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## Perception of human bodies and sexual characteristics: An ERP study

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**UNIVERSITÉ  
DE GENÈVE**

**FACULTÉ DE PSYCHOLOGIE  
ET DES SCIENCES DE L'ÉDUCATION**

# Perception of human bodies and sexual characteristics: An ERP study.

**MEMOIRE REALISE EN VUE DE L'OBTENTION DU**

**MASTER OF SCIENCE IN PSYCHOLOGY**

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## **Abstract**

ERPs were recorded to investigate the processing of the appraisal of conscious and unconscious affective stimuli as being sexual using a backward masking paradigm. Twenty heterosexual participants between 18 and 35 years old had to discriminate whether bodies were naked or dressed in a supraliminal presentation (260 ms) and in a subliminal presentation (16 ms). The results showed that during the supraliminal presentation and the subliminal presentation, the amplitude of the N190 component was significantly larger for the images of sexual characteristics versus dressed bodies over occipito-temporal electrodes. Through a segmentation procedure, a specific topographical microstate associated with the N190 component was found, though it didn't provide further information on the processing of sexual characteristics. The neural generators responsible for the processing of sexual characteristics were located at the occipito-temporal lobe as well as the amygdala. However, there were no significant differences between images of sexual characteristics of bodies and dressed bodies for the early visual P1 component over occipito-temporal electrodes.

## **1. Introduction**

The present study focused on the appraisal of human bodies as sexual stimuli in heterosexual individuals. More specifically, the neural processing of sexual characteristics, the affective condition, compared to dressed bodies as a neutral condition. It's still unclear which neural pathways are at play during the processing of visual sexual characteristics and their temporal disentanglement. The aim of the present research was to explore the cognitive evaluation of an image of a naked body as representing a sexual stimulus, while differentiating it from further processing that could possibly influence the neural response such as emotion, motivation, and physiological responses (Redouté, 2000). Thus, we investigated the very important starting point of the neural processing of sexual characteristics. In particular, we studied the conscious and unconscious processes involved in the neural processing of a sexual stimulus compared to a neutral stimulus. In the conscious condition, we investigated the neural processing of sexual characteristics and dressed bodies when they were presented above the threshold of perception (supraliminally). In a second condition, we studied the neural processing of the same images though their presentation was masked and too brief for the participants to be aware of their content (subliminally).

While there have been a limited amount of studies on bodies, these researches have been focused on the neurophysiological (Thierry et al., 2006; de Gelder et al., 2010; Taylor, Roberts, Downing & Thierry, 2010) and neuroanatomical evidence (Peelen & Downing,

2007; Taylor, Wiggett, & Downing, 2007) of neutral bodies. Even in the case of articles on viewing erotic stimulus, they've investigated the processing of sexually explicit videos (Redouté et al., 2000) or erotic photographs (Hamann, Ely, Hoffman, & Kilts, 2002; Schupp, Junghöfer, Weike, & Hamm, 2003). The present study on the temporal and spatial dynamics of viewing sexual characteristics research serves as a starting point on research about bodies as affective stimuli. Thus far, there haven't been neuroimaging studies on the processing of sexual characteristics compared to dressed bodies in neutral positions.

Since there is a lack of information on the processing of bodies as affective stimuli compared to neutral stimuli, research on the processing of emotional facial expressions will also be presented as further support for the foundation of the hypotheses of the present research. This parallel is logical considering faces and bodies signal the same type of information whether it's about identity, and more precisely the identification of other, or to facilitate social communication and interaction, or even to communicate one's emotional state. As well as analogous social cues, they also have comparable neuropsychological mechanisms (Minnebusch & Daum, 2009; de Gelder et al., 2010).

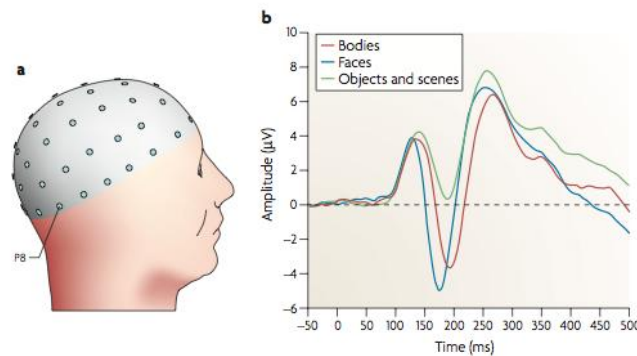
Before concentrating on the present research, fundamental concepts are going to be introduced in the present chapter. The following key concepts will be detailed: the neuroimaging evidence on the processing of bodies (Peelen & Downing, 2007; Minnebusch & Daum, 2009; de Gelder et al., 2010), as well as the differences between supraliminal and subliminal presentation methods, affective stimuli and the double visual pathways (Ledoux, 1995; Morris, Ohman, & Dolan, 1999; Pessoa, 2005), the biological perspective, bodies as sexual stimuli (Hamann et al., 2002; Schupp et al., 2003), a neurobehavioral model on sexual arousal (Redouté et al., 2000) and the state of the art concerning research on sexual characteristics (Redouté et al., 2000; Hamann et al., 2002; Schupp et al., 2003, Jiang et al., 2006).

## **1.2. Neuroimaging evidence on the processing of neutral bodies**

### **1.2.1. Neurophysiological evidence on the processing of neutral bodies**

Neurophysiological evidence has shown distinct temporal dynamics for the perception of bodies. Recently, studies have been conducted on images of human bodies compared to objects, trees, stick figures, and body parts that have shown that a negative evoked potential is greater for bodies than the other stimuli. This negative event related potential (ERP) has been shown to peak between 160 to 190 milliseconds post-stimulus onset (Thierry et al., 2006; Taylor et al., 2007; de Gelder et al., 2010). Thierry et al. (2006) named this negative

component over posterior electrodes the N190 (Figure 1 taken from Peelen & Downing, 2007).

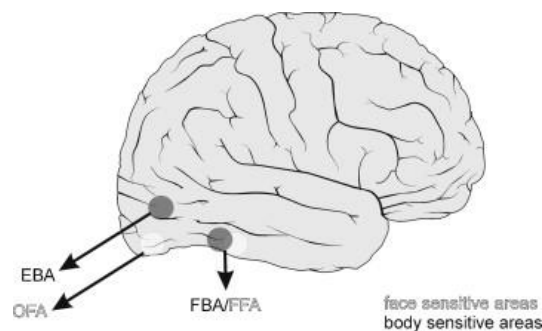


*Figure 1.* ERP illustration of the body selective N190 component.

Through a segmentation procedure, they also found that a specific ERP microstate (Thierry et al., 2006) corresponds to the body specific N190 that can be dissociated from the one they found for faces, which indicated that there are distinct topographical map distributions for bodies and faces. These findings are comparable to the discoveries on faces, where an enhanced negative face selective evoked potential that peaks at 170 milliseconds post stimulus onset is present over posterior electrodes when participants are shown faces compared to objects (Thierry et al., 2006).

### 1.2.2. Neuroanatomical evidence on the processing of neutral bodies

In addition to the specific cerebral temporal dynamics found for human bodies, there are extrastriate visual cortex areas in the occipito-temporal cortex responsible for human body perception: the extrastriate body area (EBA) and the fusiform body area (FBA). The EBA is located at the end of the inferior temporal sulcus and responds specifically to body parts, whereas the FBA, found in the lateral posterior fusiform gyrus, responds selectively to whole bodies (Figure 2 taken from Minnebusch & Daum, 2009; Peelen & Downing, 2007; Taylor et al., 2007).



*Figure 2.* Illustration of the body selective EBA and FBA.

These body selective areas are functionally similar and spatially close to the two face selective areas: the fusiform face area (FFA) located in the fusiform gyrus in the inferior temporal lobe, and the occipital face area (OFA) located in the inferior occipital area.

As well as neurophysiological and neuroanatomical evidence on the processing of neutral bodies and faces, there has also been neuroscientific evidence of a differential neural processing between affective stimuli and neutral stimuli. In addition to manipulating the affective aspect of the stimuli, these authors have also evaluated the effect of consciousness on affective processing through the presentation mode of the stimuli. (Redouté et al., 2000; Hamann et al., 2002; Schupp et al., 2003; Kiss & Eimer, 2008).

### **1.3. Supraliminal and subliminal processing of affective stimuli**

To study conscious and unconscious processes there are two different methods of exposure: a supraliminal presentation and a subliminal presentation. Through backward masking paradigm, Phillips et al. (2004) investigated the level of awareness necessary for above chance discrimination by varying stimulus onset asynchrony (SOA; 20, 30, 50, 90, 170, or 330 ms) of emotional facial expressions compared to neutral ones. The participants were first asked to discriminate whether emotional faces and neutral faces were presented, and then the confidence rating of their answer. The results showed that an SOA of 170 ms or above was necessary for both discrimination accuracy and confidence rating to be significantly above chance level and guessing.

Subliminal processing can be tested through such paradigms as masking paradigms (Morris et al., 1999; described in Pessoa, 2005) or interocular suppression (Jiang et al., 2006) or lesions studies on patients with cortical blindness (Pegna, Khateb, Layezras & Seghier, 2005). Cortical blindness occurs when the visual cortex (V1) is destroyed and patients have no conscious perception of any visual stimuli presented (Morris et al., 1999; Pegna et al. 2005).

