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**UNDRESSED FOR SUCCESS? THE EFFECTS OF HALF-NAKED
WOMEN ON ECONOMIC BEHAVIOR**

by

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Undressed for Success? The Effects of Half-Naked Women on Economic Behavior ^{*}

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Abstract

Images of half-naked women are in many societies ubiquitous in advertising and popular culture. Yet relatively little is known about the potential impacts of such images on economic decision making. In this paper, we examine how exposure to images of half-naked women affect risk taking, willingness to compete and math performance. We perform a lab experiment with a total of 648 participants of both genders, randomly exposing participants to advertising images including either women in bikini or underwear, fully dressed women, or no women. Exposure to images of half-naked women could potentially have effects on economic preferences and performance through channels such as arousal, cognitive load and stereotyping. Following a pre-registered pre-analysis plan, we find no treatment effects on any of the outcome measures for female participants. For male participants, we also find no effect on willingness to compete or math performance, but suggestive evidence that men take more risk after having been exposed to images of half-naked women compared to images including no women. We thus do not find any strong support for the hypothesis that exposure to images of half-naked women impact economic preferences, but given the suggestive evidence for risk taking future studies should explore this further.

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1 Introduction

A picture is worth more than a thousand words, according to a common idiom. A certain picture that is particularly pervasive in many societies is that of the half-naked woman, with a strong presence in both advertising and popular culture (Hatton and Trautner, 2011; APA, 2007). Yet little is known about the influences of this type of image on economic decision making. While advertisers have for a long time used images of half-naked women to sell all sorts of products and services, economists have only recently started to address to what extent related images could affect economic preferences and outcomes. This is an important question, as these types of images in advertisements could potentially influence behavior far beyond perceptions of the product or brand itself.¹

In this study, we perform a lab experiment to explore how exposure to images of half-naked women affect risk taking, willingness to compete and math performance in a sample of 648 participants. While most of the previous literature on the impact of images of half-naked women focus only on male behavior, our sample includes both men and women. We randomly allocate participants to one of three conditions: a treatment where advertisements contain half-naked women dressed in bikini or underwear, a treatment where advertisements contain fully dressed women, or a control condition where there are no women present. The only thing differing between the two treatments with images of women is the degrees of nakedness (the identity, posture and facial expression of the depicted women are kept constant). With more than 100 participants per condition and gender, we have the largest sample size in the related literature thus far.

Risk taking is measured from having participants complete two multiple-price lists in which they face a series of decisions between two lotteries, where one is more risky than the other. Participants make 20 such choices and our measure of risk taking is defined as the fraction of more risky lottery choices. The competitiveness task is similar to the seminal paper by Niederle and Vesterlund (2007), where participants in a first stage perform a math task and get paid according to a piece-rate scheme. In a second stage, participants perform a similar math task and are paid according to a competitive winner-takes-all

¹Recently, in many countries, there has been an increased policy debate around sexist and/or objectifying media images of women, with e.g. Paris banning them in the public sphere and London banning it in the subway (cf. Financial Times, 2017; The Independent, 2017).

tournament scheme. In a third stage, participants get to choose between the two payment schemes before performing the task for a third time. Willingness to compete is measured from this binary choice. As a measure of math performance, we use the number of correctly solved math problems in the first non-competitive stage of the competitiveness task.

We study these three measures since gender differences in risk taking and willingness to compete are the most robust gender differences in the experimental literature (cf. Croson and Gneezy, 2009; Charness and Gneezy, 2012; Nelson, 2015; Niederle, 2016), and math is a heavily gender stereotyped task where both men and women typically associate it with the male domain (cf. Nosek and Smyth, 2011). Moreover, risk preferences, willingness to compete and math studies have previously been related to important economic outcomes. For example, risk averse individuals have been shown to be more likely to work in sectors with low variation in salaries (Bonin et al., 2007) and less likely to be self-employed (Dohmen et al., 2011), willingness to compete has been linked positively with educational choices (Zhang, 2012; Buser et al., 2014, 2017) and salary expectations (Reuben et al., 2015), and math studies have been shown to have a positive impact on earnings and career advancement (Joensen and Nielsen, 2009).

Exposure to images of half-naked women could potentially have effects on economic preferences and performance through channels such as arousal, cognitive load and stereotyping, which need not be mutually exclusive. Our primary hypotheses are that for men, exposure to images of half-naked women increases risk taking, increases willingness to compete and increases math performance, compared to the control group.² For women, we hypothesize the opposite effects, with exposure to images of half-naked women decreasing risk taking, decreasing willingness to compete, and decreasing math performance, compared to the control group.

