RUNNING HEAD: The human-object divide in sexual objectification

Resolving the human-object divide in sexual objectification: How we settle the categorization conflict when categorizing objectified and non-objectified human targets

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Abstract

Using a mouse tracking technique, we measured the strength and the temporal unfolding of the conflict when people categorize objectified and non-objectified human stimuli in the human or object category. We recorded participants' hand movements when they categorized male and female, objectified and not objectified, human and doll-like stimuli in the person and object categories. As expected, objectified women created a stronger categorization conflict compared to all other human stimuli. The nature of the mouse trajectories indicated that this response competition was caused by the distractor (object category) rather than the target (person category) and showed to be smooth rather than abrupt suggesting dynamic competition between the object-human categories rather than the sequential unfolding of a dual process. These findings demonstrate that the human-object divide fades when women (but not men) are objectified. The implications of the current findings for theorizing on processes of sexual objectification are discussed.

Keywords: human-object distinction; sexual objectification; mouse tracker; categorization conflict

A fundamental divide in our daily lives is the one between persons and objects. In order to successfully interact with people, we need to infer their intentions, thoughts and desires. Our interactions with objects, instead, are mostly guided by their usefulness and appearance. Normally, these interaction patterns are clearly distinct and processed in different regions in the brain that are specialized in the elaboration of human vs. non-human stimuli (Mitchell et al., 2002). What happens, however, with this divide, when we start perceiving people as if they were objects?

The thing-like treatment of others has been widely studied and is central in the work on sexual objectification. When objectified, women are reduced to their physical appearance as if their body or body parts represent their entire being, devaluing their mind and personality (see Bartky, 1990; Fredrickson & Roberts, 1997). According to this definition, objectified women are perceived as similar to objects, because the perceiver focuses on how their body appears (i.e., appearance) and what it can do (i.e., usefulness).

This similarity can become quite literal as recent research has demonstrated. Through a direct comparison between objectified human and object stimuli it has been shown that objectified women are visually perceived as more similar to objects compared to objectified men at a behavioral and a neural level (Vaes, Cristoforetti, Ruzzante, Cogoni, & Mazza, 2019). This result suggests that the typical human-object divide can fade, especially when women are objectified. In the current experiment, we aim to demonstrate the existence of such categorical overlap measuring the categorization conflict when objectified, non-objectified human and perceptually similar objects are categorized in the person and object category respectively. Moreover, using a mouse-tracking technique, we analyze the way people resolve this categorization conflict between object and human features when they are confronted with objectified human targets providing important information on the cognitive processes that underlie the sexual objectification of women.

Objectification: The strength of the categorization conflict

The change from someone to something in sexual objectification has been demonstrated in several lines of research. Initially, studies focused on the dehumanization of objectified women showing that objectified depictions of women were associated with less human characteristics (Heflick & Goldenberg, 2009; Heflick et al., 2011; Vaes et al., 2011; Puvia & Vaes, 2013, 2015) or perceived as having less mind (Loughnan et al., 2010) compared to non-objectified female images. In all these studies, objectification implied the complete denial or the lack of association with traits or characteristics usually attributed to humans. Specifically, objectified female targets were described as less trustworthy, capable, mindful, and friendly or were more easily associated with object characteristics or words from the animal reign.

The second line of research tested the idea that stimuli of objectified women are elaborated using cognitive processes similar to those that people adopt when processing objects (Bernard et al., 2012; Gervais et al., 2012; Cikara, Eberhardt, & Fiske, 2011; Cogoni et al., 2018). For example, a number of studies focused on the inversion effect – the tendency to show greater difficulty recognizing inverted images when the image is processed as a whole entity (configural processing) rather than a collection of parts (analytic processing) (Yin, 1969). Given that usually people elicit configural processing whereas objects elicit analytic processing, only the recognition of people is typically impaired by the inversion leaving object recognition unaffected (Reed et al., 2003; Urgesi et al., 2007; Stein et al., 2012). In their study, Bernard and colleagues (2012; see also Bernard et al., 2015; Cogoni et al., 2018, for similar results) presented people with objectified men and women, and found, only in the latter case, that people failed to display an inversion effect. This finding allows us to conclude that objectified women are typically fragmented in a collection of body parts, a tendency that leads to the use of analytical processes that are mostly adopted for the recognition of objects.