#### **1.3.1. Supraliminal processing of affective stimuli**

Research has shown that the affective factor can also have an influence on the neural processing of bodies when presented supraliminally (Hamann et al., 2002; Schupp et al., 2003). According to a hypothesis based on an evolutionary perspective, affective stimuli such as images of food, sexual images or signals of threat are prioritized in their neural processing compared to neutral images such as pictures of objects or trees. This privileged processing occurs so that these stimuli capture our attention faster, which allows us to get away from

danger, or pursue opportunities for reproduction (Hamann et al., 2002; Schupp et al., 2003). The neural mechanism underlying emotional processes prominently recruits a specific brain region: the amygdala, which is located in the mesial temporal lobe. It has been shown that the amygdala is activated while subjects are presented emotional bodies (Hadjikhani & de Gelder, 2003 as cited in de Gelder et al., 2010) or erotic images (Hamann et al., 2002; Schupp et al., 2003). It is believed that the amygdala uses two parallel visual pathways during processing of affective stimuli: a cortical pathway and subcortical pathway (described in Ledoux, 1995; Morris et al., 1999; described in Pessoa, 2005). The cortical pathway is necessary during supraliminal presentations as it allows conscious perception, and it provides detailed information about the stimuli. This pathway projects from the retina to both lateral geniculate nucleus of the thalamus to V1 and then towards the amygdala (described in Pessoa, 2005). In contrast, the subcortical pathway can be activated during subliminal presentations and allows an appraisal of affective stimuli during unconscious perception (described in Ledoux, 1995; Morris et al., 1999; described in Pessoa, 2005). The subcortical pathway, also known as the quick and dirty pathway, involves the retina, the superior colliculus, the pulvinar and the amygdala (described in Pessoa, 2005). Using a backward masking paradigm, Morris et al. (1999) instructed participants to press a button when they detected emotional faces, and another button if they didn't detect any emotional faces. In the supraliminal condition, participants were able to detect accurately every emotional face presented; however in the subliminal condition, they did not detect any of the emotional faces. Through a neuroimaging technique (PET), the authors also showed evidence of both visual parallel pathways being involved in the processing of emotional faces compared to neutral faces. In the case of supraliminal presentations, specialized cortical areas such as the fusiform gyrus and the temporal pole were activated. However, in their subliminal processing, activation of the collico-pulvinar-amygdala pathway was present.

### **1.3.2 Subliminal processing of affective stimuli**

Lesion studies as well as studies using subliminal paradigms have shown that it isn't necessary to be aware of seeing an affective stimulus to process it in a privileged manner (Pegna et al., 2005; de Gelder & Hadjikhani, 2006; Kiss & Eimer, 2008). Through an fMRI study, Pegna et al. (2005) revealed that a patient with cortical blindness could still discriminate emotional facial expressions compared to neutral ones. As well as behaviorally being able to discriminate the affective compared to neutral expressions in a forced choice paradigm, the participant showed right amygdala activation during the presentation of the

emotional faces in the fMRI. The authors concluded that a neural processing of the emotional faces still occurred even though the participant could not consciously see the images. Similarly, de Gelder and Hadjikhani (2006) found comparable results in a patient with unilateral striate cortex damage. Behaviorally, the patient was able to discriminate above chance between emotional body images and neutral ones when the images were presented in his blind hemifield. During the presentation of the images in his blind hemifield, neural differences were found between emotional body images compared to neutral body images. They concluded that affective images can be processed without the usage of the primary visual cortex. This is another example of subliminal processing considering the patient wasn't aware of the content of the images he was viewing.

In non-patient participants, subliminal studies have shown comparable results. Instead of being blind, or having a blind spot, the images are presented for a very brief amount of time, followed by a mask in order for the participants to be unaware of seeing a particular image (Kiss & Eimer, 2008). In a backward masking paradigm, Kiss and Eimer (2008) instructed participants to discriminate between fearful faces and neutral faces. Behavioral results showed that participants were not able to discriminate accurately for the subliminal condition contrary to the supraliminal condition. They also showed through an ERP study, that in the absence of awareness, there was an enhancement of the neural processing for fearful faces compared to neutral facial expressions.

Diverse stimuli are used in neuroscientific research to assess affective processing. The present study focused on the perception of sexual characteristics of human bodies. Sexual characteristics distinguish the two sexes through physical characteristics such as external genitals (Richards & Hawley, 2010).

#### **1.4. Sexual characteristics**

In concordance with the evolutionary theory, there has been evidence of sexual stimuli being privileged to processing compared to neutral stimuli (Redouté et al., 2000, Hamann et al., 2002; Schupp et al., 2003). Various neuroimaging techniques (PET, fMRI, EGG) have been used to disentangle the temporal and spatial dynamics of the perception of sexual stimuli. Regarding temporal dynamics of sexual characteristics, Schupp, et al. (2003) found an early posterior negativity that facilitated the processing of affective stimuli, more specifically stimuli with evolutionary significance including erotic images. As for the spatial dynamics, thus far it has been found that the cerebral areas involved in the processing of erotic images are the hypothalamus, the hippocampus, the anterior cingulate gyrus, the insula

(Redouté et al., 2000), the amygdala, the frontal lobe, and the inferior temporal and occipital cortices (Redouté et al., 2000; Hamann, et al., 2002). Through a positron emission topography (PET) study, Hamann et al. (2002) showed that there is activation of the amygdala when evolutionary based stimuli are shown to healthy participants. This finding endorses the theory that the amygdala plays a major role in the neural processing of emotions. This structure in the brain has usually been found to be active for negative emotions such as fear but recent studies such as the one by Hamann et al. (2002) show that it can also play a role in positive emotions like the perception of sexual stimuli.

In order to disentangle the neural mechanics of sexual arousal, Redouté et al. (2000) proposed a four-component model on sexual arousal based on the processing of visual sexual stimuli.

#### **1.4.1 Neurobehavioral model of sexual arousal**

Through a PET study, Redouté et al. (2002) investigated the differences in regional cerebral blood flow (rCBF) of heterosexual men when viewing sexually explicit videos compared to humorous and neutral ones and non-arousing and arousing photographs of women. Along with the PET measurements, the authors collected information from sexual arousal markers such as perceived sexual arousal, penile tumescence and cardiovascular measurements. They analyzed contrasts between the various stimuli to identify the cerebral regions activated during sexual arousal as well as correlations between rCBF and sexual arousal markers. Based on these analyses, the authors organized their results in a proposed neurobehavioral model of sexual arousal. The neurobehavioral model of arousal is separated into four affiliated components: a cognitive component, an emotional component, a motivational component and finally, a physiological (autonomic and endocrinological) component. The perceptual-cognitive component covers the process of appraisal of the sexual stimuli and the subjective evaluation of it as sexual incentive. This neuroanatomically processed by the occipito-temporal lobe as well as the right orbito-frontal cortex. The emotional component comprises the pleasurable quality of sexual arousal and is activated by the primary somatosensory cortex. The motivational component involves the “processes that direct behavior to a sexual goal” activated by the left caudal anterior cingulate. Finally, the autonomic and endocrinological components include the physiological responses towards “the readiness for sexual behavior” which was activated in the rostral anterior cingulate gyrus, and the hypothalamus.

The perceptual cognitive component from the neurobehavioral model on sexual arousal (Redouté et al., 2000) overlaps with the present research as it's focused on the appraisal of a stimulus as being sexual. Thus far, there have been a few studies on the neural patterns that the viewing of sexual characteristics induces (Hamann et al., 2002; Schupp et al., 2003). However, they've all investigated the effects of erotic stimuli through supraliminal presentation. The only research that has explored the effects of a subliminal presentation of erotic stimuli was a behavioral study (Jiang et al., 2006).

#### **1.4.2. Subliminal sexual characteristics**

In 2006, Jiang, Costello, Fang, Huang and He investigated the effects of erotic images depicting men and women on spatial attention in a supraliminal condition and in a subliminal condition. Using an interocular suppression paradigm and a discrimination task, they evaluated whether sexual images presented subliminally influenced the performances in a Posner paradigm. In a first experiment, they tested whether subliminal erotic images influenced spatial attention of heterosexual men and women, and they evaluated if the attentional effect was modified by sexual orientation. In the second experiment, the participants consisted of gay men, lesbians, bisexual women as well as heterosexual women and men. After seeing the erotic stimuli, the participants had to discriminate whether a Gabor patch was tilted clockwise or counter-clockwise. Their accuracy in this task served as an evaluation as to whether the images influenced their spatial attention.

Jiang et al. (2006) concluded that spatial attention was influenced by the erotic images: heterosexual men were more accurate to discriminate the orientation of the Gabor patch when women were presented at that site, however they were less accurate when images of naked men were presented, heterosexual women and gay men were more accurate when naked men appeared at the site of the Gabor patch, lesbians and bisexual women had a similar performance as heterosexual women but to a lesser degree. The authors concluded that sexual orientation does affect spatial attention as heterosexual men were more attracted towards women and repelled by nude men whereas heterosexual women, gay men, lesbians and bisexual women's attention was attracted by nude men. Also in agreement with the evolutionary perspective, this study shows that during the subliminal presentation of erotic images a neural processing occurs that influences our behavior.

#### **1.5. Hypotheses**

While it has been established that sexual characteristics can influence our behavior whether we are aware or not of their presence (Jiang et al., 2006), the temporal and spatial

dynamics are still unclear. However, there has been neurophysiological evidence that face selective N170 can be modulated by an affective element over occipito-temporal electrodes (Kiss & Eimer, 2008). That is to say that the presentation of affective stimuli induced an enhanced ERP for the affective stimuli compared to neutral stimuli in a supraliminal condition as well as in a subliminal condition. However, there hasn't been evidence of the early visual component P1 being modulated by the affective component, or evidence of a specific microstate obtained through a segmentation procedure for emotional faces compared to neutral facial expressions. Through their EEG study, Esslen, Pascual-Marqui, Hell, Kochi, and Lehman (2004; cited by Williams, Palmer, Liddell, Song, & Gordon, 2006) have also estimated the amygdala's involvement in the processing of affective stimuli using a source localization procedure.