To distinguish between competing mechanisms, we let the participants complete an IAT (Implicit Association Test) after the main tasks, assessing to what degree they associate being male with the career domain and being female with the family domain. We use two behavioral measures based on the IAT: the average response time in the first two IAT

²It has been argued that men through evolution have been selected to be more competitive and risk taking than women, and that this is driven by competition for access to women (see Fine (2017) for a critical overview). One could argue that if this was the case then risk taking and competitiveness should be triggered further in a setting like ours.

stages, and the IAT score (described further in Section 2 and Appendix B). In addition, when collecting their payments, participants were offered candy. From this choice we create a binary measure indicating if the participant took candy or abstained. The two IAT measures and the candy choice measure allow us to explore potential mechanisms related to cognitive load and stereotyping. These mechanisms and other tests are included as secondary, or exploratory, tests. If we find significant differences between the half-naked treatment and the control, we thereafter test whether the results from the half-naked treatment are significantly different from the results from the fully dressed treatment. Thus, the additional treatment with images depicting fully dressed women allows us to cleanly distinguish between the effect of observing an image depicting a woman and the effect of observing an image depicting a *half-naked* woman.

Comparing the half-naked treatment with the control, we find no treatment effects on any of the three main outcome measures for female participants. For men, we also find no effect on math performance or willingness to compete, but suggestive evidence that men take more risk after having been exposed to images of half-naked women. This latter result is in line with some previous work but should be replicated before any strong conclusions are drawn. Moreover, we do not find a significant difference between the half-naked treatment and the fully dressed treatment on risk taking for men. In sum, we do not find any strong support for the hypothesis that exposure to images of half-naked women impact economic preferences, but given the suggestive evidence for risk taking future studies should explore this further with even larger sample sizes in order to have statistical power to detect small effect sizes.

There is a handful of related papers studying whether there are any effects of exposure to erotic images, attractive opposite gender images, or opposite gender individuals present on risk taking.³ The most relevant study is that of Jahedi et al. (2017), who perform an incentivized between-subject experiment looking at arithmetic tasks, risk tasks, impatience tasks, anchoring tasks and snack choice tasks in a sample of 144 men. Before completing each task, participants were depending on the treatment exposed to either a neutral image or an arousing image. While Jahedi et al. (2017) find no effects of arousal on arithmetic

³There is also a related strand of literature exploring how gender-stereotypic, or counter-stereotypic, depictions of women in media affect behavior, see e.g. Davies et al. (2002) and Davies et al. (2005).

tasks, risk taking in the loss domain or patience, they find that when aroused, participants were more risk taking in the gain domain and more susceptible for framing.

There are four other relevant papers on risk taking. In a study on hypothetical monetary gambles with 241 participants, McAlvanah (2009) finds that both men and women become more risk taking after having viewed opposite gender photos compared to pictures of cars, but that the attractiveness of the depicted person did not influence risk taking. In a brain imaging study of 15 men, Knutson et al. (2008) find that the anticipation of exposure to erotic images increases risk taking in an incentivized investment task. Dreber et al. (2013) study chess tournament data and find that in their sample of 626 players, men but not women use more risk taking strategies in chess when playing against attractive opposite-gender opponents. Studying a total of 260 children aged 10-11, Booth and Nolen (2012) find that girls in same-gender groups or same-gender schools are more risk taking than girls in mixed-gender groups or schools.

There are also related papers looking at non-economic risk taking. For example, Ariely and Loewenstein (2006) perform a within-subject study with 35 participants and find that, when sexually aroused, men are more willing to engage in risky sexual activities. Ronay and Hippel (2010) vary the gender of the experimenter and find that physical risk taking (measured from skateboarding) among 96 young men increase in the presence of an attractive woman.⁴

We add to this literature in several important ways. First, with more than 100 participants per condition and gender, we have the largest sample size so far in the literature on the economic decision-making effects of exposure to images of half-naked women. Second, most previous studies focus on men’s behavior and, to our knowledge, we are the first to address how women’s economic behavior is affected by images of half-naked women. This feature of our design is important, as images of undressed women are more pervasive than images of undressed men in today’s society, and the behavioral impact of

⁴When it comes to experimental work, there are a handful of papers exploring the impact of attractive opposite gender images or erotic images on patience or behavior in the trust game or ultimatum game (Wilson and Daly, 2004; Van den Bergh and Dewitte, 2006; Wilson and Eckel, 2006; Van den Bergh et al., 2008; Kim and Zauberman, 2013). There are also other indications from the field that men but not women react to the attractiveness of opposite gender individuals, with men giving more to attractive female solicitors in a field experiment on charity (Landry et al., 2006) and men increasing their demand for loans when advertising for consumer credit includes an image of an attractive woman (Bertrand et al., 2010).

such images may differ substantially across genders. Third, no previous study includes a treatment condition with fully dressed images that are identical to the undressed images in all other respects. This treatment is crucial for being able to separate the effects of being exposed to half-naked women versus just women per se. Fourth, we are the first to include willingness to compete as an outcome variable. Finally, all our analyses follow a pre-registered pre-analysis plan (registered on <https://osf.io/xpm2r/>). We thus avoid the ubiquitous problems with the various types of researcher degrees of freedom such as p-hacking (Simmons et al., 2011) and forking (Gelman and Loken, 2013) that can lead to high false positive rates even though the researchers report results with p-values less than 0.05. With our pre-analysis plan we have specified the analysis presented in this paper prior to performing any analysis. As far as we know, out of all the aforementioned papers we are the only ones with a pre-analysis plan.