Finally, the third line of research directly compared the extent to which individuals perceive similarities between objectified human targets and objects (Morris & Goldenberg, 2014; Vaes et al., 2019). Vaes and colleagues used the oddball paradigm, in which participants' neural activity was measured while they categorized 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. This effect showed to be significantly smaller for objectified women compared to both objectified and non-objectified men, and non-objectified women suggesting that objectified women are literally perceived more similar to real objects.

Especially from the latter line of research it follows that the human-object divide might fade when women are sexually objectified making it more difficult to correctly categorize an objectified woman in the human rather than in the object category compared to other human targets. Such increases in categorization conflict between the human and object categories can be measured with a mouse-tracking technique. This technique measures the computer-mouse movements made by participants while they categorize a stimulus in two opposing categories. Specifically, we expected that participants would show evidence of greater conflict between the person (target) and object (distractor) category when categorizing pictures of objectified women, compared to the other human targets (i.e., non-objectified women and both objectified and non-objectified men). In line with previous research on sexual objectification (Bernard et al., 2012; Loughnan et al., 2010; Vaes et al., 2011), we expected this pattern of results for both male and female participants.

Resolving human-object ambiguity in objectified stimuli

The mouse-tracking technique also allowed us to analyze the unfolding of the categorization process providing us with important information about the cognitive underpinnings of the sexual objectification process. To this end, we conducted two types of analyses: one that tested the evolution of the mouse trajectories and one that quantified uncertainty using an entropy decomposition approach. The first analyses verified how the ambiguity between the object and human category is resolved in the case of both objectified and non-objectified human targets. Two classes of models make predictions about the way categorization processes unfold in real time. The first are dual-process models (e.g., Strack & Deutsch, 2004) that claim that decisions unfold initially using an automatic intuitive system followed by a slower, more rational system that can either affirm or reverse the initial intuitive response. When categorizing a stimulus in two opposing categories, this model would predict that trajectories are either directed towards the wrong option and then suddenly corrected in case the rational system overrides the intuitive choice, or relatively direct trajectories towards the correct option when the rational system affirms the intuitive choice (Freeman, 2014; Stillman et al., 2018). If decisions are made following this theoretical model, mouse movements should be characterized by either straight trajectories or abruptly corrected movements.

Other models do not refer to two competing systems, but instead underline that a decision unfolds through a range of top-down and bottom-up processes that compete simultaneously. Such models are generally referred to as dynamical models (Freeman & Ambady, 2011; Ferguson et al., 2014) and imply that ambiguous social stimuli simultaneously activate multiple categories that then dynamically compete until a decision is reached. According to these models, mouse trajectories are curved instead of straight or abruptly corrected.

Little is known about the way the human-object conflict is resolved when categorizing objectified human stimuli. Previous research has shown that the dehumanization of objectified women can occur automatically (Vaes et al., 2011) and that objectifying a sexualized woman depletes fewer regulatory resources compared to not objectifying her (Tyler et al., 2017). These data would suggest that objectified women are first and automatically seen as object-like, but then categorized as humans by a controlled and effortful process. Still, dynamical models have been used as well to explain self-regulatory mechanisms (Fishbach & Shah, 2006; Critcher & Ferguson, 2016). Adopting mouse-tracking in the current research, allows us to verify for the first time how people resolve the categorization conflict when categorizing objectified and non-objectified stimuli in the human and object category.

In addition, computer-mouse movements have been analyzed using entropy decomposition models (Calcagnì et al., 2017). These models quantify the dynamic properties of hand-movements in terms of fast-movements and motor-pauses. Analyzing the dynamics between pauses and variations in hand-movements can give us fine-grained information about how uncertainty between response categories is created and resolved. Using these measures, we expect to demonstrate that the expected increase in categorization conflict towards objectified women is caused by increasing levels of cognitive processing due to the distractor category (i.e., object) instead of expressing doubts to categorize objectified women in the correct person category. This result allows us to conclude that the increased categorization conflict towards objectified women is indeed caused by our tendency to see them as object-like.

The present research

To test these hypotheses, we used the MouseTracker (Freeman & Ambady, 2010), a software that records the x and y coordinates of a participant's mouse-cursor as it is moved on the computer screen. Participants were presented with pictures of male and female targets that were either objectified or not, together with comparable doll-like objects that they had to categorize in the "person" or "object" category with a mouse click. The doll-like objects appeared to create ambiguity and to make the "object" category an equally likely response option. We had no a priori hypotheses regarding these stimuli. Mostly, because the meaning of a greater facilitation to categorize the doll-like objects both in the object or in the human category remains unclear. In both cases this result could be interpreted in favor of the hypothesis that objectified women are seen as more object-like. In the first case, one could argue that objects created on the basis of objectified humans are seen as even more object-like. In the latter case, instead, the result would suggest that female doll-like objects are perceived as more human-like blurring the distinction between what is human or object-like.