The present study aimed at disentangling the appraisal of bodies as sexual stimuli on a conscious and unconscious level. Based on Jiang et al. (2006), Kiss & Eimer (2008), and Esslen et al.'s (2004, as cited in Williams et al., 2006) findings, we hypothesized that an early visual response would be present over the body selective areas for conscious and unconscious stimuli. Operationally, this hypothesis would reflect an enhancement of the early negative component N190 over posterior electrodes for sexual characteristics of bodies versus dressed bodies in a supraliminal and in a subliminal presentation. In addition to the images of sexual characteristics versus dressed bodies inducing an enhancement of the body specific N190 component, the difference between sexual characteristics and dressed bodies would be less pronounced for the subliminal condition. Furthermore, it would also reflect the presence of a specific microstate map for the processing of sexual stimuli compared to the processing of dressed bodies. And finally, source localization analysis would show activation of the FBA, EBA and the amygdala for both conditions, with a stronger neural activation for the sexual characteristics.

## **2. Method**

### **2.1 Participants**

Twenty volunteers, 10 heterosexual men and 10 heterosexual women participated in this study. Mean age was 25.72 years ( $SD = 3.61$ ). All the participants were right handed and had either a normal or corrected-to-normal vision. They were compensated with 30 francs for their participation.

## 2.2 Experimental Design

As can be seen below in table 1, a 2x2x2 design was used for this experiment, meaning there were two presentation modes (supraliminal and subliminal), two types of stimuli (dressed and sexual characteristics), and the two genders (female and male). The table shows that there were 80 different stimuli presented to the participants and that there were an equal amount of stimuli for each condition.

---

Table 1

*Number of stimuli per condition*

		supraliminal	subliminal	Total
Male	Dressed	10	10	
	Sexual characteristics	10	10	40
Female	Dressed	10	10	
	Sexual Characteristics	10	10	40
Total		40	40	

---

## 2.3 Stimuli and Procedure

The stimuli, made with the program Quidam 3 (N-Sided, France), were grayscale sexual characteristics and dressed human bodies (male and female) with blurred faces on a gray background (RGB [146,146,146]). Photoshop CS3 (Adobe Systems Inc., San Jose, California) was used to blur the faces and to change the images to grayscale. The bodies had different skin colors, also distinguishable in grayscale pictures (white, black and mixed race) but they all had the same shape, height and body position (frontal view). They were made in five different body morphologies (small: 0.6, medium:0.7, large:0.8, and extra large: 0.9) which were determined by using the waist-to-hip ratio for women and the hip-to-shoulder ratio for men. Using the plug-in “scramble” on Photoshop CS3, eight masks were made out of eight different scrambled dressed bodies to keep as a neutral stimulation. The scramble filter was set at 20 x 20 pixels. Luminance of the stimuli was controlled with the program ImageJ (National Institutes of Health, United States).

The stimuli were presented either subliminally (16 ms) or supraliminally (260 ms) and followed by a mask for either 284 ms or 40 ms so that visual stimulation lasted a total of 300ms for each condition. Diode testing was used to make sure that the screen always

presented the image for no longer than 16 ms. All images (282 x 785 pixels) were shown on a Cathode Ray tube monitor, more specifically a 53 cm Hewlett Packard monitor, with the participants being at a 115 cm viewing distance. Every image subtended 5° x 13.7° of visual angle. E-prime software (Psychology Software Tools, Pittsburgh, PA) was used for the presentation of the stimuli and the recording of the behavioral data.

Before the task, the participants filled out a consent form and four questionnaires: personal information questionnaire, sexuality questionnaire, laterality questionnaire and a self made pornography questionnaire. The state questionnaire inquired on health aspects, for example how tired the participant was, if they had had enough sleep the night before or if they had any health issues. The 7-point Kinsey scale was used to assess the sexual orientation of the participants. This scale investigates the degree of heterosexuality or homosexuality, on a continuum, of a person. The Edinburgh Handedness Inventory determines the laterality of individuals, it inquires on which hand the participant uses for diverse tasks such as hand the participant uses to open a can or to draw (the possible answers are: always right hand, always left or no preference as to which hand is used). The self-made pornography questionnaire was used to establish to which degree the participants watched pornographic material using two multiple-choice questions: 1. Was there a period in your life where you consumed pornographic material? 2. During the last month how much pornographic materials have you consumed?

Afterwards, an explanation of how the experiment was going to take place was given and they were then instructed to stay still and not blink while the stimuli were on the screen. Once the instructions were over, the participant had a trial run of the behavioral aspect of the experiment to see if they understood the tasks.

In this experiment the participants were presented a total of 800 trials divided into ten blocks of 80 randomized stimuli (table 1). Each block lasted five minutes and consisted of ten different stimuli presented eight times each. For each trial, the participants were shown a fixation cross for a randomized duration of 1000 to 2000ms, which was then followed by the stimulus appearing for 16ms or 260 ms. After the body disappeared, the mask was presented for 284 ms or 40 ms depending on if the image was subliminal or supraliminal. The mask was then replaced by a gray screen lasting 1000ms so that the neural response to the stimuli wasn't influenced by the processing of the questions and motor output of the responses.

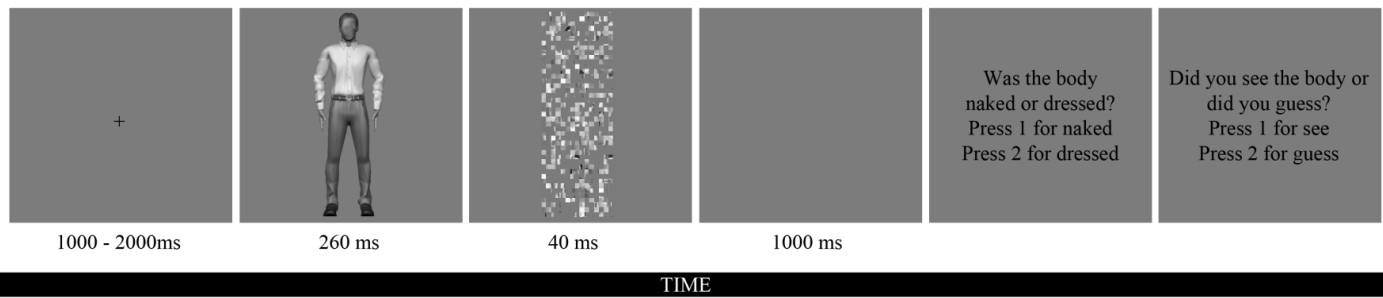


Figure 3. Schematic representation of the paradigm for the supraliminal condition.

Subsequently the participants had to say if the body was naked or dressed and then if they saw it or if they guessed on the first question. They recorded their answer on a keyboard by pressing then number “1” for naked or “2” for dressed for the first question and by pressing the number “1” if the participant guessed or “2” if they saw the stimuli for the second question (see Figure 3 and Figure 4). Once the participants answered these questions, the next trial would start.

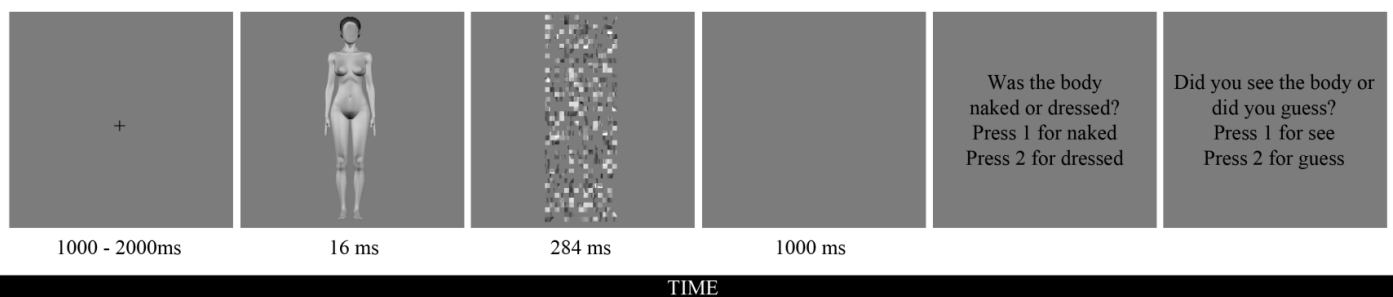


Figure 4. Schematic representation of the paradigm for the supraliminal condition.

## 2.4 EEG data acquisition and Analysis

Continuous EEG data was recorded using Biosemi (BioSemi B.V., Amsterdam, Netherlands) and the signals were sampled at 2048 Hz. The signals were recorded with 128 equally spaced scalp electrodes as well as five external electrodes placed on the participants’ face and earlobes; more specifically one on each outer canthi of the eyes, one on the right cheek and one on each earlobe. The electrodes were positioned according to the international 10-20 placement system. During the recording, two parieto-occipital references in the cap were used. The EEG was filtered offline with the high pass filter set at 0.09 and the low pass filter set at 50 Hz and then recalculated against the average reference. The threshold of the baseline correction was at 100 mV for all the electrodes. During the averaging procedure,

ocular artefacts, noise and epochs with any activity higher than 100 mV were manually rejected upon visual inspection. Twenty-eight percent of the epochs were rejected. Epochs lasted 1100 ms and started from 100 ms before the stimulus onset to 1000 ms after stimulus onset. Interpolation of some electrodes was necessary for some of the participants. The waveforms were averaged into four combinations of the presentation condition (supraliminal or subliminal) and the clothing condition (sexual characteristics or dressed): sexual characteristics and subliminal, sexual characteristics and supraliminal, dressed and subliminal, dressed and supraliminal. Only the opposite sex stimuli were taken into account when analyzing the conditions, that is to mean that for the women, only the men stimuli were analyzed and only the women stimuli were analyzed for the men.

