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Examining Sexual Stimuli Avoidance in Women with Vulvovaginal Pain: Insights from Eye Tracking Measurements

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ABSTRACT

Introduction: According to the Information Processing Model of Sexual Arousal, directing attention towards relevant sexual stimuli enhances the appraisal of such stimuli as sexually relevant, therefore facilitating sexual arousal (Janssen et al., 2000; Velten et al., 2020). So, the ability to focus on sexual cues during any kind of sexual activity is crucial for maintaining healthy sexual functioning. Previous research indicates that women experiencing sexual discomfort or vulvo-vaginal pain tend to display reduced overt attention toward sexual stimuli, in particular they tend to avoid looking at genitals or erotic scenes depicting sex with penetration.

Aim: The objective of this study was to employ the eye-tracking technique to examine whether women who report suffering from vulvo-vaginal pain exhibit different visual attention patterns towards the genital areas in dynamic sexual stimuli, specifically erotic hetero and lesbian videos, in comparison to women with no genital pain complain.

Method: 153 university students watched four videos (two erotic and two non-erotic) and completed a short questionnaire on their attitudes towards sex and their sexual life habits. Forty-one participants reported suffering from genital pain. Number of fixation, total time view, number of revisits and first view have been analysed in relation to Pain and No pain conditions.

Results: No difference has been found in visual pattern between women with vulvo-vaginal pain and healthy women, however, a significant effect has been found in regard to galvanic skin response. In fact, participants suffering from genital pain also showed higher electrodermal activity while watching the videos.

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INTRODUCTION

Vulvo-vaginal pain can be defined as persistent or recurrent pain localized in the vulva, which includes the external genitalia, and the vaginal area. It is a multifactorial condition that can significantly impact the quality of life, and sexual and psychological well-being of affected individuals (Engman et al., 2018). The pain is characterized by various sensations such as burning, stinging, itching, or soreness, and can be provoked or unprovoked in nature (Bornstein et al., 2016), that is it could be provoked by penetration during any sexual activity, by inserting a tampon or during a speculum examination, or raise with no kind of touch on the area or activity. Vulvo-vaginal pain conditions encompass a range of disorders, including Vulvodynia, Provoked Vestibulodynia, and Dyspareunia, among others. Vulvar pain can be caused by a specific disorder, i.e. infection, trauma, or hormonal deficiencies, or arise without any clear identifiable cause (Bornstein et al., 2016). Psychological factors such as anxiety, depression, pain catastrophizing, and fear of pain, and post-traumatic stress have also been identified as contributors to the development and maintenance of vulvo-vaginal pain (Harlow et al., 2005; Masheb RM et al., 2005; Arnold LD et al., 2006; Brauer M et al., 2009; Patla et al., 2023).

The impact of vulvo-vaginal pain extends beyond the physical symptoms. It can lead to significant sexual dysfunction and relationship distress. Women with vulvo-vaginal pain are often hypervigilant towards pain-related stimuli, report greater levels of anxiety and negative affective association with sexual stimuli, greater avoidance of sexual cues, and decreased sexual desire due to the anticipation of pain (Payne et al., 2004; Brauer et al., 2009; Engman et al., 2018). Obtaining a diagnosis for any of the vulvo-vaginal pain conditions requires a great amount of time and economic efforts, which has dramatic

consequences on the individual's life and well-being as mentioned above; understanding the underlying mechanisms associated with vulvo-vaginal pain can contribute to an effective assessment and a tailored treatment intervention.

Recent models on sexual function and dysfunction have focused on the importance of attention in the processing of sexual stimuli, specifically, visual attention to sexual stimuli is considered to be essential to sexual arousal (Jansen et al., 2000; Milani et al., 2021). This being said, sexual dysfunction may be the result of a different pattern of attention towards sexual stimuli; the unattended sexual cues would cause lower levels of arousal and relevant sexual stimuli perceived as not arousing would inhibit the individual's sexual response. This hypothesis states that, for example, if the female partner engages in sexual activity, the lack of sexual response and the lack of intrinsic motivation to approach her male partner, may result in an unsatisfying sexual intercourse. In this case, the female partner would let herself be involved in sexual activities with the only purpose of satisfying her male partner, which would alter her attention and the meanings attached to the sexual cues. If attention is not overtly directed to sexual stimuli then sexual and genital arousal would decrease together with lubrication, which could increase or maintain vulvo-vaginal pain (Zahler et al., 2021; Milani et al., 2021).

To reach a deeper understanding of how women with vulvo-vaginal pain engage their attention towards sexual stimuli and whether an attentional bias could cause their sexual dysfunction, several authors have relied on the eye-tracking technology, which provides a continuous recording of attention allocation in real time (Lykins et al., 2006; Lykins et al., 2011; Milani et al., 2020; Velten et al., 2020-2021). According to a review published in 2015 (Wenzlaff et al., 2015), only Lykins and colleagues had included a clinical sample of women with Dyspareunia in a study of visual attention to erotic stimuli

before 2015. Lykins and colleagues concluded that women with Dyspareunia attended less to sexual scene regions compared to women with no sexual complaints (p=.003) and women with low sexual desire (p=.0018). More research has been conducted since then involving clinical samples (Velten et al., 2020-2021). In line with previous studies, Velten and colleagues have shown that the total fixation duration in women with vulvo-vaginal pain was significantly shorter compared to the non-clinical group (t (135) = -2.27, p = .024, 95% CI = -0.71 to -0.05).

It is undoubtedly premature and difficult to draw any conclusion based on the little research existing on attentional biases and processing mechanisms behind sexual stimuli in women with vulvo-vaginal pain. So, it is compelling to study and expand research in this field for a better understanding of the different sexual conditions. For this reason, this study aims at investigating how the automatic and voluntary attention differs across groups of women with and without vulvar pain. This will be done through the presentation of erotic content videos while recording eye movement using an eye-tracking tool.

1. CHAPTER ONE: VULVOVAGINAL PAIN – POTENTIAL CAUSES, ITS IMPACT ON LIFE AND SUGGESTED TREATMENTS

1.1. Overview of vulvo-vaginal pain

The female sexual reproductive system includes both internal and external structures. Internally, we find the vagina, the cervix, the uterus, the ovaries, and the fallopian tube, while externally the vulva is composed by the labia (majora and minora), the clitoris, the vaginal opening, and the opening to the urethra. Often, in common usage, the terms *vulva* and *vagina* are misused, namely vagina is mistakenly considered to be all there is to the female genitals. Nonetheless, the vagina only includes the canal that joins the cervix (the lowest part of the uterus) to the outside of the body. On the other hand, the vulva corresponds only to the part of the genitals on the outside of the body, and as explained right above, it includes multiple parts. Pain can be experienced in both the vagina and the vulva and when it happens it is important to distinguish between the areas that might hurt and look for professional help. In the following paragraphs different types of vulvo-vaginal pain are discussed.

Vulvodynia is defined as persistent vulvar pain (Chisari et al, 2020; Andres et al., 2016). Its aetiology remains unknown although it is clear that its origin, maintenance, and consequences depend on multifactorial variables. The International Society for the Study of Vulvovaginal Disease (ISSVD), the International Society for the Study of Women's Sexual Health (ISSWSH), and the International Pelvic Pain Society (IPPS), have reached a consensus in 2015 on the terminology to use and the multidimensional variables included when referring to Vulvodynia. As defined in the 2015 Consensus terminology and classification of persistent vulvar pain document, Vulvodynia is “Vulvar pain of at

least 3 months duration, without clear identifiable cause, which may have potential associated factors" (ISSVD, ISSWSH, IPPS, 2015). Depending on where pain is experienced, Vulvodynia can be localized, generalised, or mixed; it can be provoked if pain is related to physical contact, spontaneous when no contact is needed, or mixed; it can also be described depending on the onset (primary or secondary) and according to the temporal pattern (intermittent, persistent, constant, immediate, delayed) (Consensus terminology and classification of persistent vulvar pain, 2015). In particular, one of the most common subtypes of Vulvodynia is Provoked Vestibulodynia (PVD), characterised by pain upon contact to the vulvar vestibule (Harlow BL et al., 2014; Reed at al., 2016; n Henzell et al., 2017).

Among the different diagnosis related to vulvar-vaginal pain, Dyspareunia is one of the most common, affecting up to twenty percent of the female population globally. These women suffer from painful intercourse either into the deeper parts of the vagina/lower pelvis, known as Deep Dyspareunia, or report pain located at the entrance of the vagina starting with penetration, also known as Superficial Dyspareunia. Dyspareunia is also common among women with Vulvodynia, in particular among those with Provoked Vestibulodynia (Brauer et al., 2005; Mitchell et al., 2017). Two different models suggested two diverse viewpoints on the aetiology of Dyspareunia: Spano and Lamont (1975) proposed a circular model in which pain during an intercourse and fear of pain decreases arousal, causing vaginal dryness and consequent pain; whereas Kaplan (1974) and Bancroft (1989), suggested that insufficient vasocongestion was the main cause for the lack of arousal and, as a consequence, vulvar pain. Despite the different perspectives, a common factor seems to be the lack of sexual arousal.

1.2. Causes and contributing factors

In the *Consensus terminology and classification of persistent vulvar pain* published in 2015, chronic vulvar pain has been divided into vulvar pain caused by a specific disorder and Vulvodynia, which has by definition no specific single identifiable cause to date and makes the diagnosis based on a mere exclusion of the multiple available organic causes (see Table 1). It is specified though that women could experience both Vulvodynia and have a specific disorder.

