UNIVERSITÀ
DI TRENTO

Department of Psychology and Cognitive Science

Doctoral School in Cognitive Science

XXXIV Cycle

(De-)mentalization and objectification processes towards minority groups: When the human-object divide fades.

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academic year 2020-2021

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Overview

While cutting-edge research has shown how – from a neural and cognitive point of view – human beings are perceived and elaborated differently from objects, in social psychology different studies demonstrated that this human-object divide fades in several circumstances. Research in social psychology is continuing to advance the knowledge on dehumanization and objectification phenomenon in which human beings are perceived and elaborated more similar to an object and less like a human being. Recently, this has been demonstrated quite literally directly comparing human stimuli with a mind and perceptually similar mindless objects (Vaes et al., 2019, 2020). Such direct comparisons allow us to demonstrate how the well-documented human-object divide tends to fade during dehumanization and objectification phenomena. Presenting five research studies, this thesis aims not only at proving how de-mentalized human stimuli are cognitively perceived as object-like (Chapter 2 and 3), but also at showing how these phenomena are influencing more subtle, un-controlled behaviour processes that impact human social interactions (Chapter 4).

Specifically, in Chapter 2, two similar EEG studies aimed at exploring the timeline of the mentalization process by adapting a paradigm in which the human-object divide is investigated. By manipulating both perceptual and contextual information, ingroup and outgroup human faces together with their identity-matched doll-like avatar faces were presented while registering participants' neural correlates. Thanks to the direct comparison between mindless and mindful targets our goal was to unravel the time course of mentalization and its underlying processes.

By adapting the same paradigm, in Chapter 3 we explored the process of sexual objectification and presented sexually objectified men and women with their gender-matched doll-like avatars. Our primary goal was to investigate how objectified men and women are perceptually and cognitive perceived by looking at a sample of gay men. By directly comparing mindless and mindful targets we wanted to understand whether sexual objectification might be target (i.e., always mainly directed towards women regardless of the perceivers sexual orientation) or agent specific (i.e., directed towards different targets depending on the perceivers sexual orientation). Moreover, we also wanted to explore what might drive heterosexual men and women and gay men to objectify others.

Finally, the purpose of Chapter 4 was to investigate an implicit and unconscious consequence of sexual objectification. By presenting objectified and non-objectified women expressing happiness and anger we measured participants' spontaneous mimicry responses. Our goal was to determine whether sexual objectification – a phenomenon in which women are considered as object-like – might influence such an uncontrolled and implicit human behaviour that affects normal social interactions.

Chapter 1

Theoretical Background

Humans are special. Their remarkable cognitive capacities have allowed them to invent the wheel, build the pyramids and land on the moon. Further, one of the most important capacities of humans is their ability to communicate and interact with others. Indeed, humans are social animals whose ability to request help, inform others of helpful solutions, and share attitudes is a way to enact in social bonding (Tomasello, 2008). However, social communication is grounded in human-human interactions. Indeed, our interactions with objects are usually clearly distinct from our interactions with humans. Human-object interactions are determined by their usefulness or appearance whereas human-human interactions are guided by our willingness to know and understand other people.

The human-object divide.

The differences between humans and objects are not only palpable through social interactions. From a cognitive and neural point of view, human beings seem to have a specific predisposition in perceiving and elaborating human compared to object stimuli with different brain areas and in different ways. This differentiation has been widely documented in the past literature. For example, Kanwisher et al. (1997) using functional magnetic resonance imaging (fMRI) suggested that a specific brain area might be specialized for the recognition of faces. Specifically, these authors manipulated faces presenting scrambled two-tone and full front-view faces compared to houses both in active and in passive viewing. Results indicated that only one specific region, the fusiform gyrus within the ventral temporal cortex, was selectively involved in the perception of faces. More recently, changes in this area have also been related to changes in contrast responses of face images (Avidan et al., 2002). Specifically, a gradual trend of increasing contrast invariance emerged moving from the primary visual cortex to the lateral occipital complex for both faces and objects. However, the trend for faces was greater indicating how this human-specific area is involved in inferring higher-order information when faces are presented.

Nevertheless, this face-specific brain area has been found to be supported by a complex and highly distributed neural system with which individuals are able to identify a person (e.g., gender, ethnicity, age and eventually the person's name, Haxby & Gobbini, 2011). The distinction and specificity of these brain areas has been extensively demonstrated in the past literature (Gauthier et al., 2000; Puce et al., 1998; Vuilleumier et al., 2001), and has also been used to better understand and investigate disorders such as developmental disorders (Hadjikhani et al., 2007; Schultz et al., 2000; see Schultz, 2005 for a review) or neuropsychological disorders (Zhao et al., 2018; see Avidan & Behrmann, 2009 for a review).

However, faces are not the only human stimuli in which the human brain seems to be specialized. Indeed, one of the basic mechanisms underlying all social interactions is the non-verbal communication, which consists in the transmission of messages or signals through body language that help people perceive and understand others. Non-verbal communications not only consist in facial expressions or eye movements, but also include body postures and gestures. Therefore, faces are not the only socially relevant cues, also bodies convey important social information. Human bodies compared to faces might be visually dissimilar, although they both provide cues to identity, emotion, intention, age and gender. Faces and bodies indeed tend to elicit similar physiological responses (Kret et al., 2013). By presenting fearful, happy and angry facial and bodily expressions authors have shown how bodily expressions of emotions are processed in a similar way as facial expressions, even if the presence of both adds up to the total perception of the emotion. For this reason, it comes as no surprise that studies have shown how body stimuli elicit similar cognitive and neural processes than face stimuli.

For example, the fusiform gyrus has been found to activate for bodies and faces in a similar way. By presenting images of faces, the human body without a face, outdoor scenes and handheld tools, it has been found an activation of the right ventral occipital region for faces, whilst bodies elicited an activation of the occipito-temporal region. These two brain areas, even with distinct peaks, were found to be spatially located in the same brain area. Importantly, both these areas were less active at the presentation of objects and scenes demonstrating a selectivity in the human brain for just human stimuli (Peelen & Downing, 2005).

Not only fMRI studies have been suggesting that human and object stimuli are perceived and elaborated separately. In fact, cognitive and ERP paradigms have relied on the well-known face inversion effect to demonstrate the unique processes underlying the elaboration of human vs object stimuli. This mechanism has its roots in visual perceptual mechanisms. When considering a stimulus people tend to process it either as a holistic entity, by using configural processes that involve perceiving spatial relations among the features of the stimulus, or as an assemblage of parts, that are processed analytically. The face inversion effect is a face-sensitive perceptual mechanism in which upright faces are properly recognized compared to the same face that is presented upside-down. Since this effect is much smaller for non-face, object stimuli, the inversion effect has been called face-specific or more in general human-specific, since it appears to selectively occur for both human faces and bodies (Reed et al., 2003). In addition, researchers have investigated the human neural correlates when human and object-stimuli are perceived and elaborated. For example, Bossi et al. (2020) analysed both the time and the frequency domain of participant's electrical activity while upright and inverted faces, bodies and houses appeared. The ERPs amplitude showed an increased N170 for inverted faces and bodies, but not for houses. On the other hand, spectral analysis indicated a decreased gamma-band synchronization over right occipital-temporal electrodes for inverted faces and an increased bilateral frontoparietal theta-band synchronization for inverted faces, upright bodies elicited instead an increased left occipito-temporal and right frontal theta-band synchronization. This study clearly enlightened that no activation and no power modulations were reported following the representation of objects.

This special differentiation between human and object stimuli is so ingrained in the human nature that clear cut functional differentiations are evident also in infants, both at a cognitive and neurological level. Looking at the structural encoding of body- and face-stimuli in 3-month-old infants, a similar decreased amplitude of the P400 for both faces and bodies has shown infant's ability to recognize the configuration of both these human stimuli (Gliga & Dehaene-Lambertz, 2005). Moreover, when presenting both objects and multiple faces to 6-month-old infants directed their first saccade toward faces more than toward objects (Gliga et al., 2009). By presenting both upright and inverted faces together with the presentation of multiple objects, an attention-grabbing effect of faces clearly emerged, where objects were fixated and attracted less attention than faces. More recently, upright and inverted faces and cars have been presented to 3-month-old infants showing a larger N290 to inverted faces, but not to inverted cars (Peykarjou & Hoehl, 2013).

These studies are able to highlight a different neural and cognitive encoding of us humans in elaborating and distinguishing human- from object-stimuli, and to reveal the deep-seated ability of human beings to process and elaborate human stimuli, such as faces and bodies, in a different and special way compared to objects.

The human-object divide in social psychology.

All these studies have allowed us to safely assume how human stimuli are special, and are processed and elaborated differently from object stimuli. Further, social cognition already showed how humans differed from objects in many aspects: people are intentional agents while objects are not, people are able to perceive others, themselves and to change these perceptions over time, while objects do not perceive and their perception typically remains more stable over time. For people traits are vital and fundamental to them, while object traits are less crucial. People are complex beings while objects are not (Fiske & Taylor, 2013).

Notwithstanding, human beings can still be compared to and seen as objects, and this has extensively been demonstrated in an ever-growing body of work that aimed to show the tendency of human beings to perceive others as object-like. A first relevant line of research has demonstrated how being human is not a given when perceiving other human beings. The human category is not indeed an absolute, but something that is granted or denied (in degrees) to others. The idea that we can perceive others as less than human is the basic principle of research on dehumanization. Literally a dehumanized person or group is perceived as lacking humanness (see Haslam, 2006; Haslam & Loughnan, 2014; Leyens et al., 2007 for a review). To date, many studies have shown the consequences of the denial of humanity to others (Haslam et al., 2005; Paladino et al., 2002), the groups that are affected by this refusal (Leyens et al., 2001, 2003, 2007), and the neural networks that are involved when perceiving others as less human (Harris & Fiske, 2006). Leyens et al. (2001) were the first ones to show how both positive and negative secondary emotions, that constitute uniquely human characteristics are attributed less to outgroup compared to ingroup members. Focusing on the attribution of personality characteristics rather than emotions, a similar attribution study tried to verify how human traits might be assigned differently to the self, compared to others (Haslam et al., 2005). Again, results demonstrated how people perceived themselves as more human than others, denying others humanity traits. By verifying this new framework from an implicit point of view, Paladino et al. (2002), in four different studies in which the Implicit Association Test (IAT, Greenwald et al., 1998) was presented, confirmed how human characteristics were more easily associated to ingroup members and outgroup members with primary emotions, compared to the reverse combinations, indicating that some outgroup members are perceived as less human than the ingroup.

Similarly, a specific process in which people are directly perceived as object-like is the phenomenon of objectification. Broadly speaking, objectification regards the reduction of a someone to a something. This process has been shown in a variety of contexts ranging from the doctor-patient relationship (Timmermans & Almeling, 2009), to organizational settings (Baldissarri & Andrighetto, 2021), and sexual objectification (Fredrickson & Roberts, 1997). Focusing on the latter phenomenon, different studies have suggested that women when objectified are more likely perceived and evaluated as object-like or as less than fully human. Specifically, she is attributed less mind, less competence, less warmth and morality and a lower capacity to feel pain (Heflick et al., 2011; Loughnan et al., 2010; but see Gray et al., 2011). By using an implicit association test, Rudman and Mescher (2012) were able to confirm how women were more automatically associated not only with primitive constructs, but also with objects and tools. Similarly, both men and women were found to implicitly associate objectified women with less human concepts (Vaes et al., 2011).

A vast recent literature has tried to explore the process of objectification from a more cognitive and neural point of view. First, Cikara and colleagues (2011), measured the BOLD signal while pictures of sexualized and non-sexualized men and women were presented. Their results showed how only when participants saw sexualized women, hostile sexism correlated negatively with the activation of the mPFC and other brain areas related with mental state attributions. This study was one of the first in showing how cognitive brain areas that are usually elicited by human stimuli, are less activated and related with processes in which human beings are perceived as not fully human. In an attempt to demonstrate that sexually objectified women are elaborated similarly to objects, Bernard and colleagues (2012) adapted the body-inversion effect with sexualized male and female stimuli. Results showed how participants were better at recognizing inverted female compared to inverted male stimuli. As a consequence, inversion did not affect sexualized female stimuli, a finding that is typically reported for objects demonstrating how women were reduced to their sexualized body parts and elaborated as if they were objects.

All these studies unmasked the human-object divide – the idea that the human brain has a specificity in perceiving humans and objects differently – suggesting that in specific real-life situations human beings are denied humanness and sometimes even seen as object-like. In an attempt to show this phenomenon more directly, several studies have tried to compare human stimuli directly with object stimuli. Houses or shoes have been presented in contrast with human stimuli showing how similar processes that are engaged in the elaboration of objects were also used to process human stimuli (Bernard et al., 2018; Harris & Fiske, 2006). For example, Harris and Fiske (2006) presented pictures of different social groups in Study 1 and pictures of objects in Study 2, and asked participants to complete an affective assessment of each picture while blood-oxygen-level-dependent (BOLD) signal changes were recorded. Results demonstrated how strongly marginalized outgroups elicited an activation of the medial prefrontal cortex (mPFC) similar to the activation of objects, a brain area that has been related to social cognition and specifically to the formation of an impression of individuals rather than objects. Likewise inverted faces of dehumanized individuals (e.g., criminals) did not elicit the inversion effect demonstrating how human stimuli are elaborated as if they were objects (Fincher & Tetlock, 2016). Further, Cogoni et al. (2018) by adapting the inversion effect with sexualized and non-sexualized women together with houses and mannequins showed an inversion effect for non-sexualized women and mannequins but not for houses and sexualized women. Again, suggesting that objectified women were elaborated in a similar way as plain objects.

These previous studies have made important contributions in showing how people are not always predisposed to cognitively elaborate all human stimuli as actual human beings. Notwithstanding, their findings do not allow us to infer that these social stimuli actually become more similar to objects at a perceptual level. Indeed, previous research that directly compared human and object stimuli has shown that certain brain areas (e.g., Harris & Fiske, 2006) or cognitive processes (Bernard et al., 2018; Cogoni, Carnaghi, Mitrovic, et al., 2018) are similarly involved when elaborating both objects and dehumanized targets (e.g., outgroup members, objectified women). Such parallels, however, do not necessarily imply that these human targets are the same as objects or become similar. For one, because there is no perfect overlap between the type of process (e.g., absence or presence of the inversion effect) and the target (object vs. human, see for example Reed et al., 2003). For example, Cogoni and colleagues (2018) reported an inversion effect not only for the human stimuli, but also for mannequins, a human shaped, but object stimulus. Moreover, stimuli that are very different, like tasty food and illegal drugs, sometimes do activate the same brain regions, like the reward system (e.g., Volkow et al., 2011).

Only by comparing human and perceptually similar objects and measuring their level of similarity directly, can we verify if human stimuli literally become more object-like. To our knowledge, only a few studies have tried to directly assess the similarities between human stimuli that clearly have a mind and perceptually similar stimuli that are clearly mindless. In a first attempt, Vaes and colleagues (2019) presented human male and female stimuli together with doll-like avatars that were created on the basis of the original human stimuli. While controlling participants' neural activity, these authors demonstrated that objectified female stimuli were perceived as more similar to their doll-like avatar counterparts compared to all other human stimuli (i.e., both objectified and non-objectified men and non-objectified women). As such, objects were less noted when they were presented among objectified women, compared to when they were presented among objectified men directly suggesting that even at a perceptual level objectified women and objects are differentiated to a lesser extent. In a similar vein, Vaes and colleagues (2020) measured participants' hand movements while they categorized the same human and doll-like stimuli into "human" and "object" categories with the mouse of a computer. Results indicated that objectified women created a stronger categorization conflict compared to all other human stimuli. Especially the latter set of studies directly comparing human and object stimuli demonstrated that human stimuli, when objectified or dehumanized, are elaborated and perceived as more object-like.

Taken together, while a clear and well-studied difference between how humans and objects are elaborated in the human brain, there is growing evidence that this human-object divide tends to fade when human targets are dehumanized or objectified. Directly comparing human and object stimuli seems a promising avenue to study and further our understanding of processes of dehumanization. Therefore, the main aim of this dissertation is extending this methodology to the study of two specific forms of dehumanization in which the human-object divide might fade: the (de)mentalization process and sexual objectification. Even if these processes are similar in some ways, they evolved from dissimilar cultural and theoretical backgrounds. For this reason, we will introduce them more specifically in the two following subsections.

The (de-)mentalization process

The mentalization process is a complex cognitive phenomenon that happens when we perceive and attribute mental states to others. The capacity to reason about other minds is fundamental for understanding, predicting, anticipating another's behaviour and developing a social connection with others. This process is both central to phenomena such as anthropomorphism, where people treat non-human agents as humanlike (Epley et al., 2007), but is also fundamental to the inverse process of dehumanization, in which people treat human agents as non-human (Haslam, 2006; Leyens et al., 2003).

Most of the past literature on mentalization has focused on the understanding of the specific information that is needed when attributing or denying a mind to others. For example, (Looser & Wheatley, 2010), showed how the perception of life in a face occurs especially thanks to specific facial cues, such as the eyes. Also, Deska et al. (2018), underlined the importance of specific visual information that influences the perception of humanness of a face. They demonstrated that faces with greater facial width-to-height ratio were denied important cognitive and mental capacities and seen as less human than faces with a lower facial width-to-height ratio. However, not only visual information is important when inferring a mind behind a face. Indeed, similarly, other researchers showed how a target's social category and the perceiver's social identity might influence this complex phenomenon. Fincher et al. (2017) manipulated complex, contextual information, like the social class or stigma of the target face or the social identity of the perceiver. They were able to show that contextual information influences early perceptual processes involved in extracting a mind from a face. Similarly, Krumhuber et al. (2015) showed how the target's social group membership is an important element to take into consideration when studying the process of mentalization. Indeed, by adapting the same paradigm as Looser and Wheatley (2010), they found that ingroup faces were associated to a greater extent to human features, whereas faces of the outgroup needed to appear as more realistic in order to be categorized as human. Finally, also social identification was added as an important moderating variable when it comes to mentalizing or de-mentalizing ingroup and outgroup members (Hackel et al., 2014). These studies not only allowed us to identify the specific information that influences the perception of humanity of a social target, but also confirmed that the perception of humanity is deeply grounded in the social categorization of ingroup versus outgroup members.

When mentalizing or de-mentalizing others, one can think about a mind in terms of conscious experiences, such as the capacity to sense and feel, or in terms of intentional agency, the capacity to engage in reasoned activity (Gray et al., 2007). Similarly, a mind can be perceived as reflecting abilities central to our human nature, such as the capacity for emotional responsiveness, or our human uniqueness, like the capacity to be civil and rational (Haslam, 2006). These differences are central when interfacing with ingroup and outgroup members. Indeed, it has been widely shown how outgroup members are denied mental state traits and seen as less human overall compared to ingroup members. For example, secondary emotions, that are uniquely human characteristics, are especially attributed to the ingroup and denied to the outgroup (Leyens et al., 2000), while social groups perceived low in warmth and competence are processed differently, by eliciting a lesser activation of the mPFC compared to all other social groups (Harris & Fiske, 2007). Chas and colleagues (2018) showed how even primary and secondary school children reveal a tendency to humanize the ingroup and de-mentalize the outgroup. With a series of paper-pencil and indirect measures, these authors demonstrated that children had faster reaction times and favoured the association between ingroup names and human words and between outgroup names and animal words. This pattern has also been shown with 5- and 6-year-old children, who preferred and used mental state words more often in the description of their ingroup compared to the outgroup (McLoughlin & Over, 2017).

Consequentially, perceiving outgroup members as having less mental capacities seems to be a pervasive phenomenon that has been demonstrated and replicated using a variety of approaches. In the current thesis, we aim to test this tendency more directly by showing that people tend to perceive outgroup members as more similar to mindless objects compared to the ingroup adapting the EEG paradigm that was used in Vaes et al. (2019). Furthermore, this procedure allowed us to further understand the underlying processes of mentalization.

The process of sexual objectification.

Sexual objectification often implies a process of de-mentalization that tends to impact women more than men. When a woman is objectified, she is considered only for her appearance and bodily functions, often seen as an instrument without regard for her personality and dignity (Fredrickson & Roberts, 1997). Sexual objectification and its consequences have been studied intensively both from its clinical ramifications to the study of mind perception and its cognitive and neural underpinnings. One such important consequence that has been studied widely is the phenomenon of self-objectification. When a woman lives in a world where she is potentially objectified and treated as an object, she can start to feel and interiorize this depiction of herself. However, when this happens such self-perceptions come with clear costs. Self-objectification has shown to increase women's body shame (Miner-Rubino et al., 2002), sexual disfunctions (Calogero & Thompson, 2009) and decrease their well-being in general (Mercurio & Landry, 2008). This phenomenon has been also related to multiple mental health issues. For example, women who self-objectify more likely experience symptoms of depression and eating disorders (Calogero & Thompson, 2009; Fredrickson et al., 1998; Gay & Castano, 2010; Jones & Griffiths, 2015; Peat & Muehlenkamp, 2011; Quinn et al., 2006; Steer & Tiggemann, 2008; Tiggemann & Williams, 2012).

As described above, another consequence of sexual objectification is related to the denial of humanity and human characteristics. In particular, an objectified woman is attributed less competence, warmth and morality traits (Heflick et al., 2011), implicitly associated with less humanness, and attributed less moral status and denied personhood (Loughnan et al., 2010; Puvia & Vaes, 2013; Vaes et al., 2011). Moreover, when directly comparing human and object stimuli, objectified women were perceived and elaborated as more similar to objects compared to other human targets (e.g., Vaes et al., 2019).

Building on this previous research, in the current thesis we aim to adapt the paradigm of Vaes and colleagues (2019) to test whether gay men perceive objectified men or women more closely to objects. Indeed, the literature regarding sexual objectification has mostly focused on the heterosexual population. Studies that have tried to study sexual objectification from a gay perspective are limited. Indeed, most of the objectification research including gay populations has focused on gay men as the victims of this phenomenon, suggesting that they can become the target of sexual objectifying experiences much like heterosexual women (Davids et al., 2015; Lanzieri & Hildebrandt, 2016; Souleymanov et al., 2020; Watson & Dispenza, 2014; Wiseman & Moradi, 2010). However, gay men could also be the agent of sexual objectification. Gay men are more likely to objectify other men, when focusing on physical appearance (Anderson et al., 2018; Szymanski et al., 2019). Nonetheless, Kozak et al. (2009), by asking participants to complete a questionnaire exploring the degree to which they objectified themselves, other men and other women, showed how gay men objectify both men and women. Moreover, little is known about the reasons why gay men might objectify women. Namely, whether sexual objectification is mostly target specific, with gay men perceiving sexualized women as objects much like heterosexual men and women do, or is agent specific, with gay men mostly objectifying sexualized men in contrast to the heterosexual population. This difference will tell us more about the underlying mechanisms of sexual objectification per se, identifying also the motivations that drive gay men to objectify other men or women.

Consequences of perceiving others as object-like.

Both de-mentalizing and objectifying others have different negative consequences. Considering others without mental states and humanity might dimmish the tendency to respond to them prosocially. Indeed, when inferring secondary emotions to others, that are tacitly seen as more human, people respond more prosocially (Vaes et al., 2002). Whereas, when denying humanity participants were seen to be less likely to help others (Cuddy et al., 2007; Vaes et al., 2003). Reducing prosocial behaviours means the commission and the justification of antisocial acts. For example, perceiving enemies as less than human has been associated with support for torture (Viki et al., 2013). Moreover, perceiving criminals as less than human has also been associated with harsher sentences and punishment (Bastian et al., 2013; Viki et al., 2012). Therefore, in general, negating humanity and mental states to others might encourage active harm toward them or the denial of their human rights (Fiske et al., 2007).

However, specific negative behaviours and attitudes arise from sexual objectification. Indeed, Wright and Tokunaga (2016) demonstrated that the associations between men's exposure to objectifying media and attitudes supportive of violence against women were mediated by their thinking about women as a sexual object. Similarly, the presentation of objectified women increased the acceptance of rape myths (Burgess & Burpo, 2012) and their responsibility of being raped reducing the perception of objectified women's suffering (Loughnan et al., 2013). However, sexual objectification not only influences the way in which women are perceived and treated, they are often represented as such in the media (Fredrickson & Roberts, 1997; Goffman, 1979; Ward, 2016) and treated in objectifying ways in real life. Indeed, women reported to be victims of sexism and objectifying events more than men did (Swim et al., 2001). Specifically, recent studies showed that especially young women become victims of sexually objectifying behaviours once every 2 days (Holland et al., 2017; Koval et al., 2019).

All these studies have been fundamental in increasing the knowledge regarding the consequences of perceiving humans as object-like. Specifically, when considering sexual objectification, the literature investigating its consequences has focussed on more explicit behaviours related to sexual harassment and violence. Indeed, up until now only few studies focused on unconscious and automatic behaviour. Studying such behaviours might be especially interesting as they tend to be central in any social interaction and may indicate how people that are judged low in humanness are denied successful social interactions in general. Therefore, in the current thesis we will focus on one of these more subtle and ubiquitous consequences of sexual objectification, that is, the way people mimic the emotions of objectified and non-objectified women.

When the human-object divide fades.

When mentalization fails, others might be seen as less than fully human. Similarly, when objectified a woman is not completely seen as mindless, but she is perceived as having less mind and mental capacities than other human beings. Thus, when these processes occur, the human-object divide fades. For this reason, a direct comparison of the way human and object stimuli are elaborated might give us more and new information on what dehumanization means. Indeed, if the human brain has this specificity in elaborating human and objects separately, when they are perceived as similar might allow us to investigate this phenomenon more directly.

Up to now, researchers have tried to understand dehumanization, but only few studies have tried to directly compare human and perceptually similar object stimuli (Vaes et al., 2019, 2020). For this reason, the present dissertation has different aims. The first one is to understand how de-mentalization and objectification work when human and non-human stimuli are directly compared. Moreover, the use of electroencephalography (EEG) and other physiological measures should allow us to make a further step in the understanding of the specific processes underlying de-mentalization and objectification. Therefore, the first line of research of this thesis is divided into three similar EEG studies with a single goal: studying the de-mentalization and objectification processes in a more direct way unravelling its underlying processes.

In chapter two, two studies will be presented with the aim to explore the specific timeline of mentalization by manipulating both perceptual and contextual information when human and object stimuli are presented. Specifically, human faces and non-human, doll-like faces will be presented while manipulating their social categorization. This direct comparison will give us the chance to study the time course of mentalization when the perception of humans and objects overlap while also verifying the impact of perceptual and contextual processes during mentalization.

In the third chapter, the focus of this thesis will shift from mentalization to the process of sexual objectification. The main goal of the third research study will be to better understand the possible neural mechanisms underlying the process of objectification, specifically by taking the perspective of gay men as agents of sexual objectification. Indeed, by adopting the same paradigm in which human and object stimuli are presented together, the process of objectification will be studied. More specifically, images of objectified and non-objectified men and women will be present together with their doll-like avatar counterparts in a study in which participants' neural electroactivity is recorded. To better understand the perspective of gay men, in a second study the possible motivation of this process will be investigated. Indeed, on the one hand it might be possible that gay men, growing up with media that mainly objectifies and sexualizes the female body (Ward, 2016), interiorize this cultural lens that consequently increases their likelihood of objectifying women. On the other hand, if sexual objectification is driven by physical attraction, gay men might objectify men (Szymanski et al., 2019), much like heterosexual men have shown to objectify women (Vaes et al., 2011). In the second study, both these explanations for why gay men might dehumanize objectified women or men will be compared directly.

Finally, a specific and spontaneous consequence of sexual objectification will be investigated. In the fourth chapter, we will focus on what might happen at a behavioural and implicit level when the human-object divide fades. While different studies already demonstrated some of the more explicit responses when people interact with less than human others, very few have tried to verify whether our more unconscious behaviour might be influenced by one of these phenomena. For this reason, this chapter will investigate how sexual objectification might influence a behaviour that is fundamental in all our social interactions, namely automatic and spontaneous mimicry responses. Directly manipulating the emotional expressions of both objectified and non-objectified women, the unconscious and spontaneous mimicry behaviour of participants will be measured. This will tell us more regarding the fundamental empathic responses during interactions with objectified and non-objectified women who express different emotions.

Chapter 2

The timeline of mentalization: Distinguishing a two-phase process from mind detection to mind attribution [1]

Mentalization is the ability to perceive other people's mental states. Directly comparing the elaboration of human and object stimuli, this research aimed to deepen our understanding of the underlying mechanisms, while also exploring the timeline of the mentalization process. Two studies were conducted in which participants' electrophysiological activity was measured while elaborating Black and White (Study 1), or Italian (ingroup) and Romanian (outgroup), human and doll-like faces (Study 2). Moreover, in Study 2 the presented faces differed in their Facial Width-to-Height Ratio. Subsequently, an Implicit Mind Attribution Test (IMAT) measured the strength of the association of the same ingroup and outgroup human stimuli with mind and body-related words. Analysing when the first differences between the elaboration of human and object stimuli occurred allowed us to distinguish two phases in the timeline of the mentalization process. An early ERP component (N170) indicated a first difference between doll-like, mindless and human, mindful targets, while a later ERP component (P300) represented the second stage of mentalization. In this stage, outgroup doll-like faces were elaborated more similarly to the outgroup human faces compared to the same stimuli of the ingroup. Moreover, only a positive correlation between the P300 and the IMAT emerged indicating that the differences in this later ERP component were related with an implicit behavioural measure of mind attribution. These results stipulate the timeline of the mentalization process that is defined by an initial moment of mind detection, in which mindful and mindless stimuli are differentiated for the first time, and a second phase of mind attribution, where the interplay of perceptual and contextual information determine the extraction of a mind from a face.

[1] This chapter is largely based on the paper published in Neuropsychologia, and should be cited Ruzzante, D., & Vaes, J. (2021). The timeline of mentalization: Distinguishing a two-phase process from mind detection to mind attribution. Neuropsychologia, 160, 107983. https://doi.org/10.1016/j.neuropsychologia.2021.107983.

Introduction

Mentalization is a complex cognitive phenomenon that happens when we perceive and attribute mental states to others. Even though the process of mentalization has been studied extensively in recent years (e.g., Deska et al., 2018; Waytz et al., 2010), little is known about its underlying processes. Therefore, the aim of this research project was to identify the timeline of mentalization, namely the chronological sequence of processes that people engage in, in order to perceive and attribute mental states to others. Moreover, we specifically aimed at studying the mentalization process by manipulating both perceptual and visual information together with contextual, higher-order information. We manipulated both variables at the same time in a new paradigm that directly compares the elaboration of mindful, human and mindless object-like stimuli. Specifically, we envisioned a scenario in which the timeline of mentalization implies two different, but complementary steps. A mind detection phase in which mindful (human) and non-mindful (object) stimuli are simply distinguished from each other, and a second phase of mind attribution, where the degree of an entity's mental capacities is determined. While the first phase is expected to be mostly determined by visual cues, it forms the basis of the second phase where the extraction of a mind from a face is driven by the dynamical work of both perceptual and contextual information.

The human face and its expressions are the typical stimulus from which we infer other people's minds. Mentalization is a spontaneous process in which people engage with relative ease. Willis and Todorov (2006) demonstrated how quickly and with limited information humans can infer traits such as trustworthiness or competence from a face. By showing participants unfamiliar faces for 100-ms, 500-ms or 1000-ms they showed how judgments made at 100-ms highly correlated with judgments made in longer time windows or even in the absence of time constraints. The longer participants saw the faces, the more they were confident about their judgments, but their initial judgment did not really change. These results showed how quickly and with relative ease, people form impressions of others inferring complex mental capacities from limited information.

Mentalization refers to the ability to perceive and attribute mental states to others, such as thoughts, emotions, or experiences. With the aim to understand the underlying mechanisms of the mentalization process, past research has studied the impact of perceptual and contextual information. These two variables are known to be influential in the extraction of a mind from a face and in the recognition of the person in front of us. More specifically, bottom-up processes include the primary, sensory information of the stimulus where the recognition and interpretation of the stimulus do not depend on prior knowledge or past experiences (Gibson, 1972). Top-down processes instead refer to the use of contextual information in pattern recognition meaning that the stimulus is recognized and understood using higher cognitive information from prior experiences and stored knowledge (Gregory, 1970).

However, most research focused on only one type of information. Indeed, some researchers showed how mentalization seems to be mostly influenced by visual stimulus elements. Looser and Wheatley (2010), by presenting morphed faces on a continuum from animate (human) to inanimate (mannequin), discovered how human beings are highly sensitive to specific facial cues, especially the eyes, that bring them to perceive life in a face. These authors demonstrated that life from a face starts to be inferred at one exact location close to the human endpoint. Also, Deska et al. (2018), provided evidence that perceptual visual information such as the facial width-to-height ratio influences the perception of humanness. They demonstrated that faces with greater facial width-to-height ratio were denied important cognitive and mental capacities and seen as less human than faces with lower facial width-to-height ratio.

At the same time, other researchers showed how also contextual and higher-order information influences this complex phenomenon. Fincher et al. (2017) demonstrated that when interfacing with a face, people shift from configural to featural processes while they manipulated complex, contextual information, like the social class or stigma of the target face or the social identity of the perceiver. They coined this shift from configural to featural processes respectively humanizing and dehumanizing modes of perception and as such showed that contextual information influences early perceptual processes involved in extracting a mind from a face. More directly, Krumhuber et al. (2015) showed that the perception of life from a face is influenced by the target's social group membership. Adapting the same paradigm as Looser and Wheatley (2010), they found that human features were found to be assigned to a greater extent to ingroup faces, whereas faces of members of the outgroup had to appear more realistic in order to be perceived as human. Similar findings were reported by Hackel et al. (2014) who added social identification as an important moderating variable. Specifically, high identifiers had the highest threshold for perceiving minds behind outgroup relative to ingroup faces.