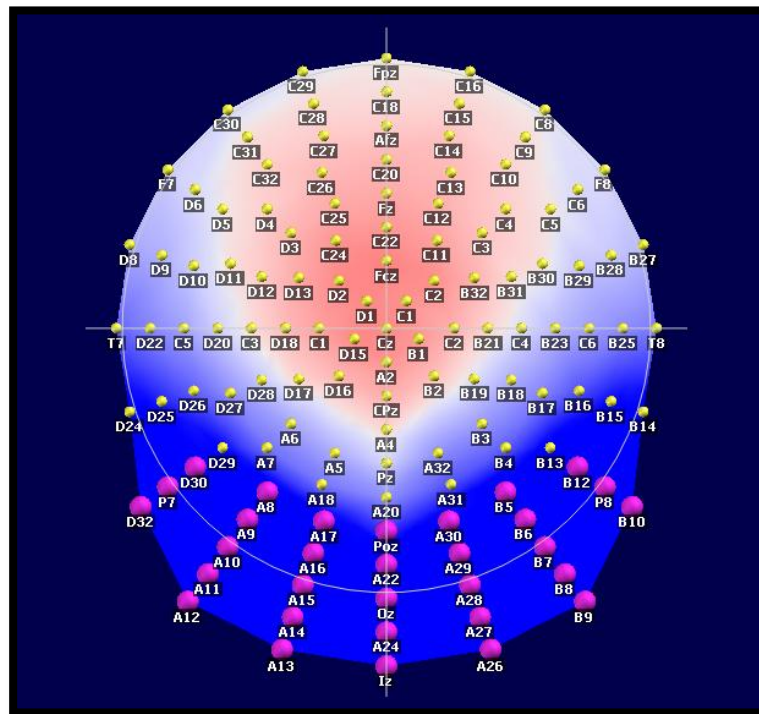


Figure 5. The seven regions of interest highlighted in pink.

Seven regions of interest (Figure 5) were defined through visual inspection of the ERPs showing a difference between the conditions: the central occipital region (electrodes: Poz, A22, Oz, A24, Iz), the middle occipital region of the right hemisphere (A26-A30), the middle occipital region of the left hemisphere (A13-17), the lateral occipital region of the right hemisphere (B5-B9), the lateral occipital region of the left hemisphere (A8-A12), the temporo-occipital region of the right hemisphere (B10, P8, B12) and the temporo-occipital region of the left hemisphere (D30, Pz, D32). The time windows selected for the early visual

components were based on visual inspection of the grand average of the ERPs.: P1 (80-125ms), N190 (134-177 ms).

Once the regions of interest and time windows were established, multiple repeated measures analysis of variance (ANOVA) were performed separately on the mean amplitudes of P1 and N190 as well as on the latencies using the conditions (4 levels: supraliminal and sexual characteristics, supraliminal and dressed, subliminal and dressed, subliminal and sexual characteristics) as factors, using Bonferroni corrections.

## **2.5 Segmentation**

For the microstate segmentation, all 4 conditions were analyzed using a topographic AAHC cluster analysis (Michel, Seeck, & Landis, 1999) to determine if there were topographical maps that remained stable during the different time windows for P1 and N1. For the subliminal condition, the topographical maps that correlated at 95% were merged together whereas the maps correlating at 92% were merged for the subliminal condition. Once combined, different map series were identified. The microstate model with the best balance of global explained variance (GEV), cross validation criterion (CV) and Krzanowski-Lai criterion (KL) was chosen for the subliminal and the supraliminal conditions. The most fitting microstate model for the supraliminal condition had a GEV of 95.8%, a CV criterion of 59.13 and a KL criterion of 18.82. As for the subliminal condition, the topographical model that best fit the data had a GEV of 94.4%, a CV criterion of 84.19, and a KL criterion of 1.86. To determine if differences between the segments of the conditions were present, a statistical analysis was performed. The microstate models were then fitted to each individual participant to establish how well their data was explained by a given microstate. Statistical comparisons of the conditions were subsequently performed to determine whether a clothing condition (sexual characteristics or dressed) had an enhanced neural processing over the other and whether the microstates identified for each component (P1 and N190) were present for all the participants for their respective time windows.

## **2.6 Source Localization**

Source localization was used to estimate the cerebral regions responsible for the activity during the presentation of the naked and dressed stimuli in the supraliminal and subliminal condition. To determine which generators of the electrical activity recorded were responsible, an inverse solution based on a Local Auto-Regressive Average (LAURA; b1,nh3,e3) was utilized (Grave de Peralta Menendez, Gonzalez Andino, Lantz, Michel, & Landis, 2001) and statistically tested.

### **3.Results**

#### **3.1 Behavioral Results**

The responses were 99% accurate for the supraliminal trials, and 59% accurate (for the subliminal trials (close to chance level – 50%). To obtain further information on the participants ability to discriminate whether the bodies were dressed or naked in the supraliminal and subliminal trials,  $d'$  values (Macmillan & Creelman, 1991) were calculated on the basis of correct and incorrect responses. A paired-samples t-test revealed that the mean  $d'$  for the supraliminal condition ( $3.17 \pm .90$ ) was significantly different ( $t(19) = 16.12, p < .001$ ) from the mean  $d'$  for the subliminal condition ( $.33 \pm .30$ ), thus indicating a significant attenuation of awareness in the subliminal condition.

#### **3.2 ERPs Results**

Both presentation conditions (supraliminal and subliminal) elicited a P1-N1-P2 complex. However, for the present study, the components of interest consist of P1 and N1. Tests of normality confirmed that the data was homogenous ( $p > .05$ ) for all the regions of interest for both components P1 and N1. On that basis, the repeated measures ANOVA was the statistical analysis of choice for the subsequent ERP results.

##### *P1: 80 ms – 125 ms after stimulus onset*

From a descriptive point of view, the ERPs in response to the presentation of naked and dressed bodies on the P1 component cannot be discriminated visually in the supraliminal condition (Figure 6) or in the subliminal condition (Figure 7 and Figure 8). The P1 component peaks at 100 ms post stimulus onset in the supraliminal condition while the peak is present at 103 ms post stimulus onset in the subliminal condition; both conditions have maximal cerebral activation over the lateral occipital electrodes of the right hemisphere.

A repeated measures ANOVA revealed that in fact there were no significant differences between naked and dressed stimuli for both the subliminal and the supraliminal condition for all the regions of interest (all  $p > .05$ ). That is to mean that there were no significant differences in the first component between the perception of sexual characteristics and dressed bodies regarding the latency and the amplitude for each condition in each region of interest.

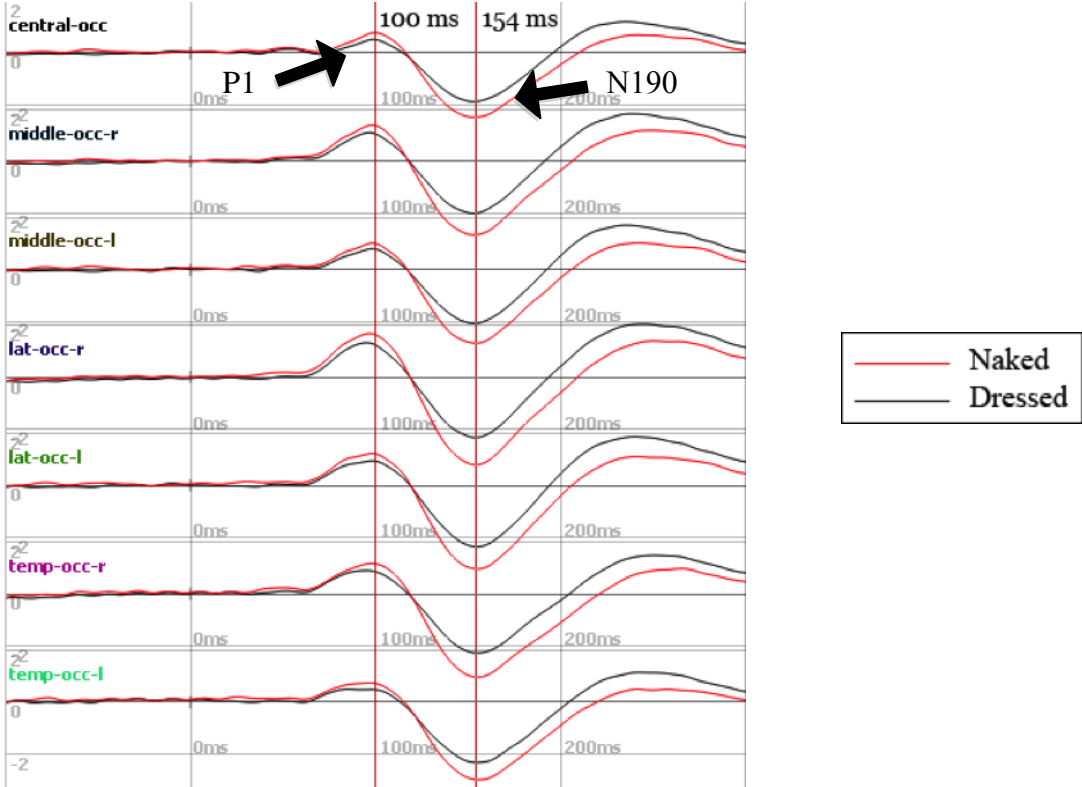


Figure 6. ERPs of the average of the regions of interest, for the supraliminal condition; illustrating the differences between the sexual characteristics (in red) and the dressed stimuli (black) for components P1 and N190.

*N190: 134 ms - 177 ms after stimulus onset*

For all regions of interest, Figure 6 shows a notable visual difference of the ERPs between the sexual characteristics and the dressed conditions for the early negative component N190 in the supraliminal condition. In contrast, there doesn't seem to be any difference between sexual characteristics and dressed stimuli in the subliminal condition for all the regions of interest (Figure 7). The peak for both the subliminal and supraliminal condition appeared to be 156ms for all regions of interest. However, the maximal neural activation occurred over the temporo-occipital electrodes of the right hemisphere for the supraliminal presentation and over the central occipital electrodes for the subliminal presentation.

