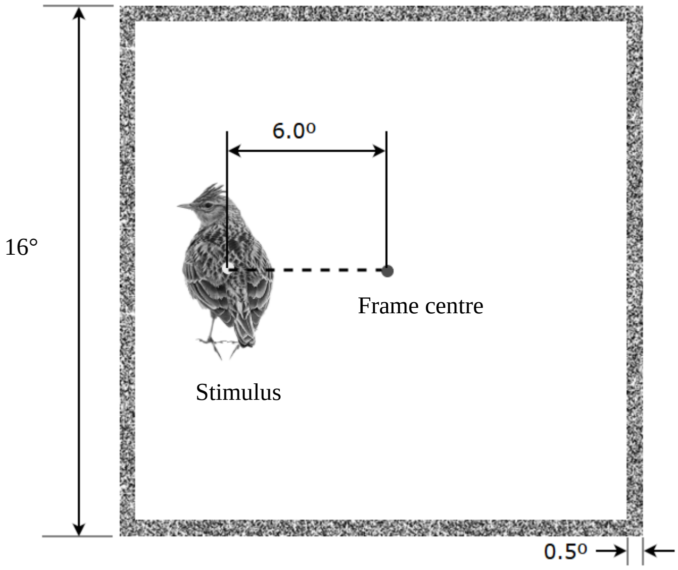

Figure 3: Example of the stimuli presentation. The stimuli will be presented on one side of the frame, centred at a horizontal distance of 6° relative to the centre of the frame. In this image the stimulus is presented on the left side and in the peripheral vision.

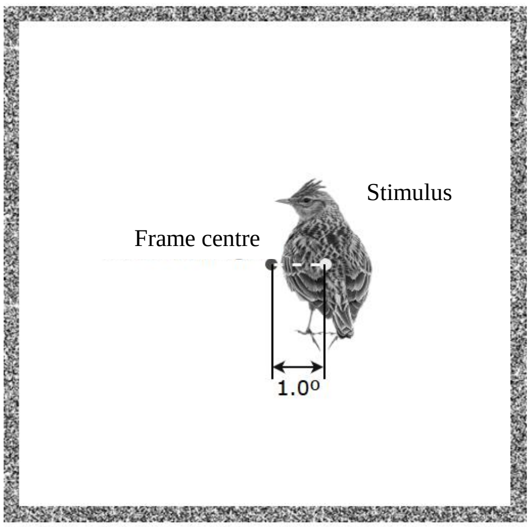

Figure 4: Example of the stimuli presentation. The stimuli will be presented on one side of the frame, centred at a horizontal distance of 1° relative to the centre of the frame. In this image the stimulus is presented on the right side and in the foveal vision.

Self-reported measures

In this study, participants will fill in a sociodemographic questionnaire (Appendix 1) to collect relevant information from each participant. They will also complete the Snake Fear Questionnaire and the State-Trait Inventory for Cognitive and Somatic Anxiety, in order to assess if fear of snakes and anxiety modulate the responses (reaction time and physiology) in the task.

The Snake Fear Questionnaire (SNAQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974) evaluates fear of snakes and consists of 30 items (true or false). This instrument was adapted and translated to Portuguese by Rosa (2012).

The State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA; Ree, French, MacLeod, & Locke, 2008) assesses anxiety with two scales, one for state and another for trait anxiety, each one with 21 items. In this study, we will only use the trait scale. Each scale is composed of two subscales, assessing cognitive (with ten items) and somatic dimension (with eleven items) of anxiety. The response scale ranges from 1 ("Nothing") to 4 ("Much"). The validated version for Portuguese will be used (Figueiredo et al., 2019).

Equipment

The experiment will be performed on a computer with a Dell Professional P2212H monitor 21.5-inch LED VGA (1920×1080 pixels) and a refresh rate of 60 Hz. Moreover, an HTC Vive (1080×1200 pixels per eye) will be used as the virtual reality device. HTC Vive is a virtual reality equipment with "a headset, two controllers and two infrared laser emitter units" (Niehorster et al., 2017) and allows a field of view of 90º per eye. It offers a spatial resolution of 1080 × 1200 pixels per eye and a refresh rate of 90 Hz. The use of this device is based on the study by Niehorster and colleagues (2017).