As previously mentioned, no clear cause has been identified for these pathologies, leading to a wide range of treatments but not a unique single effective protocol to follow. Nonetheless, several biological variables have been studied as potentially implicated in the origin and maintenance of Vulvodynia such as vestibular mast-cell proliferation, vestibular mucosa alterations, pelvic floor-muscle dysfunction, a gene polymorphism that could interfere with pain regulation, and nociceptor proliferation and sensitization (Corsini-Munt et al. 2017). Psychological and interpersonal factors could be involved as well: according to Harlow and colleagues (2005), the presence of childhood maltreatment and sexual abuse could be highly associated to the risk of developing Vulvodynia during adulthood. To further complicate the scene, women suffering from Vulvodynia also report many comorbid painful conditions such as fibromyalgia, interstitial cystitis, painful bladder syndrome, and irritable bowel syndrome (Reed BD et al., 2014); but also report experiencing higher levels of depression and anxiety, higher levels of sexual dysfunction and sexual distress, and greater avoidance of sexual activity (Mashebet al., 2005; Arnold et al., 2006; Brauer et al., 2009).

Aetiology	Disorder
Infectious	Candida
	Herpes
Inflammatory	Lichen sclerosis
	Lichen planus
	Immune disorders
Neoplastic	Paget disease
	Squamous cell carcinom
Neurological	Post-herpetic neuralgia
	Nerve compression or injury
	Neuroma
Traumatic	Female genital cutting
	Obstetric procedures
Iatrogenic	Post-surgery
	Chemotherapy
	Radiation therapy
Hormonal deficiencies	Genitourinary syndrome during menopause (vulvovaginal atrophy)
	Lack of menstruation during lactation

Table 1. Organic causes of chronic vulvar pain (own elaboration based on the 2015 Consensus terminology and classification of persistent vulvar pain).

More specifically, the current debate on vulvo-vaginal pain is questioning whether the pain is primarily caused by a local injury, or a maladaptive peripheral/central pain processing mechanism. Locally, a trigger could cause inflammation of the areas of the vulva and the repetitive stimulation of pain receptors could eventually damage the receptor itself or the nerve. Dermatitis or other urogenital infections have been pointed out as potential causes for inflammation (Ventolini G, 2013). Inversely, it may not involve peripheral sensitization of the vulva, but rather a generalised pelvic and/or central nervous sensitivity. In fact, it has been found that women suffering from vulvar pain are also more likely to have bladder sensitivity, urinary urgency, and frequency (Kahn et al., 2010; Corsini-Munt et al., 2017; Patla et al., 2022).

On the other hand, a maladaptive central pain processing mechanism could precede the peripheral sensitization. It has been suggested that some people are more likely to develop chronic pain due to their reaction to the pain itself (Leeuw et al., 2006). According to the Fear Avoidance Model of Pain, pain avoidance can lead to fear of pain, pain-related anxiety, and hypervigilance. In line with this model, it has been shown that

women with vulvo-vaginal pain engage in avoidance behaviours and catastrophic cognitions, which in turn could be associated with greater levels of pain perceived, higher sexual dysfunction and lower sexual satisfaction (Payne et al., 2006; Sadownik L., 2014; Engaman et al., 2018; Chisari et al., 2020).

1.3. Existing treatment approaches

All things considered, treatment for Vulvodynia should take into account not just the pain itself and its resolution but multiple psychological and biological aspects, favouring a multidisciplinary approach that includes physical and psychological therapy, and surgical/medical treatments. Firstly, pelvic floor physical therapy has been demonstrated to reduce pain during intercourse; physical therapy interventions, electromyography biofeedback, and electrical simulation have been found to reduce pain during sexual intercourse and improve sexual function (Morin et al., 2017). As for the psychological treatment, therapy addresses both pain management and relationship difficulties typical of couples dealing with vulvo-vaginal pain; Cognitive Behavioural Treatment has proven to give the best results in terms of pain reduced and improve sexual function even after one year follow-up (Masheb et al., 2009). Finally, vulvar vestibulectomy – a surgical intervention for Vulvodynia – resulted in reduced pain during intercourse in over 70% of treated women (Tommola P. et al., 2010), however hormonal treatments and anti-inflammatory agents have also been proven to be a promising treatment with no surgical intervention (Goldstein AT et al., 2016).

Vulvodynia is indeed a complex pathology difficult to treat. Its treatment should be holistic, involving both the primary site of pain and its consequent interference with sexual functioning. However, according to Chisari and colleagues (2020), pain associated to Vulvodynia is still considered to be either medical or psychological, with little

multidisciplinary integration. Klann and colleagues (2018) have recently published a systematic review on medical treatments for Vulvodynia. They included five studies whose participants were 297 women with localised provoked vulvodynia with 6 weeks to 6 months of treatment and 12 weeks to 10 months of follow-up. It was found that placebo treatment was as effective as any other medication used (topical, oral, or injectable). This should stress the importance of a much broader understanding of this pathology, including psychosocial factors that can contribute, increase, or influence women perception of pain and their adjustment in life.

1.4. Psychological and emotional factors involved

To address the necessity of a broader understanding of the psychosocial factors involved in the pain suffered by women with Vulvodynia, Chisari and colleagues have identified and reviewed 21 studies published from 2003 that included at least one psychosocial factor related to Vulvodynia. More in detail, they have analysed how these factors influenced pain perception and sexual functioning as primary outcomes, and quality of life and sexual satisfaction as secondary outcomes in women suffering from Vulvodynia. They have found that depression as well as anxiety were significantly associated with higher pain intensity and lower sexual functioning and consequent lower sexual satisfaction. Moreover, four out of twenty-one studies investigated patients' catastrophic thinking towards pain and all of those studies found that greater pain catastrophizing corresponded to greater pain perceived.

Among many psychosocial factors that have been taken into consideration, it is worth focusing on perceived injustice. As explained by Pâquet and colleagues (2016), perceived injustice is a multidimensional construct, "comprising elements pertaining to the severity of loss, irreparability of loss, blame, and a sense of unfairness […], associated with

psychological consequences such as anger, powerlessness, guilt, or depression". One study in the review mentioned above has investigated this variable in a sample of 50 women with Provoked Vestibulodynia (PVD) and their partners and concluded that higher levels of perceived injustice were notably associated with higher pain and greater depression (Pâquet et al., 2016).

Furthermore, pain catastrophizing has been considered as a psychosocial factor that could augment or maintain pain perception. It has been defined as a response to pain that characterizes it as being awful, horrible, and unbearable (Gracely et al., 2004). It is not clear how it contributes to this experience, however it has been hypothesized that people who catastrophize more may have difficulties in shifting the focus of their attention from painful stimuli while also considering as more threatening non-threatening stimuli (Crombez et al., 2002). In line with this, Chisari and colleagues (2020) reported in their review that higher levels of pain catastrophizing were associated with greater pain and lower sexual function.

According to Meana and colleagues (1999), causal attribution for pain and physical symptoms influence people's affect and behaviour, determining what treatment strategy the patient will follow. In addition, individuals with pathological conditions with no evident physical pathology are more prone to build psychosocial attributions, which in turn leads to self-stigmatization and more feelings of frustration and helplessness. To test whether or not self-stigmatization and frustration happen in people with no evident pathology, Meana and colleagues (1999) hypothesised that women with Dyspareunia who make psychosocial attributions regarding their pain would have poorer adjustment and report more pain than those women who only make physical attributions. In order to test their hypothesis, the authors distributed to 100 women (mean age 37.89 ±12.62) different

self-reports on pain, sexual attitudes, psychological distress, and marital adjustment. Results revealed that indeed, women who attribute their pain to psychosocial factors differ from those who think the cause of their pain is physical; they suffer from more psychological distress, experience more marital problems and higher sexual aversion.

Vestibulodynia, previously known as Vulvar Vestibulitis Syndrome, is characterised by severe pain upon vestibular touch or attempted vaginal entry; as previously clarified, in the majority of cases no organic pathology is identified, which leaves space to numerous research and questions yet to be answered. What is clear is that women affected by vestibulodynia also report lower frequencies of intercourse and self-stimulation, lower levels of pleasure, desire and arousal, less success of achieving orgasm and higher rate of negative thoughts around sexuality due to the pain they endure (Meana et al., 1997).

1.4.1. Cognitive processing of pain

Key to the cognitive processing of pain and sexual stimuli are attention and anxiety in stimulus selection. Studies have found that distraction from the source of pain reduces pain perception; furthermore, chronic pain could be maintained by an acquired hypervigilance for those stimuli believed to be the source of one's own pain. Attention towards threatening stimuli and anxiety during sexual activity is also linked to sexual dysfunctions. In addition, several studies have identified fear of pain and anxiety sensitivity as predictors of hypervigilance to pain related stimuli. This being said, hypervigilance to pain and anxiety could be involved in the aetiology and/or maintenance of Vestibulodynia symptomatology (McCaul et al., 1984; Payne et al., 2005).