Notwithstanding the separate approaches that have been used in the past, mentalization might be thought as a process that can be influenced by both types of information, but in different points in time. Indeed, Hackel et al. (2014) already suggested to differentiate the process of mentalization into two phases. A first one where visual and sensory features form the basis of the second one, where higher-order judgment like social motives and group membership shape our capacity to attribute mental capacities to others. For this reason, we aimed to investigate the underlying processes of mentalization measuring the time course of this multifaceted phenomenon with a new implicit paradigm in which we directly compared human and object stimuli.

Indeed, to our knowledge, mentalization has been defined in terms of morality and competence (Krumhuber et al., 2010), in terms of the perceived life in pictorial stimuli (Looser & Wheately, 2010) and finally by the denial of relevant cognitive abilities (Deska, 2018). Instead, we specifically aimed at defining mentalization as composed of two complementary stages: the mind detection phase, mostly guided by primary, visual information, and the mind attribution phases, mostly driven by contextual and high-order information.

Further, this complex construct has mostly been studied by using explicit questions (e.g., To what extent this face has a mind) or by asking to evaluate faces on the basis of different judgments (e.g., capable to feel pain, to formulate a plan; Deska & Hugenberg, 2017; Hackel et al., 2014; Looser & Wheatley, 2010). While none of these past studies directly compared the way mindful, human and mindless, object stimuli are elaborated, few studies tried to use cognitive and indirect paradigms (e.g., the inversion paradigm; Hugenberg et al., 2016) and even fewer tried to investigate the mentalization process by using electroencephalography (EEG, but see Wheatley et al., 2011). This latter methodology and Event-Related Potentials (ERP) more specifically are interesting because they reflect the brain response that is the direct result of a specific sensory, cognitive, or motor event in real-time.

Therefore, we aimed to unravel the mechanisms underlying the mentalization process by investigating its timeline introducing a new paradigm analysing ERP data that allowed us not only to define mentalization in terms of different ERP components, but also to differentiate early from later ERP components. Indeed, early waves or components tend to depend on the physical parameters of the stimulus (Sur & Sinha, 2009) or to be a function of attentional processes directed towards the stimulus (Luck & Hillyard, 1994). Later components, instead, are usually influenced by the evaluation of the stimulus (Sur & Sinha, 2009) or are associated with operations in working-memory (Ito & Urland, 2003). However, diverging results emerged when early and later ERP components were investigated together with perceptual and contextual processes during the elaboration and the perception of faces or social stimuli in general. Ito and Urland (2003) showed how early attentional ERP components were influenced only by perceptual information of the stimulus itself, while later ERP processes were sensitive to more complex relationships between the target's group membership and the social context.

Wheatley et al. (2011) demonstrated that only human faces compared to doll faces and clocks showed sustained brain activity after 400ms after stimulus onset. These initial results seemed to suggest that early processes are employed by perceptual visual cues of faces, while later potentials are sensitive to the social meaning and salience of human faces. Nevertheless, a clear disassociation between early and later ERP components and the influence of visual and contextual information is not always confirmed in the literature. Indeed, Ratner and Amodio (2013) demonstrated how group membership and social identity – being part of an ingroup or outgroup created in a minimal group paradigm – influenced an early-stage ERP (i.e., N170) that is usually described as the earliest ERP component that reflects the perceptual processing of a face. Similarly, Derks et al. (2015), by measuring the implicit evaluation bias in the categorization of ingroup and outgroup members, discovered how social identity motives increased the different elaboration of ingroup compared to outgroup faces in the activity of the N200, an ERP component usually associated with selective attention. Taken together, these results seem to suggest that under certain conditions early ERP components can be influenced and biased by contextual and social variables.

For these reasons, we decided to not only use an unobtrusive, real-time measure of mentalization (ERP), but also an independent external criterium of mind attribution. This allowed us to look at the relation of various ERP components and an external, independent measure of mind attribution. Specifically, we created an adapted version of the Implicit Association Test (IAT, Greenwald et al., 1998) to measure how much mind people associated with the targets they were presented with. The IAT has been extensively used to measure people's implicit stereotypes towards a variety of targets learned over time, thus it is a measure determined by the complex relationship between perceptual and contextual processes. Therefore, we decided to relate EEG data with this external criterium to have a confirmative measure that allowed us to identify when differences in mind attribution in any of the ERP components becomes observable in an implicit behavioral measure.

The present research

Adopting a novel paradigm, the current research aimed to measure the time course of mentalization distinguishing two different but complementary stages: mind detection and mind attribution and verify the impact of perceptual and contextual information in each of these stages. Therefore, we adapted an EEG odd-ball paradigm where the frequent stimuli represented real ingroup and outgroup human faces that were infrequently interrupted by the appearance of their matched doll-like faces. This procedure allowed us to measure the extent to which perceptually similar faces were elaborated differently when they either had (real human faces) or did not have a mind (doll-like avatar faces). Then, we adapted an IAT (Greenwald et al., 1998) to create the Implicit Mind attribution Test (IMAT) measuring participants implicit associations with the same human faces and mind vs. body attributes. Correlating the early and later ERP components that distinguish between the perception of a mind to ingroup and outgroup targets with the IMAT, allowed us to verify when these different neuro-correlates of the mentalization process is related to a behavioral measure of mind attribution.

The present research was designed to specifically investigate the timeline of the process of mentalization and investigate the contribution of perceptual and contextual information in this phenomenon. In order to do so, we manipulated both processes. Specifically, in Study 1 we decided to use Black and White faces. A vast literature on race relations has repeatedly demonstrated that White participants perceive and elaborate Black people as less human and deprive them of mental capacities compared to their ingroup (e.g., Cassidy et al., 2017; Goff et al., 2008). While perceptual information was manipulated by the differentiation between races, contextual information was manipulated by labelling faces as "African" and "Italian". Indeed, since "Black" and "White" labels are not commonly used in Italy (the country where the studies were conducted), we decided to use labels describing the geographical origin of the targets. In Study 2 instead, we aimed to disentangle the influence of perceptual and contextual information more clearly by presenting all Caucasian faces that differed only on their FWHR (facial-width-to-height ratio). The FWHR is a perceptual cue that has shown to influence the evaluation of humanity (Deska et al., 2018). Contextual information was manipulated by labelling faces as "Italians" or "Romanians". Romanians have similar facial characteristics compared to Italians and they represent the largest group of recent immigrants in Italy at the moment (ISTAT, 2021).

Specifically, we hypothesized to differentiate two stages in two different points in time in the process of mentalization. The first stage, mind detection was expected to be observed in a differential activation of the human and the doll-like faces in the N170 (Wheatley et al., 2011), an early ERP that has been identified as a reliable indicator of the configural processing of face stimuli (Maurer et al., 2002). Given that recent research has linked configural processing with ascriptions of humanness (Fincher et al., 2017; Hugenberg et al., 2016), particularly this ERP was expected to give us some early indication of mind detection. In the second stage, we focused specifically on the P300, a central component in the oddball paradigm. The P300 is triggered by the infrequent stimulus and its amplitude increases to the extent that the oddball stimulus is elaborated differently compared to the repeated stimuli (Ito & Urland, 2003; Tomelleri & Castelli, 2012; Vaes et al., 2019). Given that the infrequent stimuli were perceptually similar doll-like faces that do not have a mind, we expected the P300 to be significantly smaller when an outgroup doll-like face appeared among a series of outgroup human faces compared to when an ingroup doll-like face appeared among a series of ingroup human faces. Observing that outgroup stimuli with and without a mind are more similarly elaborated compared to the ingroup allowed us to directly demonstrate that outgroup rather than ingroup faces are denied a mind. Moreover, we expected only this later stage to correlate with the implicit attribution of a mind to ingroup rather than outgroup targets demonstrating that the expected differences observed in the P300 are related to behavioral responses in associating a mind to ingroup and outgroup members.

Given that the previous literature has shown inconsistent findings, our hypotheses regarding the influence of perceptual and contextual information on both early and later ERP components remain more exploratory. Tentatively, we expect the mind detection phase to be mostly driven by perceptual and visual elements of the stimuli. Therefore, the impact of the perceptual manipulations (i.e., skin color in Study 1 and FWHR in Study 2) might moderate this early ERP component. The mind attribution stage, instead, is expected to be mostly context driven implying that the impact of the targets' group membership should have a clear impact in this phase. As such, the process of mentalization might be described in an initial phase in which visual cues mostly guide the detection of a mind from a face, and a later stage related to the process of mind attribution, where contextual information, prior knowledge and higher judgments about other's mental states, together with visual and sensory information of the cues, contribute to extract a mind from a face.

Study 1

In Study 1, a sample of men and women who identify themselves as Italian were asked to categorize Black and White faces while recording participants' neural activity and to complete the IMAT. Contextual information was manipulated by labelling faces as "African" and "Italian". Early ERPs were expected to show the first phase of mentalization, that is mind detection in which mindful (human faces) are differentiated from mindless faces (i.e., doll-like faces) for the first time. The P300, instead, was expected to show a clear differentiation between the recognition and elaboration of Black and White faces demonstrating how the second phase of mentalization, that is mind attribution is influenced by both perceptual and contextual information. The link with the IMAT was only expected to be significant for the later ERP, providing an external confirmation that the modulation of the P300 reflects differences in mind attribution.

Methods

Participants

Based on previous research that used a similar paradigm (Vaes et al., 2019), we stopped data collection when 29 healthy volunteers participated. All participants had normal or corrected to normal vision and reported no history of neurological impairment. Two participants were excluded from the analysis because of an excessive rate of EEG artefacts (exceeding 25%). A final sample of 27 participants (17 males; Mage = 22.53, SD = 3.33) was retained for the analysis. A sensitivity power analysis calculated using PANGEA (for details see www.jakewestfall.org/pangea/) indicated that we had sufficient power (.807) to detect an effect size of d=.73 with an alpha = 0.05 for the interaction effect and an effect size of d=.57 with an alpha =0.05 for any of the main effects. Therefore, our current experimental set-up allowed us to reliably detect medium to large effects. The study was approved by the local Ethics Committee (protocol 2016-004) and all participants gave their consent at the beginning of the experiment. In this work we report all measures, manipulations, and exclusion criteria.

Stimuli

Pictures of Black and White male faces were selected from the Chicago Face Database (Ma et al., 2015). We selected 20 faces of each race that did not differ in attractiveness ($t_{(19)}$=1.198, p=.246, d=.39), babyface ($t_{(19)}$=.610, p=.549, d=.19), disgust ($t_{(19)}$=-.870, p=.395, d=-.28), and race prototypicality ($t_{(19)}$=-1.119, p=.277, d=-.36). Only the luminance of Black and White faces showed to differ significantly ($t_{(19)}$ =-24.16, p<.001, d=-7.84). All pictures were converted to greyscale and within each ethnic group we equalized the luminance using Matlab. For each picture, a doll-like face was created morphing the original human face (30%) and a race-matched doll-face (70%) (see Figure 2.1). All the stimuli were pre-tested to make sure that the doll-like and human faces of both ethnic groups were recognized easily and to the same extent. A total of 28 pre-test participants who did not participate in the main experiment had to categorize human or doll-like faces as fast and accurate as possible pressing different keys on the keyboard. Afterwards, they had to indicate on a 7-point Likert scale to what extent all the pictures depicted an avatar or a human being. Results of the pre-test showed that two White and two Black faces were categorized ambiguously. Since we wanted to reduce the amount of categorization errors, these four pictures were removed. Participants categorized the final sample of 18 Black and White targets equally accurately ($F(1,27)=.007$, $p=.93$, $\eta^2_p=.00$), equally fast ($F(1,27)=2.53$, $p=.12$, $\eta^2_p=.08$) and judged both Black and White human and doll-like faces as equally human- and avatar-like respectively ($F(1,27)=.58$, $p=.45$, $\eta^2_p=.021$) (see Table 1 in the Appendix 1 for means and standard deviations). Materials and data for the experiment are available at: https://osf.io/bqg8x/?view_only=3f50552be0f541bbbfcaec8c79cf2a5b.

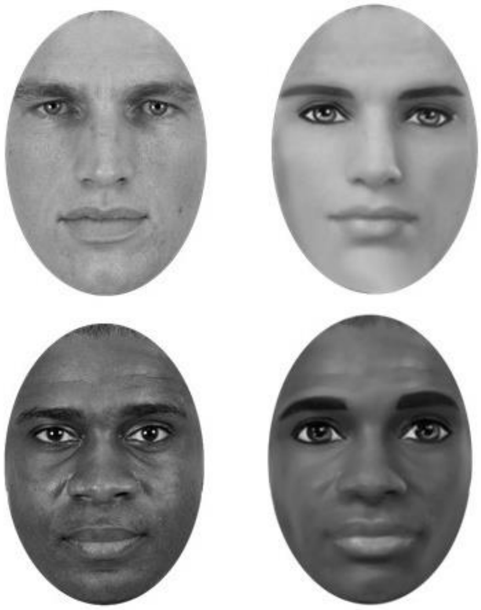


Figure 2.1. Example of Black and White faces and their doll-like counterparts

Electrophysiological recording and processing

We recorded the EEG from a 25 electrodes cap, with a left earlobe electrode and a right earlobe reference (bandpass filter: 0.01 – 200 Hz; A/D rate: 1000 Hz). During the EEG registration the electrodes impedance was maintained below 10/5 KΩ. The analyses were conducted with the EEGLAB (Delorme & Makeig, 2004b) and the ERPLAB (Lopez-Calderon & Luck, 2014a) toolbox of MATLAB. Raw data were filtered with a bandpass filter of 0.1-40 HZ. The data were re-referenced offline to the average of the right and left earlobe electrodes. The horizontal electrooculogram (HEOG) was recorded from two electrodes placed on the outer canthi of both eyes. The raw signal was segmented in 900ms long epochs that began 100ms before the stimulus onset. We used a baseline correction of the mean activity during a 100ms pre-stimulus interval. Trials with horizontal eye movements (HEOG exceeding ± 30 µV) or other movement artefacts (any channel exceeding ± 70 µV) were rejected. The mean number of retained trails for each participant was 85%.

For the statistical analyses, we first visually inspected the ERP Grand Average until 300ms after stimulus onset. Based on the literature (Ito & Bartholow, 2009; Luck, 2005b), we selected the electrodes and the time windows in which a certain component is expected. Following this procedure, the P100 was identified over the O1-electrode between 80 and 130ms (Luck, 2005b), and the N100 over the Fz-electrode between 100 and 150ms after stimulus onset (Ito & Bartholow, 2009). For both the P200 and N170 a visual inspection of our data indicated a different time window or a different electrode that is typically described in the literature. For this reason, we decided to run a latency analysis in which we identified the specific time windows of each component by centring the peak and by identifying the area's latency. Specifically, the P200 could be identified over the Oz-electrode between 160 and 280ms, while the N170 was found over the Cz-electrode between 120 and 180ms after stimulus onset. Finally, the P300 was identified using the same procedure that was used in Vaes et al. (2019) dividing the signal into 20ms between 300 and 600ms after stimulus onset and identifying when the doll-like faces significantly started and finished to differ from the human faces for both Black and White targets. Following this procedure, the P300 was found maximal over an occipital region of interest (ROI, including Oz, O1, and O2) between 360 and 580ms after stimulus onset.

Implicit Mind Attribution Test (IMAT)

Participants categorized Black and White human faces with "Italian" and "African" labels. We used the same 36 human faces (18 black and 18 white) as in the EEG experiment. At the same time, participants were asked to categorize 10 words on whether they represented mental (*personality [personalità], morality [moralità], memory [memoria], self-control [auto-controllo] and thought [pensiero])* or body characteristics (*tone [tonicità], muscles [muscoli], movement [movimento], agility [agilità] and strength [forza])*. We used "Mind" and "Body" as the attribute labels. These words were obtained on the basis of a pre-test. A total of 23 volunteers who did not participate in the main experiment or the previous pre-test judged a set of 20 mind- and 20 body-related words on 3 dimensions. In the first two questions participants were asked to indicate how much each word expressed a mental capacity or a characteristic of the body (both rated on a 7-point scale: 1=not at all to 7=very much), while the final question assessed the valence of each word (rated on a 10-point scale: -5=negative to 5=positive). We aimed to select five words for each category that were good representatives of their category and had as much as possible the same level of valence. While both word sets showed to be good representatives of their respective category, mind related words were always more positive than body related words, ($t(19) = 4.04$, $p = .001$, $d = 1.31$). Importantly, both word sets were positively evaluated ($M_{mind} = 3.75$, $DS_{mind} = .95$; $M_{body} = 2.85$, $DS_{body} = .90$). (see Table 2 in the Appendix 1 for all detailed analysis).

The IMAT started with two practice blocks in which either only the attribute words or the target pictures needed to be categorized. They were followed by a critical block in which either compatible or incompatible associations were measured. (In)compatibility was defined based on our hypothesis. Compatible associations were those in which participants were asked to categorize the White "Italian" faces and the "Mind" words with the same response key and the "African" Black faces and the "Body" words with the other key. Incompatible associations paired the opposite combinations with the same response keys ("Italian"/"Body" vs. "African"/"Mind"; see Table 3 in the Appendix 1 for a detailed description of the IMAT procedure). The order of the two critical blocks was randomized between participants. The IMAT was programmed and presented using Inquisit 4.

Procedure

A total of 72 stimuli, 36 representing Black faces (18 human stimuli and 18 doll-like avatar stimuli) and 36 representing White faces (18 human stimuli and 18 doll-like avatar stimuli) appeared at the centre of the screen. The dimension of each picture was 1100X655 pixels. Targets were presented 2.67° under the centre of the screen on a uniformly grey background. The fixation cross was located 1.91° above the centre of the screen. We used the oddball paradigm to present the stimuli, in this way the human faces were the frequent stimuli infrequently interrupted by a doll-like face, the deviant stimulus.

During the EEG experiment participants were asked to categorize the pictures by pressing two keys on the keyboard: one for the doll-like faces and another for the human faces. Four blocks were presented in a randomized order. Two of them only contained Black targets, while only White faces were presented in the other two blocks. Each block contained 250 pictures (80% frequent stimuli and 20% infrequent stimuli), and care was taken that every infrequent stimulus was followed by at least two frequent stimuli. Each trial began with a fixation cross that lasted for 1500ms and remained on the screen when the face appeared. All target pictures remained on the screen until participants gave their response.

After the EEG experiment, participants were asked to complete the IMAT.

Results

Behavioural results

Participants' accuracy was influenced by target humanity ($F(1,26) = 34.96$, $p < .001$, $\eta^2_p = .57$). Human faces ($M = .97$, $SD = .04$) were categorized more accurately than doll-like faces ($M = .85$, $SD = .09$). Target race, instead, did not show any main ($F(1,26) = 3.82$, $p = .061$, $\eta^2_p = .128$) or interaction effects ($F(1,26) = .883$, $p = .356$, $\eta^2_p = .033$). Reaction times were not influenced neither by the target's humanity ($F(1,26) = .749$, $p = .395$, $\eta^2_p = .028$) nor by the target's race ($F(1,26) = .119$, $p = .732$, $\eta^2_p = .005$).

Electrophysiological results

We focused our analysis on five different ERP components, and we conducted a fully crossed within-participants ANOVA 2 (Race: White faces vs Black faces) X 2 (Humanity: real faces vs doll-like faces) on each of them.

Electrophysiological results before 300 ms

The analysis of the P100 revealed a main effect of target race, $F(1,26) = 12.24$, $p = .002$, $\eta^2_p = .32$. The P100 was more activated during the presentation of White (*M*=3.95, *DS*=2.48) compared to Black faces (*M*=3.33, *DS*=2.23). Also, the N100 showed a significant main effect of target race, $F(1,26) = 10.95$, $p = .003$, $\eta^2_p = .29$. The N100 was more negative for the White faces (*M*=-4.22, *DS*=1.61) compared to their Black counterparts (*M*=-3.55, *DS*=1.82). The N170 showed a main effect of target race, $F(1,26) = 14.69$, $p = .001$, $\eta^2_p = .36$ and a main effect of humanity, $F(1,26) = 5.08$, $p = .033$, $\eta^2_p = .16$. The N170 was more negative for the White (*M*=-2.19, *DS*=2.09) compared to the Black faces (*M*=-1.37, *DS*=2.13) and more negative for the human (*M*=-1.95, *DS*=1.96) compared to the doll-like faces (*M*=-1.61, *DS*=2.17). Finally, we focused our analysis on the P200, and we found a main effect of humanity, $F(1,26) = 4.60$, $p = .041$, $\eta^2_p = .15$. The P200 was more active for the real faces (*M*=3.21, *DS*=2.96) compared to the doll-like faces (*M*=2.88, *DS*=3.37). Race did not influence this early ERP, $F(1,26) = 3.03$, $p = .093$, $\eta^2_p = .10$. (see Figure 2.2).

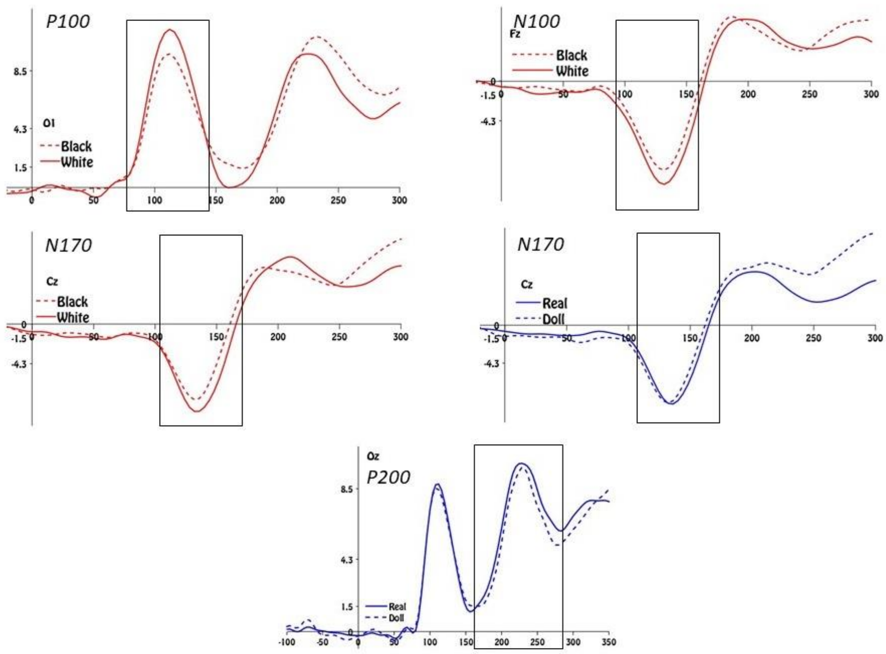


Figure 2.2. Top panels: ERP activation of P100 (left) and N100 (right) to Black and White targets. Middle panels: ERP activation of N170 to Black and White targets (left) and to human and doll-like faces (right). Lower panels: ERP activation of P200 to human and doll-like faces.

Electrophysiological results of the P300

Analyses of the P300 showed a main effect of humanity, $F(1,26) = 86.95$, $p<.001$, $\eta^2_p=.77$, demonstrating the odd-ball effect. The P300 was more activated when the doll-like faces were presented (M=22.74, DS=13.41) compared to when the real faces appeared (M=9.88, DS=8.12). In addition, the expected interaction between race and humanity emerged, $F(1,26) =5.38$, p=.028, η^2_p=.17. This result supported the hypothesis that the presentation of White doll-like faces among a series of White human faces elicited a more positive deflection of the P300 compared to the presentation of the Black doll-like faces among Black human faces. The difference between the White and Black doll-like faces was significant ($t_{(26)}$=-2.099, p=.046, d=-.58) while the difference between pictures depicting White and Black human faces was not ($t_{(26)}$=.087, p=.931, d=.02) (see Figure 2.3).

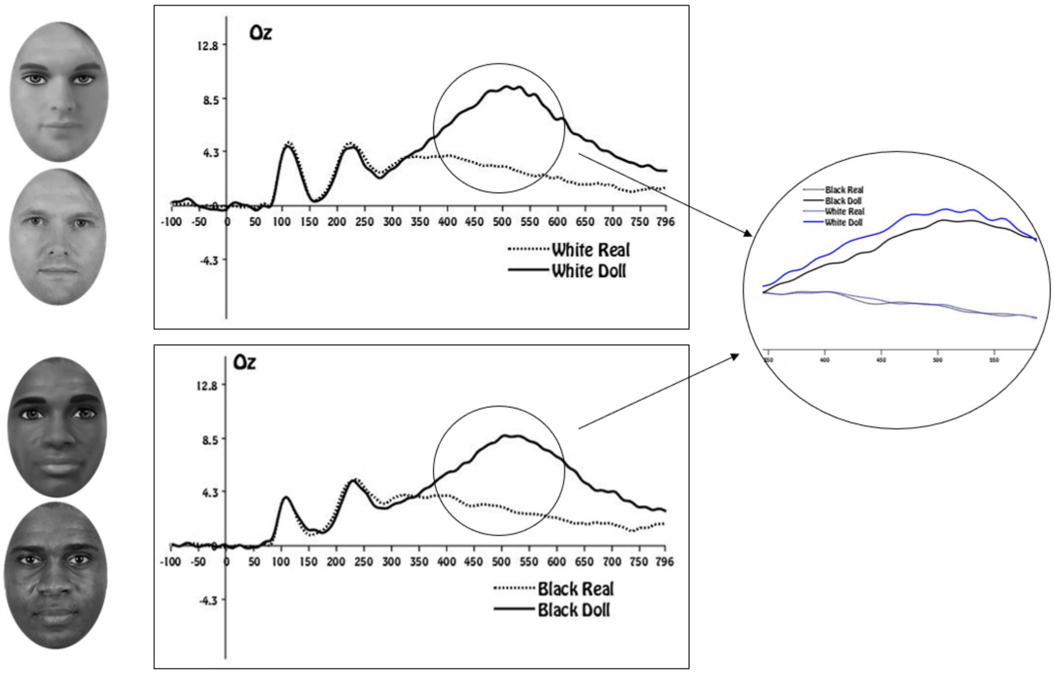


Figure 2.3. Stimuli and electrophysiological results. Left panel: Example of stimuli depicting a White and Black human and doll-like face. Mid panel: Grand average waveforms for White and Black human targets and their respective doll-like faces. Right circle: Detail of the comparison between the grand average waveforms between all targets in the P300 time window.

IMAT results and correlations with each component

Data were analysed using the D-score algorithm for IAT data (Greenwald et al., 2003). Higher scores indicated a stronger association of mind-related words with the White faces and body-related words with the Black faces. The index varied between -.38 to .72 with M=.17 and SD=.27 and was significantly different from 0 ($t_{(25)}$ =3.34, p=.003, d=1.34). This means that participants were faster and more accurate in the compatible block, where White faces were associated with mind words and Black faces with body words, compared to the incompatible block, where White faces were associated with body words and Black faces with mind words.

In order to verify whether the elaboration of the White and Black, doll-like faces vs. human targets differed as a function of participants preference to attribute a mind to White vs. Black targets, we correlated each ERP component with participants' IMAT index. These correlations were conducted on 26 participants due to a multivariate outlier's analyses using Cook's Distance which made us remove one participant (see Appendix 1 for a specific description of the multivariate outlier analysis).

Therefore, we calculated a difference score for each ERP component subtracting the difference between the elaboration of the Black human and doll-like faces from the difference between the elaboration of the White human and doll-like faces. Results showed only small correlations between the IMAT index and the P100 ($r(25)$=-.13, p=.51), the N100 ($r(25)$=.006, p=.97), P200 ($r(25)$=-.083, p=.68) and the N170 ($r(25)$=-.041, p=.84) suggesting that none of these components was significantly related to participants implicit mind attribution to White and Black targets. The same correlation between the P300 and participants IMAT index, instead, showed to be medium-sized and significant ($r(25)$ =.466, p=.017). These results confirmed that the more participants revealed a higher activation of the P300 for the White doll-like faces compared to their Black counterparts, the more they tended to attribute mind to White compared to Black targets.

Discussion

The current study aimed to investigate the time course of mentalization differentiating between a first phase of mind detection in which visual cues allow us to distinguish mindful from mindless stimuli, and a later stage in which contextual and higher-order information is integrated with perceptual clues to attribute a mind to a face. In a first attempt to differentiate these two phases early and later ERP components were analysed while participants elaborated Black and White human and doll-like faces, labelled as “African” and “Italian”, in an oddball paradigm. Interestingly, early ERPs were mostly influenced by race replicating results found in former research. The N100 was more negative for Black compared to White targets (Ito & Urland, 2003), while the P100 was more active for own- compared to other-race faces (Ran et al., 2014). Indeed, while the N100 has been linked with differences in the perception of race faces (Ito & Bartholow, 2009), the P100 has shown to be related to perceptual differences in the luminance of the stimuli (Kurita-Tashima et al., 1992; Tobimatsu et al., 1993). Since Black faces were marked by a lower luminance compared to White faces, the results of both ERPs might indicate an initial recognition of race differences or more elementary difference in luminance between the stimuli.

Focusing on the amplitude of the N170, a more negative activation was found for White compared to Black faces (Ratner & Amodio, 2013) and for human compared to doll-like faces. Since the N170 is known to be an indicator of configural processing, an increased activation was expected for real human compared to doll-like faces. Given that this ERP is the first where a difference between human and doll-like faces occurs, it can be interpreted as the first important step in the timeline of the mentalization process, where mindful stimuli are differentiated from those that can be considered mindless based on visual cues.

The P200 was more active for real faces compared to doll-like faces. This ERP has been typically associated with shifts in attention or vigilance (Luck & Hillyard, 1994) and more recently was inversely related to mental workload (Miller et al., 2011). Since participants were more accurate in detecting and categorizing human faces that were frequently presented compared to the oddball doll-like faces, it is plausible to expect the P200 to be more active to real faces compared to their doll-like counterparts.

Nevertheless, the analysis of the later ERP revealed, as expected, that the P300 was less active when a Black doll-like face appeared among Black human stimuli, compared to when White doll-like faces appeared among White human faces. This result can be interpreted as a direct indication of the denial of a mind, because Black faces with (i.e., human) and without (i.e., doll-like) a mind were elaborated more similarly, compared to their White counterparts. This effect correlated also with participants' implicit tendency to attribute a mind to White vs. Black targets in the IMAT. Indeed, participants showed a general tendency to associate mind (vs. body) related words more easily with White (vs. Black) faces and the more they did this, the less they elaborated Black faces with or without a mind in a different way. Instead, none of the early ERPs correlated significantly with the implicit mind attribution index. All these results were observed with moderate to large effect sizes for which we had sufficient power in the current sample.

Even though the current results confirm our hypothesis that the timeline of mentalization can be distinguished in two different stages, group membership was both based on visual perceptual cues (Black vs White faces) and the social category of participants (Italian) and those of the target faces (Italian vs African). Therefore, it is hard to discern the role of perceptual from that of more contextual information in any of the race effects we reported. For this reason, a second study was conducted eliminating any perceptual differences between ingroup and outgroup members and manipulating both visual and contextual information independently.

Study 2

Study 2 aimed to specifically separate the influence of perceptual and contextual information more clearly by presenting all Caucasian faces that differed only on their FWHR (facial-width-to-height ratio). Contextual information was manipulated by labelling faces as “Italians” or “Romanians”. Therefore, a sample of men and women who identified themselves as Italian, were first asked to categorize White faces while recording participants' neural activity and then to complete the IMAT. Results were expected to replicate the findings of Study 1 allowing us to better differentiate the role of perceptual and contextual information in both stages of mentalization.

Methods

Participants

Based on our previous research, we decided to gather a total of 30 healthy volunteers. All participants had normal or corrected to normal vision and reported no history of neurological impairments. Two participants were excluded from the analysis because of an excessive rate of EEG artefacts (exceeding 50% of epochs removed in a single block). A final sample of 28 participants (22 females; Mage = 24.1, SD = 5.25) were retained for the analysis. A sensitivity power analysis calculated using PANGEA (for details see www.jakewestfall.org/pangea/) indicated that we had sufficient power (.813) to detect an effect size of d=.41 with an alpha = 0.05 for any of the main effects and a power of .816, with an effect size of d=.35 with an alpha =0.05 for all the two-way interaction effects. Finally, the analyses had sufficient power (.802) to detect an effect size of d=.52 with an alpha =0.05 for the three-way interaction effect.

The study was approved by the local Ethics Committee (protocol 2016-004) and all participants gave their consent at the beginning of the experiment. In this work we report all measures, manipulations, and exclusion criteria.