All regions of interest showed a significantly enhanced N190 for the sexual characteristics stimuli compared to the dressed stimuli in the supraliminal condition. More specifically, the central occipital region ( $F(1,19) = 27.95, p < .001$ ), the left middle occipital region ( $F(1,19) = 42.912, p < .001$ ), the right middle occipital region ( $F(1,19) = 42.881, p < .001$ ), the left lateral occipital region ( $F(1,19) = 39.43, p < .001$ ), the right lateral occipital region ( $F(1,19) = 33.74, p < .001$ ), the left temporo-occipital region ( $F(1,19) = 21.698, p < .001$ ) and the right temporo-occipital region ( $F(1,19) = 17.11, p < .001$ ) showed a significant enhancement of negativity of N190 for the sexual characteristics as opposed to the dressed ones. While there were significant differences in amplitude for the supraliminal condition, a repeated measures ANOVA failed to show differences in latency between the sexual characteristics stimuli and the dressed stimuli indicating that there was a similar onset for the peaks of both stimuli ( $F < 1$ ).

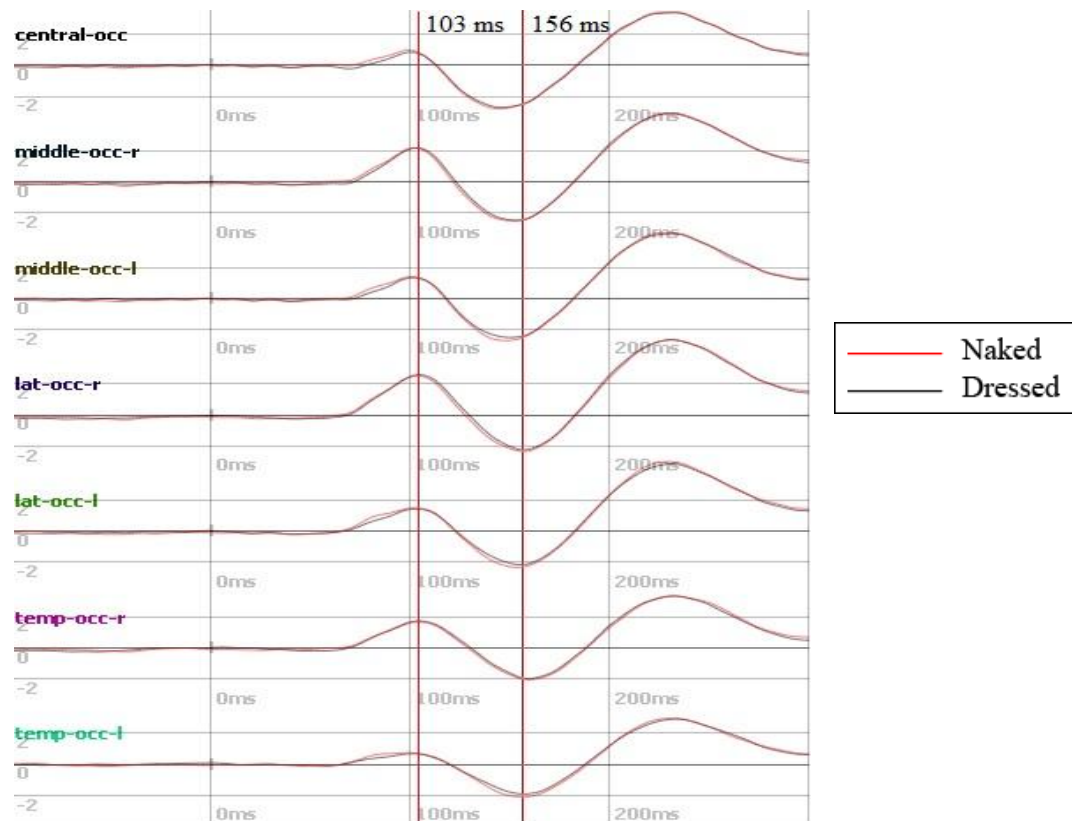


Figure 7. ERPs of the average of the seven regions of interest, for the subliminal condition, illustrating the differences between the sexual characteristics (in red) and the dressed stimuli (black) for components P1 and N190.

Concerning the subliminal trials, there weren't any significant differences in the neural response between sexual characteristics and dressed bodies for any of the regions of interest

for the peak analysis ( $p > .05$ ), and for the latency analysis ( $p > .05$ ). Further investigation showed that while taking all regions of interest at once failed to show any significant differences between the sexual characteristics and dressed conditions, several electrodes (A11-A15, Oz, A24-A27 and B8) in the occipital area did have a significantly greater negativity for sexual characteristics versus dressed bodies. Figure 5 shows the ERPs waveforms of some of the electrodes (A11-A15) with a peak at 150 ms.

Paired samples t-test revealed a significant enhancement of the N190 component for the sexual characteristics stimuli as opposed to the dressed stimuli for electrodes A11-A15, A23-A27 and B8 (respectively:  $t(19) = 2.81, 2.56, 3.33, 3.11, 2.94, 2.12, 3.27, 2.64, 2.29, 2.73, 2.15, p < .05$ )

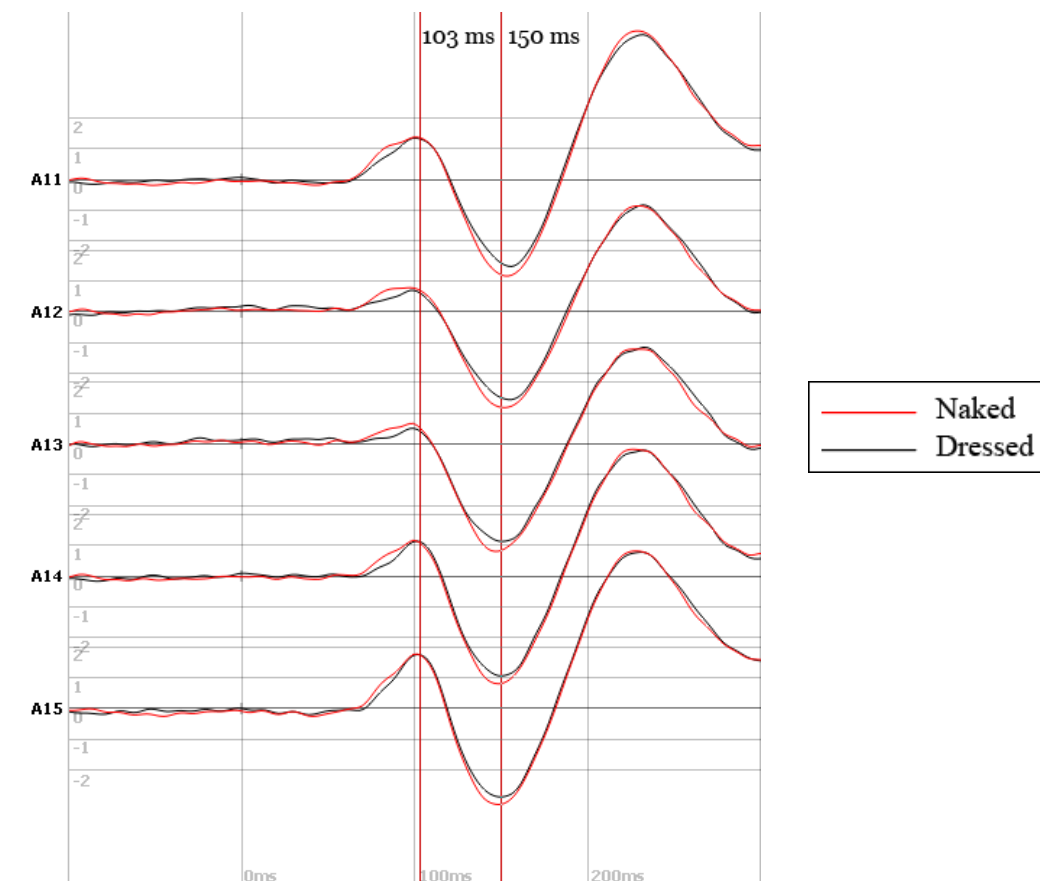


Figure 8. ERPs of electrodes A11 to A15, for the subliminal condition, illustrating the differences between the sexual characteristics (in red) and the dressed stimuli (black) for components P1 and N190.

### 3.3 Segmentation

The clustering analysis revealed multiple maps that best explained the grand average ERPs. For the supraliminal condition, 7 maps were identified whereas 6 maps were identified for the subliminal condition (respectively Figure 9 and Figure 10).

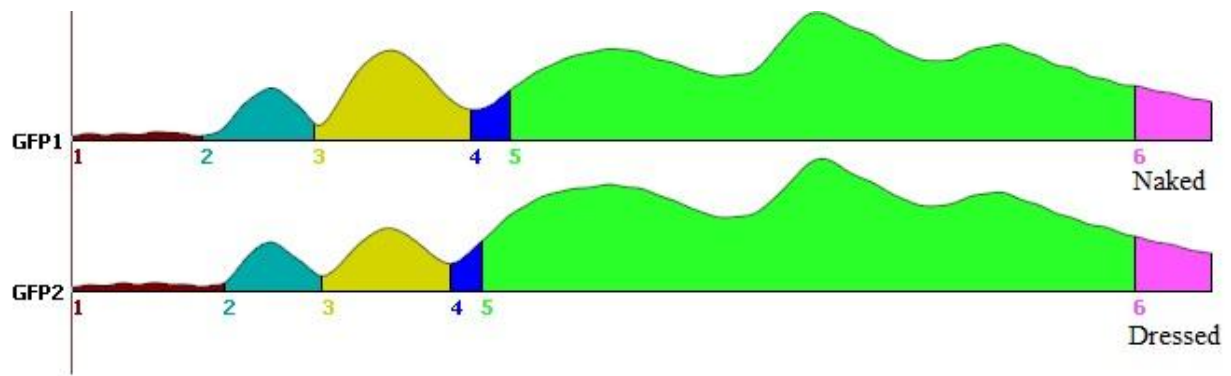


Figure 9. Microstate segmentation of the sexual characteristics (top) and dressed stimuli (bottom), resulting from the clustering analysis for the supraliminal condition. The colored areas represent the different maps for six components. P1 is in blue and represents map 2, and N190 is in yellow and represents map 3 in terms of global field power.