The paper is organized in the following way. Section 2 describes the experimental design. Section 3 presents the descriptives and Section 4 the results. Section 5 concludes.

2 Experimental design

The experiment was conducted in computer laboratories at the Center for Experimental Economics (CEE) at the University of Copenhagen in 2016 and 2017, and at the Laboratory for Research in Experimental Economics (LINEEX) at the University of Valencia in 2017. Before analyzing the data, we published a pre-analysis plan at the Open Science Framework (registered on <https://osf.io/xpm2r/>).

2.1 Treatments

During the course of the experiment, participants are shown 18 different advertising images (created by us) on their computer screen. These images are divided into three blocks with six images in each block. The three blocks differ in the product that is advertised - juice, body lotion or perfume - and the order of the blocks is randomized at the participant level.

Within each experimental session, we randomly assign participants to one out of three conditions:

- **Control (C):** No image includes a person.

- **Treatment 1 (T1):** Half of the images include a fully dressed woman, and half of the images include no person.
- **Treatment 2 (T2):** Half of the images include a half-naked woman (in bikini or underwear), and half of the images include no person.

The only difference between the advertising images shown in the control condition C and in the two treatments T1 and T2 is whether the image includes a woman or not.⁵ The images are identical in all other regards. The only difference between the treatments T1 and T2 is whether the woman is dressed in clothes (jeans and a t-shirt) or in bikini or underwear. All other features of the picture – most importantly, the facial expression and body posture of the woman – are held constant across T1 and T2.⁶ Figure 1 shows examples of images from C, T1 and T2. For an overview of all images used in the experiment, see Appendix C.

Each advertising image is shown on the computer screen for 10 seconds. After viewing each image, we ask participants to rate their attitudes toward the advertisement in three different dimensions. This type of rating is common in the marketing literature, and makes sure that participants pay attention to the images. It also allows us to introduce the images in a “natural” way to the participants.

Figure 1: Examples of advertising images used in experiment

⁵The photos of the women were taken by a professional photographer employed by us and we have copyright for these photos.

⁶To hold the facial expression constant across the treatments, we used photo editing software to insert the same facial image in each pair of dressed and half-naked pictures. To hold the body posture constant, we instructed the model to pose in the exact same way when she was fully dressed as when she was wearing bikini or underwear.

In our primary analyses, we compare participant behavior between T2 and C. This comparison provides us with the total effect of exposure to images with half-naked women. Then, if we find a difference between T2 and C, we proceed to comparing behavior between T2 and T1. This comparison allows us to disentangle the effect of exposure to images of half-naked women from the effect of exposure to images of fully dressed women.

2.2 Primary outcome measures

We elicit three main outcome measures: risk taking, willingness to compete and math performance. Below, we describe the tasks used to elicit these measures. Before performing each task, participants are shown, and asked to rate, a new block of six advertising images (for juice, body lotion or perfume). Figure 2 provides an overview of the structure of the experiment. After the experiment, participants are paid for one randomly selected task.⁷

2.2.1 Risk taking

To elicit risk preferences, we let participants complete two multiple-price lists (MPLs). In each MPL, participants face 10 different choices between two lotteries, where one lottery is more risky than the other. Andersson et al. (2016) suggest that, depending on the construction of the MPL, an increased propensity to make errors may be confounded with either an increase or a decrease in risk taking. This suggests that, if we were to find an effect of exposure to images of half-naked women on risk taking, it could be because the exposure to such images increases errors in decision making. To avoid confounding treatment effects on the propensity to make errors with treatment effects on risk taking, we include two different MPLs.⁸ Thus, participants make 20 choices in total. Our measure of risk taking is defined as the share of choices of the more risky lottery in the two MPLs combined.

⁷We randomly select one of the four following tasks for payment: (i) one randomly chosen lottery, (ii) performance in the math task under the piece-rate scheme, (iii) performance in the math task under the competitive payment scheme, or (iv) performance in the math task under the participant’s own choice of payment scheme. Participants in Denmark are paid in DKK and participants in Spain in Euro, with average earnings around \$20 including show-up fees of around \$7 (50 DKK in Denmark and €5 in Spain).