To have a better understanding of how women with vulvar pain process threatening stimuli, Payne and colleagues presented seventeen women suffering from vestibulodynia with a semi-structured interview about socio-demographical and pain history information, an emotional Stroop task with pain, social-threat, positive and neutral words, a series of self-report measures on anxiety and fear of pain, and a final gynaecological examination. The authors first hypothesised that women suffering from vestibulodynia would have been hypervigilant for pain-related stimuli; consistently with this prediction, participants from the vestibulodynia group showed higher levels of Stroop interference on pain stimuli ($F(1,32) = 4.70$, $P < 0.05$; g2 p ¼ 0:13). Secondly, it has been hypothesised that sufferers from vestibulodynia would have had a memory bias for pain stimuli, since recollection is affected by where attentional resources are allocated during the encoding phase; however, they have found no data in support to this. Finally, authors expected group differences to be explained and predicted by anxiety, fear of pain and anxiety sensitivity: vestibulodynia subjects showed higher levels of both state and trait anxiety, nonetheless, no difference was identified for anxiety sensitivity.

Many if not all of the psychological factors discussed above have a strong impact on a person's sexual life. In women suffering from vulvo-vaginal pain these factors could maintained or heighten the level of pain felt. In fact, hypervigilance for pain-related stimuli, pain avoidance, and anxiety could result in a lower frequencies of intercourse. This could cause higher levels of depression, anxiety, decreased couple intimacy and finally, sexual dysfunction (Payne et al., 2005; Brauer et al., 2007; Chisari et al., 2020).

1.5. Impact on sexual functioning

Sexual function is defined as “the absence of difficulty when moving through the different stages of sexual response (i.e., desire, arousal, and orgasm), including an absence

of pain with sexual activity, as well as subjective feelings of satisfaction and pleasure during partnered and solitary sexual behaviour" (Fielder, 2013). From this it can be stated that sexual dysfunction, on the other hand, involves obstacles in the sexual response, and/or pain during sexual activity, and feelings of dissatisfaction with one's own sexual life. Pain in particular can have a huge impact on sexual function, affecting both physical and psychological well-being. Chronic pain conditions discussed here and the experience of pain during intercourse or sexual stimulation can negatively affect sexual desire, arousal and ultimately satisfaction (Payne et al., 2004; Brauer et al., 2009; Engman et al., 2018; Janssen et al., 2020) by creating a negative association with sexual activities.

Before explaining how pain can impact sexual function, it is fundamental to understand what sexual arousal is and how it is involved in the sexual response. Bancroft defined sexual arousal as "an emotional and motivational state involving complex interaction between information processing of sexual stimuli, central arousal, genital response, and behaviour" (2006). First, an evaluation of a stimulus as sexual would initiate a process that would lead to sexual arousal and a genital response. Female genital response involves "transudation of fluid through the vaginal wall and tumescence of the vulva and vaginal introitus, which will facilitate the entry of the penis during intercourse" (Bancroft, 2006). Finally, the behavioural or motor component is the sexual activity which could be either masturbation, coitus, or oral (Bancroft, 2006). Nonetheless, if pain is experienced during the intercourse, a different process could result in a weaker genital response.

Many models have been proposed in the literature as attempts to elucidate the mechanisms underlying a weaker sexual response in women with sexual dysfunctions. Researchers such as Spano and Lamont (1975), Byrne (1977), Dewitte (2015), and

Janssen et al. (2020) have put forward various models that aim to explain the complex relation between sexual dysfunctions and the experience of pain during sexual activities. All of them rely on a negative evaluation of relevant sexual stimuli as a starting point, although they differ in the mechanisms that would cause women to experience pain during sexual activities. In the following paragraphs a brief summary of the models mentioned above will be presented to have a better understanding of the past and present trends in literature.

Spano and Lamont suggested a circular model of pain and fear (1975). The model posits that experiencing pain causes fearful reactions, further decreasing genital arousal resulting in vaginal dryness. As it is a circular model, reduced lubrication would cause pain during penetration. However, sexual arousal is not a unitary process, so it is important to consider how pain can affect the motivational process before it turns into a physical dysfunction.

To understand the motivations behind this process, Janssen and colleagues (2020) proposed a cognitive-behavioural model, the Information-processing Model of Sexual Arousal (Figure 1). This divides the process of sexual arousal into an appraisal stage and a response generation stage. Appraisal involves attributing meaning to a stimulus after it has been encoded and matched with information in our memory; response generation integrates the meaning with the motor response. This being said, the authors suggested that sexual stimuli can have different meanings, both positive or negative, stored in one's own memory; when a sexual stimulus has more than one meaning attached to it, processing of these non-sexual or emotionally negative meanings would cause attention to divert resulting in decreased sexual arousal and inhibition of the sexual response.

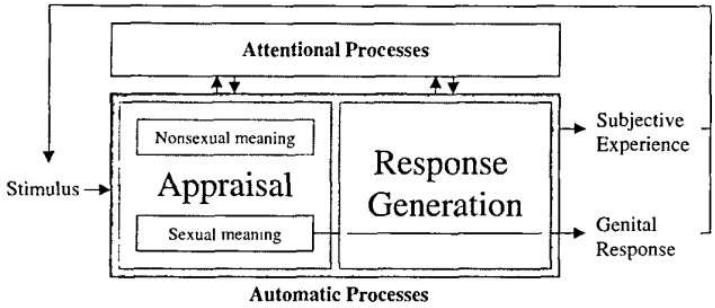


Figure 1. An Information Processing Model of Sexual Arousal (Janssen et al., 2010)

As suggested by a more recent model (Dewitte, 2015), sexual response relies on both automatic and controlled processes that can operate in parallel either in a harmonious or in a conflictive way. So, according to the Emotion-Motivational Model (EMM) sexually relevant stimuli are pre-attentively processed and capture attention automatically; the automatic evaluation of a stimulus as sexual and rewarding will increase attention towards it and eventually cause genital arousal, thus giving rise to the motivation to approach and engage in sexual behaviour. Inversely, any negative appraisal of sexually relevant stimuli would deflect attention, inhibit any sexual response, and trigger an avoidant behavioural response. Consequently, problems with sexual arousal may arise from difficulties in appraise sexual stimuli as rewarding, a failure in noticing sexual stimuli, and/or conflicts in translating one's own motivations to engage in sexual activities in an approach response (Figure 2) (Dewitte, 2016; Milani et al., 2021; Zahler et al., 2021).

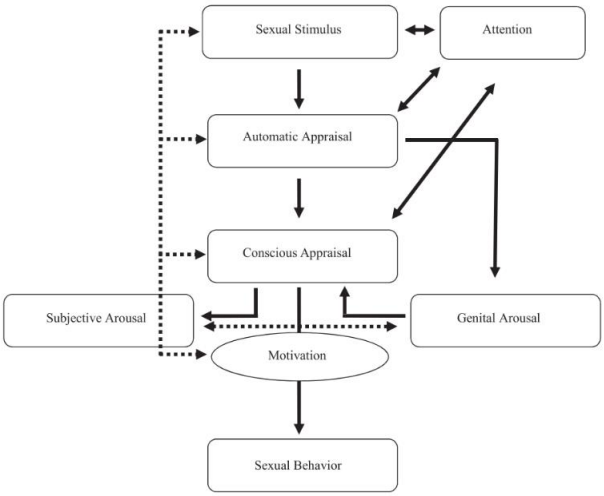


Figure 2. An emotion–motivational model on sexual arousal based on the models of Barlow (1986), Janssens and colleagues (2000) and Öhman (1993). (Dewitte, 2016)

Further, to better understand how individuals develop a negative affect towards sexual stimuli, Byrne (1977, 1983a, 1983b) proposed the Sexual Behaviour Sequence, a theoretical model that lies on the assumption that individuals acquire a series of response dispositions throughout life that mediate the effect that sexual stimuli have on the individuals' sexual behaviour. These acquired response dispositions are affective responses, informational responses, and fantasy responses. The tendency to respond to sexual stimuli along a negative-positive dimension of effect has been labelled Erotophilia-Erotophobia (Fisher et al., 1988). According to the Sexual Behaviour Sequence model, erotophobia leads to generalized avoidance responses to sexual cues so, erotophobic individuals would evade sexual experiences throughout the entire lifespan.

To sum up, experience of pain during sexual activities can install a circular pattern of fear, anticipation of pain and hypervigilance for painful sexual stimuli (Spano and Lamont, 1975; Brauer et al., 2006-2009; Payne et al., 2007; Janssen et al., 2010; Dewitte et al., 2011). Taken together, all these psychological factors contribute to a lower sexual desire and lower levels of sexual arousal, resulting in a poor sexual life. It is not a surprise

that women with vulvo-vaginal pain also experience higher levels of anxiety and are twice at risk to develop depression compared to non-clinical population (Payne et al., 2005-2007). Moreover, the difficulties encountered in experiencing sexual pleasure undermine women's feelings of femininity and relationship satisfaction which further exacerbate the patient's condition (Payne et al., 2007).