Stimuli

To avoid perceptual differences similar to those we had in the first experiment, we only selected faces of White males taken from the Chicago Face Database (Ma et al., 2015). This database already provides the calculated FWHR of each of the collected pictures. Therefore, from the norming data and codebook we selected 32 faces who had the highest FWHR (*M*= 1.97, *SD*= .07) and 32 faces who had the lowest FWHR (*M*= 1.74, *SD*= .06, $t_{(31)}$=-12.4, p<.001, *d*=-3.15). Afterwards we decided to divide each group of faces into 2 different lists. This was necessary in order to have two different groups of faces with a Low and high FWHR, presented once as ingroup and once as outgroup members. Therefore, we had a total of two groups of 16 faces that had the highest FWHR [List A (*M*= 1.98, *SD*= .07) and List B (*M*= 1.96, *SD*= .06)] and two groups with 16 faces that had the lowest FWHR [List C (*M*= 1.73, *SD*= .07) and List D (*M*= 1.76, *SD*= .04)]. These groups of pictures were perceived to be equally afraid, angry, attractive, disgusted, baby-faced, dominant, feminine, happy, masculine, prototypic for their race, sad, threatening, unusual and had a similar luminance (all ps>.10) (see Supplemental Online Material for the full report). For each picture, a doll-like face was created morphing the original human (30%) and a doll-face (70%) (see Figure 2.4). Special care was taken during the creation of the avatars that the FWHR of the doll-face remained the same as its original human face. Specifically, we selected different doll-faces with different FWHR and assured that, when creating the doll-like avatar, no changes were made between the bizygomatic width (i.e., distance between left to right zygon) and upper face height (i.e., distance between mid-brow and upper lip; Hehman et al., 2015). Finally, we balanced the luminance across human and doll-like faces converting each picture to greyscale and then equalizing their luminance using Matlab. Materials and data for the experiment are available at: https://osf.io/bqg8x/?view_only=3f50552be0f541bbbfcaec8c79cf2a5b.

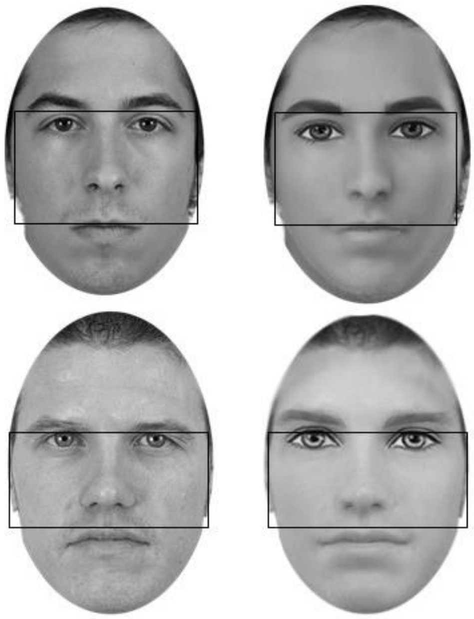


Figure 2.4. Example of Low (faces on the left) and High (faces on the right) FWHR White faces and their doll-like counterparts

Electrophysiological recording and processing

The same EEG implementation and pre-processing of Study 1 was used in the current experiment (see section Electrophysiological recording and processing of the first study). However, since we needed to analyse each block separately, an Independent Component Analysis was run on the continuous signal using the Infomax algorithm (Bell & Sejnowski, 1995) to reject components related to eye and muscle movements in order to best preserve the epochs in each block. The mean number of retained epochs for each participant in each block exceeded 60%.

For the statistical analyses, we decided to focus only on the ERPs whose amplitude was influenced by any of our manipulations. Therefore, only the N170 and the P300 were taken into consideration. We followed a similar procedure as in Study 1 and we first visually inspected the ERP Grand Average until 600ms after stimulus onset. A similar negative component to the first study was found over Cz with a different latency. Based on the recommendation of (Nieuwland & van Berkum, 2006) we identified the N170 between 110 and 150 ms, that had a maximum peak at 132 ms over CZ. Finally, the P300 was identified repeating the procedure used in the first experiment and locating the P3 with the maximum amplitude. Therefore, we identified the P300 over the central region of interest (ROI, including Cz, C3, and C4) between 340 and 600ms after stimulus onset.

Implicit Mind Attribution Test (IMAT)

Participants categorized Low and High FWHR White human faces with "Italian" and "Romanian" labels. We selected 12 faces with a Low and 12 faces with a High FWHR (6 faces from each list) out of the 64 faces that were presented during the EEG. Similar to the faces for the EEG experiment, we controlled the same ratings and no differences were found (all ps>.06) except of course for the FWHR of the faces ($t_{(11)}$=-7.67, p<.001, *d*=-3.27) (see Appendix 1 for the full report). Before starting the IMAT, participants were asked to complete a memory task categorizing the 12 Italian and 12 Romanian faces that were presented at the centre of the screen. This task was necessary to make sure that all participants had a similar capacity to correctly distinguish the ingroup from the outgroup faces whilst reducing the amount of errors during the IMAT task. The IMAT followed the same procedure as in Study 1, only now the compatible task required participants to categorize the "Italian" faces and the "Mind" words with the same response key and the "Romanian" faces and the "Body" words with the other key. The incompatible task paired the opposite combinations with the same response keys ("Italian"/"Body" vs. "Romanian"/"Mind"). Unlike the first study, we programmed two different IMATs: one in which only low FWHR faces of the ingroup and the outgroup were presented and one in which only high FWHR of both groups appeared (see Table 4 of the Appendix 1 for a full description of the procedure).

Procedure

A total of 124 stimuli, 64 representing High FWHR faces (16 human stimuli and 16 doll-like avatar stimuli for List A and 16 human stimuli and 16 doll-like avatar stimuli for List B) and 64 representing Low FWHR faces (16 human stimuli and 16 doll-like avatar stimuli for List C and 16 human stimuli and 16 doll-like avatar stimuli for List D) appeared at the centre of the screen. The dimension of each picture was 733X475 pixels. Targets were presented 2.67° under the centre of the screen on a uniformly grey background. The fixation cross was located 1.91° above the centre of the screen. We used the same oddball paradigm as in Study 1 to present the stimuli, with frequently presented human faces infrequently interrupted by the doll-like avatar faces.

During the EEG experiment participants were asked to categorize the pictures by pressing two keys on the keyboard: one for the doll-like faces and another for the human faces. In each block different conditions were presented. In one block, Low FHWR faces were presented as Italians, while in a second block the second list of Low FWHR faces were shown and presented as Romanian. In the remaining two blocks, again Italian and Romanian faces were presented, but now with a High FWHR. These blocks were randomized between participants. Each block contained 400 pictures (80% frequent stimuli and 20% infrequent stimuli), and care was taken that every infrequent stimulus was followed by at least two frequent stimuli. Each trial began with a fixation cross that lasted for 1500ms and remained on the screen when the face appeared. All target pictures remained on the screen until participants gave their response.

After the EEG experiment, participants were asked to complete the IMAT.

Results

We conducted a fully crossed within-participants ANOVA 2 (FWHR: Low FWHR faces vs High FWHR faces) X 2 (Group: Ingroup vs Outgroup) X 2 (Humanity: real faces vs doll-like faces). In all statistical analyses, the alpha level was set to .05 and all pairwise comparisons were Bonferroni-corrected.

Behavioural results

Accuracy. A main effect of humanity, , $F(1,27) = 57.42$, $p<.001$, $\eta^2_p=.68$, and FWHR, $F(1,27) = 4.92$, $p=.035$, $\eta^2_p=.15$, emerged. Participants were slightly more accurate in categorizing Low FWHR faces (*M*=.955, *SD*=.03) compared to those with a High FWHR (*M*=.948, *SD*=.03). Similar to the first experiment, human faces (*M*=.99, *SD*=.01) were recognized more accurately than the doll-like faces (*M*=.91, *SD*=.06).

Moreover, a significant interaction between FWHR and Group emerged, $F(1,27) = 4.72$, $p=.039$, $\eta^2_p=.15$. Participants tended to be less accurate when outgroup High FWHR faces were presented (*M*=.94, *SD*=.04) compared to the other faces (*M*=.96, *SD*=.03; *M*=.95, *SD*=.03; *M*=.95, *SD*=.03 for outgroup Low and ingroup High and Low FWHR faces respectively). However, post hoc analyses showed no significant differences between any of these means.

Reaction time. Reaction times were only influenced by the humanity of the targets, $F(1,27) = 20.85$, $p<.001$, $\eta^2_p=.44$. Participants were faster in categorizing real (*M*=552 ms, *SD*=.17), compared to doll-like faces (*M*=670 ms, *SD*=.21).

Electrophysiological results

A fully crossed within-participants ANOVA 2 (FWHR: Low FWHR faces vs High FWHR faces) X 2 (Group: ingroup vs outgroup) X 2 (Humanity: real faces vs doll-like faces) was conducted on both the N170 and the P300. In all statistical analyses, the alpha level was set to .05 and all pairwise comparisons were Bonferroni-corrected.

Electrophysiological results before 300 ms

The analysis of the N170 showed only a main effect of target humanity, *F*(1,27) =13.96, *p*=.001, η^2_p=.34. The N170 was more negative for the real faces (*M*=-3.50, *DS*=3.51) compared to the doll-like faces (*M*=-2.92, *DS*=3.68). (see Figure 2.5).

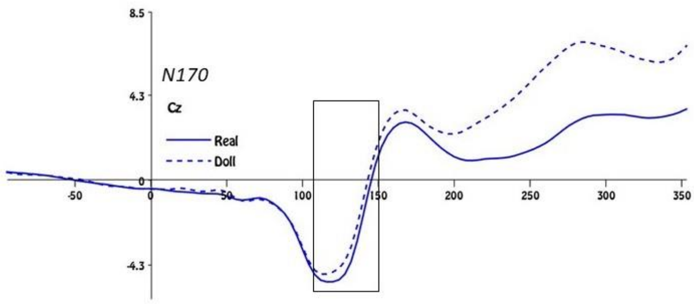


Figure 2.5. ERP activation of N170 to human and doll-like faces.

Electrophysiological results of the P300

Analyses of the P3 showed a main effect of Humanity, *F*(1,27) =131.33, *p*<.001, η^2_p=.83. As expected, the P3 was more strongly activated when the doll-like faces were presented (*M*=42.79, *DS*=18.08), compared to when the real faces appeared (*M*=17.93, *DS*=9.86). In addition, a significant interaction between FWHR and Group emerged, *F*(1,27) =6.06, *p*=.020, η^2_p=.18, that was qualified by the interaction between FWHR, Group and Humanity, *F*(1,27) =7.67, *p*=.010, η^2_p=.22.In order to better understand this interaction, we decided to conduct two different 2 (Group: ingroup vs outgroup) X 2 (Humanity: real faces vs doll-like faces) ANOVAs for Low and High FWHR faces separately. A main effect of humanity emerged both when focusing on High FWHR, *F*(1,27) =118.76, *p*<.001, η^2_p=.82, and Low FWHR faces, *F*(1,27) =133.38, *p*<.001, η^2_p=.83. As expected, in both cases doll-like faces

(M_{High}=44.26, DS_{High}=18.77; M_{Low}=42.94, DS_{Low}=18.21) elicited a stronger P3 compared to real faces (M_{High}=18.27, DS_{High}=9.96; M_{Low}=18.06, DS_{Low}=10.12). Also, a main effect of Group emerged both when focusing on High FWHR, F(1,27) =4.71, p=.039, η^2_p=.15, and Low FWHR faces, F(1,27) =8.77, p=.006, η^2_p=.24. While this main effect for high FWHR faces indicated an overall stronger activation for ingroup (M_{ing}=32.7, DS_{ing}=15.8) compared to outgroup faces (M_{out}=29.8, DS_{out}=12.8), low FWHR faces showed the reverse effect (M_{ing}=28.9, DS_{ing}=13.1 and M_{out}=32.1, DS_{out}=14.6), for in- and outgroup faces respectively.

Importantly, these main effects were qualified by a significant interaction between Group and humanity only for High FWHR faces, F(1,27) =5.07, p=.033, η^2_p=.16. As expected, when ingroup doll-like faces appeared among ingroup real faces they elicited a stronger P3, compared to the presentation of outgroup doll-like faces among outgroup human faces. The difference between ingroup and outgroup doll-like faces was significant, , $t_{(27)}$=2.10, p=.045, d=.57, while the real in- and outgroup faces did not differ significantly, $t_{(27)}$=.715, p=.48, d=.19. No significant interaction between Group and Humanity was observed for the low FWHR faces.

Finally, visual inspection of Figure 2.6 (see right circle) led us to compare the oddball effect in all conditions contrasting the P3 of the doll-like faces. Results of this analyses showed that when High FWHR faces, faces that are typically de-mentalized, were presented as ingroup members, the amplitude of the P3 was significantly more positive and wider, F(1,27) =7.77, p=.010, η^2_p=.22, compared to the P3 elicited in all the other conditions (p's>.05).

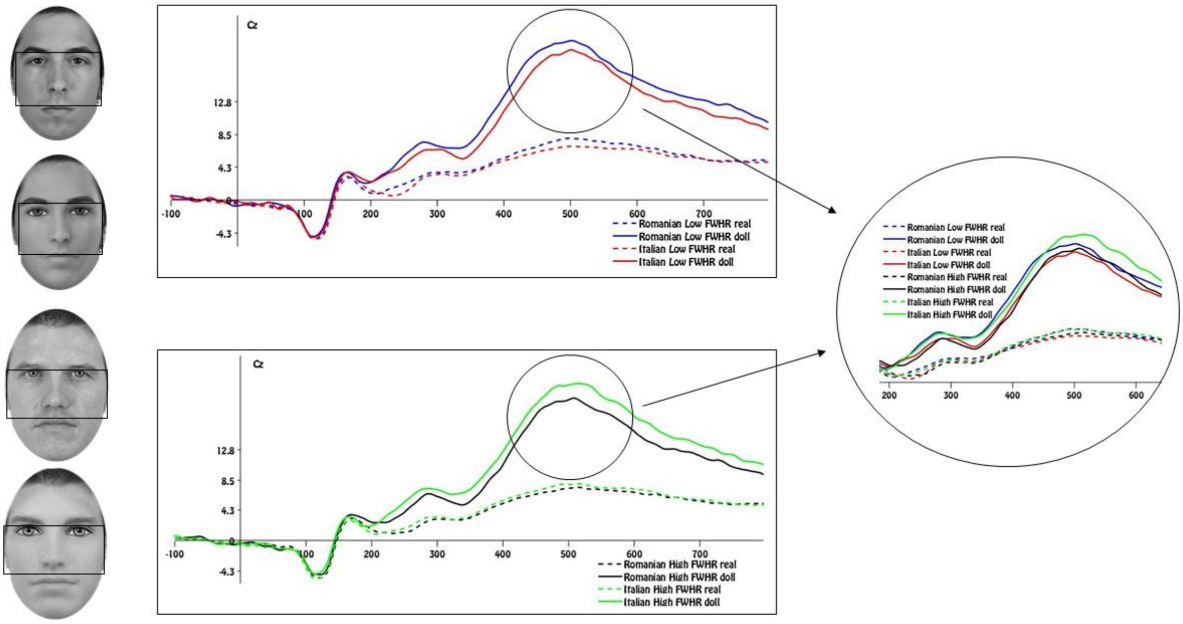


Figure 2.6. Stimuli and electrophysiological results of the P3. Left panel: Example of stimuli depicting a Low FWHR (above) and High FWHR (below) human and doll-like face. Mid panel: Grand average waveforms for the human targets and their respective doll-like faces when they were labelled as ingroup or outgroup faces. Right circle: Detail of the comparison between the grand average waveforms between all targets in the P300 time window.

IMAT results and correlations with each component

Two DIAT scores were calculated for High and Low FWHR faces separately. Three participants were removed from the analyses due to an excessive rate of errors in the memory task (they managed to categorize less than 80% of the faces accurately in their respective group)[2]. Analyses were then conducted on a total of 25 participants. Higher scores indicated a stronger association of mind-related words with the faces labelled as Italian and body-related words with faces labelled as Romanian. The index for the Low FWHR varied between -.46 to 1.3 with *M*=.19 and *SD*=.37, while the index for the High FWHR varied between -.63 to .72

[2] Retaining the participants eliminated by our a priori criteria did not change the effects.

with *M*=.016 and *SD*=.32. The DIAT for Low FWHR faces was significantly different from 0, $t_{(24)}$ =2.53, *p*=.018 , *d*=.73; while the DIAT for High FWHR faces was not, $t_{(24)}$ =.26, *p*=.79 , *d*=.07. Still, a paired sample t-test showed no significant difference, $t_{(24)}$ =-1.706, *p*=.10, *d*=-.49, between the DIAT for Low and High FWHR faces. Therefore, only for low FWHR faces, participants were generally faster and more accurate in associating ingroup members with mindful words and outgroup members with body words, compared to the reverse associations.

We followed a similar procedure as in Study 1 to verify whether the elaboration of ingroup and outgroup, doll-like vs. human faces differed as a function of participants preference to attribute a mind to ingroup vs. outgroup targets. Therefore, we correlated the N170 and the P300 with participants' IMAT for Low and High FWHR faces. Specifically, we calculated a difference score for each ERP component subtracting the strength of the ERP of real faces from the doll-like faces of the ingroup minus the same difference for outgroup faces for both Low and High FWHR faces separately.

Results showed a small non-significant correlation between the IMAT index and the N170 both for the Low, *r(24)*=-.030, *p*=.88, and the High FWHR faces, *r(24)*=.11, *p*=.59. These results suggest, like in Study 1, that this component is not related to participants implicit attribution of a mind to ingroup and outgroup targets. Regarding the P300, a significant medium-sized correlation emerged between High FWHR ingroup/outgroup faces with the DIAT for faces with a High FWHR, *r(24)*=.411, *p*=.04, while a small non-significant correlation emerged when Low FWHR, *r(24)*=.048, *p*=.82, faces appeared as ingroup or outgroup members. These results partially replicate the results found in the first study. The more participants revealed a stronger activation of the P300 for the ingroup doll-like faces compared to those of the outgroup, the more they tended to attribute a mind to ingroup compared to outgroup targets in the IMAT. Importantly, this happened when High FWHR faces, that are typically de-mentalized, appeared and not when Low FWHR faces were presented.

Discussion

This second study aimed to replicate results of the first study while also overcoming its limits. We were able to remove the perceptual differences between ingroup and outgroup stimuli and manipulated perceptual cues more directly and independently from the contextual information. In this study early and later ERP components were analysed while participants elaborated White human and doll-like faces in an oddball paradigm. Faces were perceptually identical except for the FWHR that was used to manipulate perceptual information, while contextual information was manipulated by adding ingroup (Italian) and outgroup (Romanian) labels to the faces. An early component emerged, replicating the result of Study 1. Indeed, the amplitude of the N170 was more negative for human compared to doll-like faces. It is important to note that this early ERP component was not influenced by the perceptual differences between High and Low FWHR faces. In past research manipulating the FWHR ratio (Deska et al., 2018) both High and Low FWHR were presented interspersed allowing participants to directly compare the targets' facial forms. Due to paradigm constrains, however, we needed to divide Low and High FWHR faces into separate blocks plausibly de-emphasizing the salience of FWHR differences for participants making it especially hard to impact early components.

Focusing on the results analysing the later ERP component, the difference in the location of the P3 maximum amplitude between the first and the second study becomes apparent. While the P3 amplitude was highest in Oz in Study 1, it was more clearly observed in Cz in Study 2. The main difference between both studies are the stimuli that were presented. The Black and White faces that were used in Study 1 could be differentiated using perceptual cues eliciting a P3 over Oz, in the second study, instead, the stimuli could only be differentiated using the contextual group labels likely leading to more cognitive processing and a more central activation.

Hence, in this second study the P300 was found maximal over Cz, showing a similar activation to the first study only when high FWHR faces were presented. Indeed, this later ERP component was less active when an outgroup doll-like face appeared among outgroup human stimuli, compared to when ingroup doll-like faces appeared among ingroup human faces. In addition, we found a significant and positive correlation between the P300 and the IMAT for the High FWHR faces, whereas no such correlation appeared with the early ERPs. This result replicates those of Study 1, showing how early ERPs were largely unrelated with participants performance on the IMAT, while later ERPs were.

At the same time, the lack of a similar finding for Low FWHR faces was unexpected. In this case the P300 was less active for ingroup compared outgroup faces regardless if they were doll-like or human faces. Even though we do not have a single explanation for this finding, we try list some tentative possibilities. First, both in auditory (Nieuwland & van Berkum, 2006) and in visual (Rodríguez-Gómez et al., 2020) EEG studies it has been demonstrated how conditions of incongruency seem to elicit a more active later ERP component. All our conditions can be expected to elicit different levels of incongruency, because High FWHR faces, that are typically de-mentalized, and Low FWHR faces, that are instead typically mentalized, where both presented as members of the ingroup and the outgroup. Given that people tend to perceive their ingroup as more human than the outgroup (Leyens et al., 2000; Vaes et al., 2012), it is reasonable to assume that presenting Low FWHR faces as ingroup members might have been experienced as less incongruent than the opposite eliciting a smaller P300. As a matter of fact, where the incongruency is stronger, such as when High FWHR faces were presented as ingroup members, the P3 reached its maximum amplitude and was significantly different from the other conditions.

Second, a more frontal central P300 (also called P3a; Luck, 2005b) is known to be modulated by task complexity and difficulty. Therefore, another possible explanation could be that presenting Low FWHR faces, that are typically humanized, as ingroup members required less cognitive effort resulting in the unexpected result that we obtained regarding these faces, while the opposite condition (i.e., High FWHR faces presented as ingroup members) might have been experienced as a more difficult condition to process, resulting in a stronger P3.

General Discussion

The main idea of this research project was to investigate the underlying processes of mentalization while also investigating its timeline through the introduction of a new experimental procedure that directly compared the elaboration of human, mindful and object, mindless stimuli. Indeed, by relating early and later ERP components to an external criterion of the mentalization process, we were able to show how it is possible to divide mentalization into two complementary stages that follow a linear timeline. Indeed, we hypothesized a first step called mind detection, mostly seen in the earlier ERP components and influenced by primary visual cues of the stimulus. This first step is the predecessor of the second step, the mind attribution phase. In this second stage of the mentalization process we expected to see the contribution of both perceptual and contextual information during the extraction of a mind from a face in a later ERP component.

Results of both Study 1 and Study 2 confirm and corroborate our initial hypothesis. Indeed, by manipulating both perceptual and contextual information in these studies we are able to present a first ERP component, the N170, that might define the first point in time of the mentalization process. As already mentioned, the N170 is best known as a reliable indicator of configural processing (Maurer et al., 2002). Therefore, the finding that human stimuli elicit a more negative N170 compared to doll-like stimuli, can best be understood in line with the classical observation that configural vs. analytical processing has been linked to the elaboration of people vs. objects respectively (e.g., Tanaka & Farah, 1993). Therefore, the differences that we found between human and doll-like face can be interpreted as an early occurrence of the mentalization process in which the elaboration of human (vs. doll-like) faces engages more configural processes. However, this finding was never modulated by any of our perceptual or contextual manipulations, therefore for now we cannot make any strong claims on the type of processes (bottom-up vs. top-down) that might influence this early stage of processing. Nevertheless, based on prior research, the activation of the N170 has been related to the configural processing of a face, and configural processing has been associated to perception of humanness (Fincher et al., 2017; Hugenberg et al., 2016). Moreover, no correlation with the IMAT in this early stage was found indicating that this constitutes a first and objective signal of an initial moment in which only essential stimulus information allowed participants to detect a mind behind a face. Therefore, it seems fair to say that this is the moment where people detect the presence of a mind for the first time marking the beginning of the mentalization process.

Nevertheless, focusing on a later ERP, both the dynamic interplay of perceptual and contextual information showed to modulate the level of animacy ascribed to a specific target. Indeed, the P3 not only gave direct evidence of the lack of mind attribution to outgroup compared to ingroup members, but also clearly correlated with the IMAT. This later ERP was found to be less active when doll-like outgroup faces infrequently appeared among human outgroup faces compared to when ingroup doll-like faces were infrequently presented among their human counterparts. This result was found when the outgroup was represented by Black faces (vs. White faces) in Study 1 and by High FWHR Romanian faces (vs. High FWHR Italian faces) in Study 2. As such, the P300 was influenced by both perceptual and contextual information, allowing us to conclude that the P300 marks the second phase in the timeline of the mentalization process, where both perceptual and contextual information are integrated to attribute a mind to others.

Interestingly, only this later ERP was related to an implicit measure of mind attribution, the IMAT. This is an important validation of our ERP findings as an index of mind attribution. As a result, the current research presents a new paradigm for the study of mind attribution that makes it possible to study this phenomenon combining a real time measure, manipulating both perceptual and contextual information together with an external criterium that allows us to determine when the mind attribution process is complete and observable in a behavioral measure. The combination of these measures constitutes an important tool for researchers to open new avenues to study the mentalization process and its underlying processes.

At a first glance, our results might seem in contrast with earlier work that demonstrated the speed and accuracy of social judgments, especially of competence or morality (Willis & Todorov, 2006). These studies provided evidence for people's capacity to make accurate judgments about other people's mind within 100ms of exposure. Moreover, these authors demonstrated that increasing the time exposure made participant increase only their confidence in the first evaluation they made. As such, these results might seem in contrast with our finding that the mind attribution phase only reaches full maturity between 350 and 600ms after stimulus onset. We believe that this contradiction is more illusive than real, given that one cannot directly compare the time it takes to elaborate a stimulus from the time it is presented. Indeed, while Willis and Todorov (2006) manipulated the presentation time of the stimuli, we directly measured the time it took participants to elaborate the stimuli. While participants in the studies of Willis and Todorov might have elaborated the stimuli even when they were not visually presented anymore, we specifically demonstrated that participants needed at least 350ms to elaborate the stimulus and integrate perceptual and contextual information to attribute a mind to others.

Limitations and Future Directions

With this new paradigm future research should deepen our knowledge on the mentalization process further disentangling perceptual and contextual processes. Indeed, none of our perceptual manipulations had an effect on the N170. Even though the perceptual information in Study 1 was highly salient, it overlapped with group membership. In Study 2, instead, faces with a different FWHR were presented in separate blocks making it harder to make direct comparisons and diminishing the salience of this manipulation. In future research researchers might want to increase the salience of the perceptual information with the aim to verify whether this type of information uniquely influences the early steps of the mentalization process.

Moreover, we created group membership by comparing Italians with Africans in Study 1, and Italians with Romanian in Study 2. This manipulation might have elicited both prior stereotypical knowledge associated with these groups and differences in the social identity of our participants. Even if the P300 was clearly influenced by this contextual manipulation allowing us to confirm that outgroup members were perceived as more similar to real objects compared to ingroup members, in order to better understand the underlying processes of the mentalization process it might be interesting to further disentangle the influence of these different contextual elements. Therefore, future research might manipulate group membership using the minimal group paradigm in which only participants' social identity is manipulated without activating any prior stereotypical knowledge. In any case, it is important to balance the salience of both the perceptual and the contextual information in any future endeavors, to further explore the time course of the mentalization process and unravel the perceptual and contextual information that shape it.

Finally, the IMAT that we proposed had a limit that we were not able to overcome. Indeed, while pre-testing the mind- and body-related words, mind-related words were found to be perceived as more positive than body-related words. Thus, it might be possible that the results of the IMAT could have been partialy influenced by participants liking ingroup more than outgroup members. However, our main result consists of the ERP data, that was not influenced by valence and that clearly disentangles between mindful human faces and mindless objects. Therefore, the relationship between the ERP and the IAT makes it highly unlikely that the mentalization process we are measuring is completely driven by valence judgements. In any case, we believe that even if liking might have influenced the results, the main argument of this research study does not change. Indeed, mind attribution and liking are correlated (Kozak et al., 2006) and therefore reinforce the idea that participants preferred the association ingroup - mind and outgroup – body both in study 1 and in study 2, and this association significantly correlated with a real-time measure of mind attribution.

Chapter 3

Exploring the sexual objectification of men and women: Neural and motivational insights from the perspective of gay men.[3]

Sexual objectification occurs whenever a person is reduced to his or her body without regard for his or her personality. Research on sexual objectification has typically focused on how heterosexuals objectify female targets. By investigating this phenomenon from the perspective of gay men, in Study 1 we adapted an oddball paradigm during an electroencephalographic recording (EEG) in which human stimuli were presented together with perceptually similar object-like stimuli. Results demonstrated how gay men objectify women (i.e., triggering a smaller late event-related-neurophysiological response, the P300), more than men. In Study 2, this result was replicated and the underlying motivations of gay men to objectify women rather than men were explored in an online questionnaire. Results of this study suggested that the more gay men were exposed to media sources that objectify women, the more they objectified women rather than men. Focusing on the point of view of gay men, the current research confirmed how objectified women are cognitively perceived as more similar to objects than objectified men demonstrating that the target of sexual objectification remains the same regardless of the sexual orientation of the observer and suggesting that this might happen because we are all exposed and interiorize a culture lens that mostly objectifies the female body.

[3] This chapter is largely based on a paper that has been currently submitted in a scientific journal and has been conducted in collaboration with Dr. Carlotta Cogoni (Instituto de Biofísica e Engenharia Biomédica, Faculdade de Ciências da Universidade de Lisboa, Portugal).

Introduction

Objectification research has often focused on the heterosexual population, with men as perpetrators and women as victims of sexual objectifying behaviors (Bernard et al., 2020; Vaes et al., 2013). As a result, a compelling rationale for how sexual objectification might be influenced by sexual orientation remains elusive. Namely, whether sexual objectification is mostly target specific, with gay men perceiving sexualized women as objects much like heterosexual men and women do, or is agent specific, with gay men mostly objectifying sexualized men in contrast to the heterosexual population. Studying this difference is important as it will tell us more about the underlying mechanisms of sexual objectification per se, identifying also the motivations that drive gay men to objectify other men or women. Hence, in this work we intend to verify if objectified women or men are perceived as more object-like by gay men. Moreover, we intend to explore the motivational aspects of sexually objectifying behaviors that differentially affect the heterosexual and gay population, looking at factors that might contribute to gay men enacting sexual objectification of other men and women.

Sexual objectification has been defined as the act of reducing a person, mostly a woman, to a body, by seeing her as a mere instrument, without regard for her personality or dignity (Bartky, 2015; Fredrickson & Roberts, 1997). In line with this definition, a plethora of research has shown that sexualized women often become the targets of objectification and dehumanization processes (Heflick et al., 2011; Loughnan et al., 2010; Vaes et al., 2011, 2013). More recently, research has started to define the characteristics of sexual objectification from a cognitive point of view, exploring the behavioral and neural correlates of visually inspecting sexualized targets (see Bernard et al., 2020 for a review). These studies were able to demonstrate how sexualized female targets are usually processed and elaborated similarly to objects (Bernard et al., 2012; Cogoni, Carnaghi, & Silani, 2018).

Nevertheless, these studies were not able to claim that objectified women are perceived as more object-like, but only that processes involved in the elaboration of objects were also elicited in the elaboration of some human stimuli. Only recently, a few studies have started to compare perceptually similar human and object stimuli directly to confirm that, during the process of sexual objectification, the well-known human-object divide tends to fade (Vaes et al., 2019, 2020). Specifically, Vaes and colleagues (2019) used the oddball paradigm in three experiments, measuring participants' neural activity while they analyzed frequently presented male and female human stimuli and infrequently presented gender-matched doll-like objects. The infrequent doll-like objects were expected to trigger a late event-related neurophysiological response (P300) the more they were perceived different from the repeated, human stimuli (i.e., the oddball effect). Results indicated that the oddball effect was significantly smaller for women compared to men and confined to objectified depictions of women and men. As such, these results were the first to indicate that objectified women become truly more similar to real objects.

It is important to note, however, that most of the literature regarding sexual objectification has only studied the heterosexual population. Indeed, most of the objectification research including gay populations has focused on gay men as the victims of this phenomenon, suggesting that they can become the target of sexual objectifying experiences much like heterosexual women, experiencing different negative psychological outcomes (Davids et al., 2015; Lanzieri & Hildebrandt, 2016; Souleymanov et al., 2020; Watson & Dispenza, 2014; Wiseman & Moradi, 2010). At the basis of these negative psychological consequences for both gay men and heterosexual women lies "the objectifying gaze" (Fredrickson & Roberts, 1997), the visual inspection of a person's body. It reflects an external perspective on their bodies, that takes place not only during interpersonal exchanges, but also through the exposition to visual media which over time induce self-objectification (Fredrickson & Roberts, 1997). Therefore, research seems to suggest that gay men and heterosexual women might have similar body image issues and consequently might experience objectification to the same extent, internalizing the same external view and learning to evaluate their bodily selves from another person's perspective.

Much less research has focused on gay men as agents of sexual objectification, studying if and why they objectify other people. While some work has analyzed how gay men objectify other men (Anderson et al., 2018; Szymanski et al., 2019), other work has suggested that gay men tend to objectify both men and women (M. Kozak et al., 2009). Deepening our understanding on the objectification of men and women by gay men is fundamental to explain the pervasiveness of sexual objectification and the motivations that drive it.

Why gay men objectify other men?

If sexual objectification is driven by physical attraction, gay men should objectify men, much like heterosexual men have shown to objectify women, the more they are sexually attracted to them (Vaes et al., 2011). Indeed, most of the limited literature has focused on how and when gay men tend to objectify other men. Szymanski et al. (2019), for example, demonstrated that a high importance placed on physical appearance and less restrictive affectionate behavior increased gay men's tendency to objectify other men. Anderson et al. (2018), instead, focused on the role of the use of the dating app Grindr. They found that the more gay men used Grindr and self-presented on the app in objectifying ways, the more they objectified other men. In both cases, a focus on physical attraction seems relevant when gay men objectify other men.

Why gay men objectify women?