⁸Andersson et al. (2016) argue that previous results on cognitive ability and risk aversion confuse a link between cognitive ability and risk taking because of a biased MPL and errors that are correlated with cognitive ability. Using two MPLs that vary in how risky they are, the authors show that one of the MPLs gives a positive correlation, and the other one a negative correlation, between risk aversion and cognitive ability. This suggests that errors in decision making are systematically correlated with choices in MPLs. We include both MPLs suggested in Andersson et al. (2016).

Figure 2: Overview of experiment

2.2.2 Willingness to compete

In the first round of this task, we let participants solve a series of math problems under a piece-rate payment scheme. We use the same type of math problems as Niederle and Vesterlund (2007), asking participants to add up as many sets of five two-digit numbers as they can during five minutes. For each set of numbers that the participant solves correctly, they receive €1 (or 10 DKK) in payment. In the second round, we let participants perform the same task again but now under a competitive tournament payment scheme. Following the design of Niederle and Vesterlund (2007), in this payment scheme participants are randomly allocated to groups of four. Under the tournament payment scheme, the participant with the best math performance in the group is paid €4 (or 40 DKK) for each set of numbers they solve correctly (i.e., four times as much as under the piece-rate), while the others receive nothing.

Finally, before the third round of performing the math task, participants get to choose between being paid according to a piece-rate payment scheme (as in the first round of the math task) or according to a tournament payment scheme (as in the second round of the math task). Participants who choose the tournament scheme will compete against the performance of three other, randomly chosen, participants from the second round of the math task (ensuring that participants do not need to consider any differences in math ability between participants who choose to compete compared to those who chose not to compete, or the negative externalities that their choice to compete may have on the payoff of other participants). This choice provides our measure of willingness to compete – a participant is classified as “willing to compete” if they choose the tournament scheme over the piece-rate scheme.

2.2.3 Math performance

We use the first round of the willingness to compete task to elicit math performance. Our measure of math performance is the total number of problems that the participant solves correctly during five minutes under a piece-rate payment scheme.

2.3 Secondary outcome measures

2.3.1 IAT

After the risk and willingness to compete tasks (that also measure math performance), participants complete an Implicit Association Test (IAT), assessing to what degree they associate being male with the career domain and being female with the family domain. A positive IAT score implies that participants are biased in the sense that they find it easier to associate men with career and women with the household. We include a more detailed description of the IAT in Appendix B.1.

If we find a treatment effect on any of our primary outcome measures, the results from the IAT may be informative regarding potential mechanisms. If exposure to images of half-naked women causes an increase in IAT scores, this may indicate that exposure to such images increases the salience of gender stereotypes. Moreover, if exposure to images of half-naked women causes an overall increase in response times, this may indicate that

exposure to such images increases cognitive load.

2.3.2 Candy

After the experiment, when collecting their payment, participants were offered candy. The experimenter noted whether the participant took a piece of candy or not. The idea of including this task was to use it as a proxy of cognitive load – that if participants were cognitively loaded through a treatment they would be less inclined to resist the candy.

3 Descriptive statistics

In total, 651 individuals participated in the experiment. Out of these, we drop 3 participants from Copenhagen due to lost questionnaire data (making us ignorant of their gender). Our final sample thus consists of 648 individuals (331 men and 317 women). Table 1 provides an overview of the sample size by treatment status and gender, and Table 2 provides descriptive statistics. 61 percent of the participants were recruited in Copenhagen and 39 percent in Valencia.⁹ The average participant age is 25 years old.

In the first round of the math task, participants solve on average 7.6 math problems correctly. We find no significant gender difference in math performance. In line with previous studies using similar tasks, we find a significant gender gap in the willingness to compete. While 48% of the men choose to compete, only 30% of the women do so ($p < 0.01$). We also find a significant ($p < 0.01$) gender difference in risk taking. On average, out of the 20 risky choices, men choose the risky option 45 percent of the time while women choose the risky option 40 percent of the time.

Table 1: Sample size by treatment and gender

	C	T1	T2	All
Men	102	116	113	331
Women	111	100	106	317
All	213	216	219	648

⁹We started with the experiment in Copenhagen and when it became clear that we could not reach the desired sample size we continued in Valencia.