The experimental task was implemented in a custom designed software application, developed using Unity.

Procedure

The design of this experiment is a within-subjects design, with two sessions that will be randomised (computer-virtual reality/ virtual reality-computer) and with a one-week interval between them. The experimental tasks will take place at the Emo-Senses Lab of the University of Aveiro.

All participants will give their consent to participate in the experiment (Appendix 2) and then proceed to answer all the instruments, the sociodemographic questionnaire, the SNAQ and the STICSA. Eye dominance will be tested with the Miles Test (Miles, 1930). In the Miles Test, the participant will put both hands together creating a triangle with the index fingers and the thumbs. At a distance of 6 meters on a wall, a circle will be placed, and the participant will centre it inside the triangle. Then the participant will close one eye at a time and will indicate which eye is able to visualise the circle inside the triangle. The eye that can see it, is the dominant eye. The stimuli will be presented to the dominant eye and the Mondrian Masks will be shown to the other eye.

In the virtual reality condition, we will proceed to the calibration of the lenses of the HTC Vive for each participant (binocular disparity).

The experimental phase will begin with the following instruction: “Identify, as quickly as possible, the side (right or left) where you detect a stimulus or part of it”. This detection should be made by pressing the right or the left controller of the HTC Vive device in both conditions (computer or virtual reality). The experiment starts with a training phase consisting of 20 trials with images that were not used on the experimental trials, followed by the main experiment with 120 trials (10 stimuli × 2 sides × 2 positions × 3 repetitions), the 2 sides referring to the right and left side, and the 2 positions corresponding to the foveal and peripheral vision. A fixation cross is shown during 1 second on a black background. Then the stimuli are introduced, ramping their contrast for 1.1 seconds. After this, Mondrian masks are ramped down gradually over 4 seconds. Stimuli are then fully exposed for 3 seconds. Each trial ends with the participant’s response or after 7 seconds (Figure 5). The anaglyph glasses will only be used in the computer condition.

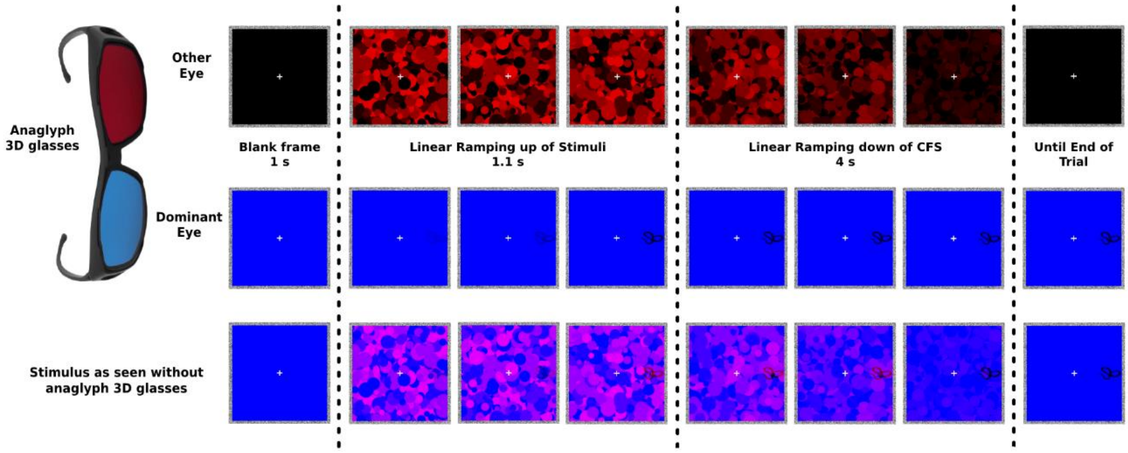

Figure 5: Example of an experimental trial including timings for exhibition and contrast, and the content seen in each anaglyph glasses lenses.