Regarding the supraliminal condition, the first meaningful functional microstate corresponding to component P1 (map 2) visible in both conditions appeared at 66 ms for the sexual characteristics stimuli and at 78 ms for the dressed stimuli. The microstate corresponding to N190 (map 3) appeared at 124 ms for the sexual characteristics stimuli and at 128 ms for the dressed stimuli. A repeated measures ANOVA failed to show any difference in global field power between the dressed condition versus the sexual characteristics condition for P1 ( $p > .05$ ). However, a significant enhanced global field power was present for the sexual characteristics condition versus dressed condition for the N190 component ( $F(1,19) = 36.12, p < .001$ ) indicating that the neural activation during the supraliminal trials was more intense for the sexual characteristics as opposed to the dressed bodies. Compared to other maps for both the sexual characteristics and the dressed conditions, the microstate map 3 was significantly more present than the other maps during N190 (for the sexual characteristics condition:  $F(1,19) = 115.16, 100.77, 55.64, 93.26, p < .001$ ; for the naked condition:  $F(1, 19) = 34.71, 31.97, 9.748, 22.34, 51.44; p < .01$ ).

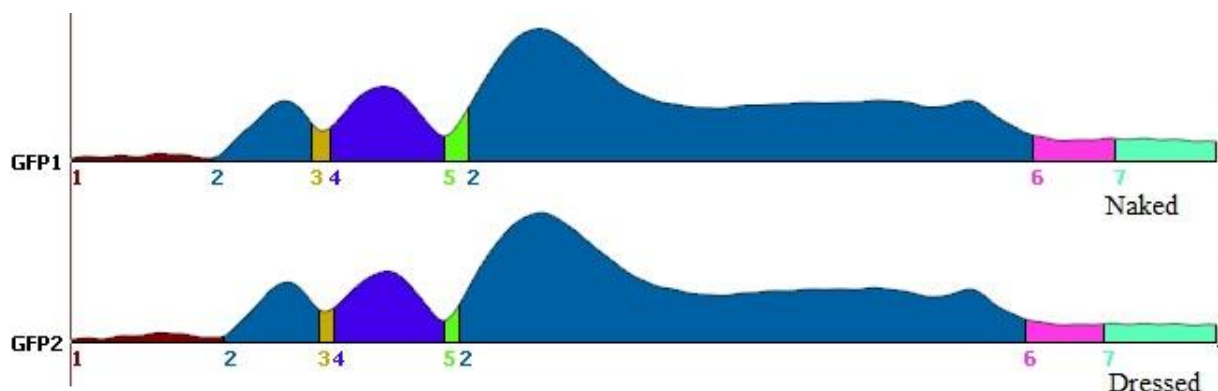
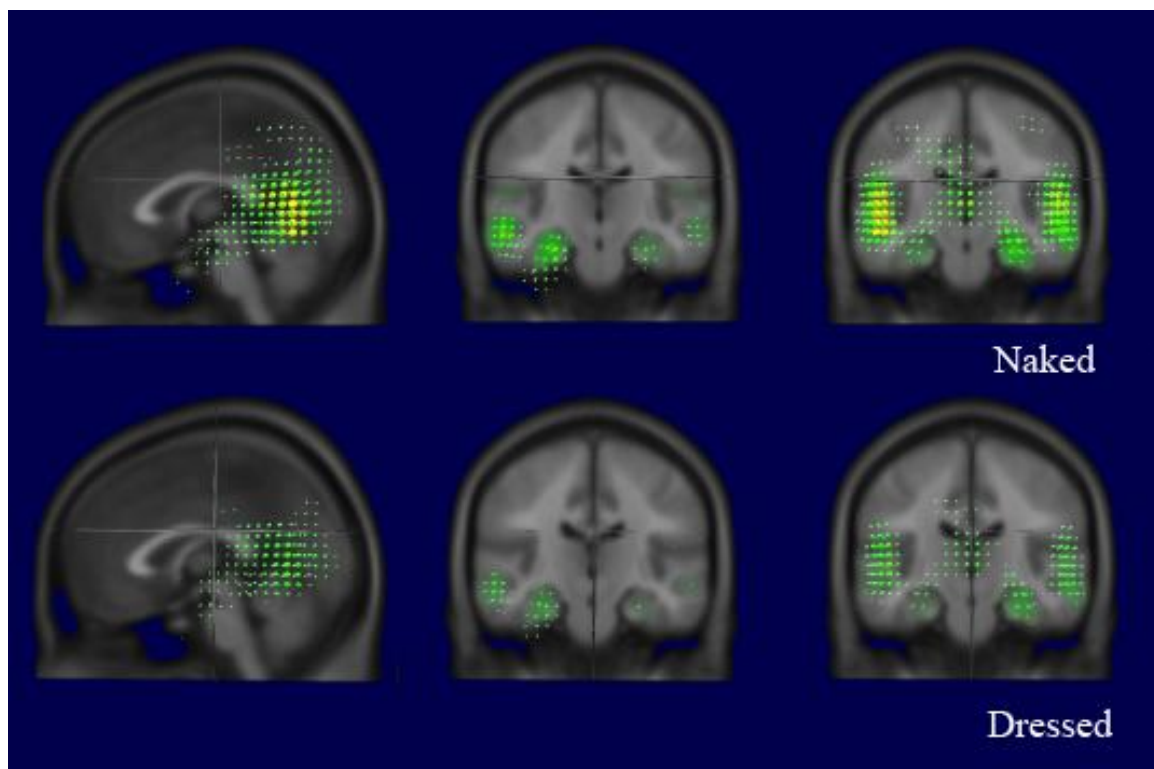


Figure 10. Microstate segmentation of the sexual characteristics (top) and dressed stimuli (bottom), resulting from the clustering analysis for the subliminal condition. The colored areas represent the different maps for seven components. P1 is in blue and represents map 2, and N190 is in purple and represents map 4 in terms of global field power

For the subliminal condition, a similar pattern emerged with a specific map for P1 (map 2) and N190 (map 4). Map 2 appearing at 72 ms for the sexual characteristics condition and at 78 ms for the dressed condition; Map 4 appearing at 132 ms for both conditions. A repeated measures ANOVA failed to show any significant difference of global field power between the sexual characteristics and dressed stimuli for both components ( $p > .05$ ) indicating a similar neural processing of sexual characteristics and dressed bodies for the subliminal condition. However, for both the dressed and the sexual characteristics conditions map 4 was significantly more present for the N190 component than any other map for that time period (for the dressed condition:  $F(1, 19) = 28.16, 53.54, 93.26, 48.23, p < .001$ ; for the sexual characteristics condition:  $F(1, 19) = 78.46, 22.02, 74.82, 52.47, 57.31, 80.88, p < .001$ ).

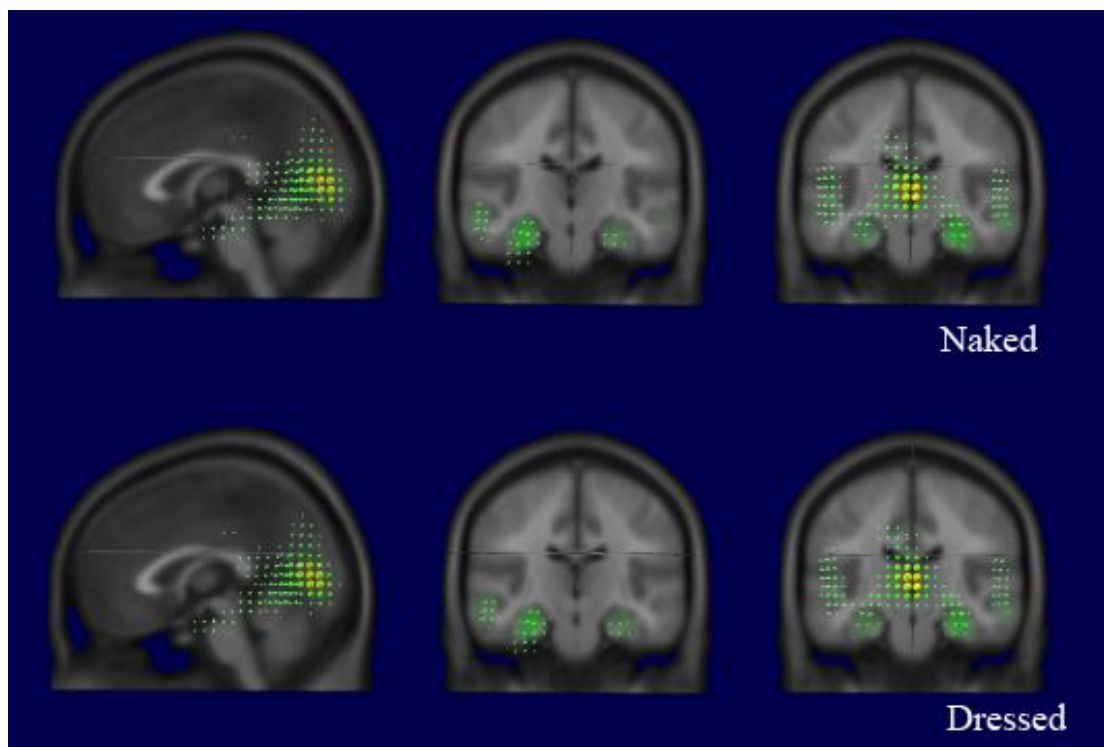
### 3.4 Source Localization

The localization of the electrical brain sources responsible for the neural activity during the presentation of the dressed and sexual characteristics stimuli were estimated using the LAURA source localization algorithm (Grave de Peralta Menendez et al., 2001).