1.6. Previous research on sexual stimuli cognitive avoidance

Up to almost a decade ago, visual attention and sexual stimuli avoidance has mainly been investigated using reaction time (RT) measures, providing support to the notion that individuals with sexual dysfunction attend sexual stimuli differently compared to healthy people (Velten et al., 2021). Reaction time-based tasks require the individual to respond to a relevant stimulus as quick as possible generally by pressing a bar on the keyboard in front of them. A common task used to assess RTs is the dot detection task (Velten et al., 2021). This requires subjects to indicate in which of the two screens available in front of them appears the dot; before the dot appears on one of the screens, two images – one neutral and one sexual – compete for the person's attention. It has been shown that healthy adults take longer to disengage from the sexual image when the dot appears on the opposite screen (Velten et al., 2021; Kagerer et al., 2014). Moreover, Prause and colleagues asked sixty-nine participants to complete the dot detection task to observe whether people with higher levels of sexual desire were quicker in detecting the dot when it appeared in the area of a sexual stimuli. In contrast with this hypotheses, results showed that faster reaction times were associated with lower sexual desire (Prause et a., 2007)

However, RTs only allow to measure initial and automatic attention while sustained and more controlled processes would be better tracked using technologies able

to follow eye movements through the entire study session (Velten et al., 2021; Milani et al., 2021). To date only three studies have previously investigated voluntary and controlled overt attention towards sexual stimuli in women with and without vulvo-vaginal pain using eye-tracking technology. Lykins and colleagues (2011) have presented 54 women – 20 with pain during intercourse, 14 with hypoactive or low sexual desire (HSD) and 20 with no sexual complaint – with nine erotic pictures that included a distracting object. They were instructed to look at the pictures as they would normally do for a period of ten seconds for each picture while eye movements where recorded. Results showed that women with dyspareunia looked at the bodies in the pictures less than the other two groups of women, whereas looking for longer time at the background; however, women with pain during intercourse looked at both the bodies and the background more than they looked at the distractor.

Velten and colleagues (2020) presented 69 women – 30 clinical, 23 subclinical and 16 control – with sixty pictures showing thirty different scenes of heterosexual intercourses for eight seconds; each scene was presented twice, with and without a distracting illustration. The authors hypothesized that women with pain would attend less to the genital area than the control and that the same group would be more distracted by the added illustration. Results supported the first hypothesis, showing that women from the clinical group not only had a shorter first fixation duration to the genital area ($F(2,132)= 5.83$, $P = .004$, $R2 = 0.08$) but also the total fixation duration resulted to be shorter compared to the non-clinical group ($t(135) = -2.27$, $P = .024$, 95% CI = -0.71 to -0.05). Nonetheless, there was no support for the second hypothesis, as the authors did not find any significant difference on the attention given to the distractor.

The same authors also investigated how women with and without pain directed their attention during the vision of an erotic video (vaginal intercourse and oral sex) and whether the level of sustained attention towards the sexual stimuli influenced subjective and genital sexual arousal (Velten et al., 2021). Genital sexual arousal was measured using a vaginal plethysmograph while subjective sexual arousal was measured asking "how much they liked and how arousing they found the clip" after the videos presentation. The results supported the current perspective in literature. That is, women with dyspareunia, while viewing videos showing the vaginal intercourse, attended the genital area significantly less than healthy women (Mean value for total fixation duration in clinical group= 3.72; Mean value for total fixation duration in control group = 4.44). Interestingly, pain did not predict fixation duration on videos depicting scenes of oral sex; in this regard, the authors hypothesized that oral sex might not be associated with negative emotions and memories of pain, therefore not showing significant difference when compared to healthy women's fixation time to oral sex scenes. Finally, Velten and colleagues' study also supported the idea that higher levels of attention towards the genital area predicted higher vaginal pulse amplitude (VPA); as a matter of fact, women with dyspareunia had lower VPA and lower subjective arousal for the intercourse video, however they still had lower VPA during the oral sex video, even though their subjective arousal and fixation duration did not differ from healthy subjects.

As Velten and colleagues highlighted (2021), the findings mentioned above can have a strong clinical impact. Women with lower genital arousal response – as in reduced vaginal blood flow indicated by the VPA – and consequently less lubrication, could experience pain during intercourse despite fully attending the sexual cues and reporting being subjectively sexually aroused. That is, lower VPA levels, lower genital arousal, and

insufficient lubrication could be the consequences of repeated sex-pain experiences. Nonetheless, the patient could present the same symptoms prior the exposure to any pain association with sexual stimuli. So, it has been suggested that VPA levels should be assessed before any genito-pelvic pain treatment to check whether any reduction in pain could correspond to an increase genital response (Velten et al., 2021).

2. CHAPTER TWO: EYE-TRACKING AND SEXUAL STIMULI AVOIDANCE

2.1. Eye-tracking technology

Eye-tracking is a real-time eye movement and gaze recording tool highly used in research, especially after 2008, when this technology has seen a peak in its application (Carter et al., 2020). Charles Bell has been the first to classify eye movements and to ascribe their control to the brain. Doing so, Bell first suggested the existence of a physiological link between the eyes and the nervous system, connecting their motion to neurological and cognitive processes (Bell, 1823). Because fine eye movements are mostly unconscious and reflexive, these have been used to track the allocation of overt attention to different visual stimuli, opening a window into the unconscious doing of our mind (Carter et al., 2020).

Only a small portion of the eye, known as fovea, is destined to high acuity vision, which motivates individuals to constantly move their eyes to focus on the stimulus they want to process. According to Just and Carpenter (1980), this is the eye-mind link, that is, the eye remains fixated on a stimulus as long as the stimulus is being processed. So, in their model of reading and comprehension, Just and Carpenter suggested that gaze duration on the stimulus reflects the time needed to execute comprehension processes in the brain (1980). Thanks to the eye-mind link, the eye-tracking technology can be a reliable technique to explore the allocation of visual attention and the processing of visual stimuli (Carter et al., 2020). In order to track eye movements, the eye-tracker shines an infrared light invisible to humans into the eyes. This light produces a reflection on the cornea that is identified by the eye tracking software together with the centre of the pupil.

Video-based eye trackers can estimate where the individual's gaze is directed by measuring the position of the corneal reflection of the infrared light relative to the pupil (Carter et al., 2020).

Once calibration has been conducted and eye movements have been recorded, there are many types of measures of attention that can be extracted for analysis. To better understand these measures, two kind of eye movements that people execute to orient their visual attention to external stimuli will be briefly described here. A fixation (See Figure 3. A for a visual representation of a fixation) is "a period of time during which the eyes are fixed on a visual target, perception is stable, and the eyes are taking in visual information" (Rayner, 2009; Carter et al., 2020). Most fixations are short, lasting around 180–330 milliseconds (Rayner, 2009). As previously mentioned, not all the information displayed in the visual field can be processed with one single fixation because the fovea is too small to capture the entire scene. As a consequence, eyes will produce ballistic movements from one fixation to the next, also known as saccades (See Figure 3. B for a visual representation of a saccade) (Rayner, 2009). So, fixations and saccades are the basic units of data for analysis.

When comparing subjects' different eye movements for the same image, analysis can focus on aggregate measures of fixation and saccades, obtaining average fixation duration, number of fixations, and average saccade amplitude. If more than one area in the image is set to be an area of interest for the analysis, then different measures can be introduced. These can be divided into early measures – that is the initial stages of processing – and late measures. The first category includes first region of interest fixated, time to first fixation, and duration of first fixation; late measures are dwell time, or total

amount of time spent fixating a region of interest, and number of fixations in a region of interest, or proportion of fixations within a region of interest (Carter et al., 2020).

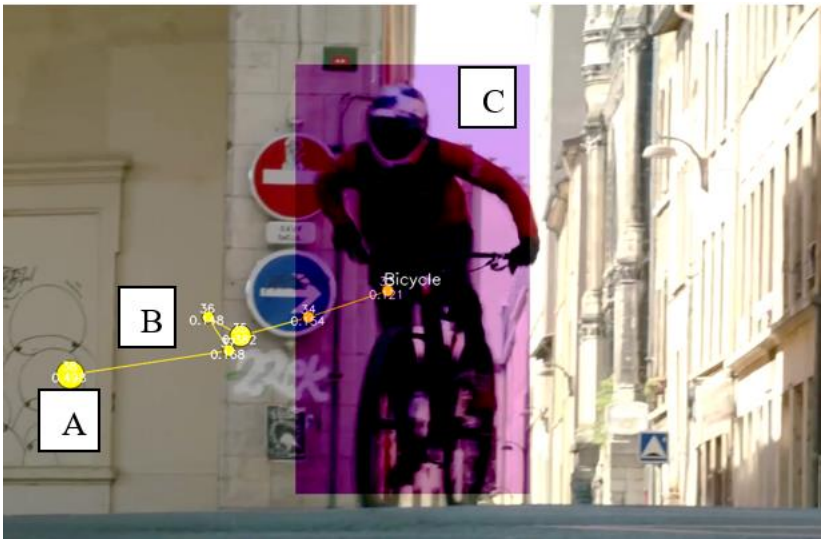


Figure 3. Scene cut from Sport video of the present study. Here are shown fixations represented by yellow dots (A), saccades (B) represented by the yellow lines in between the dots, and the AOI named Bicycle as indicated by the purple box which encompasses the stimulus of interest (C).

The terminology *area of interest* has been used above. An area of interest (AOI) is a specific part of the entire stimulus that researchers want subjects to pay attention to (See Figure 3. C for a visual representation of an AOI). Setting one or multiple AOIs allows researchers to know how many times and for how long the participant has looked at that particular area of the stimulus. Once data are collected and processed, the software will provide a full description of how subjects have interacted with the AOIs, including measures cited above and more, such as number of fixations, number of visits, and total time spent (Carter et al., 2020).