Method

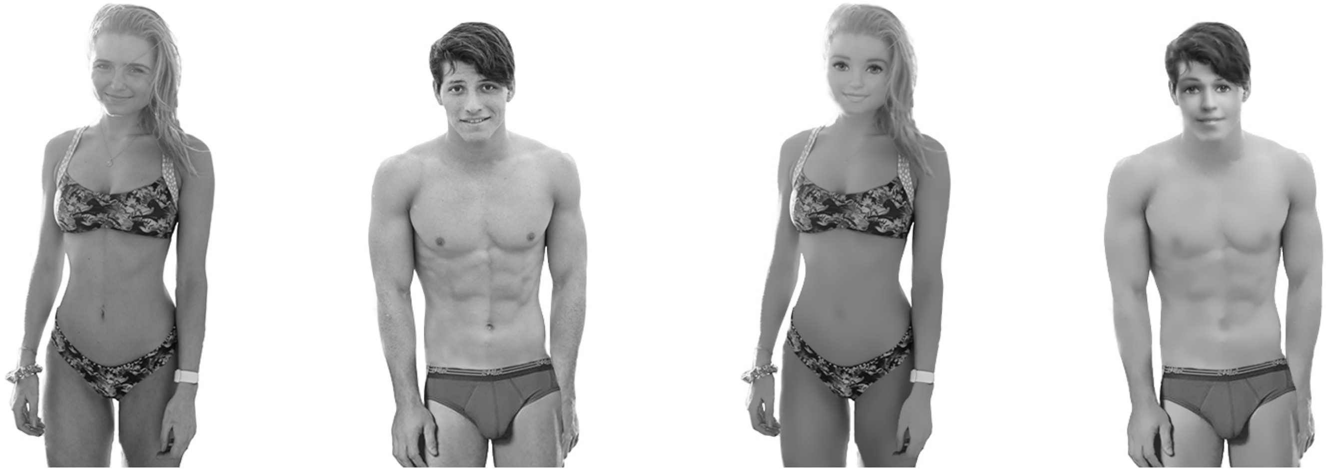
Participants

According to the PANGEA analysis tool (Westfall, 2016), it would have been possible to detect a small effect of $d = .40$ with a sample of 33 participants in each gender group to observe the expected 3-way interaction with a power of .90. Given that we were also interested in conducting distribution analyses and the analysis of trajectories, we decided to recruit a much larger sample and aimed for 80 participants for each gender group in line with comparable past work that conducted similar analyses (Stillman et al., 2017). As a result, we recruited 185 participants (96 women and 89 men, M_{age}=21.25, SD_{age}=2.75, range=18-46). In line with previous research on sexual objectification (e.g., Vaes et al., 2011), only the data of heterosexual participants were subsequently analyzed (N=171 of which 86 women).

Stimuli

Forty male and 40 female pictures were selected from the internet, half of them represented objectified images in a bikini outfit, while the other half showed a non-objectified, fully-dressed image of the same person. Each picture had a white background; it was converted into grayscale and showed the person from the knees up. From each image, an object version was created morphing the original image with a doll through the software Squitzmorph. The resulting object-face had 30% of the original human face and 70% of the doll-face. A surface blur was applied in Photoshop CS6 on all of the target's visible skin in order to "plastify" the natural appearance of the skin and create the final object image. This procedure resulted in a total number of 80 images (see Figure 1).

Figure 1: Examples of human stimuli (on the left) and doll-like objects (on the right). Objectified depictions are displayed above with their non-objectified counterparts below. 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 author.