Physical attraction – even though central – is not the only motivator underlying sexual objectification. Indeed, not only has the literature consistently shown that sexualized women are objectified by both heterosexual men and women (Cogoni, Carnaghi, Mitrovic, et al., 2018;

Cogoni, Carnaghi, & Silani, 2018; Cogoni et al., 2021; Heflick et al., 2011; Vaes et al., 2019, 2020), some research seems to suggest that they are objectified by gay men too (M. Kozak et al., 2009). Sexual objectification has shown to be related to stereotypical female roles (Eagly & Wood, 1999) and a cultural context that is marked by a patriarchal hierarchy (Bartky, 2015; Jeffreys, 2014) typically present in Western cultures. It is indeed possible that gay men, growing up with media that mainly objectify and sexualize the female body (Ward, 2016), interiorize this cultural lens that consequently increases their likelihood to objectify women too. Indeed, in advertising, social media and also in television women are stereotypically presented emphasizing their physical appearance, sentimentality and reverence depicting them as objectified and sexualized. As opposed, male depictions appear strong, independent and dominant (Ringrose & Harvey, 2015; Wood & Fixmer-Oraiz, 2018). For this reason, if sexual objectification is driven by the exposure to objectifying media, women can also be objectified by gay men.

The present research.

Most of the objectification research has focused on the perspective of the heterosexual population or has considered gay men as a victim of this phenomenon. Few studies have investigated whether gay men objectify both sexualized women and men and to what extent. Therefore, in the current set of studies we directly compared gay men's tendency to sexually objectify men and women with three aims in mind. First of all, we aimed to extend our knowledge exploring whether and why gay men objectify mostly men or women. Secondly, we aimed to show this difference using a newly developed paradigm that directly compares the elaboration of objectified human and object stimuli to demonstrated the occurrence of the process of sexual objectification. Finally, we also aimed to study the underlying societal and cultural mechanisms that drive gay men's sexual objectification. Since sexual attraction is one of the main driving forces behind the sexual objectification of women by heterosexual men and given that men are the object of gay men's sexual desire, we can expect gay men to objectify sexualized women less than sexualized men. Such a finding would emphasize the importance of sexual motivations and suggest that specific characteristics of the agents of sexual objectification become fundamental, given that the target can shift as a function of a man's sexual orientation. Nevertheless, since both heterosexuals and gay men grow-up in a culture that mostly sexually objectifies women, one might expect gay men to adopt and interiorize an objectifying gaze towards women objectifying sexualized women more than sexualized men. Not because of sexual motivations, but because of a cultural lens that typically values and focuses on women's physical features. Such a finding would emphasize the importance of socio-cultural motivations, like the exposure to objectifying media. Moreover, it would suggest that variables related to the target of sexual objectification are more important than agent characteristics, as the target of objectification remains the same regardless of people's sexual orientation.

With these goals in mind, we conducted two studies. Study 1 consisted of an electroencephalography (EEG) experiment aiming at exploring whether gay men sexually objectify female rather than male targets or vice versa from a neural and behavioural point of view. Specifically, we adopted an oddball paradigm (Vaes et al., 2019) where series of frequent male and female human stimuli are interrupted by infrequent gender-matched doll-like objects that are expected to trigger an oddball effect. The oddball is a late neurophysiological response (P300) which increases the more the infrequent stimuli are perceived different from the frequent (i.e., human stimuli). In Study 1, we expect a smaller oddball effect for those human stimuli that are perceived as less dissimilar from objects.

Study 2, an online questionnaire, tested the extent to which gay men and male and female heterosexual participants objectified sexualized male and female targets. In addition, it explored the role of interindividual differences, exposition to media sources of objectification and perceived characteristics of sexualized targets as potential drivers of sexual objectification in these different populations. As such, we aimed to replicate the effects of Study 1 and explored what drives the sexual objectification of sexualized male and female targets in gay men compared to male and female heterosexual participants.

Study 1

With this first study we wanted to explore whether gay men would rather sexually objectify men or women. Moreover, adopting the same oddball paradigm used by Vaes et al. (2019), we presented objectified human stimuli (male and female) and gender-matched doll-like objects while recording participants' neural activity. In this paradigm objectification occurs when an object is less recognized and differentiated from the human male or female targets.

Methods

Participants

Data collection was stopped when 28 healthy volunteers participated in the study. All participants had normal or corrected to normal vision and reported no history of neurological impairment. For their involvement each of them received a monetary compensation of 10 €. Three participants were excluded from the analysis because of an excessive rate of EEG artefacts (exceeding 25%), while other two participants declared to be bisexual and for the purpose of our research, we decided not to include them in the analysis. A final sample of 23 gay male participants (Mage = 23.61, SD = 5.13) was retained for the analysis. A sensitivity power analysis calculated using PANGEA (for details see www.jakewestfall.org/pangea/) indicated that we had sufficient power (.80) to detect an effect size of d=.79 with η^2_p = .135 and an alpha=.05 for the interaction effect. Thus, our experimental set-up allowed us to reliably detect medium to large effects. The study was approved by the local Ethics Committee (protocol 2016-004) and all participants gave their consent at the beginning of the experiment.

Stimuli and Procedure

Similarly, to Vaes and colleagues (2019) an Oddball paradigm was used to present a total of 82 stimuli, 42 representing females (21 objectified female and 21 female resembling doll-like avatars) and 40 males (20 objectified male and 20 male resembling doll-like avatars) were presented (see Figure 3.1). All the stimuli taken from Vaes et al. (2019), were pretested guaranteeing that all human stimuli were seen as objectified depictions of men and women and that the human and doll-like stimuli were balanced with Matlab in contrast and luminance. The human models represented the frequent stimuli that were infrequently interrupted by a doll-like avatar, the deviant stimulus. All pictures had the same dimensions (5.35°×7.64°). The stimuli were presented 2.67° under the centre of the monitor and on a uniformly grey background at the centre of the screen. The fixation cross was located 1.91° above the centre of the screen. The experiment consisted of four blocks presented in a randomized order: two of them contained only female targets, while the other two blocks contained the male targets. Each block comprised of 250 pictures (80% frequent stimuli and 20% infrequent stimuli) and were programmed so that every infrequent stimulus was followed by at least two frequent stimuli. Each trial began with a fixation cross that remained on the screen when the target appeared. All the stimuli remained on the screen until participants gave their response. Participants were asked to categorize the pictures, as fast and accurate as possible, by pressing two keys on the keyboard distinguishing between the human target and the doll-like avatar[4]. Details about the electrophysiological recording and processing can be found in the Appendix 2. Materials and

[4] At the end of the experiment participants were also asked to complete the IRI (Interpersonal Reactivity Index) and the stereotypes about male sexuality scale. Our aim was to correlate the results of these questionnaires with the ERP to have a better view of what might drive sexual objectification of men or women in gay men. However, the analyses showed no relevant or significant correlations. Therefore, these results will not be discussed any further.

data for the experiment are available at: https://osf.io/uyseh/?view_only=a6d2fa6c529e48e4bfab8a735a0c614d.

Results

Behavioural results

Accuracy. Overall participants were highly accurate in categorizing the stimuli. The percentage of participants' correct responses were analysed in a 2 (Target Gender: male vs. female) X 2 (Humanity: human vs. doll-like avatar) within-participants ANOVA, revealing a main effect of gender and humanity of the target. Participants showed a tendency to categorize male targets more accurately compared to female targets, $F(1,22)=7.81$, $p=.011$, $\eta^2_p=.26$ and human rather than doll-like avatars, $F(1,22)=34.91$, $p<.001$, $\eta^2_p=.61$. Moreover, Gender and Humanity interacted marginally, $F(1,22)=4.31$, $p=.050$, $\eta^2_p=.16$, indicating a general tendency of participants in being more accurate in categorizing male doll-like avatars (*M*=87.4%, *SD*=8.6) compared to female doll-like avatars (*M*=82.1%, *SD*=12.4). An exploratory t test analysis revealed a significant difference between the categorization of doll-like avatars, $t(22)=-2.91$, $p=.008$, $d=-.87$, while no significant differences were found between human objectified female (*M* = 96.4%, *SD*=5.92) and male (*M* = 97.1%, *SD*=4.23) targets, $t(22) = -.61$, $p = .547$, $d=-.18$. These results indicated that participants had the tendency to find it more difficult to categorize the target when a doll-like female avatar appeared among a series of objectified female targets compared to when a doll-like male avatar appeared among a set of objectified male targets[5].

[5] Signal detection analysis has also been conducted, focusing on the criterium (the bias) and on dprime (the sensitivity) to detect doll-like avatars comparing responses to female and male doll-like avatars. Both the bias, $t(18)=-3.32$, $p=.004$, $d=1.11$, and the dprime, $t(18)=-2.69$, $p=.015$, $d=-0.66$, were significant. Gay men were more sensitive and less biased when answering to male doll-like avatars ($M_{dprime}=3.33$, $SD_{dprime}=.77$; $M_{criterium}=2.27$, $SD_{criterium}=.58$) compared to female doll-like avatars ($M_{dprime}=2.97$, $SD_{dprime}=.86$; $M_{criterium}=1.97$, $SD_{criterium}=.68$). However, we decided to not include this analysis in the main text given that signal detection statistics give a measure of participant's sensitivity to detect a weak signal. Our error rate, however, was very low and participant's accuracy was very high (90%).

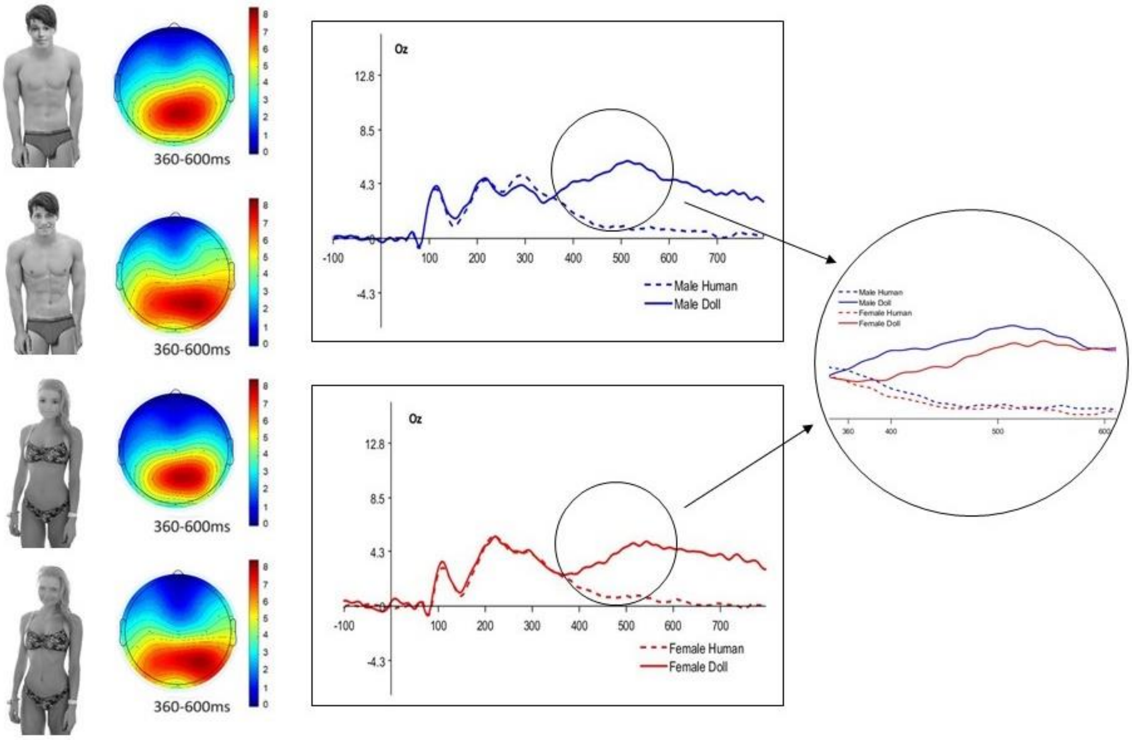
Reaction times. Participants' reaction times of their correct responses were analysed with the same 2 (Target Gender: male vs. female) X 2 (Humanity: human vs. doll-like avatar) within-participants ANOVA. In this case no significant differences emerged ($M_{overall}$ = 801 ms).

Electrophysiological results

A 2 (Target Gender: male vs. female) X 2 (Humanity: human vs. doll-like avatar) within-participants ANOVA was conducted in each region of interest between 360 and 600ms after stimulus onset. Below we only report results of the occipital electrodes given that parietal electrodes showed very similar findings, these analyses can be found in the Appendix 2.

Analysis of the occipital site revealed a main effect of Gender, $F(1,22)=7.18$, $p=.014$, $\eta^2_p=.25$, and Humanity of the target, $F(1,22)=61.61$, $p<.001$, $\eta^2_p=.74$. The P300 was more positive for male ($M=10.44$, $SD=8.61$) compared to female targets ($M=8.25$, $SD=8.60$), and in line with the oddball effect, the infrequent stimuli elicited a more positive P300 for the doll-like avatars ($M=14.22$, $SD=10.14$) compared to the human targets ($M=4.47$, $SD=7.43$). Importantly, an interaction effect emerged between Gender and Humanity, $F(1,22)=9.76$, $p=.005$, $\eta^2_p=.31$. The P300 was more positive when the doll-like male avatar appeared among a set of objectified male targets compared to when the female doll-like avatars appeared among a set of objectified female targets, $t(22)=3.53$, $p=.002$, $d=1.06$; while no differences were found between the objectified human targets, $t(22)=.901$, $p=.377$, $d=.27$ (see Figure 3.1).

Figure 3.1: Stimuli and electrophysiological results of Experiment 1.



Note. Left panel: example of stimuli depicting an objectified human male, an objectified human female and their respective doll-like avatars. The specific stimuli that are shown in this figure were not used in the current experiment but are similar to the originals. Due to copyright restrictions we cannot publish the original experimental stimuli. The experimental stimuli can be obtained on request contacting the corresponding authors. Mid panel: scalp distribution of the ERP activity in the P300 time window. Right panel: Grand average waveforms for objectified male and female targets and their respective doll-like avatars. Right circle: Detail of the comparison between the grand average waveforms between all targets in the P300 time window.

Discussion

The results demonstrated that the P300 was significantly smaller when a female doll-like avatar appeared among a set of objectified female pictures compared to when a male doll-like avatar was infrequently presented among a series of objectified male pictures. As such, this neural evidence together with participants' behavioural accuracy demonstrate that an object presented among objectified female human pictures is recognized to a lesser extent compared to when an object appears among objectified male human pictures. To verify whether this effect was similar to the one observed among heterosexual men and women, we performed a mini meta-analysis confronting the neural results of the current study with those of Study 1 in Vaes et al. (2019). A meta-analysis was performed on the P300 amplitude differences between male and female stimuli, separately for human and doll-like targets. Medium to strong effects emerged indicating that female and male doll-like targets differed in the expected direction, $r=.59$, $Z=3.87$, $p<.001$. While no differences were found between male and female human targets, r=.15, $Z=.85$, $p=.39$. Given that the index of heterogeneity between both studies was not significant, $Q_{real}(2)=1.75$, $p_{real}=.42$; $Q_{doll}(2)=4.26$, $p_{doll}=.12$, two different conclusion can be drawn. When sexual objectification occurs, sexually objectified women are truly perceived more similar to an object compared to any other human stimuli. This claim allows us to confirm how, the human-object divide literally fades when sexually objectified women are presented. Moreover, we can also conclude that gay men elaborated the sexually objectified women as more similar to an object compared to their male counterparts much like heterosexual men and women do. However, even if the results of the meta-analysis clearly confirm that objectified women were perceived similarly by gay men and a heterosexual sample, our experimental sample was limited to gay men. For this reason, a second study was conducted to overcome this limit and directly compare a sample of gay men with heterosexual men and women while evaluating sexually objectified women.

Study 2

The first aim of Study 2 was to replicate Study 1's finding, suggesting that gay men tend to sexually objectify women more than men, much like heterosexuals do. Therefore, we presented both gay men and heterosexual men and women with a questionnaire in which they were exposed to similar pictures of objectified male and female targets as in Study 1. All participants were asked to judge how much the man or the woman in the picture was objectified.

Furthermore, we wanted to explore the potentially different motivations behind gay and heterosexual participants' tendency to objectify women more than men.

For this reason, we gathered a great number of variables that were identified as potential sources of objectification in previous research. Specifically, participants were asked to judge each male and female target on their sexual availability (Kellie et al., 2019) and sexual attraction (Vaes et al., 2011). Both variables have shown to increase sexual objectification especially among heterosexual men. In contrast, judgments of vulgarity and superficiality were added because they have shown to be related to women sexual objectifying other women (Vaes et al., 2011).

Furthermore, we added a series of scales that measured a range of interindividual differences that have been related to sexual objectification. Specifically, we added and adapted to the gender of each participant the intrasexual competition scale (Piccoli et al., 2013), given that this scale has been related to sexual objectification among women. A self-objectification scale was added following the results of previous work suggesting that especially women who self-objectify tend to objectify other women as well (Puvia & Vaes, 2013; Strelan & Hargreaves, 2005). The Inclusion of Objectified Women in the Overall Gender Category scale was added to measure the perceived overlap between participants' gender categories and their objectified representations (Puvia & Vaes, 2013). The use of this scale showed that the more female participants saw women and objectified women as separate categories, the more they objectified other women. Finally, the neo-sexism scale was added as some research (Cikara et al., 2011) has suggested that especially men high in sexism were more inclined to sexually objectify women.

In the last part of the questionnaire, we investigated participants use of various traditional and social media and the extent to which they indicated to be exposed to objectified depictions of men and women in each type of media. This was mostly done because an objectifying media culture has been central in explaining sexual objectification (Fredrickson et al., 1998; Ward, 2016), but might play out differently when comparing gay men with heterosexual men and women. For each of these measures, we compared if and how they related to the tendency of gay men versus heterosexual men and women to objectify women more than men. Given that we did not know how they will play out in a gay sample, however, we consider this analysis to be exploratory.

Methods

Participants

A total number of 285 participant were involved in the study[6]. Data collection was conducted on Prolific Academic and each participant received a monetary compensation of 2£. We decided to remove all participants who responded with the same number on all the Likert scales when judging each and every model from the analysis to avoid including responses where models were not differentiated. A final sample of 219 participants was retained for the analysis. This final sample was characterized by 64 heterosexual women (M_{age}=31.5, DS_{age} =11.82), 80 heterosexual men (M_{age}=29.8, DS_{age}=11.66) and 75 gay men (M_{age}=33.4, DS_{age}=13.06). The heterosexual women were mostly White or Caucasian (89,1%) and mostly Christian (43,8) or agnostic (21,9%), 51.6% of them had a paid job with an undergraduate degree (42,2%). The heterosexual men were mostly White or Caucasian (83,8%) and Christian (41,3%) or agnostic (25%) with a paid job (43,8%) and an undergraduate degree (36,3%). The gay sample was mostly White or Caucasian (88%) and agnostic (36%) and most of them had a paid job (57,3%) and an undergraduate degree (38,7%)

[6] We also collected a total of 90 gay female participants. The analysis of their data goes beyond the scope of the current article.

A sensitivity power analysis calculated using PANGEA (for details see www.jakewestfall.org/pangea/) indicated that with a total of 219 participants we had sufficient power (.80) to detect an effect size of *d*=.38 with η^2_p=.035 and an alpha=.05 for the interaction effect between objectification and the sexual orientation of participants.

Procedure

Study 2 was subdivided into four consecutive parts: demographics, the picture rating task, the inter-individual scales and the exposure to mass media.

Demographic questions. Participants were asked to indicate their age, first language, racial identity, their gender and sexual orientation. Then, they had to select their religious preference (if any) and indicate how religious they were. Finally, they had to indicate their employment status (i.e., whether they were a student, or they had a paid job), and their level of education.

Picture rating task. Participants were asked to rate 20 pictures presented in a randomized order. A total of 20 representative stimuli out of the 40 that were used in Study 1 were selected: 10 depicting objectified female and 10 objectified male targets (see Appendix 2 for a description of the selection criteria). For each of the stimuli presented at the top of the screen, a series of questions appeared below. Specifically, participants had to indicate how much they perceived the person in the images to be “sexually available”, “sexually attractive”, “good looking”, “vulgar” and “superficial” on a 7-point scale (1= *Not at all* to 7= *Extremely*). Then, they were asked to evaluate the mind of the person in the pictures using 6 items of the Mind attribution scale (Gray et al., 2007; Gray et al., 2011), such as the level of “self-control”, “feeling pain”, “acting morally”, “feeling desire”, “planning” and “feeling fear” on a 7-point scale (1= *Not at all* to 7= *Extremely*). Finally, they evaluated whether the person in the pictures was represented as an objectified woman or man on a 7-point Likert scale (1= *Not at all* to 7= *Extremely*).

Inter-individual difference scales. Participants completed a series of four scales presented in a randomized order. The scales comprised: 1) A shortened version of the Intrasexual Competition Scale (Buunk & Fisher, 2009) adapted to the gender and sexual orientation of each participant, investigating the extent to which participants endorsed a total of 6 statements on a 7-point scale (e.g. "I tend to look for negative characteristics in an attractive women/men", 1= *Not at all Applicable* to 7= *Completely Applicable*). 2) The Self-Objectification Inventory (Fredrickson et al., 1998) where participants had to rank order a list of 10 body attributes indicating the impact of each of these attributes for their physical self-concept. Five referred to appearance related body characteristics (e.g. weight, sex appeal), while the other five referred to competence-related body characteristics (e.g. physical coordination, health). 3) The Inclusion of Objectified Women in the Overall Gender Category, an adaptation of a pictorial measure taken from Schubert and Otten (2002), partially already used by Puvia and Vaes (2015), and here also adapted for male targets. Participants needed to choose one of seven pairs of circles that range from not touching to almost completely overlapping that represented the similarity they perceived between women/men in general and their objectified counterparts. 4) The neo-sexism scale (Tougas et al., 1995), where participants had to indicate the level of agreement to a list of 11 statements on a 5-point Likert scale (e.g., Women's requests in term of equality between the sexes are simply exaggerated; ; 1= *Strongly Disagree* to 7= *Strongly Agree*).

Exposure to objectified depictions in the mass media. In this part of the questionnaire participants were asked to indicate the time they are typically exposed to different mass media (i.e., television, Tv on demand, porn websites, YouTube, printed fashion magazines, printed adult magazines, printed news magazine, online magazines, Facebook, Instagram, Snapchat, dating apps, and other social media) reporting the time they spend on average in a week looking at each of the aforementioned media on a 7-point scale ranging from 0=Never to 20=More than 20 hours. Then, they were asked to indicate how often they had seen depictions of women similar to the ones presented before (i.e., in the picture rating task of this study) on each of the media outlets on a 7-point scale (1= *Not frequently at all* to 7= *Very frequent*) and were asked to do the same for male depictions. In these last two questions an "N/A" response option was also presented to allow participants to indicate that they did not spent any time during the previous week on that specific media outlet. This response was coded as 0.

Materials and data for the experiment are available at: https://osf.io/uyseh/?view_only=a6d2fa6c529e48e4bfab8a735a0c614d.

Results

Level of objectification.

Our first aim was to verify whether the objectification ratings changed on the basis of target gender and the sexual orientation of participants. For this reason, participants' objectified evaluation of the targets was aggregated (α_{male} = .95 and α_{female} = .95) and analysed in a 2 (Target gender: male vs. female) X 3 (Sexual orientation: gay male vs. heterosexual male vs. heterosexual female) mixed ANOVA in which only the last variable was manipulated between participants. A main effect of the evaluation level of objectification of target gender emerged, $F(1,216)=14.45$, $p<.001$, $\eta_p^2=.06$, showing a tendency to objectify women ($M=4.93$, $SD=1.33$) more than men ($M=4.73$, $SD=1.37$). Moreover, the interaction on the evaluation level of objectification between target gender and sexual orientation emerged significantly, $F(2,216)=6.35$, $p=.002$, $\eta_p^2=.06$. The difference between the level of objectification of women and men was stronger in gay men, $F(1,216)=12.77$, $p<.001$, $\eta_p^2=.06$, and in heterosexual men, $F(1,216)=16.55$, $p<.001$, $\eta_p^2=.07$, where women were objectified more ($M_{gay}=4.99$, $SD_{gay}=1.29$; $M_{Hetero}=4.83$, $SD_{Hetero}=1.44$) than men ($M_{gay}=4.70$, $SD_{gay}=1.37$; $M_{Hetero}=4.50$, $SD_{Hetero}=1.48$). Whereas, heterosexual women objectified women ($M=4.97$, $SD=1.22$) similarly to men

(M=5.04, SD=1.18), F(1,216)=.562, p=.45, $\eta_p{}^2$=.00 (see Appendix 2 for ANOVA's on all variables).

Sources of objectification.

To test whether the variables inducing heterosexuals (both men and women) to objectify women are different from those of gay men, multiple regression analyses were performed using the contrast coding method (Cohen et al., 2003) that selects orthogonal group contrasts. We regressed participants level of objectification subtracting the objectification towards men from that towards women on each of the potential sources of objectification together with two contrast codes: the first contrasted both the male and female heterosexual participants (=-.33) with gay men (=.67). Given that our focus is on understanding the motivations that drive sexual objectification among gay men, we call this the main contrast. The second contrast code – the control contrast - needed to be orthogonal with the first, weighing gay men (=0) and quantifying the difference between heterosexual men (=.5) and women (=-.5). In cases where the main predictor was calculated separately for female and male targets (e.g., the media indices and the social judgments), the male index was subtracted from the female index (see Appendix 2 for a detailed description of the way each index was calculated). When any of the interaction terms or a general main effect of a specific source of objectification was significant , single slope analyses were conducted for each of the target groups (i.e., gay men, heterosexual women and men) where one group is coded with 1 while the others are coded 0 (see Cohen et al., 2003 for more details). Only relevant analyses are described (see Appendix 2 for detailed analyses).

Social Judgments. For the social judgments several main effects emerged, showing how judgments of sexual availability, B=.237, SE=.046, t=5.14, p<.001, sexual attractiveness, B=.139, SE=.068, t=2.06, p=.041, vulgarity, B=.122, SE=.044, t=2.73, p=.007, and superficiality, B=.129, SE=.042, t=3.07, p=.002, all increased participants tendency to objectify women more than men. In general, the more participants judged the female targets as more sexually available, sexually attractive, vulgar and superficial than men, the more they objectified women compared to men. One significant and positive interaction emerged between agency (i.e., a component of mind perception) and the control contrast, *B*=.251, *SE*=.123, *t*=2.03, *p*=.043. However, none of the single slope analyses in each of the separate samples revealed a significant relation between agency and objectification (see Table 3.1). On the other hand, a significant main effect was observed for experience (i.e., the second component of mind perception), *B*=.104, *SE*=.043, *t*=2.41, *p*=.016, showing how, in general, the more participants attributed more experience characteristics to female rather than male targets, the more they objectified women over men.

The single slope analyses for those social judgement which main effect appeared to be significant, indicated that Sexual Availability, *B*=.252, *SE*=.056, *t*=4.53, *p*<.001, Sexual Attractiveness, *B*=.259, *SE*=.098, *t*=2.65, *p*=.009, and Superficiality, *B*=.110, *SE*=.052, *t*=2.12, *p*=.035, especially predicted the objectification of women rather than men in heterosexual men. While social judgements such as Vulgarity, *B*=.234, *SE*=.096, *t*=2.43, *p*=.016, and the second component of mind perception, Experience, *B*=.190, *SE*=.071, *t*=2.68, *p*=.008, especially predicted the objectification of women rather than men in gay men.

Table 3.1: Association between Social Judgments and Sexual Objectification.

Predictors	Main Effects		Interactions				Single Slopes					
			Control Contrast		Main Contrast		Gay men		Heterosexual men		Heterosexual women	
	B	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**
Sexually Available	**.237*****	.046	-.038	.176	-.096	.130	.175	.122	**.252*****	.056	.290	.167
Sexually Attractive	**.139***	.068	.398	.254	.003	.163	.063	.101	**.259***	.098	-.139	.234
Good Looking	.079	.058	.230	.165	.021	.135						
Vulgar	**.122***	.044	-.081	.120	.121	.113	**.234***	.096	.073	.057	.154	.105
Superficial	**.129***	.042	-.031	.123	.060	.114	.185	.096	**.110***	.052	.141	.112
Agency	.027	.043	**.251***	.123	.049	.091	.026	.066	.102	.067	-.149	.103
Experience	**.104***	.043	.105	.110	.144	.089	**.190***	.071	.098	.071	-.007	.084

*** $p < .001$; * $p < .05$; B (unstandardized b coefficients); SE (Standard Error)

Mass Media Exposure. We first controlled the time every group spent on each media source. These analyses are not only indicative of what type of media is more probable to influence the level of objectification towards women, but also reflected the average hours each group of participants spent on that specific media outlet. Focusing on the three most popular media outlets (see Table 3.2 for details), both heterosexual men and women spent most of their time watching YouTube, Tv on Demand and Facebook, albeit in a different order, whereas gay men also prefer to spend most of their time on YouTube and on Tv on Demand, but indicated Porn as their third most watched media outlet.

Table 3.2: Means and Standard Deviations of the hours spent on each type of media.

Gay Men		**Heterosexual Men**		**Heterosexual Women**	
Time on Media	*M* *(SD)*	**Time on Media**	*M* *(SD)*	**Time on Media**	*M* *(SD)*
YouTube	4.67 (2.58)	YouTube	5.85 (2.99)	Tv on Demand	5.51 (3.38)
Tv on Demand	4.29 (3.57)	Tv on Demand	4.13 (3.38)	Facebook	4.86 (3.46)
Porn	3.64 (2.68)	Facebook	3.83 (3.61)	YouTube	4.23 (2.84)
Facebook	3.37 (3.57)	Television	3.49 (3.5)	Television	3.95 (3.62)
Television	3.31 (3.06)	Other Social Media	2.59 (3.29)	Instagram	3.86 (3.31)
Instagram	2.40 (3.04)	Instagram	2.55 (3.27)	Other Social Media	2.40 (3.49)
Other Social Media	2.06 (2.85)	Porn	2.24 (2.37)	Online Magazines	1.26 (2.55)
Dating Apps	1.64 (2.68)	Online Magazines	1.62 (2.95)	News Magazines	.68 (1.89)
Online Magazines	1.44 (2.57)	Snapchat	.72 (1.96)	Snapchat	.51 (1.79)
Snapchat	.94 (1.99)	News Magazines	.71 (1.71)	Fashion Magazines	.49 (1.27)
News Magazines	.77 (1.78)	Dating Apps	.42 (1.78)	Porn	.39 (1.17)
Fashion Magazines	.13 (.61)	Fashion Magazines	.10 (.65)	Adult Magazines	.23 (1.37)
Adult magazines	.11 (.69)	Adult Magazines	.08 (.47)	Dating Apps	.09 (.66)

To get a better idea how each type of media and the frequency with which participants were exposed to objectified women rather than men could moderate their tendency to objectify women rather than men, we ran a regression analysis for each mass media outlet on the objectification index (see Appendix 2 for full details). This analysis revealed an interaction effect between YouTube and our main contrast, B=.277, SE=.093, t=2.96, p=.003, showing a positive effect of YouTube on the objectification of women. Specifically, analysing the single slopes, only a significant relation between exposure to YouTube and objectification emerged for the gay male sample, B=.213, SE=.073, t=2.94, p=.004, demonstrating how the more gay men are exposed to images of objectified women rather than men on YouTube, the more they tend to objectify women compared to men. Both other samples, instead, showed non-significant negative links between exposure to YouTube and objectification (see Table 3.3).

An opposite pattern occurred for Facebook, where both the control contrast, B=.264, SE=.118, t=2.24, p=.026, and the main contrast, B=-.261, SE=.105, t=-2.48, p=.014, significantly interacted with exposure to this social media. The single slope analysis showed a significant and positive relation for male heterosexual participants, B=.300, SE=.094, t=3.21, p=.002, revealing how the more heterosexual men are exposed to images of objectified women rather than men on Facebook, the more they objectify them compared to men. Interestingly, the same effect was not found for heterosexual female participants and a non-significant opposite tendency emerged for the gay male sample.

Apart from these interaction effects, a series of interesting main effects emerged in the analysis of participants' exposure to the other mass media. Tv on Demand positively predicted objectification towards women, B=.116, SE=.052, t=2.25, p=.025, similar results emerged for Instagram, B=.119, SE=.048, t=2.49, p=.013, and Dating apps, B=.106, SE=.047, t=2.23, p=.027, demonstrating how greater exposure to objectified women rather than men on these social media predicted more objectification towards women compared to men (see Table 3.3 for details).

Given that we were interested in how media effects influenced objectification for each sample, we also ran a single slopes analysis in each sample where a significant main effect of mass media was found. This analysis revealed that social media such as Instagram, B=.152, SE=.071, t=2.14, p=.033, and Dating apps, B=.236, SE=.076, t=3.10, p=.002, especially predicted the objectification towards women rather than men for heterosexual male participants. Instead, gay men tended to be influenced more by mass media such as Tv on the demand, B=.183, SE=.084, t=2.18, p=.030, objectifying women the more they were exposed to the objectified images of women in these media outlets.

Table 3.3: Association between Mass Media and Sexual Objectification.