*Figure 11.* LAURA source analysis for the supraliminal condition. The figure shows cerebral activity in the occipital and the temporal lobe the left hemisphere, frontal view and dorsal view of the brain for component N190.

The sources localized consisted of the bilateral occipital lobe, bilateral temporal lobe and right amygdala for both the supraliminal and subliminal conditions. For the supraliminal condition (Figure 11), a paired sample t-test showed that the neural activity of the sexual characteristics stimuli was significantly stronger than the neural activity for the dressed bodies for component N190 ( $p < .01$ ), however for P1 component no such difference was present. Concerning the subliminal condition (Figure 12), a paired sample t-test showed that there were no significant differences in the neural activity between sexual characteristics and dressed stimuli for P1 and N190 ( $p > .05$ ).



*Figure 12.* LAURA source analysis for the subliminal condition. The figure shows cerebral activity in the occipital and the temporal lobe for the left hemisphere, frontal view and dorsal view of the brain for component N1.

#### **4. Discussion**

We hypothesized that there is a difference in the neuronal processing of sexual characteristics of bodies compared to dressed bodies in a supraliminal condition, and in a subliminal condition. More specifically, through electroencephalography we investigated the difference in electrical brain activations of sexual characteristics in humans compared to dressed bodies stimuli for the P1 and the N190 components in a subliminal and a supraliminal condition.

The results provided new evidence about the temporal dynamics of sexual characteristics that weren't previously clear. They revealed that the images of sexual characteristics of bodies and dressed bodies elicited a difference in amplitude on the body specific N190 component, however they had similar time courses in terms of latency. The hypotheses that an enhancement of the early negative component N190 over occipito-temporal electrodes was present during the processing of images of sexual characteristics versus images of dressed bodies were confirmed for the supraliminal and for the subliminal conditions. That is to say, sexual characteristics are processed significantly differently than neutral stimuli in the supraliminal condition, and in the subliminal condition for the component N190. For the supraliminal condition, the stimuli were processed 154 milliseconds after stimulus onset and the stimuli of sexual characteristics had bigger amplitudes than dressed bodies, which corroborates previous findings that the N190 component peaks between 154 and 228 milliseconds after stimulus onset for bodies (de Gelder et al., 2006) and that pleasant images such as erotic stimuli have an enhanced processing for N190 versus neutral stimuli (Schupp et al., 2003). It has also been previously shown that bodies appear to have a specific microstate associated to the N190 component (Thierry et al., 2006). While there was a noticeable difference between the sexual characteristics and the dressed bodies in the segmentation, it hasn't provided further information about the processing of sexual characteristics. The source localization analysis further supported that the cerebral activation during the presentation of sexual stimuli is different compared to neutral bodies in the bilateral occipital lobe, bilateral temporal lobe as well as the amygdala (Hamann et al., 2002). However, the amygdala's involvement can only be estimated. This structure is electrically closed which makes it unattainable to ERP measures (Kiss & Eimer, 2008) and therefore the mathematical algorithm computing the generators (LAURA) of this recorded electrical activity is only an estimation.

Up until now, there has only been one research having investigated the influence of invisible erotic images on behavior (Jiang et al., 2006). The present study showed that subliminal sexual characteristics also influence the neural processing of bodies. Similarly to the supraliminal condition, there were differences in amplitude between naked and dressed bodies as well as no differences in latency in the subliminal condition. The stimuli were processed 150 milliseconds after stimulus onset and the naked bodies had bigger amplitudes than dressed bodies. Taking into account the seven regions of interest didn't reveal a significant difference between the sexual stimuli and the neutral stimuli, however once posterior electrodes were analyzed separately, a significant difference between sexual

characteristics and dressed bodies emerged on eleven posterior electrodes. The seven regions of interest, comprising nineteen posterior electrodes had canceled out the effect. Though the N190 component microstate specific to bodies' time window was once again present, there weren't any significant differences between sexual characteristics of bodies and dressed bodies microstates. Source localization revealed cerebral activations located in the bilateral occipital, and bilateral temporal lobe similar to the supraliminal presentation, however there weren't any significant differences in intensity of activations between sexual characteristics and dressed stimuli.

As for the P1 component, the ERP peaked at 100 ms post stimulus onset in the supraliminal condition while the peak is present at 103 ms post stimulus onset in the subliminal condition over occipito-temporal electrodes for both sexual characteristics and dressed bodies. Our results revealed that there were no significant differences in terms of amplitude, latency, segmentation and source localization between naked and dressed for the P1 component in either presentation conditions which is in line with previous research (Schupp et al., 2003; Kiss & Eimer, 2008).

While the results on the P1 component were not significant, our results concerning the N190 component corroborates earlier researches that there is a differential processing of sexual characteristic compared to neutral stimuli during awareness (Hamman et al, 2002). It also provides new evidence for the perceptual-cognitive component of the neurobehavioral model of sexual arousal (Redouté et al., 2000). While Redouté et al. (2000) looked for differences in regional cerebral activation between sexually explicit videos versus humorous and neutral ones, as well as arousing photographs of females, the present research provides evidence of differences between sexual characteristics and dressed bodies using simple images of bodies.

The findings on the N190 component are also in accordance with the ecological perspective (Hamann et al., 2002) which theorizes that biologically relevant stimuli capture attention which in turn prioritizes their processing without perceptual awareness being necessary for these stimuli to have an influence on behavior. Jiang et al. (2006) have shown the influence of sexual stimuli on behavior and the present study has explored the underlying neural mechanisms of perception of sexual characteristics. While the amygdala's involvement can only be indirectly estimated, this could be further proof that significant affective stimuli use the automatic "low road pathway" (Liddell, Williams, Rathjen, Shevrin & Gordon, 2004) even in the case of positive emotions. Though the source localization analysis showed no significant differences between the processing of sexual characteristics and neutral stimuli in

the subliminal condition, we estimate that the processing of sexual characteristics must have still relied on the amygdala to some degree as Aubert (2011) found that the subcortical structures dependent on automatic processing of sexual characteristics, presented subliminally, was attenuated in lesioned patients compared to healthy control subjects. No significant difference was found between the processing of affective stimuli compared to the neutral stimuli in the subliminal condition.

It could be construed as a limitation that the stimuli used in this research weren't more ecological like photos of real bodies or videos. Though, the trouble with using photographs of bodies was that it would have been difficult to control for the differences in physical attributes between bodies. Before going further with such stimuli, we wanted to show a difference of neural processing with images of sexual characteristics and dressed bodies. Concerning actual limitations of the present study, the results to the pornography questionnaire showed that only two people regularly watched pornography. There are a multitude of possibilities that could explain these results such as lack of sensibility of the self made questionnaire, social desirability or this group of participants just did not consume pornographic material regularly. Whatever the case may be the participant pool was uneven on that front, thus the control for viewing pornographic material did not provide further information on the possible influence of pornography on the perception of sexual characteristics.

This study will also provide information on the differences between women and men. Thus far, there has been a lack of research on the gender differences in regards to processing of sexual characteristics. These types of studies have been typically based on men as it has been shown that women react less to visual sexual stimuli than men (Redouté et al., 2000; Hamann et al., 2002).

In conclusion, this was the first study to show that sexual characteristics are processed more intensely compared to neutral stimuli by the same cerebral structures, independently of the presentation condition as it was shown by the significant differences in amplitude in ERPs as well as the source localization. We also provided electrophysiological evidence that sexual characteristics are processed without perceptual awareness present. The present study is an initial step in the right direction to help bridge the gap between previous researches on sexual stimuli (Redouté et al., 2000; Hamman et al, 2002) and the very beginning of stages of the perception of sexual characteristics as it provided evidence that sexual characteristics in neutral positions are processed consciously and unconsciously when compared to neutral stimuli. Furthermore, the present research can help towards disentangling the mechanisms involved in sexual arousal, and potentially help with sexual dysfunction.

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## Annex 1 – Consent form

Hôpital Cantonal

Clinique de Neurologie  
Unité de Neuropsychologie



### Consentement éclairé – patient/sujet volontaire

En signant cette formule, j'accepte de participer volontairement à l'étude appelée « Neuropsychologie des affects ». Les chercheurs m'ont expliqués oralement et par écrit les buts de cette expérience ainsi que son déroulement et j'ai été informé que je ne tirerai aucun bénéfice, avantage, ou inconvénient à participer à cette étude. Je sais également que je n'encours aucun risque particulier en effectuant cette étude.

J'ai lu et compris le dossier d'information au patient/sujet volontaire pour l'étude susnommée. J'ai reçu des réponses satisfaisantes aux questions concernant ma participation à cette étude. Je peux garder le dossier d'information au patient/ sujet volontaire et je reçois une copie de ma déclaration écrite de consentement.

J'ai eu suffisamment de temps pour réfléchir avant de prendre ma décision de participer à cette étude. J'accepte que les spécialistes responsables travaillant pour le promoteur de l'étude, les représentants des autorités et des commissions d'éthique aient un droit de regard sur les données originales me concernant pour procéder à des vérifications, ces informations restant toutefois strictement confidentielles.

Je consens à participer à l'étude de mon plein gré et peux m'en retirer de tout temps, avec ou sans motif, dans le cas d'un patient traité ; sans que cela ait des conséquences sur la qualité des soins qui me seront prodigués ou sur les rapports que j'aurais avec les médecins ou autres thérapeutes.

Je sais qu'une assurance couvre les dommages qui pourraient survenir dans le cadre de l'étude.

**Sujet :**

Nom et Prénom : .....  
Date et Lieu : .....  
Signature : .....

**Investigateur responsable :**

Nom et prénom : .....  
Date et Lieu : .....  
Signature : .....