After completing the two conditions, a debriefing session will take place to explain the purpose of the tasks and to ensure that no distress or discomfort is observed at this stage.

This project is designed in a way to minimize the likelihood of any ethical issues and will be submitted to the Ethics and Deontology Council of the University of Aveiro and will follow the guidelines of the American Psychological Association (APA), the Code of Ethics of the Order of Portuguese Psychologists and the Declaration of Helsinki. The collected data will follow the guidelines provided by the General Data Protection Regulation.

This study will only involve volunteering adult human participants. All will have to give their consent, where they will be informed of the volunteering nature of their participation, the possibility of withdrawing at any time and the fact that the data collected is confidential. The data will be encrypted and only managed by the responsible team for scientific purposes. Sociodemographic data will be collected to characterize the sample. Participants will be given a randomized participant ID so that the personal information remains pseudo-anonymised. Regarding psychophysiological measures, their assessment is a painless procedure and does not reveal any harm to the participants.

Expected results and significance

With this project, we expect to bring a more ecologically valid setting to experimental tasks in the laboratory, particularly those involving emotional stimuli. Moreover, and given the relevance of further understanding consciousness processing, particular of fear-related stimuli, we expect the results of the proposed project to provide evidence of a valid protocol that may enable such type of research in a more immersive setting, while not neglecting the rigorous control of the studies. Finally, and in case the hypotheses are corroborated, the present project will also provide further evidence of the snake processing advantage when presented in unawareness conditions.

Due to the COVID-19 pandemic, it was not possible to carry out this project, as we could not collect data. However, we created the experimental task and the protocol and believe that by implementing this project, a complex task as the CFS, will be possible to implement in a virtual reality setting.

References

Almeida, I., Soares, S. C., & Castelo-Branco, M. (2015). The Distinct Role of the Amygdala, Superior Colliculus and Pulvinar in Processing of Central and Peripheral Snakes. *PLoS ONE, 10*(6). doi: 10.1371/journal.pone.0129949

Appel, L., Appel, E., Bogler, O., Wiseman, M., Cohen, L., Ein, N., ... & Campos, J. L. (2020). Older adults with cognitive and/or physical impairments can benefit from immersive virtual reality experiences: a feasibility study. *Frontiers in medicine, 6*(329). doi: 10.3389/fmed.2019.00329

Bentz, D., & Schiller, D. (2015). Threat processing: Models and mechanisms. *Wiley Interdisciplinary Reviews: Cognitive Science, 6*(5), 427–439. doi: https://doi.org/10.1002/wcs.1353

Bertels, J., Bourguignon, M., De Heering, A., Chetail, F., De Tiège, X., Cleeremans, A., & Destrebecqz, A. (2020). Snakes elicit specific neural responses in the human infant brain. *Scientific Reports, 10*(1), 1-12. doi: https://doi.org/10.1038/s41598-020-63619-y

Botella, C., Fernández-Álvarez, J., Guillén, V., García-Palacios, A., & Baños, R. (2017). Recent progress in virtual reality exposure therapy for phobias: A systematic review. *Current psychiatry reports, 19*(7), 42. doi: 10.1007/s11920-017-0788-4

Brookes, J., Warburton, M., Alghadier, M., Mon-Williams, M., & Mushtaq, F. (2019). Studying human behavior with virtual reality: The Unity Experiment Framework. *Behavior Research Methods*. doi: https://doi.org/10.3758/s13428-019-01242-0

Ekman, P. (1999). Basic emotions. *Handbook of cognition and emotion*, 98, 45-60. Retrieved from https://books.google.pt/books?hl=en&lr=&id=vsLvrhohXhAC&oi=fnd&pg=PA45&dq=Ekman,+P.+(1999).+Basic+Emotions.+Handbook+of+Cognition+and+Emotion.++++&ots=uTBIioY9Ha&sig=SqPc8kIfKXgIUcvZY8MClxxk9xw&redir_esc=y#v=onepage&q=Ekman%2C%20P.%20(1999).%20Basic%20Emotions.%20Handbook%20of%20Cognition%20and%20Emotion.&f=false