Predictors	Main Effects		Interactions				Single Slopes					
			Control Contrast		Main Contrast		Gay men		Heterosexual men		Heterosexual women	
	B	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**
Television	.074	.050	-.180	.132	.106	.102						
Tv on Demand	**.116***	.052	.014	.164	.104	.117	**.183***	.084	.086	.146	.073	.073
Porn	-.038	.063	.145	.637	.120	.328						
YouTube	.046	.046	-.032	.118	**.277***	.093	**.213***	.073	-.080	.084	-.047	.082
Fashion Magazines	.014	.050	-.304	.370	.181	.216						
Adult Magazines	.045	.057	-.007	.166	.003	.115						
News Magazines	.036	.047	.005	.190	.049	.109						
Online Magazines	-.019	.048	-.022	.120	.081	.122						
Facebook	.066	.049	**.264***	.118	**-.261***	.105	-.093	.087	**.300***	.094	.035	.072
Instagram	**.119***	.048	.070	.103	.006	.144	.123	.134	**.152***	.071	.082	.075
Snapchat	-.003	.045	.007	.143	-.078	.116						
Other Social Media	.028	.046	.002	.142	.064	.097						
Dating apps	**.106***	.047	.018	.298	-.211	.161	.016	.061	**.236***	.076	.218	.288

(*** $p < .001$; * $p < .05$; B (unstandardized b coefficients); SE (Standard Error))

Cluster analysis. The main analyses on social media showed differentiated effects for heterosexual and gay men to be influenced by relational and interactive social media compared to media that is driven by more passive views of objectified women respectively. For this reason, we decided to exploratively verify whether a cluster division between more social and relational media, such as Facebook, Instagram, Snapchat and dating apps, and media that implies the passive consumption of images, such as Television, Tv on Demand and YouTube, might play a specific role on our experimental sample. A significant interaction between Relational media and our control condition appeared, B=-.136, SE=.111, t=-2.02, p=.045, indicating that the more heterosexual men used social and relational media, the more they objectified women, B=.250, SE=.079, t=3.74, p<.001, while no significant effect emerged with gay men or heterosexual women. On the other hand, also the interaction between Passive media and our main hypothesized condition appeared to be significant, B=.170, SE=.101, t=-2.49, p=.013, indicating that the more gay men passively viewed sexualized women on mass media, the more they objectified women, B=.220, SE=.076, t=3.28, p=.001, while no significant effect emerged with heterosexual men and women.

Interindividual differences. Analysing the interindividual difference questionnaires no main effects emerged. However, an interaction effect between the Intrasexual Competition Index and our main contrast appeared, B=-.205, SE=.104, t=-1.97, p=.050, indicating that the more gay men felt in competition with other men, the more they objectified men rather than women, B=-.189, SE=.084, t=-2.24, p=.026. In addition, a marginally significant interaction emerged between the neosexism scale and the control contrast, B=.262, SE=.136, t=1.93, p=.055, showing how this scale predicted more objectification towards women than men in heterosexual men, B=.205, SE=.081, t=2.52, .012 (see Table 3.4 for details).

Table 3.4: Association between Interindividual Questionnaire and Sexual Objectification.

Predictors	Main Effects		Interactions				Single Slopes					
			Control Contrast		Main Contrast		Gay men		Heterosexual men		Heterosexual women	
	B	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**
IOW/IOM	-.085	.052	-.149	.131	.064	.109						
ICS	-.056	.049	.059	.122	**-.205***	.104	**-.189***	.084	.045	.090	-.014	.082
NeoSexism	.059	.052	**.262°**	.136	-.103	.108	-.029	.084	**.205***	.081	-.057	.109
Self-Objectification	.033	.051	.192	.129	.014	.107						

Note. *** $p < .001$; * $p < .05$; ° $p < .10$; B (unstandardized b coefficients); SE (Standard Error); IOW/IOM (Inclusion of Objectified Women/Men in the Overall Gender Category)

Discussion

Results of Study 2 clearly replicated the finding of the first study showing that gay men objectified women more than men. Even though we expected the same effect to occur for both male and female heterosexuals, we only found a greater tendency to objectify women rather than men in male heterosexual participants. We presume that the explicit nature of our question measuring objectification might have inhibited heterosexual women to target their female group members more than their male counterparts.

Our second aim focused on testing which differences between the three groups might explain their tendency to objectify women rather than men. Only three potential sources of objectification clearly showed a different interaction pattern for the three target groups. Specifically, exposure to objectified women on YouTube uniquely increased the tendency of gay men to objectify women more than men, while exposure to sexualized women on Facebook uniquely increased the sexual objectification of women rather than men among heterosexual men. These first two differences are particularly interesting especially when looking at the single slope analyses of the main effects of all the media. From this extended analysis, one can see that gay men objectify women the more they are exposed to them on YouTube or TV on demand, instead a similar tendency among heterosexual men is mostly driven by exposure to sexualized women on Facebook, Instagram and Dating apps. While TV on demand and YouTube present ready-made content that is chosen, but passively watched by its viewers, Facebook, Instagram and Dating apps are relational-oriented media, made to actively search for other individuals. Tentatively, one might derive from these results that the incidental exposure of gay men to sexually objectified representations of women on mainstream media (both YouTube and TV on demand were among the most popular media outlets in our sample) shapes their tendency to objectify sexualized women. Instead, more relational and interactive motives seem to play a central role for heterosexual men. The more their active search for individuals includes objectified women, the more they increase their tendency to objectify female targets. From this perspective more culturally determined representations of women seem to be influential in the objectification of women for gay men, while heterosexual men are influenced by more relational and sexual motives. This latter finding is corroborated by the observation that heterosexual men's tendency to objectify women is related to judgments of sexually availability and sexual attractiveness. This, even in the absence of a significant interaction, is in line with previous research highlighting the central role of sexual motivations in driving sexual objectification of women in heterosexual men (Kellie et al., 2019; Vaes et al., 2011).

The third source of objectification that shows a unique relationship with sexual objectification indicated that gay men objectified men the more they felt in competition with their peers. This result parallels findings that have been reported for heterosexual women in previous research (Piccoli et al., 2013) and suggests that similar processes might play a role among gay men. The more they tend to see other men as potential competitors in terms of appearance and attention, the more they objectify other men.

Another finding in line with previous research (Cikara et al., 2011), indicated that the more heterosexual men had sexist attitudes towards women rather than men, the more they tended to objectify women. This result confirms the idea that sexual objectification, at least for heterosexual men, is grounded in more general, cultural, gender stereotypes.

Apart from these findings, some unexpected significant relations that were harder to explain emerged as well. First of all, while the main effect of superficiality and vulgarity were not strange per se, they were unexpectedly mostly significant among heterosexual and gay men respectively. For the vulgarity results, it is important to take into consideration how gay men perceive sexualized images of women. Indeed, it has been demonstrated that gay men show increased activation of the neural circuit of disgust when looking at sexy images that only depict women (Zhang et al., 2011). Moreover, disgust has been related to processes of dehumanization in other contexts (Buckels & Trapnell, 2013) suggesting why judgments of vulgarity towards sexualized female pictures might be related to the objectification of women by gay men. Regarding the superficiality results, we found a positive and significant correlation between the judgments of heterosexual men of superficiality and sexual availability, $r(80) = .31$, $p = .005$. The more heterosexual men evaluated objectified women as superficial, the more they were also evaluated as sexually available. Therefore, the relation between superficiality judgments and objectification for heterosexual men, might be driven by their tendency to see women as sexually available and instrumental for their sex goal.

Still, previous research demonstrated that heterosexual women were the ones objectifying other women the more they see them as superficial and vulgar (Vaes et al., 2011). As a matter of fact, several other sources of objectification (i.e., intersexual competition, IOS, and self-objectification) that were linked to the objectification of women towards other women in previous research, did not show to be significant. Since we did not see a general tendency to objectify women more than men in the sample of heterosexual women, we believe that the explicit nature of our objectification measure might have reduced its sensitivity in assessing their tendency to objectify other women. Indeed, most of the participants that always responded in the same way to all questions towards all pictures were heterosexual women (31 equal responses out of 95 heterosexual women, 19 equal responses out of 94 gay men and 16 equal responses out of 96 heterosexual men). While this might indicate that they tried to respond cautiously, it also reduced the sample size of heterosexual women reducing the predictive power of our analysis in this sample. Both elements might at least partially explain the lack of effects in this sample.

Finally, also the mind perception scale measuring the attribution of agency and experience to each male and female target showed some unexpected results. While the link between an increase in experience and the sexual objectification of women has been shown in previous research (Cogoni, Carnaghi, Mitrovic, et al., 2018; Cogoni et al., 2021; K. Gray et al., 2011a), we would have expected agency to show a general negative relation with sexual objectification. This tendency, however, was only observed in the sample of heterosexual women while for both male subsamples agency, and not experience, was related to the sexual objectification of women. It is important to note, however, that none of these links reached conventional levels of significance and therefore remain hard to interpret.

Overall, the current findings support the notion that gay men objectify women more than men and that this tendency is uniquely driven by culturally determined representations of women in mass media.

General Discussion

Since 1997, the year in which the Objectification Theory was introduced (Fredrickson & Roberts, 1997), a consistent amount of studies has been conducted on this phenomenon. Several antecedents and consequences of sexual objectification were unravelled. Some of these studies have not only tried to explore the mechanism of sexual objectification, but also showed how sexual objectification implies the reduction of objectified human to real objects. Such a claim, however, is only possible to make when human and perceptually similar objects are directly compared and presented together. Further, these studies explored sexual objectification mostly from a heterosexual perspective. The scant research on the gay population has mostly studied the negative consequences for gay men when they become targets of sexual objectification and self-objectify as a result. Little research has focused on gay men as the agents of objectification. The present set of studies was designed to deepen our knowledge on the extent to which gay men tend to objectify women and men with the aim to shed light on some of the major causes of objectification. Hence, this work advances the objectification literature in two ways.

Firstly, similar to the procedure used in Vaes et al. (2019) object stimuli were presented together with humans allowing us to affirm that sexual objectification directly implies seeing objectified human stimuli more similar to objects. Moreover, in two studies we found converging evidence that gay men objectify sexualized women more than sexualized men. Specifically, in Study 1 behavioral and neural evidence showed that objects were recognized less by gay men when presented among objectified female rather than objectified male images.

Moreover, a mini meta-analysis with our previous findings on a heterosexual sample (Vaes et al., 2019) showed no differences between the heterosexual and male gay population. In addition, these findings were replicated in a self-report questionnaire in Study 2 showing that gay men objectified sexualized women more than sexualized men, similarly to heterosexual men (but not heterosexual women). Together these results suggest that variables related to the target of sexual objectification are more important than agent characteristics as the target of objectification remains the same regardless of people's sexual orientation.

Secondly, we wanted to explore the role of a number of potential sources of objectification to further compare the role of agent (e.g., sexual motivations) and target characteristics (e.g., culturally determined representations of women and men) in sexual objectification. Therefore, in Study 2, we tested whether the motivations of gay men to objectify sexualized women more than men would be different compared to both heterosexual samples. Overall, the results gave more support for the centrality of target characteristics when gay men are the agents of sexual objectification. They objectified women more than men, and did so, the more they were exposed to sexualized depictions of women in media like YouTube and TV on demand. These types of media present ready-made content that often mirrors broader cultural elements like beauty standards (Wiseman & Moradi, 2010) and the sexualization of women as natural (Fredrickson & Roberts, 1997). Exposure to this type of media might habituate the audience to an objectifying gaze on the female body that is potentially interiorized and consequently applied when viewing women in general. The current results seem to suggest that gay men are susceptible to this process as well, not out of a sexual interest, but because they adopt a cultural and mediatic lens that often reduces women to their bodies and body parts.

The objectification of women over men from the perspective of heterosexual men, instead, largely confirmed previous findings that highlight the centrality of relational and sexual motivations (Vaes et al., 2011). Heterosexual men sexually objectified women more, the more they were exposed to sexualized depictions of women on social media like Facebook, Instagram and Dating apps. All media in which users actively search to know more or interact with other people. Moreover, they also objectified women more, the more they saw them as sexually available or attractive, findings that are clearly in line with the idea that men who feel sexually attracted towards a woman, activate an instrumental mindset that makes them emphasize a female's physical characteristics and objectify her as a result.

Limitation and future directions

The present research findings need to be interpreted in light of a number of limitations. Even though the current research clearly demonstrates that gay men objectify women more than men, the underlying motivations that have been related to this phenomenon should be seen as mostly exploratory. Therefore, confirmative research is needed to test the hypothesis that media-related sources of objectification can be driving forces behind the sexual objectification of women by gay men. In a similar vein, these underlying motivations should be tested using a longitudinal design or an experimental paradigm before any causal inferences can be made. We believe that the current experiments might inform this type of research indicating what sources of objectification are most likely relevant to explain why gay men might sexually objectify other people.

Conclusion

The present research is the first to highlight differences and similarities between gay and heterosexual participants' tendency to objectify men and women using neural, behavioral and self-report measures. The obtained results expand our understanding of the phenomenon of sexual objectification confirming that women are not only objectified by heterosexual, but also by gay men. We also showed that gay men objectify women more than men due to their repeated exposure to objectified representations of women in the media (especially YouTube and TV on demand). We propose that this exposure potentially leads to an internalization of an objectifying gaze towards women in general also among gay men. These findings are consistent with a socio-cultural explanation of sexual objectification. Moreover, these results further confirm the prevalence of the sexual objectification of women in our society as they are not only potentially objectified by heterosexual, but also by gay men. All together this work advances our knowledge on objectification showing that the target remains the same regardless of the sexual orientation of the agent and suggests that this might happen because we all are exposed and interiorize a culture lens that mostly objectifies the female body.

Chapter 4

Sexual objectification impairs emotional mimicry in social interactions

While research on sexual objectification has mainly focused on how sexually objectified women can become subject to sexual harassment and sexual aggression, the studies that have tried to explore more unconscious and uncontrolled behavioral consequences of sexual objectification are scarce. Specifically, given the prevalence of sexual objectification towards women in the Western world, it is important to study the more subtle, but potentially damaging consequences of sexual objectification in everyday social interactions. For this reason, the present research aimed at investigating the basic empathic processes that underlie and determine the success of every social interaction, measuring participants' mimicry behavior towards objectified and non-objectified women who express genuine facial emotions. Using electromyography (EMG), participants were presented with objectified and non-objectified female targets who expressed happiness and anger. Results indicated that both male and female participants showed less mimicry behavior only when sexually objectified women were presented regardless of the expressed emotion. Given that a lack of mimicry could impede the success of everyday interpersonal interactions, the result of this research advances our understanding of the daily consequences of sexual objectification in real-life situations.

Introduction

Sexual objectification is a widespread phenomenon that has been studied extensively in the past years (Bernard et al., 2020; Moradi & Huang, 2008; Vaes et al., 2013). This literature already provides some evidence regarding the explicit consequences of sexual objectification showing that objectified women more likely become victims of sexual harassment (Dill et al., 2008; Galdi et al., 2014), unwanted sexual advances (Loughnan et al., 2013) or social exclusion (Vaillancourt & Sharma, 2011). How sexual objectification might impact more benign, day-to-day social interactions, however, remains largely understudied. Therefore, the current research aims to understand the implicit and unconscious consequences of sexual objectification that might impact any social interaction. Specifically, we will focus on mimicry behavior hypothesizing that objectified women who express genuine emotions are mimicked less than women who are not objectified.

The theory of sexual objectification has been originally proposed by Fredrickson and Roberts (1997) and stated that when objectified, a woman's body, body parts or sexual functions are elaborated and perceived as a mere instrument and separated out from her personality and individuality. The literature regarding sexual objectification has primarily focused on understanding the possible causes and consequences of this pervasive phenomenon. Indeed, living in a world that potentially objectifies a woman's body could lead them to internalize the external perspective of others on their own body. Consequentially, when objectified a woman tends to perceive herself more as an object to be evaluated by others rather than a human being (Loughnan et al., 2017). Furthermore, self-objectification has been widely related to body shame (Miner-Rubino et al., 2002), sexual disfunctions (Calogero & Thompson, 2009), a decrease in general well-being (Mercurio & Landry, 2008), and mental health issues such as depression or eating disorders (Calogero & Thompson, 2009; Fredrickson et al., 1998; Gay & Castano, 2010; Jones & Griffiths, 2015; Peat & Muehlenkamp, 2011; Quinn et al., 2006; Steer & Tiggemann, 2008; Tiggemann & Williams, 2012).

However, one of the main and most devious consequences of sexual objectification is the denial of humanity and human characteristics (Heflick et al., 2011; Loughnan et al., 2010; Puvia & Vaes, 2013; Vaes et al., 2011). In particular, the change in the perception of an objectified woman has shown to reduce the attribution of competence, warmth and morality traits only when participants focused on the appearance of female, but not male targets (Heflick et al., 2011). An objectified woman has shown to be attributed less mind and moral states (Loughnan et al., 2010) and implicitly associated with less uniquely human qualities (Vaes et al., 2011). The consequences of this phenomenon have been explored also from a cognitive and neural point of view. Bernard et al. (2012) by applying the inversion effect to objectified male and female stimuli, were able to show how a sexualized woman, but not a sexualized man, tended to be elaborated through analytical rather than holistic processes. Indeed, participants were more accurate in recognizing inverted female compared to inverted male targets. Like the sexualized female targets, the inversion effect is typically not observed for objects. As a result, these findings suggest how a sexualized woman is perceived as if she was an object. More recently, Vaes and colleagues (2019), by looking at participants' neural activity, were able to demonstrate how an objectified woman is perceived and elaborated more similar to an object compared to other human beings. By presenting objectified and non-objectified female and male targets together with gender-matched doll-like avatars, they were able to demonstrate how objectified female targets were perceived as more similar to the object-like stimuli compared to objectified male and non-objectified male and female targets. Presenting sexually objectified women to participants has also been related with a positive correlation between hostile sexism and the activation of the mPFC and other brain areas related with mental state attributions (Cikara et al., 2011). These brain areas that are typically involved in mentalizing and are responsible for the encoding of affective and somatosensory components of pain were also less active when a sexually objectified female target was ostracized compared to when the same treatment befell a non-objectified woman (Cogoni, Carnaghi, & Silani, 2018).

Depriving a woman from personality and humanity traits has shown to have important negative consequences. Sexually objectified women more likely become victims of sexual violence, sexual harassment, unwanted sexual advances and social exclusion. Specifically, the more men were exposed to sexually objectified depictions of women in the media, the greater was their level of acceptance of rape myths (Wright & Tokunaga, 2016) and the more they manifested gender-harassing behavior (Galdi et al., 2014). Similarly, the more men were presented with music videos depicting sexually objectified women, the more they showed victim blaming attitudes when confronted with a story of violence in which a woman was victimized (Burgess & Burpo, 2012). Not only music videos and television have shown to influence men's perception of a woman. Dill and colleagues (2008) demonstrated a similar effect on sexual harassment and acceptance of rape myths after long term exposure to videogames depicting objectified women. Objectified women are also perceived as more responsible for becoming rape victims and they are denied victims' suffering compared to non-objectified women who go through a similar experience (Loughnan et al., 2013). Further, the more women objectified or dehumanized other women, the less they wanted to spend time or be friends with her (Vaillancourt & Sharma, 2011), the more they distanced themselves from her (Puvia & Vaes, 2015; Vaes et al., 2011) and the more they showed aggressive intentions towards her (Arnocky et al., 2019). Still, while most of this research has focused on explicit harassing, sexual aggression or social exclusion behaviors when studying the consequences of sexual objectification, hardly any research to date has tried to understand changes in unconscious behavior that is likely to affect social interactions with objectified and non-objectified women in general. For example, past studies asked participants to complete a questionnaire (Wright & Tokunaga, 2016), or to pronounce an explicit judgement (Burgess & Burpo, 2012; Dill et al., 2008), or to complete an explicit social distancing task (Vaes et al., 2011; Vaillancourt & Sharma, 2011), while none have investigated spontaneous physiological responses to sexually objectified women. With this in mind, the aim of the current research project is to better investigate how sexual objectification affects our basic empathic abilities in the form of mimicry that are crucial to attain successful social interactions.

Mimicry as a basic empathic response

Empathy refers to the ability to share and understand the feelings of others. Up to now quite a few researchers have defined empathy as a multi-dimensional process that could be divided into experience sharing, the ability to take on the sensory, motor, visceral, and affective states of others, mentalizing, that refers to the capacity to make inferences regarding other's people intentions, believes and emotions, and finally mind perception. This last component is related to the detection of others' internal and mental states (see Zaki, 2014). Adopting the perspective of others and imagining what they might feel is a process that requires cognitive and neural abilities and the capacity to mentally simulate other's points of view. Empathic abilities are strategically used in people's social interactions and seem to predict how many close relationships people maintain. As such, the more empathy we exercise, the closer are the relationships with others (Kardos et al., 2017). Therefore, our capacity to infer and feel other people's minds allows us to adapt and direct our way of communication to obtain a fruitful social interaction marked by understanding and mutual respect. Indeed, the neural network for mentalizing processes works in close connection with the brain areas that support social cognition and social perception (Frith & Frith, 2006).

Thanks to our social interactions we teach, we learn, and we create social bonds. In the creation of these social bonds two specific communications are fundamental, the verbal communication that reflects the ability of human beings to speak, and the non-verbal communication. Most of the unconscious and automatic bonding that happens between two people occurs through non-verbal communications. This type of communication is one of the fundamental bases of social interactions, because it helps people perceive and understand others through eye-contact, facial expressions, gestures, postures or body language. Among all these, emotional facial expressions are one of the first social traces that we use to be able to interact and communicate with others. The processing of this information occurs in the brain almost without any accompanying conscious thought. Specifically, this process is known as unconscious mimicry behavior that has been introduced as a fundamental and primitive step of empathic processes. Unconscious mimicry has been related to the definition of empathy (Chartrand & Bargh, 1999; Waal, 2012) using both observational and experimental studies. Therefore, when individuals look at a facial expression, they can respond with that exact facial emotion without having to pass through conscious processes. As such, this process becomes fundamental not only to interact with others, but also to predict and understand others. For this reason, mimicry can be thought as the unconscious and unintentional imitation of other people's postures, gestures, mannerism, moods and emotions that allow people to understand other's emotions and intentions through the simulation of their emotional states.

The relationship between mimicry and prosocial behaviors has been widely studied in past research with the aim to understand how people unconsciously change their behavior on the basis of contextual factors. Specifically, mimicry can be related to relationship goals and liking. By priming participants with a non-conscious affiliation goal, Lakin and Chartrand (2003) showed how participants whose goal was to affiliate with a confederate, exhibited more mimicry than those who did not have such a goal. Similarly, nonconscious mimicry of others has found to be helpful to socially excluded individuals (Lakin et al., 2008). Participants were first excluded in a classic Cyberball paradigm and then videotaped while interacting with another person in the room. Participants in the exclusion condition were the ones that mimicked others more compared to included individuals.

These studies allowed us to conclude how mimicry can lead to the development of social relationships and stimulates closeness to others. However, non-conscious mimicry can also be sensitive and selective to target characteristics. When participants faced a stigmatized to-be-mimicked target, an inhibition of the mimicking behavior was observed (Johnston, 2002). More recently the specific impact of group membership on non-conscious behavioral mimicry has been studied by presenting female participants a video of female or male targets rubbing their faces (Lakin et al., 2008; Yabar et al., 2006). Results showed how members of the ingroup were mimicked more than members of the outgroup and this was positively related with liking. Finally, not only the inter-group context, but also the way we perceive and elaborate the other person has shown to influence this un-conscious behavior. Indeed, spontaneous mimicry has shown to be moderated by the extent to which individuals humanize or attribute mental capacities to a non-human target. The less people perceived an android as humanlike; the less participants mimicked the android's emotional expressions compared to a fully human target (Hofree et al., 2014).

A lack of mimicry in interactions could result in less smooth interactions and less liking of the interaction partner leading to avoidance of such interactions in the future. Building on previous work, the aim of the current research project was to better understand how unconscious and spontaneous mimicry responses might change when we elaborate the emotional facial expressions of a human target that we tend to dehumanize in a specific social context. A pervasive social phenomena in which a single target is stigmatized, de-humanized and de-mentalized both by men and women, is sexual objectification (see Moradi & Huang, 2008 for a review).

Given that objectified women are not only perceived similar to objects and denied human characteristics, but also elicit less empathic responses (e.g., Cogoni et al., 2018), the goal of the present research is to verify the impact of sexual objectification on people's spontaneous and unconscious mimicry behavior. Mimicry is a basic empathic process that is fundamental to ensure the success of any social interaction. While previous research has mostly focused on the explicit consequences of sexual objectification in terms of sexual harassment and aggression (Burgess & Burpo, 2012; Dill et al., 2008; Loughnan et al., 2013; Wright & Tokunaga, 2016), showing that objectified women who express emotions elicit less spontaneous facial mimicry would strongly suggest that sexual objectification impairs fundamental processes potentially compromising social interactions with them in general. This information could indeed give us more details on what happens during real and normal interactions with a woman we judge low in humanness allowing us to demonstrate this phenomenon in both controlled and spontaneous social interactions for the first time.

The present research

While the literature on sexual objectification has mainly focused on understanding the main causes and consequences of this phenomenon, little research has tried to study this phenomenon directly in social interactions (Gervais et al., 2020). Understanding what happens in real interactions when women are objectified, however, is important. Not only focusing on outcomes related to sexual harassment and aggression, but by studying unconscious and uncontrolled behavior in social interactions in general. Therefore, in the current research project we aimed at investigating the unconscious mimicry behavior when objectified and non-objectified women express different emotional facial expressions.

With these goals in mind, we conducted a single experiment in which participants' electrophysiological facial movements were registered, while videos of objectified and non-objectified female targets expressing happiness and anger were presented. We adopted the same paradigm as Hofree and colleagues (2014), in which first a spontaneous condition is presented. In this first phase natural and spontaneous facial movements are registered. In a second, intentional condition, participants are explicitly asked to express the same emotion as the target allowing us to control whether participants recognized the emotions correctly. In addition, we measured both participants tendency to dehumanize the female target more in the objectified compared to the non-objectified condition and to verify the impact of interindividual differences in people's empathic tendencies.

Our specific hypotheses are as follows:

H1: Objectified models are expected to be perceived as having less human characteristics compared to the non-objectified models. Specifically, we used an adapted version of the Mind Attribution Scale (Gray et al., 2007). Based on the results of Gray et al. (2011), objectified women are expected to be perceived as having less agency attributes and more experience attributes compared to their non-objectified counterparts. However, other work focussing on warmth (a dimension akin to experience) and competence (a dimension closely related to agency) traits has suggested that objectified women are denied both types of attributes compared to female targets that are not objectified (Heflick et al., 2011; Heflick & Goldenberg, 2009). Therefore, we expected objectified women to be attributed less agentic capacities compared to non-objectified women while we did not make any a priori predictions concerning the experience traits.

H2: Objectified compared to non-objectified models are expected to elicit less mimicry behavior only in the spontaneous condition. Since the literature on sexual objectification has consistently shown that sexualized women are objectified by both heterosexual men and women (Cogoni et al., 2018; Heflick et al., 2011; Loughnan et al., 2010; Vaes et al., 2011, 2019, 2020), we did not expect female and male participants to have different mimicking behaviors.

H3: Mimicry behavior is expected to reflect basic empathic processes and therefore, we expected to find correlations between mimicry and at least some of the subscales of the Interpersonal Reactivity Index (IRI, Davis, 1983), an frequently used scale of dispositional empathy.

Method

Participants

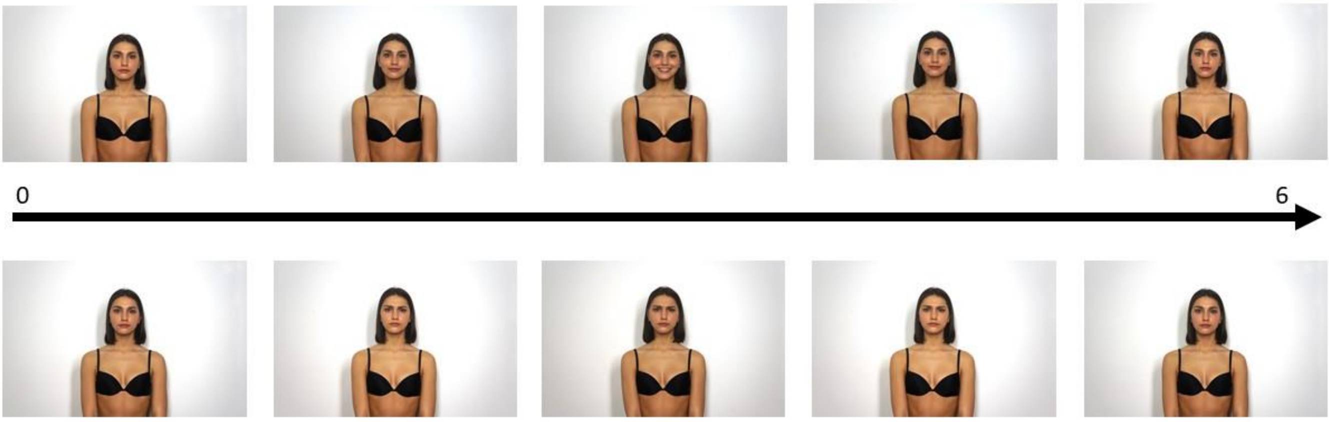
A total of 92 participants were enrolled to participate in the experiment where they received a fee of 10.00 € or university credits for their participation. Due to the nature of the experiment and in line with previous research on sexual objectification, only heterosexual participants were considered. Further, participants whose electrode was found to be corrupted during the EMG (Electromyography) recording, were not considered for the analysis. Therefore, analyses were conducted on a total of 67 participants (30 males; M_{age} =25.1, *SD* =4.7). A sensitivity power analysis calculated using PANGEA (for details see www.jakewestfall.org/pangea/) indicated that we had sufficient power (.804) to detect both an effect size of *d*=.37 with an alpha = 0.05 for the expected main effect. Therefore, our current experimental set-up allowed us to reliably detect medium to large effects. The study was approved by the local Ethics Committee (protocol 2019-036) and all participants gave their consent at the beginning of the experiment.

Stimuli Creation

Videos of sexually objectified and non-objectified models expressing anger and happiness were presented. To create the videos, we selected pictures of neutral, low intensity and high intensity happiness and anger, for each model from the SOBEM database (Ruzzante et al., 2021). The selected pictures were morphed together by using FantaMorph Deluxe software (Version 5; Abrosoft Co., Beijing, China). A 6 second video started with the model expressing a neutral expression that slowly changed into the expression of a low intensity emotion, that gradually reached the high intensity emotion after around 3 seconds followed by an offset phase in which the emotional face came back again to the final neutral expression (see Fig 4.1 & 4.2 for an example of the stimuli). Special care was taken while creating each video in order to preserve the spontaneity and naturalness of the emotions. Materials and data for the experiment are available at: https://osf.io/ftrbj/?view_only=58efa398d367489988b8c5ef4f88c38c.

Fig. 4.1 Example of how the videos were created. These sequences showed a non-objectified models expressing happiness (in the upper sequence) and anger (in the lower sequence).

Fig. 4.2 Example of how the videos were created. These sequences showed an objectified models expressing happiness (in the upper sequence) and anger (in the lower sequence).



Stimuli pre-test

A total of 40 videos depicting 10 different models (in 20 videos the models were scantily dressed, while they were fully dressed in the remaining 20 videos; in half of the videos they expressed happiness, while they expressed anger in the other half) were pre-tested to make sure that both emotions were recognized properly and that the scantily dressed models were objectified significantly more than ones who were fully dressed. A total of 39 pre-test participants who did not participate in the main experiment had to indicate the type of emotion the person in the video was expressing by selecting one out of four choices (e.g., “happiness”, “anger”, “sadness”, “other: please specify”). Afterwards, they had to rate the extent to which there was a good fit between the emotion selected and the one that was expressed in the video and the intensity with which the person in the video was expressing the emotion. A final question asked participants to judge the extent to which the person in the video represented an objectified woman on a 7-point Likert scale. On the basis of the results, we decided to consider six out of ten models whose emotional expressions were well recognized and showed a comparable intensity in the objectified and non-objectified condition (see Appendix 3 for details on the pretest analyses).

We decided to divide models into 2 different groups in order to make sure that each participant was presented with all 6 models and that both objectified and non-objectified models appeared in each version. Specifically, in each version, every single model expressed happiness and anger, but in one version three out of six models were objectified and the other three non-objectified, vice versa in the second version. Based on the pre-test we conducted, we controlled that objectification did not influence the evaluation of fit and intensity of the emotion expressed, by conducting a 2 (emotions: anger, happiness) X 2 (objectification: objectified, non-objectified) ANOVA for each evaluation (fit and intensity) for each list. While no main effect of objectification emerged showing that the emotions were perceived coherently regardless of the manipulation (all *ps'*>.089), a main effect of emotion emerged in every analysis we conducted (all *ps'*<.001). Indeed, happiness was always perceived as having a better fit between the emotion selected and the one that was expressed in the video and was seen as more intense in each of the versions we created compared to the emotion of anger. This is probably due to the high human sensitivity to this kind of emotional expression (Calvo et al., 2016). An interaction effect between Objectification and Emotion appeared in one of the versions we created both for the evaluation of fit, $F(1,38) = 8.94$, $p = .005$, $\eta^2_p = .19$, and intensity, $F(1,38) = 4.21$, $p = .047$, $\eta^2_p = .100$. In both cases post-hoc comparisons showed that when objectified models expressed anger, the evaluation of fit of the selected emotions, $F(1,38) = 7.2$, $p = .011$, $\eta^2_p = .16$, and the evaluation of intensity, $F(1,38) = 5.04$, $p = .031$, $\eta^2_p = .117$, were higher compared to when non-objectified models expressed the same emotion. Even if we tried to avoid these biases when selecting the stimuli, this result works counter to our hypothesis.