Table 2: Descriptive statistics, by gender

	All	Men	Women	Gender Difference	p-value
Participant age	24.67 (4.04)	25.12 (4.48)	24.19 (3.47)	0.93	0.00
Attracted to women	0.51 (0.50)	0.85 (0.35)	0.15 (0.36)	0.71	0.00
Copenhagen session	0.61 (0.49)	0.62 (0.49)	0.61 (0.49)	0.01	0.78
Valencia session	0.39 (0.49)	0.38 (0.49)	0.39 (0.49)	-0.01	0.78
Spanish participant	0.38 (0.49)	0.39 (0.49)	0.38 (0.48)	0.02	0.65
Danish participant	0.13 (0.34)	0.17 (0.38)	0.09 (0.28)	0.08	0.00
Share of risky choices	0.42 (0.18)	0.45 (0.18)	0.40 (0.17)	0.05	0.00
Competed	0.39 (0.49)	0.48 (0.50)	0.30 (0.46)	0.18	0.00
Math score piece rate	7.58 (3.54)	7.80 (3.88)	7.36 (3.14)	0.44	0.11
Participant took candy	0.37 (0.48)	0.36 (0.48)	0.38 (0.49)	-0.02	0.54
IAT score	0.22 (0.27)	0.20 (0.28)	0.25 (0.25)	-0.04	0.05
IAT stages 1 and 2 mean response time	1.07 (0.26)	1.09 (0.29)	1.04 (0.22)	0.04	0.03

Note: Standard deviations in parentheses. P-values are obtained using a t-test.

4 Results

In this section, we present the results for our primary outcome variables: risk taking, willingness to compete and math performance. We also elicited treatment effects on a set of secondary outcome measures: (i) IAT score, (i) mean response time from the IAT, and (iii) propensity to take candy. We find no significant treatment effects on any of these secondary outcome measures – see Appendix B for more details. Our main tests were pre-specified to be performed with t-tests or χ^2 -tests, while the regression analysis is part of our robustness tests.

4.1 Risk taking

Figure 3 illustrates the average share of risky choices, by gender and treatment, and Figure A.1 shows the distributions. The average share of risky choices among men increases from 42.3 % in the control group (images with no women) to 47.1 % in T2 (images of half-naked women). This 4.8 percentage points increase corresponds to a Cohen's d of 0.26 - i.e., an effect size in the range between small and medium. Using a t -test, the increase is not significant at the five percent level ($t=1.91$, $p=0.057$, 95% CI: [-0.002; 0.098]). However, as indicated by the coefficient of $T2$ in Column (2) of Table 3, when running an OLS regression (clustering the standard errors on the session level), the effect reaches statistical significance ($p=0.025$, 95% CI: [0.007; 0.090]). This provides suggestive evidence that men become more risk taking when being exposed to images of half-naked women. To determine if this effect is primarily due to the presence of a woman in the image, or the fact that she is half-naked, we compare T2 (images of half-naked women) to T1 (images of the same women fully dressed). The increase in risk taking among men between T1 and T2 is 2.0 percentage points and not statistically significant ($t=-0.81$, $p=0.420$).

Figure 3: Average share of risky choices, by treatment and gender

For women, the difference in the average share of risky choices between the control group and T2 is very small and insignificant (Cohen's $d=0.03$, $t=0.19$, $p=0.850$, 95% CI:

$[-0.050; 0.041]$). In addition, as indicated by the interaction between *Female* and *T2* in Column (2) of Table 3, the gender difference in treatment effects is not significant at the five percent level ($p=0.071$, 95% CI: $[-0.110; 0.005]$).

4.2 Willingness to compete

Figure 4: Share competing, by treatment and gender

As illustrated in Figure 4, men are more prone to choose the competitive payment scheme in T2 than in the control group. The share of men competing increases by 9.8 percentage points, from 45.1 % in the control group to 54.9 % in T2 (Cohen's $d=0.20$), but this increase is not statistically significant ($\chi^2=2.05$, $p=0.153$). The treatment effect on the share of women competing is small (a decrease of 2.3 percentage points, Cohen's $d=0.08$) and not statistically significant ($\chi^2=0.31$, $p=0.578$). Moreover, while the treatment effects on men and women point in different directions, there is no statistically significant gender difference in treatment effects ($p=0.101$, 95% CI: $[-0.290; 0.027]$, see the coefficient of $Female \times T2$ in Column (5) of Table 3).

4.3 Math performance

Figure 5 shows the average number of math problems solved under the piece-rate payment scheme in the first round of the willingness to compete task, and Figure A.2 shows the distributions. For men, the difference in math performance between the control group and T2 is very small and insignificant (Cohen's $d=0.01$, $t=-0.087$, $p=0.931$, 95% CI: $[-1.077; 0.986]$). For women, the effect size is larger – women solve on average 0.677 more math problems in T2 compared to the control group (Cohen's $d=0.22$). However, this effect is not statistically significant ($t=1.59$, $p=0.113$; 95% CI: $[-0.161; 1.515]$) and is not in the hypothesized direction. There is no statistically significant gender difference in the size of the treatment effect ($p=0.304$, see the coefficient of $Female \times T2$ in Column (8) of Table 3).