A pretest was conducted to ensure that human and object pictures were correctly categorized. Based on the judgments of 22 participants (12 female), both the human and the object pictures were almost perfectly recognized (98% correct responses in both cases). Importantly, the correct recognition of the pictures did not change as a function of the way they were dressed, the gender of the targets, or of participants' gender. Only for the human pictures, we asked to indicate the extent to which the picture portrayed an objectified man or woman. This question confirmed, in line with previous research (Vaes et al., 2011; Cogoni et al., 2018) that both male and female targets were judged to be objectified to a greater extent when they were presented in swim- or underwear (M=3.07, SE=.37, 95%CI [2.30, 3.84]) compared to when they were fully clothed (M=2.25, SE=.26, 95%CI [1.70, 2.79]), $F(1, 20)$=14.70, p=.001, η^2_p=.41 (see Supplemental Online material for a full analysis of all measures that were taken in the pretest).

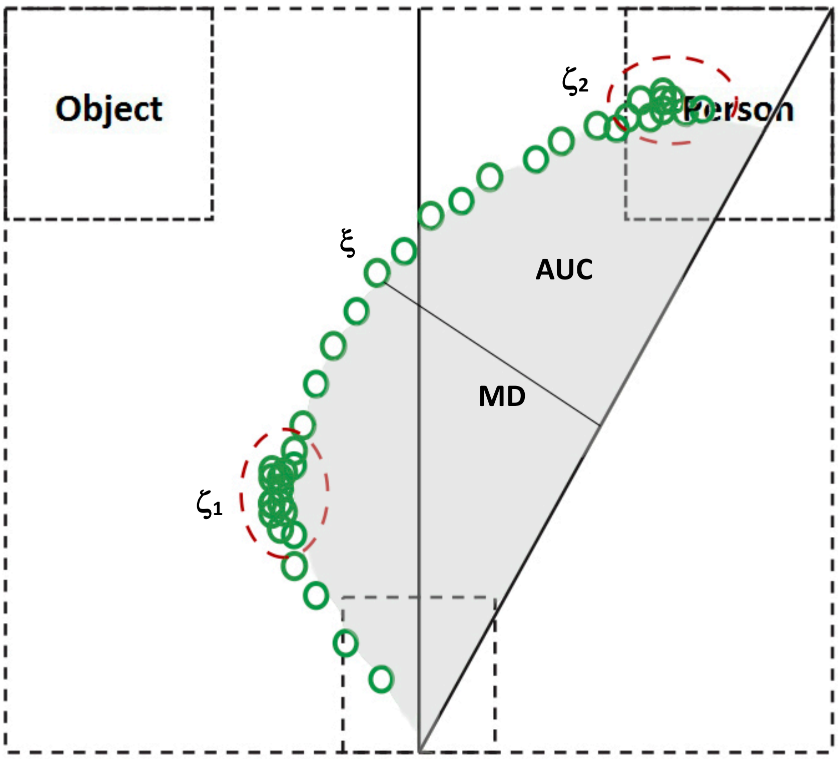
Procedure

Participants were seated in front of a computer screen and were instructed to perform the MouseTracker task (Freeman & Ambady, 2010) moving a mouse with their dominant hand. At the beginning of each trial, they were instructed to click on the start button that was placed at the center on the bottom of the screen. An image that appeared just above the start button needed to be categorized by participants mouse-clicking the labels "Object" or "Person" displayed at the top corners of the screen. The object or person category labels appeared on opposing sides of the screen and their location was counterbalanced between participants. The trajectories used to categorize the stimuli were recorded in terms of x and y coordinates and subsequently analyzed using the MouseTracker software package. Participants were instructed to make the decision as fast and accurate as possible. If they did not start to move within 500ms from stimulus onset a warning message appeared suggesting participants to start moving immediately after the appearance of the stimulus. All participants responded to 16 practice trials in order to familiarize themselves with the task. The task had a 2 (Target gender: Male vs. Female) X 2 (Stimuli: Human vs. Object) X 2 (Objectification: Objectified vs. Non-objectified) within participant design and consisted in 144 test trials. In this study, we report all measures, manipulations and exclusions.