In addition, we also counterbalanced the two stimulus sets on other social evaluations that might affect our results. Based on the Norming Data of the SOBEM database (Ruzzante et al., 2021), we controlled that the two groups of models did not differ on the basis of the evaluation of sexiness when objectified, $F(1,83) = 1.65$, $p=.202$, $\eta^2_p=.020$, and when non-objectified, $F(1,83) = .05$, $p=.82$, $\eta^2_p=.001$, attractiveness when objectified, $F(1,83) = 1.03$, $p=.313$, $\eta^2_p=.012$, and when non-objectified, $F(1,83) = .202$, $p=.654$, $\eta^2_p=.002$, and on the level of perceived objectification when objectified, $F(1,83) = .624$, $p=.432$, $\eta^2_p=.008$, and when non-objectified, $F(1,83) = .103$, $p=.749$, $\eta^2_p=.001$.

EMG processing

EMG was measured by pairs of electrodes over the regions of zygomaticus major (cheek) and corrugator supercilii (brow). AcqKnowledge software (Biopac Systems, Goleta, CA) along with Biopac mp160 (Biopac Systems, Goleta, CA) were used to acquire the EMG signal. The amplified EMG signals were filtered online with a low-pass of 500 Hz and a high-pass of 10 Hz. The signal was sampled at a rate of 2000 Hz.

Data was pre-processed and analyzed using Matlab (version R2015a, The Mathworks, Natick, MA), R (R Core Team, 2020) and SPSS (version 25, IBM Corporation, Armonk, NY). First, a notch filter at 50 Hz was applied to attenuate line noise. Then, the raw signal was segmented in 9000ms long epochs that began 2000ms before the stimulus onset and lasted for the whole duration of the video. We considered a longer latency due to a 1000ms delay that appeared at the end of the video before the trigger. A mean of the activity during the time window of 2000ms before the onset of each video served as a baseline. After the rectification and integration, data was normalized by subtracting the corresponding mean signal within the baseline period (-2000 to 0, pre-stimulus) and then dividing the result by the same value. This normalization process yields the EMG signal representation expressed in terms of the relative change compared to the baseline. Afterwards, following the way in which each video was built and by controlling the average peak latency of each condition, a single epoch between 2000ms to 5000ms was exported that captured the time window in which the peak of the emotion was expressed.

Procedure

The experiment started with participants signing the informed consent. Afterwards, participants viewed the videos of the objectified and non-objectified models, each displaying happy and angry expressions in a random order. Two different phases were presented. Firstly, in the spontaneous phase participants were instructed to simply observe the videos, without receiving any instructions or encouragement to mimic. Secondly, in the intentional phase, participants were explicitly told to make the same facial expression as the person in the video. This intentional condition was included to have a control condition ensuring that all facial expressions were correctly recognized. These two phases were always presented in this order to avoid that participants felt inclined to mimic the targets' emotional expressions in the spontaneous phase. In the spontaneous phase, a total of 120 videos were presented, in this way each model expressing each emotion was presented 10 times, whereas in the final phase each video was repeated two times. As a result, a total of 144 videos were shown to each participant. During the experiment we gauged participants' mimicry behavior using facial electromyography (EMG), this allowed us to measure electrical changes in the selected underlying muscle activity. We followed the published standards for EMG recording and analyses (Cacioppo et al., 2000; Fridlund & Cacioppo, 1986). During the whole experiment, participants' eye movements were controlled with a Tobii eye-tracker (TOBII Pro X3-120). At the end of the video's presentation, electrodes were removed from participant's face and participants were asked to complete a final questionnaire that aimed at measuring the mental capacities that they would attribute to each model and the level of dispositional empathy of each participant. Specifically, participants needed to evaluate the pictures of each model that was presented in the videos when expressing a neutral expression, on the basis of a shortened version of the Mind Attribution Scale (Gray et al., 2011). This scale measures mind perception using Agency items (e.g., self-control, acting morally, planning, communication, memory, and thought) and Experience items (e.g., feeling pain, feeling pleasure, feeling desire, feeling fear, feeling rage, feeling joy). Subsequently, participants were asked to complete the Interpersonal Reactivity Index Scale (IRI, Davis, 1983) that defines empathy through 4 subscales: Perspective Taking (the tendency to adopt the point of view of others), Fantasy (the tendency to transport oneself into the feelings or actions of people in books or movies), Empathic Concern (the tendency to concern for unfortunate others) and Personal Distress (the tendency to feel personal anxiety and unease in interpersonal settings). In the final part, participants were asked to answer to four demographic questions (e.g., gender, age, sexual orientation and nationality).

Results

Analytical strategies

We performed four different analyses. We first controlled participants' eye movements with the aim to verify that during the emotional expression participants were looking especially at the face of the model regardless of the way they were dressed. We then performed analyses on the Mind Attribution scale in which we aimed at verifying that the objectified models that we presented were dehumanized and attributed less mental states compared to their non-objectified counterparts. Our main analysis was performed on the EMG signal. Finally, we monitored whether our EMG signal correlated with participants' empathic dispositions.

In all statistical analyses, the alpha level was set to .05 and all pairwise comparisons were Bonferroni-corrected.

Eye movements

Given that participants were unaware that their eye movements were measured throughout the experiment, the accuracy of the eye tracker to detect at least one eye for less than 50% of the time was low for some participants. Therefore, the analyses on participants' eye movements were conducted on 60 participants. Each of the other analyses reported were conducted on 60 participants too and results confirmed all the effects that are reported below. However, to increase our statistical power, we decided to list the analyses conducted on the full sample of 67 participants for all the remaining measures. A mixed ANOVA 2 (Objectification: objectified, non-objectified) X 2 (Area of Interest: face, body) X 2 (Emotions: happiness, anger) X 2 (Gender of participants: male, female) in which only the latter variable was manipulated between participants was conducted on the total fixation duration.

A main effect of objectification emerged, $F(1,58) =12.1$, $p=.001$, $\eta^2_p=.17$. Objectified women were looked at for a longer time ($M=54.05$, $DS=49.13$) compared to their non-objectified counterparts ($M=32.6$, $DS=16.3$). Also, the area of interest showed to be significant, $F(1,58) =129.3$, $p<.001$, $\eta^2_p=.69$. The face area was looked at for a longer time ($M=83.5$, $DS=56.6$) compared to the body ($M=3.15$, $DS=4.6$). Finally, also a significant main effect of emotion emerged, $F(1,58) =12.26$, $p=.001$, $\eta^2_p=.17$. Participants dedicated more time looking at the expression of happiness ($M=53.5$, $DS=48.1$) compared to anger ($M=33.2$, $DS=15.9$).

In addition, a significant interaction between area of interest and gender emerged, $F(1,58) =9.47$, $p=.003$, $\eta^2_p=.14$. Women spend significantly more time looking at the faces of the models compared to male participants, $F(1,58) =8.82$, $p=.004$, $\eta^2_p=.13$, while no differences emerged between male and female participants in the total fixation duration of the body, $F(1,58) =1.37$, $p=.25$, $\eta^2_p=.02$. Moreover, objectification and area of interest, $F(1,58) =7.68$, $p=.007$, $\eta^2_p=.12$, emotion and objectification, $F(1,58) =10.5$, $p=.002$, $\eta^2_p=.15$, and emotion and area of interest, $F(1,58) =10.8$, $p=.002$, $\eta^2_p=.16$, all interacted significantly, but were qualified by the significant three-way interaction between objectification, emotion and area of interest, $F(1,58) = 10.3$, $p = .002$, $\eta^2_p = .15$. Specifically, the body of objectified models expressing both anger, $F(1,58) = 20.43$, $p < .001$, $\eta^2_p = .26$, and happiness, $F(1,58) = 10.8$, $p = .002$, $\eta^2_p = .16$, was looked at for a longer time compared to the non-objectified models who expressed the same emotions. At the same time, however, also the face of the objectified models especially while expressing happiness was characterized by longer fixations, $F(1,58) = 10.3$, $p = .002$, $\eta^2_p = .15$, compared to their non-objectified counterparts. No differences appeared between the total fixation duration of the face of the objectified and non-objectified targets expressing anger ($p > .70$). As a result, even though the bodies of the objectified models attracted the attention of both male and female participants, their face was looked at more (expressions of happiness) or similarly (expressions of anger) compared to the non-objectified models.

De-humanization analyses

A fully crossed mixed ANOVA 2 (Objectification: objectified, non-objectified) X 2 (Mind: agency, experience) X 2 (Gender: male, female) in which only the latter variable was manipulated between participants was conducted on the Mind Attribution Scale. Results revealed a significant interaction between Objectification and Mind, $F(1,65) = 18.76$, $p < .001$, $\eta^2_p = .22$. In line with H1, post hoc comparisons showed a significant difference between objectified and non-objectified models both in the evaluation of agency, $F(1,65) = 13.05$, $p = .001$, $\eta^2_p = .17$, and in the evaluation of experience, $F(1,65) = 4.53$, $p = .037$, $\eta^2_p = .06$. Objectified models were attributed less agency ($M = 4.81$, $DS = .80$), but more experience ($M = 4.83$, $DS = 1.04$) compared to the non-objectified models ($M_{agency} = 5.10$, $DS_{agency} = .71$; $M_{experience} = 4.74$, $DS_{experience} = 1.03$).

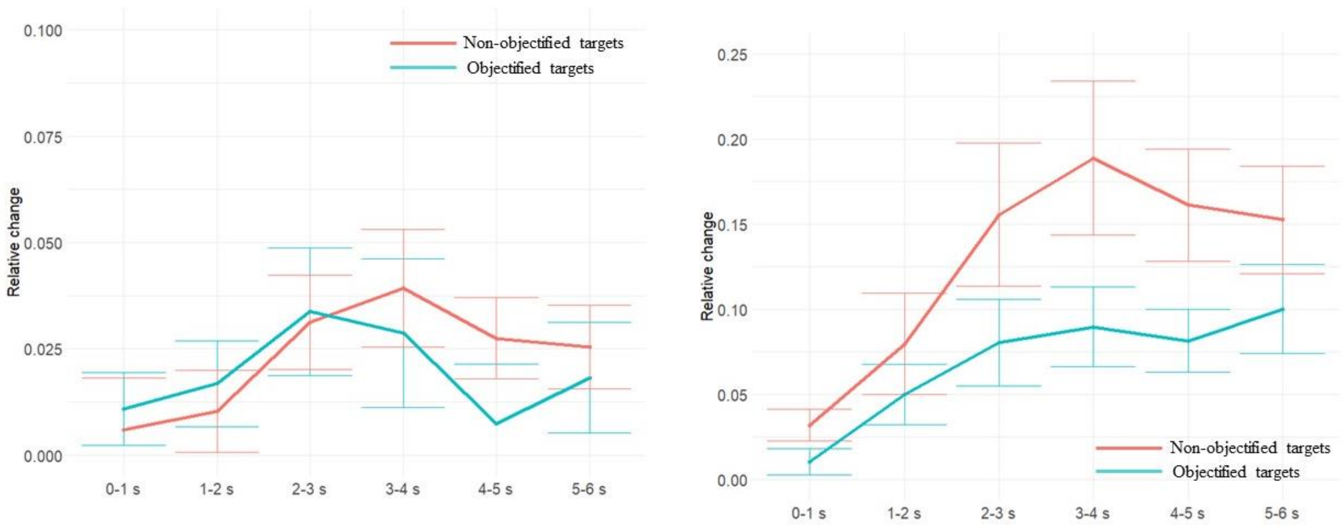
EMG Data

We performed the main analysis over a single epoch that started at 2000ms and ended at 5000ms by conducting a mixed ANOVA 2 (Objectification: objectified, non-objectified models) X 2 (Emotions: happiness, anger) X 2 (Gender: male, female) for each condition.

As expected and in line with H2, a significant main effect of objectification emerged in the spontaneous condition, $F(1,65) = 6.97$, $p = .01$, $\eta^2_p = .097$. Objectified models elicited in general less mimicry responses (*M*=.05, *DS*=.10) compared to the non-objectified models (*M*=.10, *DS*=.16). Also, a main effect of emotions emerged, $F(1,65) = 15.67$, $p < .001$, $\eta^2_p = .19$, showing how the emotion of happiness elicited higher responses in the EMG signal (*M*=.12, *DS*=.20) compared to the emotion of anger (*M*=.03, *DS*=.08, see Fig. 4.3).

In the intentional condition no objectification effect emerged but, similarly to the spontaneous condition, a main effect of emotion appeared, $F(1,65) = 62.28$, $p < .001$, $\eta^2_p = .48$. Even in the intentional condition, the emotion of happiness elicited stronger mimicry responses (*M*=7.10, *DS*=6.04) compared to the emotion of anger (*M*=1.45, *DS*=1.02).

Fig. 4.3 Spontaneous mimicry of the corrugator activity (left) and zygomaticus activity (right) across 6 second trials in response to objectified and non-objectified targets.



Even though in none of these analyses the interaction between objectification and emotion emerged significantly, a closer look at Fig. 4.3 seemed to justify an analysis for each emotion separately. Separate mixed ANOVA's 2 (Objectification: objectified, non-objectified) X 2 (Gender: male, female) demonstrated a single main effect of objectification, $F(1,65) = 5.71$, $p = .020$, $\eta^2_p = .08$, when the emotion of happiness was expressed in the spontaneous condition. Participants mimicked the objectified models less when they expressed happiness ($M = .08$, $DS = .17$) compared to their non-objectified counterparts ($M = .17$, $DS = .31$). No effect emerged in the intentional condition ($p > .40$) and no effect appeared when the emotion of anger was expressed, neither in the spontaneous ($p > .31$), nor in the intentional condition ($p > .19$).

Empathy measurement

In order to verify that the mimicry responses at least partially reflected participants' empathic tendencies, a correlation analysis was performed between the different EMG signals we acquired and the four different subscales of the Interpersonal Reactivity Index (IRI).

A positive correlation emerged between the fantasy subscale and the EMG signal acquired while objectified models were expressing happiness, $r(66) = .27$, $p = .025$. Even if only one subscale showed a significant relation with the mimicry responses, this relation might tell us a bit more about participants motivation to mimic less objectified women. Indeed, the more participants had the capacity to step into others' feelings, the more they showed mimicry responses of happiness towards objectified models.

Table 4.1: Correlation analysis between Interpersonal reactivity Index subscale and mimicry responses toward objectified and non-objectified women expressing happiness.

		M	SD	1	2	3	4	5	6
1.	Fantasy	3.44	.59	-					
2.	Empathy Concern	3.71	.56	.29*	-				
3.	Perspective Taking	3.63	.53	.14	.13	-			
4.	Personal Distress	2.87	.53	-.04	.23	.08	-		
5.	Objectified Stimuli	.08	.17	.27*	.12	.07	-.05	-	
6.	Non-Objectified Stimuli	.17	.31	.06	-.13	.07	-.17	.39**	-

Note. Objectified/Non-Objectified Stimuli: mimicry responses towards objectified or non-objectified women expressing happiness; *p<.05; **p<.01

Discussion

Sexual objectification is a widespread phenomenon that impacts the everyday lives of women. The literature until now has primarily focused on the behavioral and explicit consequences of this phenomenon without considering its implicit and unconscious repercussions. For this reason, there is a need to understand how people might unconsciously react when encountering a woman that is judged low in humanness. Since our empathic capacities lie at the basis of the success of all our social interactions, exploring what influences and changes these empathic responses is fundamental for understanding and predicting what might happen in real-life social interactions. One such basic empathic response is our capacity to mimic other people's emotional expressions.

We specifically measured participants' spontaneous mimicry responses during the presentation of objectified and non-objectified models expressing happiness and anger. Our results clearly confirmed the second hypothesis showing how both men and women responded to objectified targets with less spontaneous mimicry responses, especially when models expressed the emotion of happiness, compared to their non-objectified counterparts. This result was observed with medium effect sizes for which the current sample provided sufficient power.

Importantly, this effect was not explainable by perceptual differences across the models' emotional expressions, given that we precisely selected only those models whose emotional expression were accurately and similarly recognized. Further, it occurred even if participants paid more attention at the face of the models especially when expressing emotions of happiness. Indeed, eye movement analyses revealed how participants tended to look at the face of objectified models for a longer time compared to non-objectified models, especially while expressing happiness. However, at the same time, they mimicked their emotional expression of happiness to a lesser extent. If, on the one hand, this result clearly rules out the possibility that participants' mimicry responses were explainable by a reduced attention to the face of the objectified models, on the other hand, this result raises some interesting questions. Indeed, even if a person looks at the face of an objectified woman and still does not mimic her emotions, what could be the real reason underneath this implicit behaviour? Past research already demonstrated how the more women are looked at focusing on their bodies the more they are objectified and, consequentially, perceived as having less mental capacities (Gervais et al., 2013; see Heflick & Goldenberg, 2014 for a review). Showing that this might happen without the focus on sexual body parts of objectified women might inform future studies not only to redefine the theory of sexual objectification, but also to better understand what really guides sexual objectification and its consequences.

Our analysis of the level of mental states attributed to each model, confirmed our first hypothesis and is fully in line with the results of Gray et al. (2011). Specifically, while the objectified models were clearly denied agentic traits, they were attributed with more experience related attributes compared to the non-objectified models. This pattern of results is in line with a partial dehumanization of objectified women linked to agentic, but not experience related traits. Moreover, at first glance these results might seem contradictory. Indeed, the same objectified models that elicited less spontaneous mimicry are granted a better capacity to experience emotions at the same time. On the one hand, it is not uncommon to observe different results in explicit, self-report and implicit, spontaneous measures (e.g., Nosek, 2007). On the other hand, we believe that this effect is specific to the measure of Gray et al. (2011) since other studies using other dehumanization measures have not reported similar results (Heflick et al., 2011; Heflick & Goldenberg, 2009; Loughnan et al., 2010; Vaes et al., 2011). Instead, these studies consistently find that objectified compared to non-objectified women are attributed less humanness regardless of the specific dimension of humanness that is taken into consideration. Therefore, future research including other measures of dehumanization is necessary before we can ascertain that the dehumanization of objectified women lies at the basis of the lack of mimicry responses towards them.

Finally, and in line with our third hypothesis, the unconscious and spontaneous mimicry responses showed to be related to participants empathic dispositions. We only found a single correlation between the fantasy subscale of the IRI, that measures people's capacity to transport oneself into the feelings or actions of others in books or movies, and the mimicry responses of participants towards objectified models who expressed happiness. The more participants had higher scores on the IRI subscale of fantasy, the more they mimicked objectified women when expressing happiness. The fact that we have only 1 significant out of 8 possible correlations does not allow us to make a strong claim, but can inform future research to study how empathy influences unconscious mimicry responses towards objectified targets, especially because empathy has already shown to be influenced in contexts of sexual objectification (Cogoni, Carnaghi, & Silani, 2018).

Importantly, while results regarding the emotion of happiness are clear and concur with previous results demonstrating that the recognition and imitation of happiness seems to be easy and more sensitive compared to negative emotions (Calvo et al., 2016; Suzuki et al., 2010), the mimicry results for the emotion of anger were unexpected. Past studies already reported similar results when measuring the activity of the corrugator supercilia during passive viewing of anger expressions (Rymarczyk et al., 2011, 2016; Weyers et al., 2006). Some of these studies explained the lack of mimicry for the expression of anger due to cultural and social norms that regulate this emotion (Hess & Bourgeois, 2010). Further, corrugator supercilia activity has not only been related to the imitation of anger, but also to mental efforts (Koriat & Nussinson, 2009) or to a general negative affect (Larsen et al., 2003). Additionally, anger has been classified as a higher-cost emotion compared to happiness (Bourgeois & Hess, 2008), thus another possible explanation is that in an artificial situation, negative stimuli can lose their valence (Larsen et al., 2003). Therefore, participants in this study might have found it difficult to empathize with this specific emotion in a laboratory setting, consequentially influencing the results. Importantly for our purpose, however, the main result did not change. An overall lack of mimicry was observed when participants were presented with objectified rather than non-objectified models regardless of the emotions they expressed.

It is important to note, that this work only focused on expressions of anger and happiness. Our choice was determined by the fact that these emotions are marked by unique facial movements and to have a balanced condition between one negative and one positive emotion. However, future studies might try to verify if the effect obtained for these emotions might be generalized to other positive and negative emotions.

This research study is the first one that clearly shows how unconscious mimicry behavior, that comprises a fundamental element in all our social interactions, is flattened when emotions are expressed by an objectified woman. Moreover, these results are able to increase our knowledge on the phenomenon of sexual objectification and its consequences. Indeed, up to now the literature reported some of the consequences that affect objectified women focusing on sexual harassment, aggression and social exclusion (Burgess & Burpo, 2012; Dill et al., 2008; Loughnan et al., 2010, 2013; Vaes et al., 2011; Vaillancourt & Sharma, 2011; Wright & Tokunaga, 2016). However, these studies just focused on explicit consequences that might be changed or controlled. Instead, this study showed a more subtle and spontaneous consequence of sexual objectification that is harder to control and that might influence social interactions more generally. Investigating more unconscious and spontaneous behavior, adds to the impression that sexual objectification is a pervasive phenomenon. Indeed, when interacting with an objectified woman, spontaneous negative behaviors might occur without having to pass through consciousness, as a sort of default mode. Consequentially, sexual objectification is more widespread and pervasive than previously assumed, impacting the recognition and perception of emotions.

Chapter 5

General Discussion

Several studies have investigated the different elaboration of human and object stimuli, from a cognitive and neural point of view. These studies showed how different brain areas seem to be specialized in elaborating either human or object stimuli (Haxby & Gobbini, 2011; Kanwisher et al., 1997), and that human stimuli elicit different neural processes that are not involved in the elaboration of object stimuli (Haxby et al., 1999; Reed et al., 2003). These research studies have helped to form a solid knowledge base in which human and object stimuli are elaborated and perceived as two distinct entities. Still, through an increasing number of studies social psychologists are telling another and completely different story. Humans are sometimes perceived as object-like and elaborated as less than human. This occurs when processes that are typically used to elaborate objects are adopted to elaborate humans (e.g., Bernard et al., 2012; Fincher et al., 2017); brain areas that are typically involved in social cognition are not activated toward human stimuli (Cikara et al., 2011; Harris & Fiske, 2006); and humans are elaborated and perceived more similar to objects (Vaes et al., 2019; 2020). All instances where the human-object divide tends to fade.

Studying the fading of the human-object divide in processes of de-mentalization and objectification

The main goal of this thesis was to adapt a new and innovative way to further our knowledge on mentalization and objectification processes. More specifically, directly comparing the elaboration of human stimuli with perceptually similar objects while measuring people's neural activity in real time, provides a unique opportunity to unravel how these social and ubiquitous phenomena work. In other similar paradigms, human stimuli have been compared with object stimuli such as houses or shoes (Bernard et al., 2018; Harris & Fiske, 2009), or with mannequins (Cogoni, Carnaghi, Mitrovic, et al., 2018) that do not allow to make direct comparisons about how human and object stimuli are elaborated. Instead, direct comparisons are possible in the current paradigm, where human stimuli with a mind and perceptually similar objects without a mind are presented together. This might give us a clearer idea of what happens when a human is perceived as more object-like.

Following this procedure, in chapter two we introduced the timeline of the mentalization process with two EEG studies in which faces of ingroup and outgroup members were presented together with their matched doll-like faces. With this new paradigm we compared real faces that clearly had a mind with faces that did not, while manipulating their social identities. Thanks to the direct comparison between human and object-like stimuli, these two studies allowed us to differentiate two consequential steps in time unravelling the time course of the mentalization process. In a first mind detection phase, regardless of the faces' social identities, mindless targets were distinguished from mindful targets for the first time, indicating that this is the first moment in which people detect a mind behind a face. A second mind attribution stage occurred – starting at around 360ms after stimulus onset – in which people adjusted their attribution of a mind to the faces as a function of the dynamic interplay between perceptual (e.g., skin colour or facial-width-to-height ratio) and contextual information (e.g., group membership). This research study is an example of how it is possible to determine and learn more about the underlying processes of mentalization directly comparing human and object stimuli and measuring whether the human-object divide tends to fade.

In order to demonstrate how this paradigm might be used in different contexts, we adapted the same paradigm to better understand another social phenomenon in which humans are perceived as more object-like: the objectification phenomenon. Hence, chapter three introduced another EEG study in which objectified male and female human stimuli were presented together with their gender-matched doll-like avatars. The main aim was to confirm whether an objectified human target and a similar mindless object were literally perceived as more similar. Specifically, we wanted to further the literature regarding sexual objectification not only by adapting this new paradigm to this field of study and showing that the human-object divide tends to fade for objectified human targets, but also by focusing on a specific – scarcely studied – population. Indeed, until now research has primarily focused on the heterosexual population or on the homosexual population as victims of this phenomenon. Little is still known about gay men as potential agents of sexual objectification. Therefore, chapter three allowed us to explore sexual objectification from a new perspective. Not only did we confirm that from a neural point of view, sexually objectified women are perceived more similarly to objects than sexually objectified men (Vaes et al., 2019), we also found that gay men sexually objectify women much like male and female heterosexuals do. Thus, sexual objectification is found to be a target specific process in which women are the main victims. In chapter three, we also wanted to delve into the motivations that drive gay men to objectify women more than men. Results of a second online study showed how gay men might be influenced by ready-made content in the mass media, such as YouTube and Tv on Demand, that often mirrors broader cultural elements like beauty standards (Wiseman & Moradi, 2010) and the sexualization of women (Fredrickson & Roberts, 1997). This exposition might induce gay men to potentially interiorize and consequently apply this lens when viewing women in general. This third chapter allowed us to broaden the picture on sexual objectification in which objectified women are perceived as more object-like than objectified men, and this might be driven by a culture that mainly objectifies women to which we are all exposed.

Finally, chapter four helped us to investigate a more subtle and uncontrolled consequence of sexual objectification. Indeed, while most of the research up to now has predominantly focused on explicit and more direct ways to study the consequences of sexual objectification (Dill et al., 2008; Galdi et al., 2014; Loughnan et al., 2013; Vaillancourt & Sharma, 2011; Wright & Tokunaga, 2016), very few have tried to focus on more basic and unconscious processes (Cogoni, Carnaghi, & Silani, 2018). For this reason, in this final research study we focused on a spontaneous behaviour that is fundamental in all our social interactions: unconscious and spontaneous mimicry. Sexually objectified and non-objectified women were presented expressing two genuine emotions such as anger and happiness, while participants' spontaneous mimicry of these facial expressions was registered. Results were able to show how both male and female participants showed less mimicry behaviour when objectified rather than non-objectified female targets were presented. This final chapter was able to reveal how basic empathic processes and people's willingness to socially interact with objectified rather than non-objectified women is impaired. These results underline the importance of taking unconscious behaviours that often determine the success of any social interaction into consideration while investigating the consequences of sexual objectification.

A new paradigm to study dehumanization, mentalization and objectification phenomena.

Across three chapters we have explored and investigated some of the social phenomena in which the human-object divide tends to fade. Introducing an innovative paradigm, we aimed to further the literature on dehumanization, objectification and mind attribution. Indeed, up to now, this literature has been marked by different paradigm shifts. Initially, using trait- or metaphor-based paradigms authors have adapted explicit measures to investigate dehumanization or objectification phenomena (e.g., Goff et al., 2008; Hackel et al., 2014; Loughnan et al., 2010). These paradigms rely on the idea that certain traits or metaphors are typically or uniquely attributed to humans, while others are more closely associated to non-human entities. Demonstrating that the former traits or metaphors are used to consistently differentiate between social targets has been interpreted as an instance of dehumanization or objectification. More recently, some paradigms have analysed the cognitive and neural processes that are known to be more specifically used for the elaboration of objects demonstrating that they were also implicated in the elaboration of dehumanized or objectified human stimuli (Bernard et al., 2012; Cogoni, Carnaghi, Mitrovic, et al., 2018; Fincher et al., 2017). In a similar vein, fMRI studies have revealed that certain brain areas that are typically involved in the elaboration of human stimuli (e.g., Cikara et al., 2011; Harris & Fiske, 2006) are not or less active when elaborating dehumanized targets. Even though these paradigms provide interesting ways to gauge dehumanization and objectification processes, they cannot directly ascertain that human beings become more similar to objects at the eye of others. Only by directly measuring the level of similarity in elaborating human and perceptually similar objects can one provide researchers with a tool to measure processes of dehumanization, objectification and mentalization directly and delve into its underlying mechanisms. In this thesis we were indeed able to adapt this paradigm presenting different human and object-like targets focusing on two different phenomena: (de)mentalization and objectification. Doing so gave us the possibility to provide a first outline of the timeline of the mentalization process and to confirm that objectified women become more object-like also in a gay male sample, furthering the knowledge on both phenomena in significant ways.

Importantly, within this new paradigm we have shown that it is possible to combine the obtained neural data with an external behavioural criterium. Indeed, within this thesis we showed for the first time that a real-time, neural measure that is able to detect the differences in elaboration between human and object stimuli correlated with an external measure that verified whether differences at a more cognitive level might be found at a behavioural level as well. This relation is important in externally validating our paradigm demonstrating that the differences in people’s neural patterns are indeed related with their behavioural responses. An example can be found in chapter two, where ERP data were related with an Implicit Mind Attribution Test. This relationship allowed us to determine at what time more complex information was needed while detecting and attributing a mind to others. A second example can be found in chapter 3 where the same pattern of results was found analysing the neural pattern (Study 1) and questionnaire data (Study 2) of gay men. Therefore, associating this new proposed paradigm together with an external criterium might allow researchers to further our knowledge on the underlying mechanisms of dehumanization and objectification processes.

The fact that comparing human and object-like stimuli with this paradigm will allow researchers to study online real-time processes in which the human-object divide tends to fade, opens up other important avenues for future research. While we were able to define the timeline of the mentalization process, the next step might be to link this mechanism with the person perception process as a whole. Mentalization is the process in which a mind is perceived or attributed to others, person perception focusses instead on understanding the cause of an agent's behaviour (Fiske & Neuberg, 1990). Both processes are clearly related with one another making it interesting in future research to integrate both literatures. We believe that the paradigm that was proposed and extended in the present thesis might be important in understanding, step by step, what happens when we encounter and meet someone, especially when mentalization and person perception fails, and we perceive the other person as less than human.

More subtle consequences of dehumanization and objectification phenomena.

Processes involved in face perception and dehumanization have already been linked in past research. On the one hand, several studies have reported how faces convey important information that influences our perception of them. For example, the Facial Width-to-Height Ratio (Deska et al., 2018), as well as a person's eyes (Looser & Wheatley, 2010) directly influence the ascription of humanity to a person. On the other hand, processes that have shown to impair face recognition often lead to dehumanized perceptions (i.e., the face inversion effect, Hugenberg et al., 2015; Fincher & Tetlock, 2016). In the current thesis, we directly compared the elaboration of human and doll-like faces potentially further strengthening the relationship between face perception and dehumanization. Specifically, the N170 that has been identified as a central ERP component in face perception (Rossion et al., 2000) also showed to be sensitive to distinguishing human from non-human faces suggesting that the literature on face perception and mentalization show a clear overlap.

Faces not only convey information that help us recognize or categorize others, faces also dynamically produce signals critical for non-verbal communication during social interactions. The human face is the main visual stimulus from which we infer socio-affective information about others and their identity (Graham & LaBar, 2012; Palermo & Rhodes, 2007), or their mental states, intentions and behaviours (Mitchell & Phillips, 2015). By using information that was inferred from faces we were indeed able to discover an implicit and spontaneous consequence of sexual objectification, that can influence how we perceive others and how we interact with them. By measuring peoples' spontaneous mimicry, for the first time, we found a link between objectification and impaired facial mimicry. These results are interesting since they explore the more subtle and implicit consequences of dehumanization and objectification, at the same time linking the literature on objectification, mind perception, and emotion recognition. Even though the exact relationship between the processes of emotion recognition and mind perception is still unclear (Mitchell & Phillips, 2015), they are clearly closely connected and a new approach on the more subtle and hidden consequences of objectification through mimicry processes might be a first step to link these areas of research.

Conclusion

Dehumanization, objectification and (de-)mentalization are phenomena of social perception. Based on their facial cues, facial expression, social identities, skin exposure or more general cultural stereotypes, human beings are sometimes perceived as less than human. Studying specifically what it takes to elaborate others as object-like, or what behaviours are influenced by this perception is essential for understanding how these phenomena work and how we can contrast them.

Across five studies we have adapted a paradigm able to investigate the fade of the human-object divide in different contexts. First, we have uncovered the timeline of the mentalization process by directly comparing ingroup and outgroup human faces with their race-matched doll-like avatar faces. Further, we have adapted this new paradigm to study sexual objectification in a sample of gay men demonstrating how this phenomenon is mainly target specific and women are the main victims. Finally, we manipulated the relationship between face perception and dehumanization investigating how sexual objectification can affect unconscious behaviour such as spontaneous mimicry, likely influencing real-time social interactions.