Figure 5: Math performance under piece rate, by treatment and gender

Table 3: OLS regressions on the whole sample, using risk taking, willingness to compete and math performance as outcome variables

	Share risky choices			Willingness to compete			Math performance (piece rate)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-0.050 (0.015)**	-0.035 (0.024)	-0.031 (0.028)	-0.184 (0.042)***	-0.163 (0.074)*	-0.112 (0.086)	-0.444 (0.255)	-0.967 (0.476)	-0.844 (0.626)
Half-naked (T2)		0.048 (0.020)*	0.054 (0.022)*		0.098 (0.068)	0.104 (0.070)		-0.045 (0.565)	-0.027 (0.602)
Female X Half-naked (T2)		-0.053 (0.028)	-0.055 (0.028)		-0.131 (0.077)	-0.136 (0.079)		0.723 (0.687)	0.712 (0.712)
Fully dressed (T1)		0.028 (0.021)	0.032 (0.020)		-0.003 (0.072)	-0.005 (0.073)		-0.301 (0.535)	-0.298 (0.564)
Female X Fully dressed (T1)		0.010 (0.031)	0.011 (0.030)		0.074 (0.093)	0.078 (0.094)		0.856 (0.645)	0.862 (0.663)
Constant	0.449 (0.010)***	0.423 (0.018)***	0.352 (0.080)***	0.483 (0.028)***	0.451 (0.056)***	0.246 (0.179)	7.801 (0.207)***	7.922 (0.383)***	7.228 (1.257)***
N	648	648	646	648	648	646	648	648	646
Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
T2 + Female X T2		-0.004	-0.001		-0.034	-0.032		0.677	0.685
F statistic		0.033	0.003		0.392	0.356		3.381	3.256

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Note: Standard errors are clustered on the session level (there are 24 sessions in total, with between 8 and 50 participants in each session). Controls include participant age, indicators for Danish and Spanish participants, and an indicator for if the participant is attracted to women (defined as answering 'women' or 'both' when asked which gender they are attracted to). The two final rows present results from an F-test, testing the effect of T2 (compared to C) for women.

5 Discussion

In a large study with 648 participants and more than 100 participants per condition and gender, we find little evidence of exposure to images of half-naked women affecting economic decision-making. Unlike in all previous papers on related topics, all of our tests were pre-specified in a pre-analysis plan. We perform six main tests (t-tests or χ^2 -tests), comparing the treatment with images of half-naked women to the control condition with images of no persons, and none is statistically significant at the five percent level. When performing the same analyses in a regression framework (clustering standard errors at the session level), we find that one result is significant, with men being more risk taking when exposed to images of half-naked women compared to the control condition. While this is in line with some previous results, the effect size (Cohen’s d) is small to medium, and the p-value is 0.025, thus not providing strong evidence of any effect (see Benjamin et al. (2018) for more discussion of p-values below 0.05 versus below 0.005). Also, the regression analysis is part of the robustness analysis and not the main test. Moreover, men’s risk taking does not differ significantly between the treatment with images of half-naked women and the treatment with images of fully dressed women. We thus do not find any strong support for the idea that exposure to images of half-naked women impact economic preferences.

Given our sample size and pre-registered analysis, we have a lower risk of both false negative and false positive results than previous papers. There are however several caveats to our largely null results. First, while we have a larger sample size than most previous studies, we do not have statistical power to detect small effect sizes. Also, there might be a difference between exposure to half-naked images like ours and exposure to images that objectify women. Most of the policy debate has been about the objectification or sexualization of women in advertising and popular culture, rather than nakedness per se. Images of fully dressed women can be highly sexualized while naked images can be (at least to a certain extent) non-sexualized. Our images are not very objectifying or sexualized, and it is also not clear (to us) whether they can be considered arousing. The previous studies that found effects of attractive women or arousal on economic-decision making may thus have found effects through e.g. sexualization, that we do not explore. At the end of

the day, we can only say something about the effects on behaviors from this particular set of images. It could also be the case that short term exposure to half-naked images have no effects on behavior, while long-term exposure would have an effect, or that still images like ours have less of an effect than a movie. Finally, it would be interesting to explore the effects of exposure to images of half-naked men. More work is thus needed on this topic.

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Appendix A Additional tables and figures

Figure A.1: Distribution of risk taking by gender and treatment

(a) C: Control

(b) T1: Fully dressed women

(c) T2: Half-naked women

Figure A.2: Distribution of math performance by gender and treatment

(a) C: Control

(b) T1: Fully dressed women

(c) T2: Half-naked women

Appendix B Secondary outcome measures

B.1 Procedure of IAT

The IAT consists of seven stages:

1. Learn the concept dimension (male-female).
2. Learn the attribute dimension (career-family).
3. Practice the first concept-attribute pairing (linking male with career and female with family).
4. First concept-attribute pairing (linking male with career and female with family).
5. Learn to switch the spatial location of the concepts.
6. Practice the second concept-attribute pairing (linking male with family and female with career).
7. Second concept-attribute pairing (linking male with family and female with career).