Eye movements, and all the measures described above as a direct consequence, are influenced by a large variety of physical and cognitive factors. Complexity of the image and salience of the stimulus will draw the person's attention, so that the more

complex and salient, the longer the time required to be processed and, proportionately, the longer the fixation on the stimulus (Henderson et al., 2003; Carter et al., 2020). The quality of the stimulus plays an important role too; if the stimulus is blurred, degraded or dark, it will take more viewing time to be clearly recognised. Moreover, larger stimulus will attract more attention, so that even though fixations may be randomly placed on the entire scene, a larger stimulus will receive more fixations than a smaller one (Carter et al., 2020). Cognitive factors will also influence eye movements. Less familiar, less expected and any meaningful stimuli require more attention and more viewing time. Similarly, emotional stimuli draw more attention and are processed more easily and quickly than neutral ones (Carter et al., 2020). So, it is important to thoroughly analyse and wisely pick the most adequate stimuli for the specific purpose of the eye tracking study conducted.

Eye tracking can be coupled with electroencephalography (EEG) and functional magnetic resonance imaging (fMRI), becoming an even more powerful tool to research the link between eyes and mind. On one hand EEG provides a record of the neural response to the information the eye has set its attention on. On the other hand, fMRI shows the brain's response to the visual information the person is looking at allowing researchers to have a complete understanding of the individual's visual attention processes. It is true that EEG and eye tracking have a high temporal resolution, making this pairing a strong match, however, fMRI allows participants to freely look at the stimulus without corrupting data with any mechanical noise coming from the subject's eye movements (Carter et al., 2020). Progress is being made so that these techniques can be used together to reach high quality research in topics including face processing, reading, change detection, memory, and scene processing (Carter et al., 2020).

As it has already been stressed, eye tracking is a highly versatile recording tool which allows to attribute to eye movements many different cognitive processes only by adjusting the experimental design and using the most appropriate stimuli. This makes it particularly suitable for research within the psychological field. In fact, fifty-eight percent of publications from 1968 to 2018 fall into this category (Carter et al., 2020). Nonetheless, a variety of disciplines use this technique with multiple goals and different study designs. Medicine and health care, neuroscience, mathematics, computer science, engineering and technology, linguistics, physics and chemistry, business and law, and environmental science use eye tracking to assess memory, reading, learning, decision making processes, or to diagnose affective disorders, neuropsychiatric disorders, and autism (Carter et al., 2020). However, there are only a few eye tracking studies focused on sexual stimuli avoidance in women suffering from vulvo-vaginal pain, which makes this field widely unexplored.

2.2. Research gap in sexual stimuli avoidance

Eye-tracking is a valuable technique that allows one to explore many different cognitive processes hidden behind our eye movements, and to have a better understanding of different phenomena. Vulvo-vaginal pain is one phenomenon still poorly understood and accepted as one that deserves attention and multidisciplinary research. Progress has been made recently, however, much work is needed, and eye tracking is one valid technique that can help explore the cognitive processes behind pain, allowing researchers to formulate more hypotheses and propose more theories on causes and consequences of vulvo-vaginal pain in women suffering from it.

As previously mentioned, eye tracking allows one to analyse visual attention through different gaze measurements. Thanks to this, eye tracking has been used across

different disciplines, and has helped researchers delve deeper into human cognition and perception. In sex research, eye tracking has been used to explore the impact of different sexual stimuli to assess gender differences (Dewitte, 2016), to investigate how visual attention to sexual and non-sexual stimuli changes depending on gender (Lykins et al., 2006), and to explore the role of sexual orientation (Dawson et al., 2017).

Wenzlaff and colleagues (2015) published a review of studies that used eye tracking in different topics related to sex research, excluding those focusing on gender differences (e.g., anatomical differences) and those whose stimuli were faces rather than genitals. At the end of the extraction process, thirty-four studies were included and divided into three macro categories depending on the topic the research was focused on: body perception and attractiveness, forensic research, and sexual orientation. These will be briefly presented in the following paragraphs.

Sexual orientation

Wenzlaff and colleagues found that sexual orientation was a common topic of research in studies using eye-tracking. This line of research has focused on the differences between heterosexual and non-heterosexual individuals. Rieger and Savin-Williams (2012) have found that men's visual response was more specific to their preferred sexual stimuli than it was for women. In fact, heterosexual, bisexual and homosexual men had greater pupil dilation in response to their specific preferred erotic target compared to heterosexual and bisexual women.

Forensic research

In spite of being less central to the present paper, numerous studies on forensic research have focused on paedophilic sexual interest using eye-tracking tool technology.

Trottier and colleagues (2013) have proposed eye tracking as a complementary technique to use with the penile plethysmography (PPG) suggesting that it would improve its internal validity. In North America PPG results are extremely important since these can influence risk appraisal or release approval. Their findings suggested that when trying to control erectile response eye movements patterns had specific variations, providing relevant information on covert processes linked to erectile inhibition.

Body perception and attractiveness

The largest group of studies belong to the first group that Wenzlaff and colleagues named "body perception and attractiveness". Studies on body perception generally encourage free exploration of the image or video presented while recording exactly where and how subjects look when perceiving bodies. Lykins and colleagues (2006) have been the first to study viewing patterns in relation to erotic and non-erotic stimuli. They concluded that participants fixated longer on faces when models were in casual clothing, whereas they had longer fixations on genitals when models where naked or dressed but posing in a sexual manner. Questions on what influences perception of attraction have also been investigated with eye tracking. For instance, Maner and colleagues (2008) found that observers attended to men, but not women, that exhibit signs of social dominance. Moreover, Cacioppo (2014) found that participants had longer fixations on faces when they had to make decisions on romance while directing their gaze longer on bodies if decision was mainly focused on sexual interest.

This being said, central to this discussion is the application of eye tracking in research to explore body perception. This group of studies has investigated how eye movements change in relation to erotic and non-erotic stimuli, according to differences

in gender, age, and personality traits (Wenzlaff et al., 2015). Wenzlaff and colleagues included in this category one study, unique in its kind and pioneering in this field of research, that had explored differences in visual patterns in women with pain during sexual intercourse compared to women with no sexual complain (Wenzlaff et al., 2015; Lykins et al., 2021). This gap in this field of research has been recently addressed by different authors whose researches have been discussed already in Chapter one and two (Velten et al., 2020; Lykins et al., 2021), and are central to the understanding of the present study. Nonetheless, it is hard to find eye tracking based studies whose focus is on a clinical sample of women suffering from Dyspareunia, Vaginismus or Vulvodynia.

2.3. Present study

As mentioned above, until 2015 only one study has focused on visual patterns in women reporting vulvo-vaginal pain compared to visual patterns in women with no complaints in this regard (Wenzlaff et al., 2015). As extensively explained in Chapter 1, Lykins and colleagues instructed participants to look at a series of erotic pictures for a period of ten seconds each; the authors concluded that women with Dyspareunia attended less to sexual scene regions compared to women with no sexual complaints ($p=.003$) and women with low sexual desire ($p=.0018$) (Lykins et al., 2011). Almost ten years past before more research on the matter was published. In fact, Velten and colleagues reported in 2020 that women from a clinical group (women who received a diagnosis of at least one sexual dysfunction, low sexual functioning, and high sexual distress) had shorter first fixation duration to the genital area ($R^2 = 0.08$) and shorter total fixation duration when compared to the non-clinical group (CI = -0.71 to -0.05).

One year later, Velten and colleagues published a new study whose intention was not only to have a better understanding of visual pattern differences between women with

and without vulvo-vaginal pain complaints, but also to clarify whether or not direct attention to the stimuli is needed to obtain genital arousal. The authors concluded that women with dyspareunia attended genital areas depicted in the erotic videos less than healthy women, however, pain did not predict fixation duration on scenes depicting only oral sex. As for genital arousal, Velten and colleagues reported that higher levels of attention towards the genital area predicted higher vaginal pulse amplitude (VPA). That is, women with dyspareunia, who attended less to erotic scenes, also showed lower VPA and lower subjective arousal for the intercourse video (2020).

These three studies all converge into one line of results: women with vulvo-vaginal pain have shorter fixations and look at genital areas in erotic pictures or erotic videos for a shorter time compared to healthy women with no vulvo-vaginal pain. However, more research is needed to extend this conclusion to the general population and to be able to extract solid data and suggest valid hypothesis on the reasons why this happens and perhaps in the future treatment options that could help women suffering from different vulvo-vaginal conditions.

This being said, the present study aims at investigating whether women aged 19-31 (mean age 22.88) who report suffering from vulvo-vaginal pain (self-reported or previously diagnosed) show different visual patterns while watching at erotic videos. Based on the existing literature, it is hypothesized that women who suffer from vulvo-vaginal pain will have shorter first fixations and shorter total fixation durations on areas depicting genitals and explicit sexual intercourse (1). Moreover, in line with what Velten and colleagues have previously found (2020), I expect no pain influence on first fixations and total fixation durations in areas depicting oral sex only (2). Finally, it will be investigated whether negative affective associations, such as discomfort in watching

erotic videos, have any influence on the time spent watching specific Areas of Interest depicting genitals and sexual intercourse (3).

3. CHAPTER THREE: METHOD

3.1. Participants

The present study was conducted at the University of Padua, Italy, more specifically in the Social Psychology Laboratory at the DPSS department. Researchers first invited participants of a previous study who had provided consent to be contacted for future studies. Then participants were recruited from the Faculty of Psychology through direct invitation in class and a QR Code that allowed them to leave their email address in order to be contacted later on. Only at a later time the study was extended to the faculties of Medicine and Engineering.