In conclusion, with this thesis we aimed at increasing new avenues and new links between different research areas increasing the knowledge regarding dehumanization and objectification. Directly measuring the similarity between humans and objects, we believe is a promising avenue to further our understanding of how and under what conditions a person might be perceived as more object-like. The different procedures proposed in the current thesis allow us to test what information moderates dehumanization and objectification processes, what kind of inferences are made and also what unconscious and implicit behaviours are influenced when the human-object divide fades.

Appendices

Appendix 1 – The timeline of mentalization: Distinguishing a two-phase process from mind detection to mind attribution

Stimuli pre-test of Study 1:

To assess the validity of our set of stimuli we conducted a pre-test. 28 participants had to categorize as fast and accurate as possible the 40 human and 40 avatar faces in the human or object category respectively. Afterwards they had to indicate on a 7-point Likert scale to what extent each human or doll-like face represented a human or an object (see Table A1.1).

Table A1.1. Means and standard deviations of the selected pre-test pictures.

		Mean	Standard Deviation
White human face	Accuracy	.96	.061
	RT	601.5 ms	109.9 ms
	Humanness rating (1-7)	1.09	.04
Black human face	Accuracy	.97	.038
	RT	617.55 ms	120.3 ms
	Humanness rating (1-7)	1.16	.07
White doll-like face	Accuracy	.95	.053
	RT	598.1 ms	125.8 ms
	Humanness rating (1-7)	6.47	.26
Black doll-like face	Accuracy	.93	.038
	RT	620.8 ms	110.9 ms
	Humanness rating (1-7)	6.45	.33

Pre-test of the words for the Implicit Mind Attribution Test (IMAT) for both Study 1 and Study 2:

On the basis of a pre-test in which 23 participants judged a set of 20 mind- and 20 body- related words on 3 dimensions, 5 mind- and 5 body-related words were selected. Results of a paired sample t-test demonstrated that the mind related words expressed mental capacities significantly better than the body related words ($t_{(22)}$=-14.97, p<.001, d=6.38). Vice versa the body related words represented their category better compared to the mind related words ($t_{(22)}$=-14.46, p<.001, d=-6.16). We attempted to balance the valence, but mind related words were always judged as more positive than body related words. Even though we tried to reduce this difference as much as possible, mind and body related words were still significantly different on the valence dimension ($t_{(19)}$=4.04, p=.001,d=1.72). Importantly, both mind and body related words were evaluated positively (see Table A1.2 for means and standard deviations).

Table A1.2. Means and standard deviations of the selected words.

	Mind words	Body words
Mental characteristic (scale 1 – 7)	6.41	2.59
(SD)	(.72)	(.94)
Body characteristic (scale 1 – 7)	1.77	6.27
(SD)	(.61)	(1.19)
Valence (scale -5 – 5)	3.74	2.85
(SD)	(.95)	(.91)

Table A1.3. Full description of the IMAT procedure of Study

Block	Type of Judgment	Instructions	N. of trials
1.	Word discrimination (practice)	Press "D" to categorize body-related words and "K" to categorize mind related words	20
2.	Face discrimination (practice)	Press "D" to categorize Italian faces and "K" to categorize Romanian faces	36
3.	Faces-words compatible categorization (practice)	Press "D" to categorize body-related words and Romanian faces "K" to categorize mind-related words and Italian faces	56
4.	Faces-words compatible categorization (test)	Press "D" to categorize body-related words and Romanian faces "K" to categorize mind-related words and Italian faces	112
5.	Faces discrimination (practice)	Press "D" to categorize Romanian faces and "K" to categorize Italian faces	36
6.	Faces-words incompatible categorization (practice)	Press "D" to categorize body-related words and Italian faces "K" to categorize mind-related words and Romanian faces	56
7.	Faces-words incompatible categorization (test)	Press "D" to categorize body-related words and Italian faces "K" to categorize mind-related words and Romanian faces	112

Note. The order of the blocks 3/4 and 6/7 were counterbalanced between participants. The DIAT index was calculated taking participants' responses of blocks 4 and 7 into account.

Table A1.4. Full description of the IMAT procedure of Study

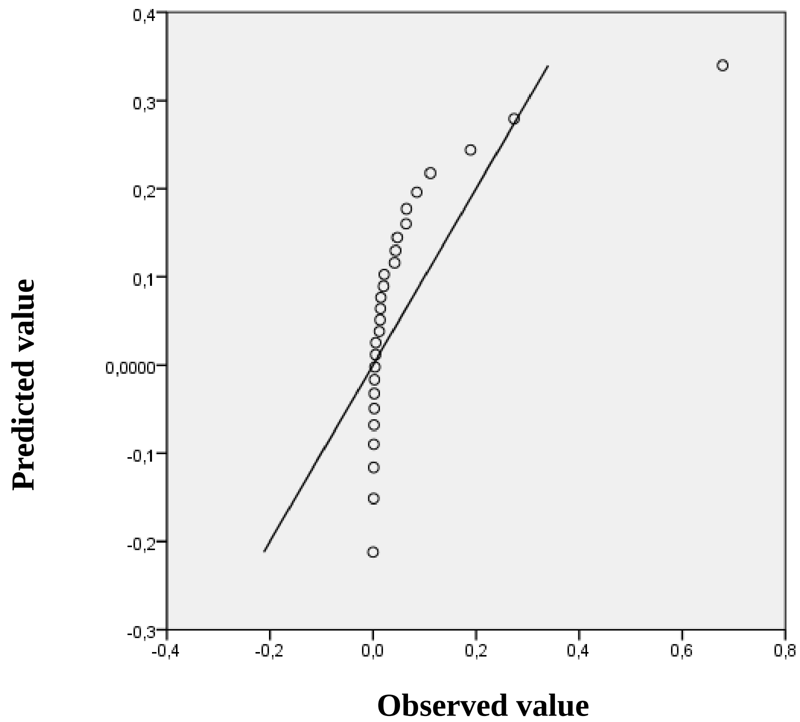
Block	Type of Judgment	Instructions	N. of trials
1.	Word discrimination (practice)	Press "D" to categorize body-related words and "K" to categorize mind related words	20
2.	High FWHR Face discrimination (practice)	Press "D" to categorize Italian faces and "K" to categorize Romanian faces	12
3.	High FWHR Faces-words compatible categorization (practice)	Press "D" to categorize body-related words and Romanian faces "K" to categorize mind-related words and Italian faces	44
4.	High FWHR Faces-words compatible categorization (test)	Press "D" to categorize body-related words and Romanian faces "K" to categorize mind-related words and Italian faces	88
5.	High FWHR Faces-words incompatible categorization (practice)	Press "D" to categorize body-related words and Italian faces "K" to categorize mind-related words and Romanian faces	44
6.	High FWHR Faces-words incompatible categorization (test)	Press "D" to categorize body-related words and Italian faces "K" to categorize mind-related words and Romanian faces	88
7.	Low FWHR Faces discrimination (practice)	Press "D" to categorize Romanian faces and "K" to categorize Italian faces	12
8.	Low FWHR Faces-words incompatible categorization (practice)	Press "D" to categorize body-related words and Italian faces "K" to categorize mind-related words and Romanian faces	44
9.	Low FWHR Faces-words incompatible categorization (test)	Press "D" to categorize body-related words and Italian faces "K" to categorize mind-related words and Romanian faces	88
10.	Low FWHR Faces-words compatible categorization (practice)	Press "D" to categorize body-related words and Romanian faces "K" to categorize mind-related words and Italian faces	44
11.	Low FWHR Faces-words compatible categorization (test)	Press "D" to categorize body-related words and Romanian faces "K" to categorize mind-related words and Italian faces	88

Note. The order of the blocks 2/3/4/5/ and 7/8/9/10/11 were counterbalanced between participants. The DIAT for High FWHR index was calculated taking participants' responses of blocks 4 and 6 into account, while the DIAT for Low FWHR index was calculated considering responses of blocks 9 and 11.

Multivariate outliers' analyses of Study 1:

We first conducted a regression analysis between the IMAT index and the ERP difference between the elaboration of the Black human and doll-like avatar faces from the difference between the elaboration of the White human and doll-like faces between 360 and 580ms after stimulus onset. A marginally significant effect emerged (β=.33, *p*=.08), demonstrating a tendency for participants who showed a stronger odd-ball effect for White compared to Black targets to attribute less mind to Black compared to White targets. Within the same analysis we calculated the Cook's distance of all observations (Cook, 1977) and identified a multivariate outlier following the criterium of Cohen et al. (2003). Any Cook's distance that was bigger than the critical value of the F distribution at α=.50 – in our case any value that exceeded $F(1,26)=0.46$ – was identified as a multivariate outlier (see Fig.A1.1 for Cook's Distance normality plot). Following this criterium, one observation (*Czook's D*=.67) was identified as an outlier and excluded from this analysis. As a result, all the correlational analyses between the ERP components and the IMAT were calculated on 26 participants.

Fig A1.1: Normality plot of Cook's Distance.



Stimuli selection of Study 2:

For the EEG experiment of Study 2, we first selected a total of 64 White male faces taken from the Chicago Face Database (Ma et al., 2015). From these, 32 faces had the highest facial width-to-height ratio (M= 1.97, SD= .07) and 32 the lowest FWHR (M= 1.74, SD= .06). Apart from the FWHR, that was clearly statistically different, t(31)=-12.4, p<.001, d=-3.15, these two groups did not differ on the basis of any of the other judgements included in this database. Specifically, they were equally perceived as afraid, t(31)=.09, p=.93, d=.02, angry, t(31)=-1.09, p=.28, d=.27, attractive, t(31)=-.74, p=.47, d=.18, as having baby face, t(31)=-1.3, p=.20, d=.33, as disgusted, t(31)=-1.05, p=.30, d=.26, dominant, t(31)=-1.22, p=.23, d=.31, feminine, t(31)=-.67, p=.51, d=-.17, happy, t(31)=.18, p=.86, d=.04, masculine, t(31)=-.66, p=.51, d=-.17, as prototypical for their race, t(31)=.47, p=.64, d=.12, sad, t(31)=.33, p=.74, d=.08, surprised, t(31)=.23, p=.82, d=.05, threatening, t(31)=-1.0, p=.32, d=.25, trustworthy, t(31)=.11, p=.91, d=.03, unusual, t(31)=.78, p=.44, d=.19, and as having equal luminance, t(31)=1.9, p=.07, d=.48 (see Table S5 for means and standard deviations).

Afterwards, in order to counterbalance the faces that we wanted to present once as ingroup and once as outgroup members, we divided faces into 2 different lists of 16 faces each. Thus, we had List A and List B with 16 faces each that had the highest FWHR. These two list with the highest FWHR did not differ on their FWHR, t(15)=1.05, p=.31, d=.38, and were equally perceived as afraid, t(15)=1.08, p=.29, d=.39, angry, t(15)=.14, p=.88, d=.05, attractive, t(15)=.09, p=.93, d=.03, as having baby face, t(15)=.71, p=.48, d=.26, as disgusted, t(15)=-.17, p=.86, d=-.06, dominant, t(15)=.002, p=.99, d=.00, feminine, t(15)=-.61, p=.55, d=-.22, happy, t(15)=.46, p=.65, d=.17, masculine, t(15)=.11, p=.91, d=.04, as prototypical of their race, t(15)=.95, p=.35, d=.34, sad, t(15)=.34, p=.73, d=.12, surprised, t(15)=.15, p=.88, d=.05, threatening, t(15)=-.83, p=.32, d=-.03, trustworthy, t(15)=.92, p=.37, d=.33, unusual, t(15)=-

1.27, *p*=.22, *d*=-.46, and having equal luminance, *t*(15)=-.34, *p*=.74, *d*=-.12 (see Table S5 for means and standard deviations).

Likewise, we created List C and D with 16 faces each with the lowest FWHR that did not differ on their FWHR, *t*(15)=-1.12, *p*=.28, *d*=-.41, and were equally perceived as afraid, *t*(15)=-.99, *p*=.38, *d*=-.36, angry, *t*(15)=.87, *p*=.39, *d*=.31, attractive, *t*(15)=1.47, *p*=.16, *d*=.53, as having baby face, *t*(15)=.28, *p*=.77, *d*=.10, as disgusted, *t*(15)=.22, *p*=.83, *d*=.08, dominant, *t*(15)=.57, *p*=.58, *d*=.21, feminine, *t*(15)=.43, *p*=.67, *d*=.16, happy, *t*(15)=.40, *p*=.69, *d*=.15, masculine, *t*(15)=.14, *p*=.88, *d*=.045, as prototypical of their race, *t*(15)=-1.36, *p*=.19, *d*=-.49, sad, *t*(15)=-1.51, *p*=.15, *d*=-.55, surprised, *t*(15)=.27, *p*=.78, *d*=.09, threatening, *t*(15)=.58, *p*=.57, *d*=-.21, trustworthy, *t*(15)=.05, *p*=.96, *d*=.02, unusual, *t*(15)=1.33, *p*=.20, *d*=.48, and as having equal luminance, *t*(15)=-.70, *p*=.49, *d*=-.25 (see Table A1.5 for means and standard deviations).

Table A1.5: Means and standard deviations of the selected stimuli.

		Low FWHR faces	High FWHR faces	List A High FWHR faces	List B High FWHR faces	List C Low FWHR faces	List C Low FWHR faces
		32 faces	**32 faces**	**16 faces**	**16 faces**	**16 faces**	**16 faces**
FWHR	**M (SD)**	1.74 (.06)	1.97 (.06)	1.98 (.06)	1.96 (.06)	1.73 (.07)	1.75 (.04)
Afraid	**M (SD)**	2.03 (.45)	2.02 (.28)	2.06 (.27)	1.98 (.29)	1.95 (.34)	2.11 (.53)
Angry	**M (SD)**	2.39 (.58)	2.56 (.62)	2.58 (.66)	2.54 (.61)	2.49 (.62)	2.29 (.55)
Attractive	**M (SD)**	2.82 (.52)	2.92 (.59)	2.93 (.61)	2.91 (.58)	2.96 (.56)	2.68 (.45)
Baby face	**M (SD)**	2.45 (.75)	2.67 (.71)	2.76 (.79)	2.58 (.64)	2.49 (.72)	2.40 (.81)
Disgusted	**M (SD)**	2.1 (.36)	2.2 (.44)	2.2 (.46)	2.21 (.43)	2.10 (.37)	2.08 (.36)
Dominant	**M (SD)**	2.86 (.60)	3.05 (.76)	3.05 (.82)	3.05 (.82)	2.92 (.58)	2.81 (.63)
Feminine	**M (SD)**	1.8 (.42)	1.86 (.33)	1.83 (.34)	1.9 (.32)	1.84 (.44)	1.76 (.43)
Happy	**M (SD)**	2.33 (.58)	2.3 (.57)	2.35 (.68)	2.26 (.45)	2.38 (.45)	2.28 (.69)
Masculine	**M (SD)**	4.32 (.53)	4.42 (.59)	4.43 (.63)	4.41 (.58)	4.33 (.58)	4.30 (.50)
Prototypic	**M (SD)**	3.52 (.76)	3.41 (.86)	3.58 (.77)	3.25 (.94)	3.33 (.82)	3.70 (.68)
Sad	**M (SD)**	2.6 (.66)	2.56 (.39)	2.58 (.42)	2.54 (.39)	2.43 (.53)	2.77 (.75)
Surprise	**M (SD)**	1.74 (.19)	1.73 (.19)	1.74 (.16)	1.73 (.23)	1.75 (.20)	1.73 (.19)
Threatening	**M (SD)**	2.39 (.60)	2.53 (.60)	2.44 (.60)	2.63 (.61)	2.46 (.63)	2.33 (.59)
Trustworthy	**M (SD)**	3.2 (.39)	3.2 (.34)	3.25 (.31)	3.13 (.38)	3.20 (.36)	3.19 (.43)
Unusual	**M (SD)**	2.5 (.46)	2.39 (.53)	2.29 (.43)	2.50 (.61)	2.60 (.53)	2.39 (.37)
Luminance	**M (SD)**	160.5 (12.5)	156.0 (11.8)	155.5 (12.11)	156.6 (11.9)	159.4 (10.1)	161.8 (14.8)

Stimuli selection of the IMAT of Study 2:

Regarding the IMAT, we selected 12 faces with a Low (*M*= 1.73, *SD*= .06) and 12 faces with a High (*M*= 1.97, *SD*= .07) FWHR (6 faces from each list) out of the 64 White male faces that were presented during the EEG and were taken from the Chicago Face Database (Ma et al., 2015). Apart from the FWHR, that were clearly statistically different, *t*(11)=-7.67, *p*<.001, *d*=-3.27, these two groups did not differ on the basis of any of the other judgements presented in the current database. Specifically, they were equally perceived as afraid, *t*(11)=.20, *p*=.84, *d*=.08, angry, *t*(11)=-.53, *p*=.61, *d*=-.22, attractive, *t*(11)=.12, *p*=.90, *d*=.05, as having baby face, *t*(11)=-1.5, *p*=.16, *d*=-.64, as disgusted, *t*(11)=-.29, *p*=.77, *d*=-.12, dominant, *t*(11)=-.66, *p*=.52, *d*=-.28, feminine, *t*(11)=-1.02, *p*=.33, *d*=-.43, happy, *t*(11)=.04, *p*=.97, *d*=.01, masculine, *t*(11)=.24, *p*=.81, *d*=.10, as prototypical of their race, *t*(11)=-.32, *p*=.75, *d*=-.13, sad, *t*(11)=-1.13, *p*=.28, *d*=.48, surprised, *t*(11)=.61, *p*=.55, *d*=.26, threatening, *t*(11)=-.70, *p*=.49, *d*=-.29, trustworthy, *t*(11)=-.33, *p*=.74, *d*=-.14, unusual, *t*(11)=-.16, *p*=.88, *d*=-.07, and as having equal luminance, *t*(11)=.55, *p*=.59, *d*=.23 (see Table A1.6 for means and standard deviations).

Again, we divided faces into 2 different lists of 6 faces each. Thus, we had List A and List B with 6 faces each that had the highest FWHR. These two list with the highest FWHR did not differ on their FWHR, *t*(5)=.64, *p*=.55, *d*=.40, and were equally perceived as afraid, *t*(5)=.02, *p*=.98, *d*=.01, angry, *t*(5)=-1.09, *p*=.32, *d*=-.68, attractive, *t*(5)=.53, *p*=.62, *d*=.33, as having baby face, *t*(5)=.52, *p*=.62, *d*=.33, as disgusted, *t*(5)=-1.36, *p*=.23, *d*=-.86, dominant, *t*(5)=-.39, *p*=.71, *d*=-.24, feminine, *t*(5)=.07, *p*=.94, *d*=.04, happy, *t*(5)=1.75, *p*=.14, *d*=.1.10, masculine, *t*(5)=-.24, *p*=.82, *d*=-.15, as prototypical of their race, *t*(5)=1.31, *p*=.25, *d*=.83, sad, *t*(5)=-.84, *p*=.44, *d*=-.53, surprised, *t*(5)=.44, *p*=.68, *d*=.28, threatening, *t*(5)=-1.41, *p*=.21, *d*=-.89, trustworthy, *t*(5)=1.32, *p*=.24, *d*=.83, unusual, *t*(5)=-.30, *p*=.77, *d*=-.18, and as having equal luminance, *t*(5)=.97, *p*=.38, *d*=.61 (see Table S6 for means and standard deviations).

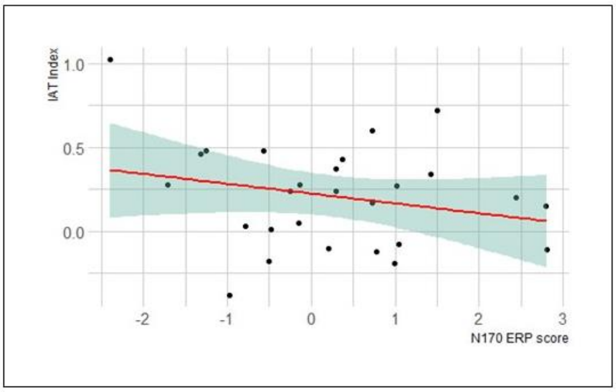
Likewise, we created List C and D with 6 faces each with the lowest FWHR that did not differ on their FWHR, $t(5)=-.79$, $p=.46$, $d=-.49$, and were equally perceived as afraid, $t(5)=-.43$, $p=.68$, $d=-.27$, angry, $t(5)=.21$, $p=.84$, $d=.13$, attractive, $t(5)=1.44$, $p=.21$, $d=.91$, as having baby face, $t(5)=.57$, $p=.59$, $d=.36$, as disgusted, $t(5)=.07$, $p=.94$, $d=.04$, dominant, $t(5)=-.63$, $p=.56$, $d=-.39$, feminine, $t(5)=-.16$, $p=.87$, $d=-.10$, happy, $t(5)=.10$, $p=.92$, $d=.06$, masculine, $t(5)=.08$, $p=.94$, $d=.05$, as prototypical of their race, $t(5)=-.65$, $p=.55$, $d=-.41$, sad, $t(5)=.18$, $p=.86$, $d=.11$, surprised, $t(5)=-.57$, $p=.59$, $d=-.36$, threatening, $t(5)=-.44$, $p=.67$, $d=-.27$, trustworthy, $t(5)=-.07$, $p=.95$, $d=-.04$, unusual, $t(5)=-.59$, $p=.57$, $d=-.37$, and as having equal luminance, $t(5)=-.32$, $p=.76$, $d=-.20$ (see Table S6 for means and standard deviations).

Table A1.6: Means and standard deviations of the selected stimuli.

		Low FWHR faces	High FWHR faces	List A High FWHR faces	List B High FWHR faces	List C Low FWHR faces	List C Low FWHR faces
		12 faces	**12 faces**	**6 faces**	**6 faces**	**6 faces**	**6 faces**
FWHR	**M (SD)**	1.72 (.06)	1.97 (.07)	1.98 (.09)	1.95 (.06)	1.71 (.06)	1.74 (.05)
Afraid	**M (SD)**	2.04 (.34)	2.03 (.21)	2.03 (.21)	2.03 (.22)	1.99 (.42)	2.1 (.25)
Angry	**M (SD)**	2.38 (.54)	2.51 (.61)	2.37 (.59)	2.63 (.64)	2.42 (.65)	2.34 (.48)
Attractive	**M (SD)**	2.84 (.52)	2.81 (.59)	2.92 (.58)	2.70 (.64)	3.06 (.59)	2.61 (.34)
Baby face	**M (SD)**	2.50 (.76)	2.88 (.45)	2.96 (.28)	2.80 (.59)	2.66 (.75)	2.35 (.81)
Disgusted	**M (SD)**	2.11 (.38)	2.16 (.48)	2.01 (.41)	2.30 (.55)	2.12 (.48)	2.10 (.28)
Dominant	**M (SD)**	2.78 (.51)	2.94 (.86)	2.84 (.91)	3.04 (.89)	2.69 (.34)	2.86 (.66)
Feminine	**M (SD)**	1.85 (.43)	2.01 (.41)	2.02 (.37)	2.00 (.47)	1.83 (.35)	1.88 (.54)
Happy	**M (SD)**	2.37 (.66)	2.36 (.72)	2.65 (.92)	2.07 (.29)	2.40 (.66)	2.35 (.73)
Masculine	**M (SD)**	4.24 (.41)	4.19 (.64)	4.15 (.54)	4.24 (.77)	4.25 (.34)	4.23 (.51)
Prototypic	**M (SD)**	3.32 (.86)	3.44 (.84)	3.67 (.68)	3.22 (.99)	3.12 (.73)	3.52 (.99)
Sad	**M (SD)**	2.53 (.54)	2.64 (.41)	2.52 (.54)	2.75 (.25)	2.56 (.67)	2.49 (.43)
Surprise	**M (SD)**	1.76 (.16)	1.71 (.19)	1.73 (.13)	1.68 (.26)	1.73 (.15)	1.79 (.19)
Threatening	**M (SD)**	2.34 (.54)	2.48 (.66)	2.26 (.64)	2.71 (.65)	2.27 (.46)	2.41 (.63)
Trustworthy	**M (SD)**	3.14 (.39)	3.18 (.29)	3.28 (.33)	3.07 (.34)	3.13 (.29)	3.15 (.50)
Unusual	**M (SD)**	2.55 (.36)	2.57 (.34)	2.55 (.31)	2.60 (.39)	2.48 (.46)	2.62 (.26)
Luminance	**M (SD)**	156.3 (14.2)	154.7 (9.75)	156.3 (8.50)	153.1 (11.43)	155.75 (14.05)	156.91 (15.75)

Plot demonstration of the correlation between the IAT and the ERP scores

Fig A1.2: scatterplots for the relationship between the IAT and the ERP scores of Study 1.



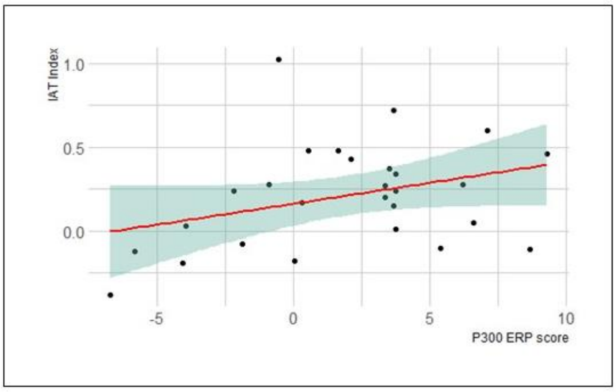
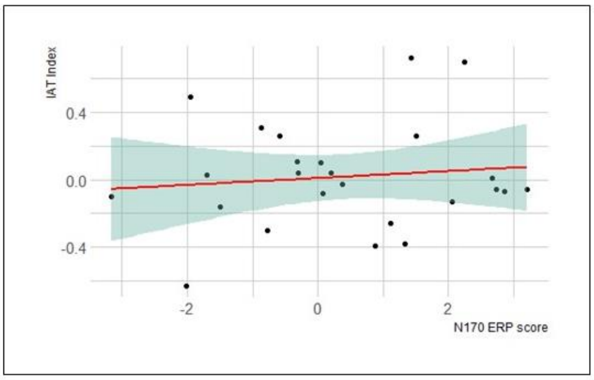
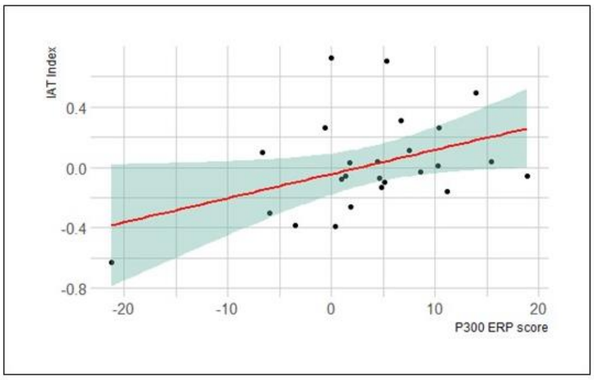


Fig A1.3: scatterplots for the relationship between the IAT and the ERP scores of Study 2





Note. In this case we took only in consideration the relationship between the IAT index and the ERP scores when High FWHR faces were presented.

Appendix 2 – Exploring the sexual objectification of men and women: Neural and motivational insights on the perspective of gay men.

Electrophysiological recording and processing in Study 1

We recorded the EEG with a 25 electrodes cap, with a left earlobe electrode and a right earlobe reference (bandpass filter: 0.01 – 200 Hz; A/D rate: 1000 Hz). During the EEG registration the electrodes impedance was maintained below 10/5 KΩ. The analyses were conducted with the EEGLAB (Delorme & Makeig, 2004a) and the ERPLAB (Lopez-Calderon & Luck, 2014b) toolbox of MATLAB. Raw data were filtered with a bandpass filter of 0.1-40 HZ. The data were re-referenced offline to the average of the right and left earlobe electrodes. The horizontal electrooculogram (HEOG) was recorded from two electrodes placed on the outer canthi of both eyes. The raw signal was segmented in 900ms long epochs that began 100ms before the stimulus onset. We used a baseline correction of the mean activity during a 100ms pre-stimulus interval. Trials with horizontal eye movements (HEOG exceeding ± 30 µV) or other movement artefacts (any channel exceeding ± 70 µV) were rejected. The mean number of retained trails for each participant was 85%.

Based on the literature (Luck, 2005a) and on the findings of Vaes et al. (2019) we first visually inspected the ERP Grand Average from 300ms to 600ms after stimulus presentation and then selected the electrodes and the time windows in which this component was expected. Following this procedure, the P300 maximum amplitude was visually found over the Oz and Pz electrodes. The final analysis was conducted over the occipital and the parietal region of interests (ROI, the former including Oz, O1, and O2 and the latter including the Pz, P4 and P3 electrodes) between 360 and 600ms after stimulus onset. In all statistical analyses, the alpha level was set to .05 and all pairwise comparisons were Bonferroni-corrected.

Electrophysiological results of Pz ROI

In the parietal site the analysis showed a main effect of Gender, $F(1,22) = 8.42$, $p = .008$, $\eta 2p = .28$, demonstrating a tendency of the P300 to be more positive for male ($M = 18.09$, $SD = 6.6$) compared to female targets ($M = 14.71$, $SD = 7.27$), and a main effect of Humanity, $F(1,22) = 85.97$, $p < .001$, $\eta 2p = .80$. Similar to the occipital area, the infrequent stimuli elicited a more positive P300 ($M = 23.8$, $SD = 9.5$) compared to the frequent stimuli ($M = 9.01$, $SD = 4.45$). Finally, the interaction effect emerged, $F(1,22) = 8.19$, $p = .009$, $\eta 2p = .27$. When a doll-like male avatar appeared among a series of objectified male targets the P300 was more positive compared to when a doll-like female avatar appeared among a set of objectified female targets, $t(22) = 3.17$, $p = .004$, d=.95. No difference was found between the activation of the P300 for the male and female objectified human targets, $t(22) = 1.78$, $p = .088$, d=.54.

Likewise analyses performed over occipital site, we performed a mini meta-analysis confronting the neural results of the current study with those of Study 1 in Vaes et al. (2019). A meta-analysis was performed on the P300 amplitude differences between male and female stimuli, separately for human and doll-like targets. Medium to strong effects emerged indicating that female and male doll-like targets differed in the expected direction, r=.52, Z=3.27, p<.001. While no differences were found between male and female human targets, r=.23, Z=1.34, p=.17. Given that the index of heterogeneity between both studies was not significant, $Q_{real}(2)=2.82$, $p_{\text{real}}=.24$; $Q_{doll}(2)=3.82$, $p_{doll}=.14$, we can conclude that gay men elaborated the sexually objectified women as more similar to an object compared to their male counterparts much like heterosexual men and women do.

Selection criteria of the stimuli of Study 2

Based on the pre-test conducted by Vaes et al. (2019), where participants rated the stimuli on the basis of their sexiness, beauty and the level of objectification, 10 female and 10 male models were selected whose ratings did not differ from the unselected ones. Indeed, the level of attractiveness, $t(22)_{female}$ = 1.88, p = .07, d=.56; $t(15)_{male}$ = .69, p = .50, d=.21, sexiness, $t(22)_{female}$ = 1.67, p = .11, d=.50; $t(15)_{male}$ = 1.57, p = .14, d=.47, and the rating of the level of objectification, $t(22)_{female}$ = .63, p = .53, d=.19; $t(15)_{male}$ = -.75, p = .46, d=-.23, did not significantly differ between the selected and unselected models for both the female and male models. The selected pictures had a dimension of 5.35° × 7.64° and were displayed on a white background.

Differences between male and female stimuli as a function of sexual orientation

Social judgments

We analysed all social judgements in a 2 (Target gender: male vs. female) X 3 (Sexual orientation: gay male vs. heterosexual male vs. heterosexual female) mixed ANOVA in which only the last variable was manipulated between participants (see Table A2.1 for details).

Table A2.1: Means (standard errors) for each social judgement as a function of the gender of the target and the sexual orientation and gender of participants.

	Gay Men		**Heterosexual Men**		**Heterosexual Women**	
	Female target	Male target	Female target	Male target	Female target	Male target
Sexually Available	4.27 (1.39)	4.85 (1.28)	4.7 (1.27)	3.76 (1.58)	4.45 (1.05)	4.61 (1.12)
Sexually Attractive	3.84 (1.94)	5.58 (1.06)	5.62 (.99)	3.43 (1.79)	4.87 (1.3)	4.54 (1.16)
Good Looking	5.33 (1.12)	5.67 (.84)	5.69 (.86)	4.35 (1.51)	5.19 (1.02)	4.73 (.99)
Vulgar	2.35 (1.28)	2.22 (1.15)	2.90 (1.35)	3.02 (1.34)	3.02 (1.28)	3.21 (1.37)
Superficial	3.81 (1.38)	3.69 (1.37)	4.01 (1.25)	3.76 (1.4)	4.22 (1.16)	4.36 (1.14)
Agency	3.4 (.69)	3.5 (.61)	3.28 (.61)	3.1 (.65)	3.21 (.55)	3.08 (.5)
Experience	3.58 (.86)	3.47 (.82)	3.33 (.78)	3.06 (.82)	3.41 (.74)	3.31 (.67)
IOW/IOM	3.93 (1.81)	3.2 (1.4)	3.72 (1.5)	3.25 (1.7)	3.94 (1.8)	2.67 (1.33)

For the Sexually availability judgments a significative interaction with participants sexual orientation emerged ($F(2,216)$= 26.5, p<.001, η_p^2=.19). Heterosexual males tended to judge women as significantly, $F(1,216)$= 39.1, p<.001, η_p^2=.15, more sexually available (*M*=4.7, *SD*=1.27) compared to men (*M*=3.76,*SD*=1.58), while gay men showed a significant opposite tendency judging male stimuli as more sexually available (*M*=4.85, *SD*=1.28) compared to female targets (*M*=4.27, *SD* =1.39, $F(1,216)$= 14.1, p<.001, η_p^2=.06). Heterosexual women, instead, did not significantly differentiate between the level of sexually availability, $F(1,216)$= .98, p=.32, η_p^2=.005, of female (M=4.45, SD =1.05) and male targets (M=4.61, SD =1.12).