Mousetracker indices

Two families of mouse-tracking indices were calculated: the geometric measures such as the Maximum Deviation (MD, the distance between the farthest point of the observed mouse-trajectory and the straight line that represents the shortest distance between the start button and the response category), the Area Under the Curve (AUC, the geometric area defined by the observed mouse-trajectory and a straight line that reflects the shortest distance between the start button and the response category; Hehman et al., 2014), and the EMOT indices (Calcagnì et al., 2017). The latter are a set of entropy-based measures that, unlike standard geometric measures, allow quantifying the dynamic properties of hand-movements in terms of fast-movements and motor-pauses. In particular, mouse-trajectories are first quantified using an overall psi-index (ψ) that expresses the overall information about the dynamics of the movement (e.g., the higher the attraction exerted by the distractor, the higher the ψ index). Then ψ is decomposed into three sub-indices: the csi-index (ξ) relates to fast movements**,** which represent typical motor components executed after a decision has been made, instead, the zeta1 (ζ_1) and zeta2-index (ζ_2) are associated with motor-pauses indicating decisional conflicts in categorization, and goal formulation. Specifically, ξ tends to increase when the target category is reached through a longer trajectory with mostly fast movements. The value of ζ_1 gets higher the more motor-pauses occur in the area of the distractor whereas ζ_2 quantifies the motor-pauses that occur in the target area (see Figure 2 for a representation of all indices). Taken together, these indices can provide a comprehensive framework to analytically understand the movement dynamics that occur during the task.

Figure 2: Conceptual representation of the mousetracker indices. The light gray area represents the Area Under the Curve (AUC), the line represents the Maximum Deviation (MD), the fast mouse movements (ξ) are represented in green circles, the motor-pauses are represented by the red ellipses (ζ_1) for motor-pauses in the area of the distractor, (ζ_2) for motor-pauses in the area of the target category.



Results

Following our hypotheses, we conducted two types of analyses: the first analyzed the strength of the categorization conflict, the second the nature of the trajectories toward the target.

Categorization conflict

Three mousetracker indices were analyzed to gauge the strength of the categorization conflict: MD, AUC, and ψ. At the same time, we analyzed participants' response times (RT) expecting that a stronger categorization conflict goes hand in hand with longer RTs. Analyses were carried out only on the accurate trials (5,11% of the trials were errors) in a 2 (Target gender: male vs. female) X 2 (Stimuli: human vs. object) X 2 (Objectification: Objectified vs. Non-objectified) X 2 (Participants' gender: male vs. female) mixed ANOVA in which only the last variable was manipulated between participants. The expected 3-way interaction between Target gender, Stimuli and Humanization emerged for every index ($F(1, 169)=46.28$, $p<.001$, $\eta_p^2=.22$, $F(1, 169)=46.98$, $p<.001$, $\eta_p^2=.22$, $F(1, 169)=41.86$, $p<.001$, $\eta_p^2=.20$, and $F(1, 169)=49.53$, $p<.001$, $\eta_p^2=.23$ for MD, AUC, ψ, and RT respectively). Importantly, this interaction was not qualified by participants gender (*p*-values ranging from .11 to .15). To better understand the significant 3-way interaction, separate analyses were conducted on the human and the object pictures.

For the human stimuli the 2 (Target gender: male vs. female) X 2 (Objectification: Objectified vs. Non-objectified) repeated measures ANOVA resulted in two main effects of Target gender and Objectification on all indices. The main effect of Target gender ($F(1,170)=25.72$, $p<.001$, $\eta_p^2=.13$, $F(1,170)=24.97$, $p<.001$, $\eta_p^2=.13$, $F(1,170)=32.27$, $p<.001$, $\eta_p^2=.16$, and $F(1, 170)=19.98$, $p<.001$, $\eta_p^2=.11$ for MD, AUC, ψ, and RT respectively) indicated that the female images displayed a higher categorization conflict than the male pictures. The main effect of Objectification instead indicated that objectified compared to non-objectified images created a stronger categorization conflict ($F(1, 170)=16.96$, $p<.001$, $\eta_p^2=.09$, $F(1, 170)=16.39$, $p<.001$, $\eta_p^2=.09$, $F(1, 170)=18.51$, $p<.001$, $\eta_p^2=.10$, and $F(1, 170)=22.55$, $p<.001$, $\eta_p^2=.12$, for MD, AUC, ψ, and RT respectively). The interaction between Target and Objectification was not significant (all *p's*>.25). Indeed, as the means in Table 1 show, there is an additive rather than an interaction effect, with the highest categorization conflict always observed towards objectified female targets. Therefore, both target gender and the level of objectification contribute independently and to the same extent to the current effect making the categorization conflict towards objectified female stimuli the strongest of all.

Table 1. Mean values, standard deviations and 95% confidence intervals of the categorization conflict for human and object stimuli.