Figueiredo, C., Mendes, A., Barros, F., Moura, D., Madeira, N., Silva, C. F., & Soares, S. C. (2019). Measuring the cognitive and somatic dimensions of anxiety:

psychometric analysis of state-trait inventory for cognitive and somatic anxiety (STICSA). *European Psychiatry, 56S*(S3–S321), S213. doi: 10.1016/j.eurpsy.2019.01.003

Foerster, R. M., Poth, C. H., Behler, C., Botsch, M., & Schneider, W. X. (2016). Using the virtual reality device Oculus Rift for neuropsychological assessment of visual processing capabilities. *Scientific reports, 6*(37016). doi: 10.1038/srep37016

Foerster, R. M., Poth, C. H., Behler, C., Botsch, M., & Schneider, W. X. (2019). Neuropsychological assessment of visual selective attention and processing capacity with head-mounted displays. *Neuropsychology, 33*(3), 309-318. doi: http://dx.doi.org/10.1037/neu0000517

Freeman, D., Haselton, P., Freeman, J., Spanlang, B., Kishore, S., Albery, E., ... & Nickless, A. (2018). Automated psychological therapy using immersive virtual reality for treatment of fear of heights: a single-blind, parallel-group, randomised controlled trial. *The Lancet Psychiatry, 5*(8), 625-632. doi: http://dx.doi.org/10.1016/S2215-0366(18)30226-8

Gomes, N., Silva, S., Silva, C. F., & Soares, S. C. (2017). Beware the serpent: the advantage of ecologically-relevant stimuli in accessing visual awareness. *Evolution and Human Behavior, 38*(2), 227-234. doi: http://dx.doi.org/10.1016/j.evolhumbehav.2016.10.004

Gomes, N., Soares, S. C., Silva, S., & Silva, C. F. (2017). Mind the Snake: Fear Detection Relies on Low Spatial Frequencies. *Emotion.* doi: http://dx.doi.org/10.1037/emo0000391

Gujjar, K. R., van Wijk, A., Kumar, R., & Jongh, A. (2019). Efficacy of virtual reality exposure therapy for the treatment of dental phobia in adults: A randomized controlled trial. *Journal of anxiety disorders, 62*, 100-108. doi: https://doi.org/10.1016/j.janxdis.2018.12.001

Hayre, C. M., Muller, D. J., & Scherer, M. J. (2020). Introduction virtual reality for health and rehabilitation. In Hayre, C. M., Muller, D. J., & Scherer, M. J. (Eds.). *Virtual Reality in Health and Rehabilitation* (pp. 3-7). Retrieved from https://books.google.pt/books?hl=en&lr=&id=Ov8MEAAAQBAJ&oi=fnd&pg=PA3&dq=using++%22virtual+reality%22++in+therapy&ots=zURPRd2WNa&sig=uK

uN_dCCm6vZ2xEsLNO5WsluvRk&redir_esc=y#v=onepage&q=using%20%20%22virtual%20reality%22%20%20in%20therapy&f=false

He, H., Kubo, K., & Kawai, N. (2014). Spiders do not evoke greater early posterior negativity in the event-related potential as snakes. *Neuroreport*, *25*(13), 1049-1053. doi: 10.1097/WNR.0000000000000227

Isbell, L. A. (2006). Snakes as agents of evolutionary change in primate brains. *Journal of human evolution, 51*(1), 1-35. doi: 10.1016/j.jhevol.2005.12.012

Kawai, N., & He, H. (2016). Breaking snake camouflage: humans detect snakes more accurately than other animals under less discernible visual conditions. *PLoS One, 11*(10). doi: 10.1371/journal.pone.0164342