To compute the IAT score for each participant, we use the improved IAT scoring procedure recommended by Greenwald et al. (2003). In short, this scoring procedure is implemented as follows:

1. Delete trials with response time $> 10,000$ ms.
2. Delete subjects for whom more than 10 % of trials have a response time < 300 ms.
3. Compute the inclusive standard deviation for all trials in stages 3 and 6, and likewise for all trials in stages 4 and 7.
4. Compute the mean response times for each of stages 3, 4, 6 and 7.
5. Compute the difference in mean response time between stage 6 and 3, and likewise between stage 7 and 4.
6. Divide each of these two differences by its associated inclusive standard deviation.
7. The IAT score = the equal-weight average of the two resulting ratios.

B.2 Treatment effects on IAT score

Since a participant's IAT score is defined as their average response time when male [female] and household-related [career-related] words are linked *minus* their average response time when male [female] and career-related [household-related] words are linked, a positive IAT score implies that participants are biased in the sense that they find it easier to associate men with career and women with the household. A negative IAT score implies that participants find it easier to associate women with career and men with the household.

Figure B.1 shows the average IAT score by gender and treatment. On average, the IAT score of men is 0.033 higher in T2 compared to C while the IAT score of women is 0.021 lower. None of these differences are statistically significant (men: $t=-0.846$, $p=0.399$; women: $t=0.594$, $p=0.553$). Moreover, as indicated by the coefficient of $Female \times T2$ in column (2) of Table B.1, the gender difference in treatment effects is not significant ($p=0.358$).

Figure B.1: IAT score, by treatment and gender

B.3 Treatment effects on IAT response time (stages 1 & 2)

Stages 1 and 2 of the IAT test are practice rounds. We are interested in eliciting each participant's average response time in these stages, since it may be used as a proxy for

'cognitive load' (higher cognitive load would imply a slower response time).

Figure B.2 illustrates the average response time by gender and treatment. On average, men respond 0.020 seconds faster, and women respond 0.050 seconds faster, in T2 compared to C. None of these differences are statistically significant (men: $t=0.643$, $p=0.521$; women: $t=1.683$, $p=0.093$). Moreover, there is no statistically significant gender difference in treatment effects ($p=0.476$, see the coefficient of $Female \times T2$ in column (5) of Table B.1).

Figure B.2: Average IAT response time (stages 1 & 2), by treatment and gender

B.4 Treatment effects on willingness to take candy

Figure B.3 illustrates the share of participants taking candy, by gender and treatment. Men are 4.0 percentage points more prone to take candy in T2 compared to C (42.7 % vs. 38.8 %), while women are 1.7 percentage points less prone to take candy. None of these differences are statistically significant (men: $\chi^2=0.33$, $p=0.563$; women: $\chi^2=0.07$, $p=0.798$). There is no statistically significant gender difference in treatment effects ($p=0.538$, see the coefficient of $Female \times T2$ in Column (8) of Table B.1).

Figure B.3: Share taking candy, by treatment and gender

Table B.1: OLS regressions on the whole sample, using IAT score, mean IAT response time, and propensity to take candy as outcome variables

	IAT score			IAT mean response time			Taking candy		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	0.041 (0.018)*	0.082 (0.038)*	0.138 (0.049)**	-0.044 (0.018)*	0.002 (0.032)	0.014 (0.035)	0.023 (0.041)	0.024 (0.058)	0.009 (0.065)
Half-naked (T2)		0.033 (0.039)	0.045 (0.044)		-0.020 (0.024)	-0.017 (0.024)		0.043 (0.063)	0.038 (0.054)
Female X Half-naked (T2)		-0.054 (0.058)	-0.056 (0.064)		-0.030 (0.042)	-0.034 (0.038)		-0.062 (0.100)	-0.060 (0.096)
Fully dressed (T1)		0.035 (0.043)	0.041 (0.049)		0.040 (0.044)	0.040 (0.043)		-0.079 (0.065)	-0.070 (0.063)
Female X Fully dressed (T1)		-0.066 (0.053)	-0.061 (0.061)		-0.112 (0.043)*	-0.106 (0.039)*		0.057 (0.100)	0.048 (0.097)
Constant	0.204 (0.025)***	0.180 (0.038)***	0.019 (0.106)	1.089 (0.033)***	1.082 (0.035)***	0.892 (0.071)***	0.360 (0.038)***	0.373 (0.047)***	0.512 (0.096)***
N	627	627	627	647	647	645	647	647	645
Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
T2 + Female X T2		-0.021	-0.010		-0.050	-0.052		-0.019	-0.022
F statistic		0.205	0.051		4.747	5.055		0.070	0.088

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Note: Standard errors are clustered on the session level (there are 24 sessions in total, with between 8 and 50 participants in each session). Controls include participant age, indicators for Danish and Spanish participants, and an indicator for if the participant is attracted to women (defined as answering 'women' or 'both' when asked which gender they are attracted to). The two final rows present results from an F-test, testing the effect of T2 (compared to C) for women.