		Female		Male	
		Obj	Non-Obj	Obj	Non-Obj
Human					
	MD	.43[a] (.27) [.39, .47]	.39[b] (.26) [.35,.43]	.37[b] (.26) [.33, .41]	.33[c] (.26) [.29, .37]
	AUC	.87[a] (.70) [.77, .98]	.79[b] (.70) [.69, .89]	.73[b] (.67) [.63, .83]	.63[c] (.62) [.54, .73]
	ψ	2.69[a] (.97) [2.55, 2.84]	2.58[b] (.98) [2.43, 2.72]]	2.48[b] (.94) [2.34, 263]	2.33[c] (.99) [2.18, 2.48]
	RT	1152[a] (13.56) [1126, 1179]	1134[b] (13.22) [1108, 1160]	1133[b] (13.14) [1107, 1159]	1103[c] (12.59) [1078, 1228]
Object					
	MD	.42[a] (.27) [.38, .46]	.47[b] (.26) [.43, .51]	.34[c] (.25) [.30, .37]	.56[d] (.27) [.52, .60]
	AUC	.81[a] (.65) [.71, .91]	.94[b] (.67) [.84, 1.04]	.63[c] (.56) [.54, .71]	1.18[d] (.71) [1.07, 1.29]
	ψ	2.73[a] (1.01) [2.58, 2.88]	2.85[b] (.96) [2.71, 3.00]	2.48[c] (.97) [2.33, 2.63]	3.19[d] (.89) [3.06, 3.33]
	RT	1096[a] (11.79) [1073, 1119]	1117[b] (11.47) [1095, 1140]	1067[c] (11.28) [1044, 1089]	1164[d] (11.66) [1141, 1187]

Note. Means with a different superscript in the same row differ significantly from one another ($p < .05$).

In the case of the object images, the 2 (Target gender: male vs. female) X 2 (Objectification: Objectified vs. Non-objectified) repeated measures ANOVA resulted in a significant main effect of Objectification ($F(1, 170)=189.47$, $p<.001$, $\eta_p^2=.53$, $F(1, 170)=172.39$, $p<.001$, $\eta_p^2=.50$, $F(1, 170)=140.18$, $p<.001$, $\eta_p^2=.45$, and $F(1, 170)=198.29$, $p<.001$, $\eta_p^2=.54$ for MD, AUC, ψ, and RT respectively) and a significant interaction for every index ($F(1, 170)=86.80$, $p<.001$, $\eta_p^2=.34$, $F(1, 170)=75.34$, $p<.001$, $\eta_p^2=.31$, $F(1, 170)=72.90$, $p<.001$, $\eta_p^2=.30$, and $F(1, 170)=88.47$, $p<.001$, $\eta_p^2=.34$ for MD, AUC, ψ, and RT respectively). The means are reported in Table 1 and suggest that the categorization conflict of non-objectified vs objectified targets is always higher, but this difference is consistently stronger for male (η_p^2 range .56 - .60) compared to female targets (η_p^2 range .03 - .09).

Nature of trajectories

In order to analyze the nature of participants' trajectories we analyzed three different measures: the relation between the subcomponents that make up ψ (Calcagnì et al., 2017), the frequency of midflight corrections (Freeman, 2014; Stillman et al., 2018) and the modality (uni- vs. bimodality) of the AUC distribution (Freeman & Dale, 2013; Stillman et al., 2017; Stillman et al., 2018).

Subcomponents of ψ. ψ is the sum of three subcomponents ξ (quantifies the (fast) movements that are associated with the decision process), ζ_1 (expresses motor-pauses that occur in the area of the distractor), and ζ_2 (expresses motor-pauses that occur in the area of the target). Calcagnì and colleagues (2017) summarized the most relevant relations that might exist between these subcomponents and their interpretation. In total, they differentiated between five different relations that indicate different varieties of response competition. The first relation ($\xi > \zeta_1 > \zeta_2$) indicates the typical case in which the distractor exerts its influence and creates the highest levels of categorization conflict as long, fast motor executions indicate that participants did not take the shortest route to the target and the motor-pauses toward the distractor are higher than those toward the target. The second relation ($\xi > \zeta_1$ and $\zeta_2 > \zeta_1$) indicates just a slight influence due to the distractor as the high ζ_2 component indicates a tendency to slow down towards the target which typically indicates a verification of the decision before finalizing it. The third relation ($\xi < \zeta_1$ and $\zeta_2 < \zeta_1$) occurs anytime the response is characterized by a large amount of pauses towards the distractor instead of a typical dynamic continuous movement. This pattern is typically observed when people go back and forth between both response alternatives before responding. The final two relations are differentiated in two configurations that indicate an absence ($\xi > \zeta_1 = \zeta_2 = 0$) or low levels of categorization conflict ($\xi > \zeta_1 = \zeta_2 > 0$).