Klorman, R., Weerts, T. C., Hastings, J. E., Melamed, B. G., & Lang, P. J. (1974). Psychometric description of some specific-fear questionnaires. *Behavior therapy*, *5*(3), 401-409. doi: https://doi.org/10.1016/S0005-7894(74)80008-0

Korisky, U., Hirschhorn, R., & Mudrik, L. (2018). “Real-life” continuous flash suppression (CFS)-CFS with real-world objects using augmented reality goggles. *Behavior Research Methods,* 1-13. Retrieved from http://link.springer.com/10.3758/s13428-018-1162-0

LeDoux, J. (1996). *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. New York: Shuster Sa

LeDoux, J. E. (2012). Evolution of human emotion: a view through fear. *Progress in brain research, 195,* 431-442. doi: 10.1016/B978-0-444-53860-4.00021-0

Lobue, V., & Deloache, J. S. (2011). What's so special about slithering serpents? Children and adults rapidly detect snakes based on their simple features. *Visual Cognition, 19*(1), 129-143. doi: https://doi.org/10.1080/13506285.2010.522216

Maack, D. J., Buchanan, E., & Young, J. (2015). Development and Psychometric Investigation of an Inventory to Assess Fight, Flight, and Freeze Tendencies: The Fight, Flight, Freeze Questionnaire. *Cognitive Behaviour Therapy, 44*(2), 117 -127. doi: http://dx.doi.org/10.1080/16506073.2014.972443

Masataka, N., Hayakawa, S., & Kawai, N. (2010). Human young children as well as adults demonstrate ‘superior’ rapid snake detection when typical striking posture is displayed by the snake. *PloS one*, *5*(11). doi: https://doi.org/10.1371/journal.pone.0015122

Miles, W. R. (1930). Ocular Dominance in Human Adults. *The Journal of General Psychology, 3*(3), 412–430. doi: http://doi.org/10.1080/00221309.1930.9918218

Miloff, A., Lindner, P., Dafgård, P., Deak, S., Garke, M., Hamilton, W., ... & Sjölund, J. (2019). Automated virtual reality exposure therapy for spider phobia vs. in-vivo one-session treatment: A randomized non-inferiority trial. *Behaviour research and therapy*, *118*, 130-140. doi: https://doi.org/10.1016/j.brat.2019.04.004

Mühlberger, A., Weik, A., Pauli, P., & Wiedemann, G. (2006). One-session virtual reality exposure treatment for fear of flying: 1-year follow-up and graduation flight accompaniment effects. *Psychotherapy Research*, *16*(1), 26-40. doi: https://doi.org/10.1080/10503300500090944

Nelson, R. J. (2013). Is virtual reality exposure therapy effective for service members and veterans experiencing combat-related PTSD?. *Traumatology*, *19*(3), 171-178. doi: https://doi.org/10.1177/1534765612459891

Niehorster, D. C., Li, L., & Lappe, M. (2017). The accuracy and precision of position and orientation tracking in the HTC vive virtual reality system for scientific research. *i-Perception*, *8*(3), 1-23. doi: 10.1177/2041669517708205

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: toward an evolved module of fear and fear learning. *Psychological review*, *108*(3), 483-522. doi: . http://dx.doi.org/10.1037/0033-295X.108.3.483

Öhman, A., & Mineka, S. (2003). The malicious serpent: Snakes as a prototypical stimulus for an evolved module of fear. *Current directions in psychological science*, *12*(1), 5-9. Retrieved from https://journals.sagepub.com/doi/abs/10.1111/1467-8721.01211

Öhman, A., & Soares, J. J. (1994). " Unconscious anxiety": phobic responses to masked stimuli. *Journal of abnormal psychology*, *103*(2), 231. doi: https://doi.org/10.1037/0021-843X.103.2.231

Olk, B., Dinu, A., Zielinski, D. J., & Kopper, R. (2018). Measuring visual search and distraction in immersive virtual reality. *Royal Society open science*, *5*(5), 172331. doi: http://dx.doi.org/10.1098/rsos.172331