The analysis of sexually attractiveness showed a significant main effect of Target gender, $F(1,216)$= 5.52, p=.020, η_p^2=.25, with women judged in general as more sexually attractive (M=4.79, SD =1.64) than men (M=4.49, SD =1.66). Also, the interaction with sexual orientation emerged, $F(2,216)$= 112.19, p<.001, η_p^2=.51, showing a similar pattern as the sexually availability judgments. Indeed, heterosexual men tended to judge, $F(1,216)$= 143.8, p<.001, η_p^2=.40, the female stimuli as significantly more sexually attractive (M=5.62, SD =.99) compared to the male targets (M=3.43, SD =1.79), while gay men showed the opposite effect, $F(1,216)$= 85.3, p<.001, η_p^2=.28, (M=5.58, SD =1.06 vs. M=3.84, SD =1.94, for male and female stimuli respectively). Likewise, heterosexual women judged the sexually attractiveness of both male (M=4.54, SD =1.16) and female (M=4.87, SD =1.29) targets similarly, $F(1,216)$= 2.68 p=.103, η_p^2=.012.

Also, for the judgments of the targets' good looks a significant main effect emerged, $F(1,216)$= 38.1, p<.001, η_p^2=.15. In general, women were judged as better looking (M=5.42, SD =1.02) compared to men (M=4.91, SD =1.29). Also, the main effect of sexual orientation was significant, $F(2,216)$= 7.57, p=.001, η_p^2=.066. Gay men significantly judged all targets as better looking (M=5.5, SD =.83) compared to heterosexual men (M=5.02, SD =1.01) and heterosexual women (M=4.96, SD =.91).This analysis revealed also a significant interaction between Target gender and participants' sexual orientation ($F(2,216)$= 40.58, p<.001, η_p^2=.27). Indeed, heterosexual men tended to judge female targets (M=5.69, SD =.86) as significantly better looking, $F(1,216)$= 106.4, p<.001, η_p^2=.33, compared to men (M=4.35, SD =1.51). Similarly, heterosexual women judged women (M=5.19, SD =1.02) as significantly, $F(1,216)$= 10.06, p=.002, η_p^2=.04, better looking compared to men (M=4.72, SD =.99). While gay men tended to judge the male targets (*M*=5.67, *SD* =.84) as better looking, $F(1,216)$= 6.45, *p*=.012, η_p^2=.03, compared to the female targets (*M*=5.33, *SD* =1.12).

The social judgment of vulgar showed a significant main effect of participants' sexual orientation, $F(2,216)$= 9.33, *p*<.001, η_p^2=.080. Gay men significantly judged all images as less vulgar (*M*=2.29, *SD* =1.17) than heterosexual men (*M*=2.96, *SD* =1.24) and heterosexual women (*M*=3.11, *SD* =1.28). In addition, a marginally significant interaction between sexual orientation and target gender showed to be significant, $F(2,216)$= 3.01, *p*=.051, η_p^2=.027). Still, no significant differences were found in the evaluation of the vulgarity of male and female targets in none of the heterosexual and gay samples.

Also, for the social judgement of superficiality a significant main effect of the sexual orientation of participants emerged, $F(2,216)$= 3.64, *p*=.001, η_p^2=.080. Heterosexual women judged the images in general as significantly more superficial (*M*=4.28, *SD* =1.1) compared to gay men (*M*=3.74, *SD* =1.34), while their judgments did not differ from those of heterosexual men. In addition, we found a marginally significant interaction effect, $F(2,216)$= 2.98, *p*=.053, η_p^2=.027. Heterosexual men significantly judged the female targets (*M*=4.01, *SD* =1.24) as more superficial, $F(1,216)$= 5.29, *p*=.022, η_p^2=.024, compared to the male targets (*M*=3.76, *SD* =1.4). Whereas the heterosexual women, $F(1,216)$= 1.39, *p*=.24, η_p^2=.006) and the gay men, $F(1,216)$= 1.27, *p*=.26, η_p^2=.006, did not significantly evaluate the male ($M_{HeteroWomen}$=4.35 $SD_{HeteroWomen}$ =1.14; M_{GayMen}=3.68, SD_{GayMen} =1.37) and the female targets ($M_{HeteroWomen}$=4.22, $SD_{HeteroWomen}$ =1.16; M_{GayMen}=3.81, SD_{GayMen} =1.38) differently.

The agency and experience index of the mind perception scale were analysed separately. This analysis revealed a Target gender main effect of both agency, $F(1,216)$= 6.11, *p*=.014, η_p^2=.028, and experience, $F(1,216)$= 47.65, *p*<.001, η_p^2=.181. The female targets were judged as having more agentic (*M*=3.30, *SD* =.60) and experience characteristics (*M*=3.44, *SD* =.80) compared to the male targets (M_{agency}=3.23, SD_{agency}=.62¸ $M_{experience}$=3.27,

$SD_{experience}$=.79). In addition, for both agency, *F(2,216)*= 6.27, *p*=.001, η_p^2=.055, and experience, *F(2,216)*= 3.58, *p*=.029, η_p^2=.032, a significant main effect of sexual orientation emerged. In general, gay men evaluated the targets as less agentic (*M*=3.45, *SD* =.61) compared to heterosexual women (*M*=3.15, *SD* =.50) and men (*M*=3.18, *SD* =.56). While, for the experience index, gay men attributed more experience characteristics to the stimuli in general (*M*=3.53, *SD* =.82) only compared to heterosexual men (*M*=3.19, *SD* =.78) while no differences emerged between gay men and heterosexual women. Finally, both indices significantly interacted with the sexual orientation of participants. Specifically, agency characteristics (*F(2,216)*= 10.45, *p*<.001, η_p^2=.088) were found to be assigned more to the female ($M_{HeteroWomen}$=3.21, $SD_{HeteroWomen}$=.55; $M_{HeteroMen}$=3.28, $SD_{HeteroMen}$=.55) than to the male targets ($M_{HeteroWomen}$=3081, $SD_{HeteroWomen}$=.50; $M_{HeteroMen}$=3.09, $SD_{HeteroMen}$=.65) both by heterosexual men, *F(1,216)*= 15.7, *p*<.001, η_p^2=.068, and women, *F(1,216)*= 6.36, *p*=.012, η_p^2=.03, while gay men attributed more agency characteristics to male (*M*=3.5, *SD*=.61) compared to female targets (*M*=3.39, *SD*=.69), *F(1,216)*= 4.89, *p*=.028, η_p^2=.022. On the other hand, the experience characteristics, *F(2,216)*= 5.50, *p*=.005, η_p^2=.048, were attributed more to the female ($M_{HeteroWomen}$=3.41, $SD_{HeteroWomen}$=.74; $M_{HeteroMen}$=3.33, $SD_{HeteroMen}$=.78; M_{GayMen}=3.58, SD_{GayMen}=.85) than to the male targets ($M_{HeteroWomen}$=3.31, $SD_{HeteroWomen}$=.67; $M_{HeteroMen}$=3.06, $SD_{HeteroMen}$=.81; M_{GayMen}=3.47, SD_{GayMen}=.82) in all samples (*F(1,216)*= 48.5, *p*<.001, η_p^2=.184; *F(1,216)*= 5.88, *p*=.016, η_p^2=.027; and *F(1,216)*= 7.83, *p*=.006, η_p^2=.035, for heterosexual men, women and gay men respectively).

Finally, we analysed the Inclusion of Objectified Women and Men in their Overall Gender Category index. In this case both a significant Target gender main effect, *F(1,216)*= 52.18, *p*<.001, η_p^2=.195, and a significant interaction, *F(2,216)*= 4.00, *p*=.020, η_p^2=.036, emerged. In general, women were considered to be more similar to objectified female targets (*M*=3.86, *SD* =1.70) compared to men (*M*=3.06, *SD* =1.52). This pattern was found in all samples, but was stronger for heterosexual women, $F(1,216)$= 36.23, p<.001, η_p^2=.144 (M=3.94, SD=1.85 and M=2.67, SD=1.33 for women and men respectively) a bit less for gay men, $F(1,216)$= 14.25, p<.001, η_p^2=.062 (M=3.93, SD=1.81 and M=3.20, SD=1.40 for women and men respectively) and even less strong, but still significant for heterosexual men, $F(1,216)$= 6.38, p=.012, η_p^2=.029 (M=3.72, SD=1.50 and M=3.25, SD=1.71 for women and men respectively).

Media indices

For the media indices we analysed whether the exposition of male and female objectified images on each mass media could be influenced by the sexual orientation of participants. For this reason, we analysed each index in a 2 (Target gender: male vs. female) X 3 (Sexual orientation: gay male vs. heterosexual male vs. heterosexual female) mixed ANOVA in which only the last variable was manipulated between participants (see Table A2.2 for an overview).

Table A2.2: Means (standard errors) for each media outlet as a function of the gender of the target and the sexual orientation and gender of participants.

	Gay Men		Heterosexual Men		Heterosexual Women	
	Female target	Male target	Female target	Male target	Female target	Male target
Television	13.9 (15.5)	13.9 (15.7)	13.5 (16.6)	10.5 (13.4)	20.3 (22.1)	18.3 (21.05)
Tv on Demand	16.7 (19.2)	17.3 (18.1)	14.06 (15.2)	13.2 (16.1)	21.61 (21.2)	17.1 (17.02)
Porn	13.2 (17.6)	22.4 (18.7)	12.9 (15.6)	9.4 (13.6)	2.45 (7.6)	2.1 (6.7)
YouTube	14.4 (13.4)	15.9 (12.9)	18.5 (15.2)	15.5 (14.8)	15.5 (16.1)	12.2 (13.5)
Fashion Magazines	.88 (3.8)	.44 (2.1)	.32 (2.3)	.42 (2.9)	2.03 (5.9)	2.3 (6.4)
Adult Magazines	.12 (1.04)	.4 (2.4)	.3 (1.8)	.15 (1.34)	.98 (7.5)	.82 (6.25)
News Magazines	1.7 (4.5)	2.37 (7.1)	1.9 (6.6)	2.02 (5.9)	1.81 (6.6)	2.34 (9.3)
Online Magazines	4.89 (12.7)	4.3 (10.3)	6 (13.02)	3.98 (10.7)	6.25 (14.5)	5.34 (11.3)
Facebook	9.6 (13.7)	11.6 (16.9)	15.5 (17.4)	11.6 (16.2)	19.5 (20.03)	14.8 (15.61)
Instagram	11.3 (16.9)	12.7 (17.3)	15.7 (21.6)	8.5 (13.25)	22.4 (22.02)	14.5 (16.4)
Snapchat	2.16 (6.2)	3.37 (8.45)	2.6 (7.9)	2.27 (7.36)	3.18 (11.6)	2.11 (9.37)
Other Social Media	3.67 (9.98)	4.54 (10.2)	6.4 (13.6)	3.31 (7.02)	3.84 (10.1)	3.14 (7.79)
Dating Apps	3.7 (8.5)	9.78 (16.57)	2.73 (12.18)	.56 (2.38)	.39 (2.05)	.93 (4.87)

The analysis of the television index resulted in a significant Target gender main effect, $F(1,216)$= 10.6, p=.001, η_p^2=.047). In general, participants indicated to be more frequently exposed to objectified women (M=15.6, SD=18.23) on television compared to objectified men (M=13.9, SD=16.9). Also, a significant main effect of the sexual orientation of participants emerged, $F(2,216)$= 3.43, p=.034, η_p^2=.031. Heterosexual women seemed to be more significantly exposed to objectified images on television (M=19.32, SD =21.24) compared to heterosexual men (M=12.02, SD =14.7), while no differences emerged between heterosexual women and gay men. Moreover, television significantly interacted with participants sexual orientation, $F(2,216)$= 3.26, p=.040, η_p^2=.029. Heterosexual men, $F(1,216)$= 4.5, p=.035, η_p^2=.020, and women, $F(1,216)$= 12.9, p<.001, η_p^2=.056, indicated to be more exposed to objectified women ($M_{HeteroWomen}$=20.3, $SD_{HeteroWomen}$=22.1; $M_{HeteroMen}$=13.5, $SD_{HeteroMen}$=16.6) than men ($M_{HeteroWomen}$=18.3, $SD_{HeteroWomen}$=21.05; $M_{HeteroMen}$=10.5, $SD_{HeteroMen}$=13.4) on television, whereas gay men indicated to be equally, $F(1,216)$= .001, p=.97, η_p^2=.00, exposed to objectified male (M=13.9, SD=15.7) and female (M=13.9, SD=15.5) images on television.

A similar pattern emerged for Tv on Demand. A Target gender main effect appeared, $F(1,216)$= 4.8, p=.03, η_p^2=.022), in general participants indicated to be more frequently exposed to objectified women on tv on demand (M=17.2, SD=18.7) than objectified men (M=15.7, SD=17.1). Also, the interaction effect with participants sexual orientation emerged significantly, $F(2,216)$= 4.3, p=.014, η_p^2=.039. In this case, however, only heterosexual women reported to be more frequently exposed, $F(1,216)$= 11.8, p=.001, η_p^2=.052, to objectified women (M=21.6, SD=21.21) than men (M=17.1, SD=17.02) on tv on demand. While heterosexual men, $F(1,216)$= .48, p=.48, η_p^2=.002, and gay men, $F(1,216)$= .28, p=.59, η_p^2=.001, did not indicate to be more or less exposed to images of objectified men ($M_{HeteroMen}$=13.2, $SD_{HeteroMen}$=16.01¸M_{GayMen}=17.3, SD_{GayMen}=18.1) or women

($M_{HeteroMen}$=14.06, $SD_{HeteroMen}$=15.2 ,M_{GayMen}=16.7, SD_{GayMen}=19.25) when watching Tv on Demand.

A significant Target gender main effect of the exposure to pornography, $F(1,216)$= 10.8, p=.001, η_p^2=.048, indicated that in general objectified men (M=11.7, SD=16.4) were seen more frequently on this type of media than objectified women (M=9.9, SD=15.3). The main effect of the sexual orientation of participant was highly significant, $F(2,216)$= 21.81, p<.001, η_p^2=.168. Gay men were more significantly exposed in general to objectified images when watching porn (M=18.05, SD =17.27) compared to heterosexual men (M=11.2, SD =14.25) and compared to heterosexual women (M=2.27, SD =7.14). A significant interaction with participants' sexual orientation, $F(2,216)$= 52.4, p<.001, η_p^2=.327, emerged as well. Male participants were found to significantly differentiate their exposure to images of men and women when watching porn in an opposite way. Indeed, gay men were significantly, $F(1,216)$= 100, p<.001, η_p^2=.316, more frequently exposed to objectified men (M=22.4, SD=18.7) than women (M=13.2, SD=17.6), whereas heterosexual men showed a significant opposite effect, $F(1,216)$= 15.5, p<.001, η_p^2=.067 (M=12.9, SD=15.6 and M=9.4, SD=13.6 for objectified women and men respectively). Heterosexual women, instead, were much less exposed to pornography and were not differently, $F(1,216)$= .13, p=.72, η_p^2=.001, exposed to images of objectified men (M=2.09, SD=6.7) and women (M=2.45, SD=7.6).

For the YouTube index, analyses revealed a Target gender main effect, $F(1,216)$= 4.30, p=.040, η_p^2=.019, showing that in general participants indicated to be exposed more frequently to objectified women (M=16.2, SD=14.9) than men (M=15.4, SD=14.8) on YouTube. Also the interaction effect emerged, $F(2,216)$= 4.16, p=.017, η_p^2=.037. Only the heterosexual sample significantly differentiated between the time they were exposed to depictions of objectified women and men on YouTube. Indeed, heterosexual men significantly ($F(1,216)$= 5.60, p=.018, η_p^2=.026) perceived objectified women (M=18.5, SD=15.2) to appear more frequently than men (*M*=15.5, *SD*=14.8), similarly heterosexual women ($F(1,216)$= 5.4, *p*=.022, $\eta_p{}^2$=.024) perceived objectified women (*M*=15.5, *SD*=16.1) to be more present on Youtube than men (*M*=12.2, *SD*=13.5). This did not happen with gay men, $F(1,216)$= 1.34, *p*=.25, $\eta_p{}^2$=.006, who indicated to be equally exposed to objectified men (*M*=15.9, *SD*=12.9) and women (*M*=14.4, *SD*=13.4) on YouTube.

The analysis of adult magazines and news magazines showed no significant effects. While the Target gender main effect of online magazines was significant, $F(1,216)$= 8.5, *p*=.004, $\eta_p{}^2$=.038, showing how in general participants indicated that objectified women (*M*=5.7, *SD*=13.4) appeared more frequently than objectified men (*M*=4.5, *SD*=10.7) in online magazines. For the fashion magazines, instead, a main effect of sexual orientation emerged, $F(2,216)$= 4.33, *p*=.014, $\eta_p{}^2$=.039. Heterosexual women were more generally exposed to objectified images on fashion magazines (*M*=2.18, *SD* =5.73) only compared to heterosexual men (*M*=.37, *SD* =2.64), while no differences emerged between heterosexual women and gay men on the general exposition of objectified images on fashion magazines.

The analysis of participants' exposure on Facebook showed a significant Target gender main effect, $F(1,216)$= 7.6, *p*=.006, $\eta_p{}^2$=.034, indicating that participants were more frequently exposed to depictions of objectified women (*M*=14.5, *SD*=17.5) than objectified men (*M*=12.5, *SD*=16.2) on Facebook. A main effect of the sexual orientation of participants also appeared to be significant, $F(2,216)$= 3.02, *p*=.051, $\eta_p{}^2$=.027. Only heterosexual women seemed to be more significantly exposed to objectified images on Facebook in general (*M*=17.17, *SD* =16.47) compared to gay man (*M*=10.69, *SD* =14.51). No differences emerged for the exposition of objectified images on Facebook between heterosexual women and heterosexual men. In addition, participants' sexual orientation significantly interacted with Target gender, $F(2,216)$= 7.3, *p*=.001, $\eta_p{}^2$=.063. Heterosexual women indicated to be exposed significantly more, $F(1,216)$= 10.7, *p*=.001, $\eta_p{}^2$=.047, to objectified women (*M*=19.5, *SD*=20.03) than men

(*M*=14.7, *SD*=15.6) on Facebook. Similarly, heterosexual men were more frequently exposed, $F(1,216)$= 8.6, *p*=.004, η_p^2=.039, to pictures of objectified women (*M*=15.5, *SD*=17.4) than man (*M*=11.6, *SD*=16.2), while gay men ($F(1,216)$= 2.3, *p*=.13, η_p^2=.011) indicated to be exposed equally to objectified men (*M*=11.6, *SD*=16.9) and women (*M*=9.6, *SD*=13.7) on Facebook.

The Instagram analyses revealed a similar pattern as the Facebook analyses. A Target gender main effect emerged, $F(1,216)$= 33.3, *p*<.001, η_p^2=.134, showing a generalized major exposure to objectified women (*M*=16.2, *SD*=20.6) compared to men (*M*=11.7, *SD*=15.8) on Instagram. A significant main effect of the sexual orientation of participants emerged, $F(2,216)$= 3.12, *p*=.046, η_p^2=.028. However, none of the pairwise comparisons between heterosexual women, men and gay men showed to be significant. Finally, the interaction between participants' sexual orientation and target gender was also significant, $F(2,216)$= 14.5, *p*<.001, η_p^2=.119. Both heterosexual men, $F(1,216)$= 30.9, *p*<.001, η_p^2=.125, and women, $F(1,216)$= 29.1, *p*<.001, η_p^2=.119, were significantly more exposed to objectified women ($M_{HeteroWomen}$=22.4, $SD_{HeteroWomen}$=22.02; $M_{HeteroMen}$=15.7, $SD_{HeteroMen}$=21.6) than men ($M_{HeteroWomen}$=14.5, $SD_{HeteroWomen}$=16.4; $M_{HeteroMen}$=8.5, $SD_{HeteroMen}$=13.2) on Instagram. Whereas similarly to Facebook, gay men indicated to dedicate equal amounts of time, $F(1,216)$= 1.10, *p*=.29, η_p^2=.005, to depictions of objectified men (*M*=12.7, *SD*=17.3) and women (*M*=11.3, *SD*=16.9) on Instagram.

As far as the use of Snapchat is concerned, a Target gender X sexual orientation interaction emerged, $F(2,216)$= 3.5, *p*=.032, η_p^2=.032. Only gay men indicated to be differently exposed to images of objectified women and men on Snapchat, $F(1,216)$= 3.90, *p*=.048, η_p^2=.018. They indicated to see more images of objectified men (*M*=3.37, *SD*=8.45) than objectified women (*M*=2.16, *SD*=6.2) on snapchat. Both heterosexual men, $F(1,216)$= .43, *p*=.51, η_p^2=.002, and women, $F(1,216)$= 2.60, *p*=.104, η_p^2=.012, indicated to dedicate about equal amounts of time to images of objectified men ($M_{HeteroWomen}$=2.11, $SD_{HeteroWomen}$=9.4; $M_{HeteroMen}$=2.27, $SD_{HeteroMen}$=7.36) and women ($M_{HeteroWomen}$=3.18, $SD_{HeteroWomen}$=11.6; $M_{HeteroMen}$=2.66, $SD_{HeteroMen}$=7.9) on snapchat.

Similarly, a significant interaction between participants' sexual orientation and Target gender emerged for Other social media, like Twitter, $F(2,216)$= 4.90, p=.008, η_p^2=.044. In this case, heterosexual men indicated to see significantly more, $F(1,216)$= 12.3, p=.001, η_p^2=.054, images of objectified women (M=6.42, SD=13.5) compared to those of objectified men (M=3.31, SD=7.02). While heterosexual women, $F(1,216)$= .50, p=.48, η_p^2=.002, and gay men, $F(1,216)$= .87, p=.35, η_p^2=.004, indicated no differences in exposure between the images of objectified men ($M_{HeteroWomen}$=3.14, $SD_{HeteroWomen}$=7.79; M_{GayMen}=4.54, SD_{GayMen}=10.26) and women ($M_{HeteroWomen}$=3.84, $SD_{HeteroWomen}$=10.16; M_{GayMen}=3.67, SD_{GayMen}=9.98) on other social media.

Finally, analysing participants' exposure to objectified women and men on dating apps a significant Target gender main effect emerged, $F(1,216)$= 4.54, p=.034, η_p^2=.021, showing how in general images of objectified men (M=3.80, SD=10.9) were more frequently seen on dating apps than images of objectified women (M=2.38, SD=9.02). Also, the main effect of sexual orientation emerged significantly, $F(2,216)$= 11.8, p<.001, η_p^2=.099. Gay men were significantly more exposed to objectified images in general on dating apps (M=6.84, SD =11.39) compared to heterosexual men (M=1.65, SD =7.05) and women (M=.66, SD =3.4). The interaction between participants' sexual orientation and target gender emerged as well, $F(2,216)$= 12.9, p<.001, η_p^2=.107. This interaction was mainly explained by gay men who were significantly, $F(1,216)$= 26.4, p<.001, η_p^2=.109, more frequently exposed to objectified men (M=9.8, SD=16.6) than women (M=3.7, SD=8.5) on dating apps. Heterosexual women showed a non-significant similar tendency, $F(1,216)$=.18, p=.67, η_p^2=.001 (M=.93, SD=4.87 and M=.39, SD=2.05 for objectified men and women respectively), while heterosexual men showed a marginally significant opposite tendency, $F(1,216)$= 3.61, p=.059, η_p^2=.016, indicating to be significantly more exposed to images of objectified women (M=2.73, SD=12.2) than objectified men (M=.56, SD=2.38) on dating apps.

Calculation of indices in Study 2

Several indices were created for each of the measures collected in Study 2. To create an index of objectification, our main dependent variable, the ratings of the objectification question for each model was averaged across participants separately for male (α_{male} = .95) and female targets (α_{female} = .95). The same procedure was applied to the other social judgments, obtaining indexes of sexual availability (α_{female} = .94, α_{male} = .95), sexual attractiveness (α_{female} = .97, α_{male} = .96), good looking (α_{female} = .92, α_{male} = .94), vulgarity (α_{female} = .94, α_{male} = .94) and superficiality (α_{female} = .92, α_{male} = .93). The same procedure was followed for the mind attribution scale: In line with Gray and colleagues (K. Gray et al., 2011a) we averaged the agency items (self-control, acting morally and planning) to obtain an agency index, and the experience items (feeling pain, feeling desire and feeling fear) to obtain an experience index. To obtain these indices we first averaged the item across all pictures and then we averaged the items to create the general agency and experience indices. Again, these indices were calculated for both male (α_{agency} = .89, $\alpha_{experience}$ = .88) and female (α_{agency} = .87, $\alpha_{experience}$ = .88) targets separately.

To obtain an index of participants' level of intrasexual competition the six items of the Intrasexual Competition scale (Buunk & Fisher, 2009) were averaged for each participant (α = .79). The self-objectification index was calculated following the procedure of Fredrickson et al. (1998). First, the ranks for the appearance and the competence items were separately summed together and then subtracted from each other. Following this procedure, positive and higher scores indicated granting greater importance to appearance rather than competence related items, so higher levels of self-objectification. From the Neo-Sexism Scale (Tougas et al., 1995) we obtained an index of participants' level of sexism. First, the scores of two statements were inverted and then all 11 statements were averaged to obtain a single sexism index (α = .83). Finally, we created indices for each of the presented social media. We wanted to obtain an index that could reflect the amount of time participants were exposed to depictions of objectified female or male targets for each specific media outlet. First of all, we coded the responses on the questions about time spent on media referring to the actual hours participants spent on each media outlet. Specifically, *Never* was coded as 0, *less than 1 hour* was coded as 0.5, *1 to 2 hours* was coded as 1, *3 to 5 hours* was coded as 3, *5 to 10 hours* was coded as 5, *10 to 20 hours* was coded as 10 and *more than 20 hours* was coded as 20. In this way, these indices reflected the actual minimal time participants dedicated to each type of mass media. Afterwards, we multiplied the time participants spent on each media outlet with the responses on how often they had seen images of objectified men or women on each type of media. We calculated this index separately for male and female targets.

Appendix 3 – Sexual objectification impairs emotional mimicry in social interactions

Pre-test of the videos

A total of 39 participants who did not participate in the main experiment were asked to indicate the type of emotion the person in the video was expressing by selecting one out of four choices (e.g., “happiness”, “anger”, “sadness”, “other: please specify”). Afterwards, they had to rate the extent to which there was a good fit between the selected emotion and the one that was expressed in the video and the intensity with which the person in the video was expressing this emotion. A final question asked participants to judge the extent to which the person in the video represented an objectified woman on a 7-point Likert scale. Initially, a total of 10 objectified and non-objectified models expressing happiness and anger were presented.

We decided to exclude four out of 10 models from the main experiment since their emotional expression were not well recognized and were not perfectly comparable in the objectified and non-objectified condition (see Table A3.1 for the details).

Table A3.1: Means (standard errors) of participants' evaluation of fit, intensity and object for each model.

		Anger			Happiness		
Models	**Condition**	**Fit**	**Intensity**	**Object**	**Fit**	**Intensity**	**Object**
	Obj	2.89	2.27	5.41	6.00	5.32	5.38
1		(2.22)	(1.76)	(1.61)	(1.05)	(1.22)	(1.64)
	Non-Obj	3.67	3.00	1.92	6.00	5.6	2.08
		(2.18)	(1.9)	(1.26)	(1.37)	(1.40)	(1.40)
	Obj	**4.59**	**3.95**	**5.46**	**5.77**	**4.90**	**5.33**
2		**(2.27)**	**(2.16)**	**(1.41)**	**(1.16)**	**(1.33)**	**(1.34)**
	Non-Obj	**4.78**	**4.43**	**2.68**	**5.92**	**5.11**	**2.49**
		(1.88)	**(1.72**	**(2.17)**	**(.72)**	**(1.02)**	**(2.06)**
	Obj	3.49	2.84	5.41	6.08	5.7	5.41
3		(2.28)	(1.89)	(1.66)	(.95)	(.97)	(1.78)
	Non-Obj	4.54	3.85	1.95	6.26	5.90	2.21
		(1.84)	(1.75)	(1.25)	(.99)	(1.05)	(1.61)
	Obj	4.78	4.43	5.57	6.03	5.51	5.08
4		(1.90)	(1.85)	(1.55)	(1.30)	(1.28)	(1.97)
	Non-Obj	3.74	3.36	1.92	6.33	5.87	2.28
		(2.42)	(2.24)	(1.24)	(.77)	(.89)	(1.74)
	Obj	**5.16**	**4.68**	**5.43**	**5.22**	**4.70**	**5.24**
5		**(2.20)**	**(1.98)**	**(1.74)**	**(1.42)**	**(1.58)**	**(1.77)**
	Non-Obj	**4.82**	**4.44**	**2.31**	**5.51**	**4.95**	**2.05**
		(2.15)	**(2.08)**	**(1.52)**	**(1.5)**	**(1.46)**	**(1.45)**
	Obj	2.64	2.21	5.51	5.87	5.21	5.13
6		(2.45)	(2.18)	(1.47)	(1.13)	(1.38)	(1.67)
	Non-Obj	4.19	3.89	2.51	5.43	4.46	2.81
		(2.17)	(2.04)	(1.95)	(1.50)	(1.32)	(2.19)
	Obj	**5.24**	**5.11**	**5.59**	**5.59**	**4.92**	**5.41**
7		**(1.30)**	**(1.05)**	**(1.48)**	**(1.12)**	**(1.38)**	**(1.78)**
	Non-Obj	**5.08**	**4.67**	**2.10**	**5.10**	**3.79**	**1.95**
		(1.88)	**(1.96)**	**(1.31)**	**(1.46)**	**(1.56)**	**(1.32)**
	Obj	**4.28**	**3.51**	**5.46**	**5.08**	**4.38**	**5.28**
8		**(2.23)**	**(1.83)**	**(1.33)**	**(1.82)**	**(1.81)**	**(1.73)**
	Non-Obj	**3.03**	**3.08**	**2.70**	**5.65**	**4.59**	**2.54**
		(2.89)	**(1.92)**	**(1.87)**	**(.98)**	**(1.32)**	**(1.86)**
	Obj	**4.15**	**3.90**	**5.64**	**6.33**	**6.08**	**5.38**
9		**(2.22)**	**(2.14)**	**(1.37)**	**(.93)**	**(.93)**	**(1.66)**
	Non-Obj	**4.38**	**4.11**	**2.70**	**6.22**	**5.89**	**2.65**
		(2.14)	**(2.06)**	**(2.08)**	**(1.55)**	**(1.54)**	**(2.09)**
	Obj	**4.74**	**4.41**	**5.31**	**6.26**	**5.79**	**5.41**
10		**(1.94)**	**(1.94)**	**(1.47)**	**(.88)**	**(1.05)**	**(1.41)**
	Non-Obj	**4.05**	**3.59**	**2.59**	**5.89**	**5.38**	**2.61**
		(2.40)	**(2.25)**	**(2.00)**	**(1.43)**	**(1.48)**	**(2.05)**

Note: In bold models that were selected from the pre-test analyses

We conducted a 2 (emotions: happiness, anger) X 2 (objectification: objectified, non-objectified) ANOVA for each evaluation on the remaining 6 models. Only a main effect of emotions appeared when analyzing the type of emotions participants recognized in the video, $F(1,38) = 26.51$, $p<.001$, $\eta^2_p = .41$. When participants were asked to indicate the type of emotion the model in the video was expressing, participants recognized the emotion of happiness (M=.98, DS=.04) better compared to the emotion of anger (M=.88, DS=.13). Similarly, a main effect of emotions emerged when participants were asked to rate the fit between the expressed emotion and the one selected, $F(1,38) = 81.39$, $p<.001$, $\eta^2_p = .68$. The emotion of happiness was perceived as having a stronger fit (M=5.7, DS=.61) compared to the emotion of anger (M=4.53, DS=.95). Analyses of the evaluation of intensity showed again a single main effect of emotions, $F(1,38) = 48.37$, $p<.001$, $\eta^2_p = .56$, reflecting a similar pattern as before. Participants evaluated the emotion of happiness as being more intense (M=5.03, DS=.65) compared to the emotion of anger (M=54.13, DS=.83). Finally, results regarding evaluation of objectification showed a main effect of objectification, $F(1,38) = 138.28$, $p<.001$, $\eta^2_p = .78$. Objectified models were evaluated as more objectified (M=5.42, DS=.92) compared to their non-objectified counterparts (M=2.42, DS=1.14). Also a main effect of emotions, $F(1,38) = 4.39$, $p=.043$, $\eta^2_p = .10$, emerged. Participants evaluated models expressing anger as more objectified (M=3.84, DS=.71) compared to models expressing happiness (M=4.00, DS=.69). Importantly, these effects were not qualified by an interaction effect ($p>.62$).

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