We calculated the proportion of each type of response for each participant and analyzed the proportions as a function of our main independent variables. We noticed that the final three patterns were observed less than one percent of the time, so we decided to focus on the first two relations that described more than 94% of the observed trajectories (note that some trajectories fell in none of these 5 categories). A look at Table 2 first of all shows that the most common response followed the second relation ($M_{overall}$=69%) meaning that participants even though slightly influenced by the distractor, mostly showed motor executions and pauses towards the target. The uncertainty that is expressed in this response reflects a verification component of the final decision given that motor-pauses towards the target typically occur in the direct vicinity of the target. Interestingly, however, the first relation that clearly indicates increased cognitive processing due to the distractor occurs less (between 20% and 26% of all trajectories), but is more frequent for the same stimuli for which the strength of the categorization conflict is highest. Specifically, in the case of the human stimuli, both main effects are significant ($F(1, 170)=17.34$, $p<.001$, $\eta_p^2=.09$ and $F(1, 170)=6.44$, $p=.012$, $\eta_p^2=.04$ for Target gender and Objectification respectively) and a similar additive effect can be observed. As was the case for the strength of the categorization conflict, the highest number of trajectories that indicate decision competition can be found towards objectified women. As far as the object stimuli are concerned, the first relation is again less frequent, but mirrors the pattern of results that was described for the strength of the categorization conflict. While the non-objectified pictures always trigger more response competition compared to the objectified pictures, this difference is stronger for male ($\eta_p^2=.37$), compared to female pictures ($\eta_p^2=.03$; see Table 2 for more details).

Midflight correction. The second index we analyzed was the frequency with which participants make sudden corrections in their responses from the distractor towards the target. These responses are called midflight corrections and past work indicated that trajectories with an MD greater than 0.9 reliably show this phenomenon (Freeman, 2014). A closer look at the final row in Table 2 first of all shows that these abrupt movements constitute the minority of responses meaning that most responses occur rather smoothly. Still, the frequency of midflight corrections is higher in those conditions in which the highest categorization conflict was observed.

Table 2: Mean proportions, standard deviations and 95% confidence intervals of the relations among the subcomponents of ψ and the midflight corrections for human and object stimuli.

	Female		**Male**	
	Obj	Non-Obj	Obj	Non-Obj
Human				
$\xi > \zeta_1 > \zeta_2$	.26[a]	.24[ab]	.23[b]	.20[c]
	(.17)	(.16)	(.18)	(.17)
	[.24, .29]	[.22, .27]	[.20, .25]	[.18, .23]
$\xi > \zeta_1$ and $\zeta_2 > \zeta_1$	.68[a]	.70[a]	.73[b]	.75[b]
	(.16)	(.15)	(.17)	(.16)
	[.66, .71]	[.68, .73]	[.71, .76]	[.72, .77]
Midflight corrections	.21[a]	.18[b]	.16[b]	.14[c]
	(.19)	(.18)	(.18)	(.16)
	[.18, .23]	[.15, .21]	[.14, .19]	[.11, .16]
Object				
$\xi > \zeta_1 > \zeta_2$	.29[a]	.31[b]	.25[c]	.37[d]
	(.19)	(.18)	(.18)	(.19)
	[.26, .31]	[.28, .34]	[.22, .28]	[.34, .39]
$\xi > \zeta_1$ and $\zeta_2 > \zeta_1$	.67[a]	.65[a]	.70[b]	.60[c]
	(.18)	(.17)	(.17)	(.18)
	[.64, .70]	[.62, .67]	[.67, .73]	[.57, .63]
Midflight corrections	.19[a]	.22[b]	.14[c]	.30[d]
	(.18)	(.19)	(.15)	(.19)

Note. Means with a different superscript in the same row differ significantly from one another ($p < .05$).

Uni- vs. bimodality of the AUC distribution. To further test whether the response competition between object and human categories follows a sequential (i.e., dual-process models) or dynamic evolution, following Freeman and Dale (2013), we assessed whether the distribution of AUC scores is different from a unimodal distribution. If decisions are driven by an initial intuitive response that is later corrected or confirmed by a rational and controlled system (i.e, dual-process model), one might expect a bi- or multi-modal distribution of AUC scores. Indeed, if the controlled process affirms the initial response, trajectories are relatively direct towards the target category; alternatively, when the controlled response corrects the initial reaction, trajectories will be marked with sizable midflight corrections. However, when response competition unfolds dynamically, one can expect AUC scores to range continuously from small to large resulting in a unimodal distribution.