Peira, N., Golkar, A., Öhman, A., Anders, S., & Wiens, S. (2012). Emotional responses in spider fear are closely related to picture awareness. *Cognition & emotion*, *26*(2), 252-260. doi: https://doi.org/10.1080/02699931.2011.579087

Raab, D. H. (1963). Backward masking. *Psychological Bulletin, 60*(2), 118–129. doi: 10.1037/h0040543

Ree, M. J., French, D., MacLeod, C., & Locke, V. (2008). Distinguishing cognitive and somatic dimensions of state and trait anxiety: Development and validation of the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA). *Behavioural and Cognitive Psychotherapy, 36*(3), 313. doi:10.1017/S1352465808004232

Rosa, P. J. M. (2012). Efeitos da exposição repetida subliminar a estímulos biologicamente relevantes nos estados emocionais (Doctoral thesis, ISCTE-IUL). Retrieved from https://repositorio.iscteiul.pt/bitstream/10071/7434/1/Tese%20de%20doutoramento%20Pedro%20Rosa.pdf

Rosén, J., Kastrati, G., Reppling, A., Bergkvist, K., & Åhs, F. (2019). The effect of immersive virtual reality on proximal and conditioned threat. *Scientific reports, 9*(1), 1-8. doi: https://doi.org/10.1038/s41598-019-53971-z

Sadr, J., & Sinha, P. (2004). Object recognition and random image structure evolution. *Cognitive Science, 28*(2), 259-287. doi: 10.1207/s1 5516709cog2802_7

Schiller, P. H., Malpeli, J. G., & Schein, S. J. (1979). Composition of geniculostriate input 21 ot superior colliculus of the rhesus monkey. *Journal of Neurophysiology, 42*(4), 1124–33. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/113508

Seeley, R. R., Stephens, T. D., & Tate, P. (2003). Anatomy *& Physiology* (6th edition). United States: McGraw-Hill Higher Education.

Seligman, M. E. P. (1971). Phobias and preparedness. *Behavior Therapy, 2*(3), 307–320. doi: http://doi.org/10.1016/S0005-7894(71)80064-3

Soares, S. C., & Esteves, F. (2013). A glimpse of fear: fast detection of threatening targets in visual search with brief stimulus durations. *PsyCh journal, 2*(1), 11-16. doi: 10.1002/pchj.18

Soares, S. C., Lindström, B., Esteves, F., & Öhman, A. (2014). The hidden snake in the grass: Superior detection of snakes in challenging attentional conditions. *PloS One, 9*(12), 1-26. doi: http://dx.doi.org/10.1371/journal.pone.0114724

Soares, S. C., Maior, R. S., Isbell, L. A., Tomaz, C., & Nishijo, H. (2017). Fast detector/first responder: interactions between the superior colliculus-pulvinar pathway and stimuli relevant to primates. *Frontiers in Neuroscience*, *11*, 67. doi: 10.3389/fnins.2017.00067

Stein, T., Hebart, M. N., & Sterzer, P. (2011). Breaking continuous flash suppression: A new measure of unconscious processing during interocular suppression?. *Frontiers in human neuroscience, 5*, 167. Retrieved from https://www.frontiersin.org/articles/10.3389/fnhum.2011.00167/full

Tooley, M. D., Carmel, D., Chapman, A., & Grimshaw, G. M. (2017). Dissociating the physiological components of unconscious emotional responses. *Neuroscience of Consciousness, 1*. doi:10.1093/nc/nix021

Tsuchiya, N., & Koch, C. (2005). Continuous flash suppression reduces negative afterimages. *Nature neuroscience, 8*(8), 1096-1101. doi: http://dx.doi.org/10.1038/nn1500

Van Le, Q., Isbell, L. A., Matsumoto, J., Le, V. Q., Hori, E., Tran, A. H., ... & Nishijo, H. (2014). Monkey pulvinar neurons fire differentially to snake postures. *PLoS One, 9*(12). doi: 10.1371/journal.pone.0114258