After permission was obtained to contact potential participants, each individual was contacted through a phone call to the female students who had previously expressed their interest in participating to the study. During the call, one of the researchers explained the goal of the study, its structure, and the right for privacy during the entire duration of the study. The researcher answered any question and addressed any doubt the potential participant could have. To participate participants could have been using hormonal contraception or with a natural cycle. Once the student accepted to formally participate to the study, the first appointment was schedule on average five days before menstruation.

For the specific goal of the study, participants were all women, university students aged 18 to 25, 98 heterosexual and 52 homosexual or else (asexual, bisexual, pansexual, fluid), fluent in Italian, with normal or corrected-to-normal vision, on premenopausal hormonal status. 64 participants were using contraceptive methods while 86 were not using any hormonal contraception. Only those participants whose eye-tracking, as well as galvanic skin response data were valid have been included in the study (N= 153).

3.2. Procedure

As previously mentioned, data collection started with those participants who the previous year had provided consent to be contacted for future studies. Recruitment then moved on including females from undergraduate and postgraduate degrees of Psychology, Engineering, Mathematics, Biology and Biotechnology. Participation to the study was directly asked at the end of each classes' lessons. All males in the class were asked to leave the room in order to create a safe space where to explain the study, its goal and structure. Once the explanation was completed, a QR Code was given to all the females left in the room, inviting them to leave their email address if they wanted to be contacted.

The first contact with the participant was through a phone call. During the call the experimenter repeated the essential information needed to have a full comprehension of the study and if the interest was still alive in the subject, the first appointment was set. The appointment had to be taken approximately 5 days before the first day of menstruation. When the day arrived, the experimenter welcomed the participant in the Social Psychology Laboratory where two screens, the eye tracker and the headrest had already been set. Once the participant had read, understood, and signed the informed consent, the experiment could start.

First, the participant sat in front of the screen where the eye tracker was attached, put her head onto the headrest, and was asked to seat still with two fingers into the GSR and HR finger sensors. Once calibrated the eye tracker, the participant could watch the four videos previously described. Following the videos, each participant completed a general questionnaire, also described above. Finally, further instructions for a second daily questionnaire were given, however, this does not concern the present study so it will

not be discussed in here. Before leaving, the researchers gifted participants with some gadgets as a gratitude gesture for their participation.

Data were collected for a total of seven months, ranging from October 2022 to June 2023 using the same procedure explained above. Once collected, the AOIs were selected for each video (See Table 2 for the all the AOIs chosen), all participants' eye tracking data were uploaded into the GazePoint software and then exported into one single Excel file. The excel file exported contained all the eye movement measures necessary for the analyses such as first fixation, number of fixation, total fixation duration.

	Media Name	AOI Name	Mean (AOI Duration (sec - U=UserControlled))
1	Hetero	Oral Sex	25,296
2	Hetero	Penetration	90,742
3	Hetero	Woman's face	84,803
4	Lesbian	Oral Sex	96,69
5	Lesbian	Stimulation	31,3
6	Lesbian	Women's faces	69,397
7	Neutral	Brush	47,735
8	Sport	Bicycle	114,441

Figure 4. AOI names and duration

3.3. Instruments and measures

The present study is part of a larger study. For this reason, this section will be dedicated only to those instruments that have been used in this study and the hypotheses previously mentioned. The following paragraphs will contain a brief description of the

videos used as stimuli for the study, the eye-tracking method already introduced in Chapter 2, the galvanic skin response (GSR) and the heart rate (HR), and finally, the first of two questionnaires all participants completed.

3.3.1. Video-stimuli

Each participant watched four videos while eye movements, HR and the GSR were recorded. Two videos were defined as Neutral for their non-specific content and were shown to establish a baseline for the participants' physiological measures. The two Erotic videos were the target stimuli used to compare subjects' visual patterns. Of these videos, one included explicit hetero oral sex and sexual intercourse with penetration, while the other one showed a two women engaged in oral sex and vaginal/clitoral stimulation. Of the neutral videos, the first included a hand at the centre of the screen painting on canvas, while the second one was a RedBull Ad showing a bicycle racing through the streets of an unrecognizable city. The order of presentation of the videos was Neutral painter, Hetero Erotic, Neutral bicycle, and Lesbian Erotic. Before the beginning and between each video a 2-minutes white screen with a message was presented to the participant; the text reported "Relax (but do not move your head from the headrest)".

3.3.2. Eye tracker

Eye movement were tracked and recorded using the GazePoint GP3, a research-grade eye tracker utilizing a 150Hz machine-vision camera, recording a gaze point approximately every 16.67 ± 1.42 ms and with an accuracy rate between 0.5° and 1° of visual angle (GazePoint, personal communication, 2020). The system was compatible with most eyeglasses and contact lenses. The eye tracker has been used in combination with a standalone 22″ monitor and a headrest to minimize small head movements.

GazePoint eye trackers require a nontechnical setup, which simplifies the correct device placement and the experiment execution. To reach an optimal eye movement calibration though, the GazePoint GP3 eye tracker was places at 65 cm from the participants eyes. The monitor was placed at the centre of the table at 52.5 cm from the participant's headrest.

3.3.3. Galvanic skin response

Galvanic skin response is a change in the electrical properties of the skin (Sharma et al., 2016) which provides information of changes in the sympathetic nervous system (SNS) (Shi et al., 2007). It can also be defined as the amount of change in the resistance level, that is the static resistance between two points, once introduced an "adequate" stimulus. The GSR usually corresponds to a decrease in the skin static resistance (McCleary, 1950; Sharma et al., 2016) and it has often been linked to cognitive load and stress levels, so that when a person becomes more or less stressed, the GSR increases or decreases respectively (Shi et al., 2007).

Participants' GSR was recorded while watching the videos. The GazePoint Biometrics system was used for this purpose. The GazePoint Biometrics system is a research-grade biometric signal tracker for capturing heart rate and galvanic skin response from a two-finger sensor (GazePoint, personal communication, 2018).

3.3.4. Self-Report Measures

Each participant completed a general questionnaire after watching the videos. The questionnaire took around twenty minutes to be completed. It was divided into Video Ratings, Personal Sexuality Inventory (baseline, body image, and sexuality), Female Sexual Function Index (FSFI) (masturbation, sexual desire, sexual intercourses,

satisfaction, penetration), Personal Sexuality Inventory – Partner, Porn Use, Sexual Trauma, and final feedback. For the purpose of the present study, the sections of interest for the analyses are the Video Ratings, the Personal Sexuality Inventory (genital health subsection), FSFI (penetration subscale), and Sexual Trauma. These sections will be briefly described in the following paragraphs.

Video-rating

The Video Rating section asked participants to express the emotions and sensations they felt while watching the videos and to rate them in a scale from "Not at all" to "Very much". The emotions we asked about were pleasure, indifference, uneasiness, and *eccitazione* which we will translate as sexual arousal. Free spaces were left to allow participants to add any other emotion they felt and that was not included in the ones suggested (See Figure 5 as example).

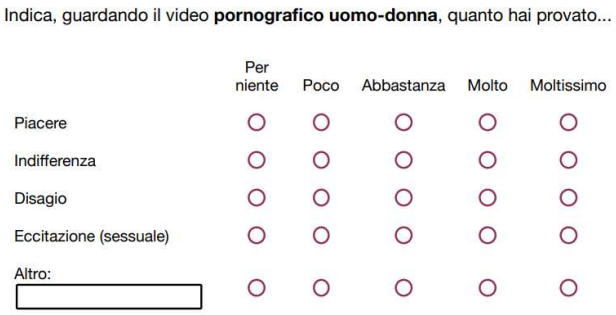


Figure 5. Video Ratings section: question example.

Genital Pain

The genital health subsection of the Personal Sexuality Inventory aimed at investigating whether participants had any experience with vulvo-vaginal pain, genitals, or urinary infections. Some example questions are "In the last month, did you suffer from any urinary infections? (e.g., cystitis)" or "In the last month, did you suffer from any

vaginal infections? (e.g., Candida albicans)". To have a better understanding of the type and intensity of pain felt, a drawing of a vulva was shown so that participants could directly click and select the areas affected. The picture was associated to questions such as "Define the type of vulvar pain" or "Define the type of vaginal pain", or again "In what circumstances do vulvo-vaginal pain symptoms appear". General genital pain was a 0-1 value question with a yes/no answer on whether the participant experienced pain in the genital area before.

Genital Pain during penetration

The Female Sexual Function Index is a survey measuring women sexual function in different domains. Questions in Penetration domain measure how often in the past four weeks the participant has had vaginal penetration – notice the term vaginal penetration includes penetration with penis, fingers, sex toys or anything else. Moreover, questions on whether or not participants had felt pain or uneasiness while practising any form of penetration have also been asked.

A pain during penetration score was obtained by summing the scores from the three FSFI questions referring to pain during penetration, pain after penetration and the intensity of pain. This has been labelled "Sexual Pain". Finally, as explained before, all participants answered questions investigating emotions they felt while watching the four videos, so *pleasure* or *uneasiness* have been used in the final analysis.

Sexual trauma

This section wanted to investigate the presence of any negative sex-related experiences. Examples of questions in this section are "Have you ever been involved in a sexual situation in which you felt you didn't have full control of?" and "Have you ever

found yourself in an unwanted situation in which you felt you had to engage in sexual activities?".