## Annex 2 – Health Questionnaire

Hôpital Cantonal

Laboratoire Expérimental de Neuropsychologie (LenPsy)  
Département Neuropsychologie  
Service de Neurologie



### Etude EEG

Données personnelles: Questionnaire confidentiel pour la participation à l'étude

“ Neuropsychologie des affects ”

*Responsable de l'étude : Dr A.-J. Pegna (Tél: 022 372 83 53)*

### Questionnaire confidentiel (1/2)

Nom :

.....

Prénom :

.....

Sexe (M/F) : .....

.....

Date de naissance (J/M/A) : ..... / ..... /

.....

Date de l'expérimentation :

.....

Profession (si étudiant, précisez faculté et année) :

.....

Seriez-vous disposé à participer à une nouvelle expérience (oui/non) ?

.....

Nous vous remercions d'avoir accepté librement et de votre plein gré de participer à cette recherche. Nous voudrions vous rappeler i) que vos données personnelles (ce questionnaire et autres données y compris les enregistrements seront traitées en toute confidentialité ; que l'accès à ces données est placé sous la responsabilité du responsable et l'expérimentateur de la recherche et que celles-ci ne peuvent être divulguées à l'extérieur.

Les questions qui suivent nous aident à mieux établir l'influence de votre état actuel de santé sur le déroulement de l'expérience et les résultats :

## Questionnaire confidentiel (2/2)

1. Combien d'heures avez-vous dormi la nuit passée (à ½ heure près) ?

.....

La durée de votre sommeil a-t-elle été :

un peu trop courte	normale	plutôt longue

2. Heure du dernier repas : .....

3. Combien de tasse de café ou de thé avez-vous bu depuis ce matin ? .....

Par rapport a vos habitudes, cette consommation a été :

moins que d'habitude	normale	plus que d'habitude

4. Combien de cigarettes avez-vous fumé aujourd'hui ?

.....

Par rapport a vos habitudes, cette consommation a été :

moins que d'habitude	normale	plus que d'habitude

5. Souffrez-vous actuellement d'un problème de santé ? .....

Si oui, lequel ?

.....  
.....

6. Avez-vous déjà eu un problème neurologique ? .....

Si oui, lequel ?

.....  
.....

7. Votre acuité visuelle est-elle bonne ? Si corrigée, précisez .....

8. Avez-vous pris hier ou aujourd'hui des médicaments ou des drogues ?  
Si oui, lesquels

.....  
.....

9. Avez-vous consommé de l'alcool dans les dernières 24 heures ?

.....

10. Si oui, précisez l'heure :

.....

Pour les femmes,

10a. Dans quel période de votre cycle menstruel vous trouvez vous actuellement ?

.....

10b. Qu'elles en sont les influences (s'il y en a) sur votre état ?

.....

10c. Prenez-vous un contraceptif oral ?

.....

11. Indiquez ci-dessous les éventuels autres facteurs qui auraient pu influencer votre performance.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

Date et Signature sur Sujet (mention lue et approuvée).....

### Annex 3- Edinburgh Handedness Inventory

Nom.....  
Date de naissance.....

Prénom.....  
Sexe.....

#### **TEST DE LATERALITE** *(Edinburgh Handedness Inventory)*

Prière d'indiquer votre préférence manuelle pour chacune des activités ci-dessous en inscrivant un signe "+" dans la colonne appropriée.

Si la préférence est si forte que vous n'utilisez l'autre main que si vous y êtes absolument forcé, inscrivez "++".

Si vous utilisez l'une ou l'autre main indifféremment, inscrivez un "+" dans chaque colonne.

Essayez S.V.P. de répondre à toutes les questions

<i>No'</i>	<i>Activités</i>	<b>Main gauche</b>	<b>Main droite</b>
1	Ecrire		
2	Dessiner		
3	Coudre (main tenant l'aiguille)		
4	Tenir une paire de ciseaux		
5	Se brosser les dents		
6	Tenir un couteau		
7	Tenir une cuillère		
8	Tenir un balai (main supérieure)		
9	Allumer une allumette (main tenant l'allumette)		
10	Ouvrir une boîte (main tenant le couvercle)		
Total gauche =		Total droite =	
<i>QL</i> =		<i>Décile</i> =	

## Annex 4 - 7 point Kinsey Scale

### Sexual Orientation Q.

1. Think about your sexual feelings (the extent to which you are attracted to, and fantasize about, persons of the opposite or same sex). Would you say they are:

- Exclusively heterosexual.
- Predominantly heterosexual, only occasionally homosexual.
- Predominantly heterosexual, but more than occasionally homosexual.
- Equally heterosexual and homosexual (i.e. Bisexual).
- Predominantly homosexual, but more than occasionally heterosexual.
- Predominantly homosexual, but occasionally heterosexual.
- Exclusively homosexual.

2. Please indicate the number of OPPOSITE-SEX sexual partners you have had during your entire lifetime (“sexual contact” is taken to mean any activity which made you sexually excited and in which your genitals made contact with any part of the other person).

- 0 (none)
- 1
- 2
- 3 – 5
- 6 – 10
- 11 – 20
- 21 – 50
- over 50

3. Please indicate the number of SAME-SEX sexual partners you have had during your entire lifetime (“sexual contact” is taken to mean any activity which made you sexually excited and in which your genitals made contact with any part of the other person).

- 0 (none)
- 1
- 2
- 3 – 5
- 6 – 10
- 11 – 20
- 21 – 50
- over 50

4. Think about how you identify yourself. Would you say that you are:

- Heterosexual (Straight)
- Bisexual
- Homosexual (Gay/Lesbian)

## Annex 5 - Pornographic material Questionnaire

### Questionnaire CONFIDENTIEL matériel pornographique

1. étiez-vous un consommateur de matériel visuel pornographique régulièrement pendant une certaine période dans le passé?

non

oui

- Pendant : ..... années, il y a ..... années  
(p.e. pendant plus ou moins 3 ans, il y a 5 ans)

-  films       photos

2. Pendant le dernier mois vous avez consommé

pas de matériel visuel pornographique

matériel visuel pornographique

une fois/ mois

une fois par 2 semaines

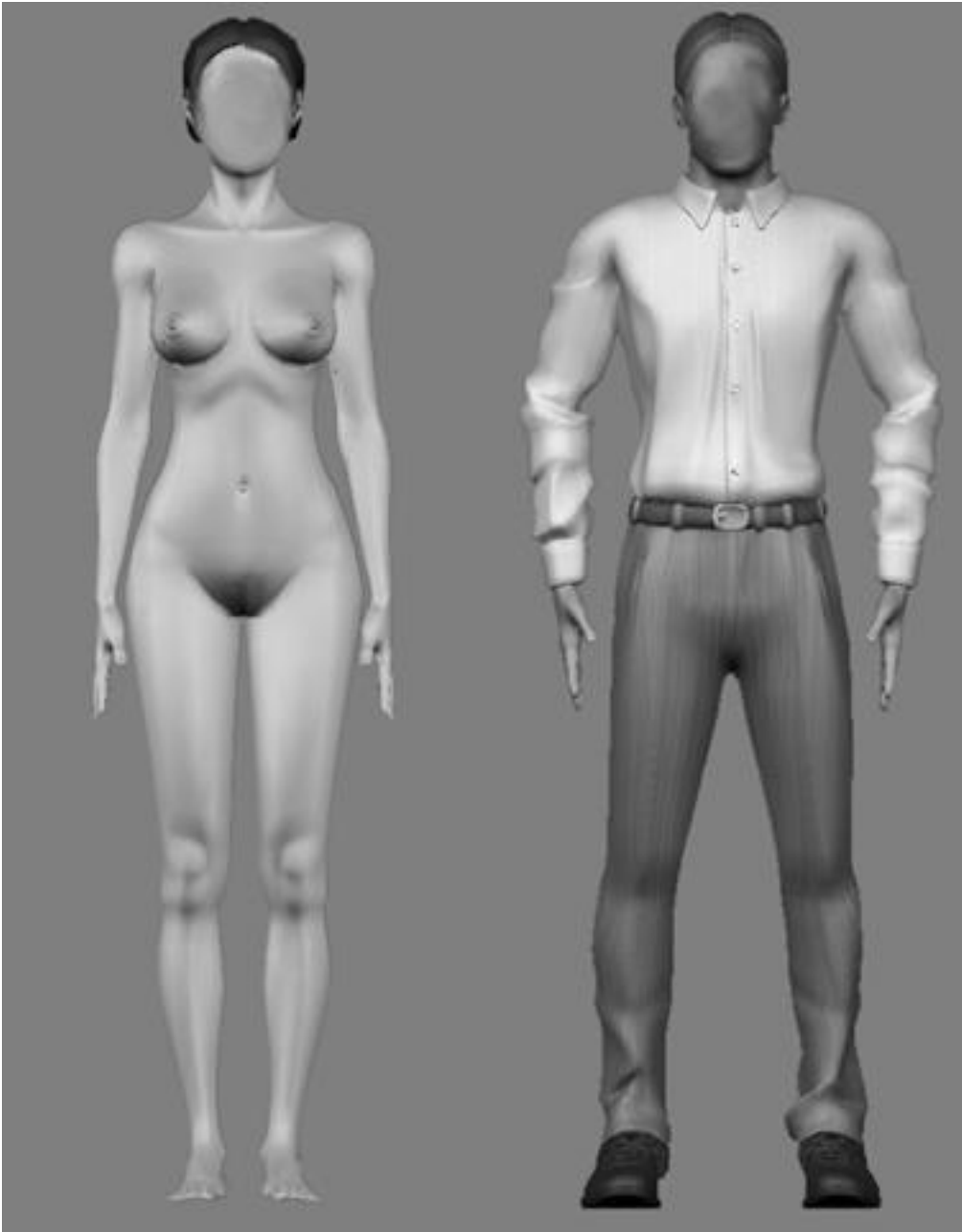
une fois chaque semaine

plusieurs fois par semaine

une fois par jour

- de préférence :  films       photos

**Annex 6 – Sample images of the naked and dressed bodies**



**Annex 7- Sample images of 2 masks**