Van Le, Q., Isbell, L. A., Matsumoto, J., Nguyen, M., Hori, E., Maior, R. S., ... & Nishijo, H. (2013). Pulvinar neurons reveal neurobiological evidence of past selection for rapid detection of snakes. *Proceedings of the National Academy of Sciences, 110*(47), 19000-19005. doi: https://doi.org/10.1073/pnas.1312648110

Van Strien, J. W., Christiaans, G., Franken, I. H., & Huijding, J. (2016). Curvilinear shapes and the snake detection hypothesis: an ERP study. *Psychophysiology, 53*(2), 252-257. doi: 10.1111/psyp.12564

Van Strien, J. W., Eijlers, R., Franken, I. H. A., & Huijding, J. (2014). Snake pictures draw more early attention than spider pictures in non-phobic women: evidence from event-related brain potentials. *Biological psychology, 96,* 150-157. doi: https://doi.org/10.1016/j.biopsycho.2013.12.014

Van Strien, J. W., Franken, I. H., & Huijding, J. (2014). Testing the snake-detection hypothesis: larger early posterior negativity in humans to pictures of snakes than to pictures of other reptiles, spiders and slugs. *Frontiers in Human Neuroscience, 8,* 691. doi: https://doi.org/10.3389/fnhum.2014.00691

Vangkilde, S. Bundesen, C., & Coull, J. T. (2011). Prompt but inefficient nicotine differentially modulates discrete components of attention. *Psychopharmacology, 218,* 667– 680. doi: http://dx.doi.org/10.1007/s00213-011-2361-x

Appendices

Appendix 1

Questionário de dados sociodemográficos

ID: ______

Data: ____________________

Idade: _____

Sexo: Feminino ___; Masculino ___

Lateralidade: Dextro(a) ___; Canhoto(a) ___; Ambidextro(a) ___

Tem medo de pássaros? _________

Com que frequência tem contacto com cobras? (sendo 0 "nenhum contacto" e 5 "contacto muito frequente")

0 1 2 3 4 5

Costuma jogar videojogos no computador?

____

Tem experiência com óculos de realidade virtual?

____

Encontra-se a tomar alguma medicação? Se sim, especifique qual(ais)?

____

Tem algum problema de visão? Se sim, está corrigido (ex.: óculos, lentes)?

____

Tem algum diagnóstico de psicopatologia ou doença neurológica? Se sim, qual(ais)?

____

Tem antecedentes de epilepsia?

____

Appendix 2

Consentimento informado

A realização desta tarefa surge no âmbito da tese de Mestrado da mestranda Ana Ventura e do mestrando Francisco Lopes, orientados pela Professora Doutora Sandra Soares e pelo Professor Doutor Samuel Silva.

Objetivo da experiência:

Avaliar a capacidade de atenção visual perante a presença de estímulos ameaçadores.

Procedimento:

A experiência está dividida em duas sessões. Serão apresentados estímulos num ecrã de computador numa sessão, e em HTC Vive (Realidade Virtual) noutra sessão. O participante terá de identificar a presença destes recorrendo aos comandos dos óculos do aparecimento destes do lado direito ou do lado esquerdo.

Duração:

Esta tarefa terá a duração aproximada de … minutos

Risco para o participante:

A realização desta tarefa não envolve qualquer tipo de dano a nível físico ou emocional.

Benefício para o participante:

Terá oportunidade de contribuir para a investigação na área da Psicologia e da ciência no geral.

Natureza voluntária da participação:

A sua participação tem um cariz voluntário, sendo que poderá desistir a qualquer momento.

Confidencialidade:

Os dados recolhidos serão exclusivamente usados para fins de investigação, mantendo-se anónimos e confidenciais ao longo da experiência.

Contacto:

Se tiver alguma dúvida relacionada com a experiência poderá contactar os investigadores responsáveis (anasventura@ua.pt ou lopes.francisco@ua.pt)

Nome do Participante   Data

_______________________________________   _____/_____/_____

Nome do Investigador   Data

_______________________________________   _____/_____/_____