It surely is a delicate matter however, we strongly believe it is fundamental to study negative experiences around sex; this topic is still very actual and deserves its space to be heard and understood. We hope, as a team, to have a better understanding of how women who suffer from sexual trauma live their sexuality, and so finding in research some indication to help them retake and fully live their own sexual life.

4. CHAPTER FOUR: RESULTS

Initial processing of eye tracking data was done using the GazePoint software. The GazePoint software calculated the duration, the number of fixations and the revisits for each AOIs. Initially thirty-six AOIs were selected (twelve for the Hetero video, thirteen for the Lesbian video, four areas for the Neutral video, and six for the Sport video), however, some of them have been excluded from the analysis because they were deemed to be irrelevant for the final purpose of this study or too short to extract information to analyse. The final total number of AOIs was eight including "Oral Sex", "Penetration" and "Woman's face" for the Hetero video; "Oral Sex", "Stimulation" and "Women's faces" for the Lesbian video; and two from the neutral and sports videos, one for the Neutral depicting a brush, and one for the Sport video following the bicycle all along (See Table 2 for reference).

The GazePoint software, as previously explained, also extracted information about the GSR, allowing further research into the levels of arousal of each participant while watching the videos. It is important to specify that the term *arousal* is not used here to indicate sexual arousal. The galvanic skin response offers insights on the individual's emotional arousal through changes in sweat activity so that the higher the GSR signal the higher the individual's arousal and the lower the electrical resistance in the skin.

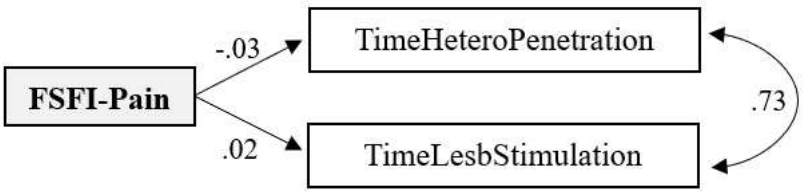
4.1. Results

The main purpose of the present study was to investigate whether women with vulvo-vaginal pain avoid looking at areas depicting genitals or sexual activities during the vision of two pornographic videos, one hetero and one lesbian. Forty-one participants out of one hundred-fifty-three reported feeling pain while having vaginal penetration. For

these participants the Sexual-Pain measure was analysed in relation to the total time viewing each AOI, the number of fixations, the number of revisits, and the first view on the AOIs. All variables are continuous variables. A structural equation model was used in which the gaze variables are predicted by genital pain (allowing them to be correlated). The results are reported in the following paragraphs.

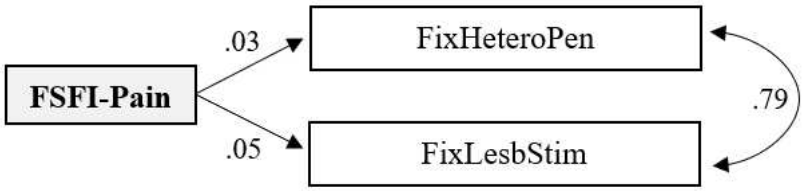
Total Time View

Pain did not predict total time viewing for either the HeteroPenetration or the LesbianStimulation AOIs. As shown in the graphic, Sexual-Pain was not associated neither with time spent looking at Hetero Penetration nor with time spent looking at Lesbian Stimulation (FSFI-Pain → TimeHeteroPenetration = -.03; FSFI-Pain → TimeLesbStimulation = .02). Total time viewing of these AOIs were correlated with each other r = .73.



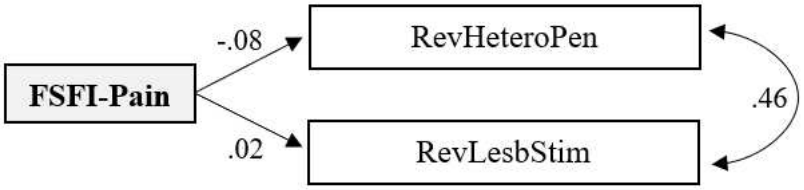
Number of Fixations

Pain did not predict the number of fixations for either the HeteroPenetration or the LesbianStimulation AOIs. As shown in the graphic, Sexual-Pain was not associated neither with fixations on Hetero Penetration nor with fixations on Lesbian Stimulation (FSFI-Pain → FixHeteroPen = .03; FSFI-Pain → FixLesbStim = .05). Total time viewing of these AOIs were correlated with each other r = .79.



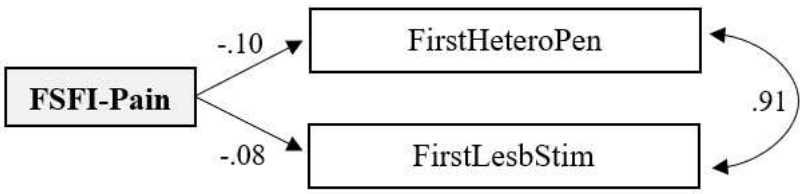
Number of Revisits

Pain did not predict the number of revisits for either the HeteroPenetration or the LesbianStimulation AOIs. As shown in the graphic, Sexual-Pain was not associated neither with revisits on Hetero Penetration nor with revisits on Lesbian Stimulation (FSFI-Pain → RevHeteroPen = -.08; FSFI-Pain → RevLesbStim = .02). Total time viewing of these AOIs were correlated with each other r = .46.



First View

Pain did not predict the first view for either the HeteroPenetration or the LesbianStimulation AOIs. As shown in the graphic, Sexual-Pain was not associated neither with first view on Hetero Penetration nor with first view on Lesbian Stimulation (FSFI-Pain → FirstHeteroPen = -.10; FSFI-Pain → FirstLesbStim = -.08). Total time viewing of these AOIs were correlated with each other r = .91.



Pain and Galvanic Skin Response

A within subject design with GSR as the dependent variable was used to test for an association between GP-Pain and GSR. Skin conductance does not depend on the time passing, which makes this measure suitable for an ANOVA. As explained above, the measure General genital pain (GP-Pain) assessed whether participants had experienced genital pain before, independently of the act of penetration. Therefore, this measure is less specific, which allowed to collect a much broader sample of participants with genital pain. For this reason, GP-Pain has been used for the analysis of Pain. Participant was treated as a random factor. Means and standard deviations are reported in the Table 3.

	Mean	*Std Dev*
GSR-Hetero	1,050857	1,0174026
GSR-Lesbian	0,9917165	1,0111642
GSR-Neutral	1,0837119	0,9289714
GSR-SportBycicle	0,9781665	0,9925876

Table 2. Means and SD for GSR on the four conditions.

The effect of GP-Pain resulted significant (r= .57; Prob > F 0,0009*). This revealed that those participants who had genital pain or had experienced genital pain before also had higher GSR. The effect of the type of the video shown was significant too (Prob > F 0,0337*), but the interaction between the two variables was not significant (Prob > F 0,9096), meaning the levels of GSR in participants with genital pain were higher during the vision of the videos, independently of the video shown to them.

5. CHAPTER 5: DISCUSSION

This study showed that there are no differences in what women look at during the view of an erotic video between women suffering from genital pain during penetration and women with no complaints in our sample. The Sexual-Pain measure did not correlate with any of the gaze variables considered, showing that women who reported vulvo-vaginal pain looked at genitals or areas depicting sexual activities with the same probability as women with no pain, displaying no attentional bias towards sexual cues. This finding differs from previous research (Lykins et al., 2006; Lykins et al., 2011; Velten et al., 2020) which reported that women with genital pain had shorter total time view for erotic images compared to healthy women.

Nonetheless, an association between Genital Pain on the Galvanic Skin Response was observed. To date no study has reported any result on Genital Pain predicting for GSR. Being the first time such results are reported in a study, these findings here explained would have to be replicated. The results suggest that an increase in genital pain corresponds to an increase in the GSR, meaning that those participants who scored higher in Genital Pain also had higher GSR and lower resistance during the vision of the selected AOIs in all four videos. However, when the interaction between Genital Pain and the Label (type of the video shown) was tested, it resulted not significant. As explained above, GSR levels resulted to be higher in those participants who reported to have experienced or still experience genital pain independently of the video shown. In other words, participants with genital pain displayed higher levels of skin conductance during erotic videos but also during the neutral and the sport videos, showing no difference in the type of stimulus presented. Two hypothesis are advanced in the following paragraphs to try explaining this result.

First, participants with genital pain could have probably been more aroused since the beginning of the study compared to those participants not suffering from any vulvo-vaginal pain. The object of the study was communicated to participants in advance, which could have made those suffering from any genital dysfunction more sensitive to the purpose, more agitated independently of which video they were going to watch. This remains for now a hypothesis. This event could probably be avoided by controlling the information given to participants during the phone call previous to the study. However, this would mean concealing important information about the study which would be unethical. Perhaps a solution to this could be to divide the sample in two, showing different videos to each. The first group would watch explicit erotic videos (experimental group), while the second would look at softer content, such as videos of couples cuddling and spending quality time together (control group). This could be useful to understand whether the increase in GSR is linked to erotic content because of an association with one's own pain.