To test this hypothesis, Hartigan's dip statistic (Hartigan & Hartigan, 1985), which gives a *d* statistic and a *p*-value, was calculated for each type of stimulus. If the test is significant, one can reject the null hypothesis that the distribution is unimodal (see Freeman & Dale, 2013; Stillman et al., 2017 for a similar analysis). The results found no evidence for bimodality for none of the stimuli (all $d<.094$, all $p>.10$) suggesting that for all targets response competition was resolved in a smooth, rather than in both an abrupt and straight manner.

Discussion

Our interactions with objects and humans typically require the involvement of different cognitive and emotional processes. Separate areas of the brain are employed to elaborate, recognize and interact with humans compared to objects. In the current study, we aimed to show that this clear distinction between humans and objects fades when women, but not men, are objectified. Using the MouseTracker technique, we confirmed this hypothesis showing that objectified women created a stronger categorization conflict between the human and object categories. This pattern of results was found on geometrical (MD and AUC) and entropy-based (ψ) measures that take both the deviation of the trajectory towards the opposing category and the uncertainty expressed in fast hand movements and motor-pauses into account. This finding resulted from an additive rather than an interaction effect. In fact, both target gender and the objectification of the stimuli contributed independently, meaning that being a woman rather than a man or being objectified rather than not objectified created a stronger categorization conflict. As a result, participants were especially attracted by the object category when categorizing objectified women, the stimulus that contained both characteristics. These results indicate that the typically clear-cut human-object divide fades when women are sexually objectified seeing them as more object-like compared to other human targets. Importantly and in line with past work on the dehumanization of objectified women (e.g., Heflick & Goldenberg, 2009; Loughnan et al., 2010; Heflick et al., 2011; Vaes et al., 2011), both male and female participants showed this tendency to the same extent.

Even though the object pictures mostly served to create ambiguity between the human and object stimuli, the observed results are potentially interesting. That the objectified doll-like objects created less categorization conflict compared to their non-objectified counterparts was to be expected. On the one hand, because more changes to the original images were made to create the objectified doll-like pictures (i.e., more visible skin was changed) as compared to the non-objectified ones; on the other hand, the clothing of the human and object stimuli was exactly the same and this could have potentially anthropomorphized the doll-like targets. This difference, however, was always more pronounced for the male compared to the female stimuli suggesting that a potentially anthropomorphic feature humanized male doll-like targets to a greater extent than their female counterparts. Even though more research is needed, potentially this result further corroborates the idea that especially women are more likely seen as object-like.

These findings also reveal for the first time how response competition between the object and person category is resolved when people categorize objectified and non-objectified human stimuli. First of all, the analysis of entropy-based measures allowed us to determine that the categorization conflict was indeed caused by response competition that derived from the distractor rather than from the target. This finding is important, because it indicates that the highest categorization conflict towards objectified women was the result of an increased attraction towards the object category, instead of a higher uncertainty towards the person category. This result suggests that objectified women tend to be seen as more object-like, instead of inducing doubts about them having human qualities. In addition, analyzing the midflight corrections and distribution of the AUC, we found evidence for smooth rather than abrupt trajectories, which suggests dynamic competition between the object-human categories rather than the sequential unfolding of a dual process. These latter findings are important and might have consequences for reducing people's tendency to objectify women. While past work has emphasized the automaticity of objectification processes (Vaes et al., 2011) and has shown that avoiding to objectify a sexy woman has a cost in terms of cognitive resources (Tyler et al., 2017), the identification of dynamic processes of person construal (Freeman & Ambady, 2011) suggests that the objectification of women might be more flexible and less inevitable than we initially thought. Following the logic of dual process models, a provocatively dressed woman would be initially objectified and only subsequently seen as a person when the motivational cues activate a controlled process that corrects this first impression. Instead, given that bottom-up perceptual processes simultaneously interact with top-down motivational cues, dynamic models predict that with the right motivation this same woman does not need to be objectified at all. These findings open the door to formulate more accurate theoretical accounts on the process of sexual objectification and possible avenues to reduce its detrimental consequences for women.

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