Secondly, skin conductance reflects changes in the sympathetic nervous system, and it has been used in numerous studies to measure pain. In these studies, skin conductance has shown a significant increase during painful events such as post operative times (Ledowski et al., 2006; Ledowski et al., 2007; Storm, 2008). Since genital pain is indeed a painful and stressful experience, I hypothesise that participants reporting genital pain might have developed higher levels of skin conductance as their everyday baseline. Ledowski and colleagues showed that after the administration of a fentanyl bolus (a synthetic opioid drug) the number of fluctuations of skin conductance per second were significantly lower (0.2 (0.2–0.4 [0–0.8]) vs 0.2 (0.13–0.4 [0–0.8]), respectively; $p < 0.013$) meaning that pain relief was followed by a decrease in fluctuations of skin

conductance. To test this hypothesis GSR levels should be taken before any of the videos are shown to the participants and questions about any treatment for pain would have to be asked. These measures would allow to understand whether there is a difference in participants' GSR baseline and if this could be controlled by any pain killer or treatment followed.

Finally, as explained before, one section of the questionnaire all participants completed after watching the video was dedicated to the video rating. It has been asked to all participants to express how they felt while watching the videos. The emotions we asked about were pleasure, indifference, uneasiness, and sexual arousal. Although there was no correlation between uneasiness in watching porn videos and Genital Pain, post-hoc analyses showed that uneasiness did predict looking more at the actors' faces ($r = .19$, $p < .05$) than to their genitals or to sexual activities on the screen, especially to the penetration. Indeed, the more pleasure reported in looking at the videos, the more time was spent looking at genitals and less at the actors' faces ($r = .16$, $p < .05$).

As already mentioned, the results obtained in the present study are in contrast with the existing literature, however, stimuli used in each study were different. Lykins and colleagues (2011) presented fifty-four women with a series of nine erotic images that included a distracting object while recording their eye-movements. Consequently, Velten and colleagues published two studies (2020-2021) using different stimuli for each of them. In the first one the authors used a series of ten pictures depicting heterosexual couples during vaginal intercourse (Velten et al., 2020), whereas in the second one Velten and colleagues presented sixty-nine women with four 1-minute videos showing heterosexual couples engaging in vaginal intercourse or cunnilingus (2021). The present study used two 3-minutes erotic videos (one hetero and one lesbian) with no distracting

object, spaced by two neutral ones. Samples were different too. The most recent study published by Velten and colleagues included both healthy women and women diagnosed with female sexual interest/arousal disorder and genito-pelvic pain/penetration disorder. On the other hand, the same authors have not been so specific in the selection of their sample in their first study published in 2020. In fact, during a short telephone screening they selected women with at least one sexual dysfunction without mentioning which dysfunction they included. Lykins and colleagues (2011) included women with dyspareunia, low sexual desire and healthy women. As it can be noted, the three samples are different from ours. Indeed, we did not screen for women with diagnosed sexual dysfunctions and only asked participants about their subjective experience of pain during sexual activities and with no sexual stimulation. In order to have comparable results, future studies should be in line with existing literature in terms of sample and stimuli.

There are several limitations to this study. For instance, one of them is the limited number of women suffering from genital pain in our sample. As previously mentioned, the present study is part of a larger study which was not focused exclusively on genital pain, however the high number of participants who complained about genital pain related or not to any sexual activity is striking and stresses the importance of studies like this and the need for more research and comprehension in this field. Statistics show that about sixteen percent of women suffer from chronic vulvar pain or genital discomfort (Lotery et al., 2004; Sadowkin, 2014). More specifically, vulvodynia's prevalence in the general population has been estimated to be at 8-28%, however only sixty percent of them seek help and just half of these women finally receive a diagnosis (Corsini-Munt et al., 2017). Nevertheless, according to Reed and colleagues (2011) the number of women suffering from chronic genital pain is underestimated and genital conditions, such as vulvodynia,

are underdiagnosed because of the complexity of its aetiology. In the present study forty-one participants reported to have genital pain. This number represents the twenty-seven percent of our sample, which is already a lot higher than the worldwide estimations for genital pain.

The study only involved Italian university students aged 19-32, making it highly probable that they shared a similar cultural background and some sort of openness to the use of pornography. One Italian study published in 2015 reported that eighty-nine percent of male and thirty-nine percent of female students had already watched sexually explicit material online by the end of high school years (Romito et al., 2015). In our sample nineteen percent of participants reported watching porn videos once a week, while only eleven percent uses sexually explicit material two-three times a week. Thirty-eight percent of the female students involved in our study reported to have never watched a porn before.

The videos chosen as stimuli and the order they have been shown to participants could have influenced the results. Unlike other studies before this (Lykins et al., 2006; Velten et al., 2020), our stimuli did not contain any distractor. We presented participants with two erotic videos spaced out by one neutral and one sport video, each lasting three minutes. Previous studies cited above used erotic pictures first (Lykins et al., 2006) and 1-minute-videos depicting heterosexual couples engaging in vaginal intercourse or cunnilingus then (Velten et al., 2021). So, even though the increase in the sexual content exposure is an improvement from previous studies, in this study throughout the entire videos there was little opportunity for participants to look away from the sexual stimuli since these occupied almost the entire screen. Moreover, the order of the four videos was not randomized. Even though between each video there were 2-minutes of white screen

to relax and get the arousal back to its basic value, the emotional arousal from one video could have overlapped to the next one, resulting in high correlations between the Hetero Video and the Sport one.

Sexual orientation was not controlled for in the present analyses since limited variability was found. Giving the double nature of our erotic videos, controlling for sexual orientation could have given this study more opportunities to explore visual patterns and genital pain according to one's own preferences. In fact, the limited number of bisexual and bi-curious participants involved in this study reported the same level of sexual arousal in both the Hetero and the Lesbian video. Moreover, they also reported the same sexual arousal in the Hetero Video as hetero participants in the same category. This being said, it would have been interesting to know if any change in the sample's sexual orientation would have resulted into a different outcome, however controlling for sexual orientation was not the goal for the primary research that this study has been extracted from. In fact, as previously explained, this study is part of a bigger research which aim is to study sexual desire throughout two menstrual cycles, and for this the only criterion was to have menstrual cycles.

CONCLUSION

This study's goal was to investigate whether genital pain could have any influence on women's visual patterns when looking at videos depicting explicit sexual content. Studies in literature have suggested that women suffering from vulvo-vaginal pain have different visual patterns compared to women with no sexual complaints, displaying shorter time view when looking at erotic pictures (Lykins et al., 2006; Lykins et al., 2011; Velten et al., 2020). In contrast with these findings, the present study has not found such differences between the two groups of women. Despite the results, research in this field is much needed to understand the information processing mechanisms typical of women with genital pain to contribute with new hypothesis and potential treatments for vulvo-vaginal pain conditions.

As explained in Chapter One, vulvo-vaginal pain conditions encompass a range of disorders, including Vulvodynia, Provoked Vestibulodynia, and Dyspareunia, among others. Causes of genital pain are wide, namely, Vulvodynia has, by definition, no specific identifiable cause. Many biological variables have been suggested to cause these conditions, such as vestibular mucosa alterations and pelvic floor-muscle dysfunction to mention some (Corsini-Munt et al. 2017). But also, psychological factors such as sexual trauma and abuse during childhood have been associated with later development of genital painful chronic conditions. Among the consequences, higher levels of depression and anxiety, greater sexual dysfunction and sexual distress and higher avoidance of sexual activity as a result (Mashebet al., 2005; Arnold et al., 2006; Brauer et al., 2009). A circular pattern of fear and hypervigilance for painful sexual stimuli has been suggested to feed experience of pain during sexual activities contributing to lower levels of arousal and a

poor sexual life (Spano and Lamont, 1975; Brauer et al., 2006-2009; Payne et al., 2007; Janssen et al., 2010; Dewitte et al., 2011).

Fear of pain and other negative emotions associated to sexual stimuli could contribute to divert the person's attention from sexual cues to any distracting stimulus resulting in decreased sexual arousal and inhibition of the sexual response. So, the Information-processing Model of Sexual Arousal (Chapter 1, Figure 1) highlights the importance of understanding how attention is allocated to sexual stimuli. Therefore, a decade ago a line of research has started investigating whether women's visual patterns during the vision of erotic pictures or videos differ depending on whether they were suffering from vulvo-vaginal pain or not. Up to date two authors have compared overt visual attention allocation of women with and without genital pain finding consistent difference between the two samples of women. In fact, as explained in both Chapter 1 and 2, Lykins (2011) and Velten (2020-2021) converge into suggesting that women with vulvo-vaginal pain have shorter fixations and look at genital areas in erotic pictures or erotic videos for a shorter time compared to healthy women with no vulvo-vaginal pain.

Nonetheless, much research is needed to better understand this phenomenon. For this reason, the present study aimed at investigating women visual patterns in relation to genital pain. In contrast with previous studies, we did not find significant differences in overt attention between women with genital pain and healthy women while watching pornography. This is not to say there isn't any at all. Some limitations to the current study, highlighted in Chapter 5, could have influenced the results. For instance, future research in this field could involve a larger number of non-heterosexual participants, include erotic videos with one distractor in it, control for the order of the presentation of the videos

opting for a randomised order and finally project a study design able to minimize the influence of the information given to participants about the study itself.

In conclusion, chronic vulvo-vaginal pain conditions, such those discussed here, have important implications in every women's life suffering from it. The uncertainty around the topic is a struggle they face from the moment the first signs and symptoms show up until probably ever. Thanks to recent therapies, sometimes symptoms can decrease and relieve the patient for a period of time, however, the experience of pain can leave these women with an every-day fear of a looming relapse which has great psychological consequences. Even though no significant results have been found in this study, I personally hope it could a step forward in this field, motivating more researchers into believing that more is needed.

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