Appendix C All advertising images

All images including women are the intellectual property of the authors.¹⁰

Figure C.1: Perfume

¹⁰Please contact the authors for reuse of these images.

Figure C.2: Juice

Figure C.3: Body lotion

Appendix D Instructions

D.1 General Instructions

Welcome to this experiment! The experiment will not take more than 60 minutes. Please do not talk with one another for the duration of the experiment. If you have any questions, please raise your hand.

You will be paid a show-up fee of 50 kroner and in addition you will have the opportunity to earn more.

In this experiment you will be asked to rate advertisements as well as perform four different tasks. In addition to the show-up fee, you will be paid for one of these four tasks; which one will be randomly determined. Before each task we will describe in detail how your payment is determined.

D.2 First rating of advertisements

D.2.1 Screen 1:

Before you start the first task, we would like you to look at six different advertisements for [randomize: juice/perfume/body lotion]. Each advertisement will be shown for 10 seconds.

D.2.2 Screen 2:

What is your attitude toward this advertisement?

Bad	1—2—3—4—5—6—7	Good
Unpleasant	1—2—3—4—5—6—7	Pleasant
Unfavorable	1—2—3—4—5—6—7	Favorable

[Participants are not able to continue before the advertisement has been shown for at least 10 seconds, and they have answered all three questions.]

D.2.3 Screens 3-7:

[Screen 2 is repeated until six different advertisements have been shown. Participants in the control group are shown six advertisements with no person. Participants in T1 are shown three advertisements with a fully dressed woman and three advertisements with no person. Participants in T2 are shown three advertisements with a half-naked woman and three advertisements with no person.]

D.3 Risk taking task

D.3.1 Screen 1:

In the two following screens, please choose between two lotteries.

Please state, whether you prefer the lottery to the LEFT or to the RIGHT. Each lottery has two possible outcomes: HEADS or TAILS. The outcome is determined by the toss of a coin and the chances of getting either HEADS or TAILS are equally big, i.e. each lottery has a probability of 50 percent for HEADS and a probability of 50 percent for TAILS. If the outcome is HEADS, you will receive the HEADS outcome of your chosen lottery. If the outcome is TAILS, you will receive the TAILS outcome of your chosen lottery. There is no right or wrong answer. Just choose the lottery you prefer.

For example:

	LEFT		I prefer:		RIGHT	
	LOTTERY:		LEFT	RIGHT	LOTTERY:	
	Heads	Tails	LOTTERY	LOTTERY	Heads	Tails
Decision 1:	Win 30	Win 50			Win 5	Win 80

If you choose the LEFT LOTTERY in the example above: you will win 30 kroner if the coin shows HEADS; and you will win 50 kroner if the coin shows TAILS. If you choose the RIGHT LOTTERY: you will win 5 kroner if the coin shows HEADS; and you will win 80 kroner if it shows TAILS.

In the following two screens, there will be two tables, where you will be asked to choose between lotteries similar to the ones in the above example. In total, you have to make 20 choices. When you have made all your choices, one of the 20 rows will be randomly selected. All the rows have the same probability of being chosen. In the selected row, the lottery you have chosen will be played out which means a coin will be flipped to determine the outcome of the lottery. Thereafter, your earnings will be added to your income if this task is randomly selected for your profit.

D.3.2 Screen 2:

For each row, please state if you prefer the LEFT LOTTERY or the RIGHT LOTTERY.

	LEFT LOTTERY:		I prefer:		RIGHT LOTTERY:	
	Heads	Tails	LEFT LOTTERY	RIGHT LOTTERY	Heads	Tails
Decision 1:	Win 30	Win 50			Win 5	Win 60
Decision 2:	Win 30	Win 50			Win 5	Win 70
Decision 3:	Win 30	Win 50			Win 5	Win 80
Decision 4:	Win 30	Win 50			Win 5	Win 90
Decision 5:	Win 30	Win 50			Win 5	Win 100
Decision 6:	Win 30	Win 50			Win 5	Win 110
Decision 7:	Win 30	Win 50			Win 5	Win 120
Decision 8:	Win 30	Win 50			Win 5	Win 140
Decision 9:	Win 30	Win 50			Win 5	Win 170
Decision 10:	Win 30	Win 50			Win 5	Win 220

D.3.3 Screen 3:

For each row, please state if you prefer the LEFT LOTTERY or the RIGHT LOTTERY.

	LEFT LOTTERY:		I prefer:		RIGHT LOTTERY:	
	Heads	Tails	LEFT LOTTERY	RIGHT LOTTERY	Heads	Tails
Decision 1:	Win 25	Win 45			Win 2	Win 40
Decision 2:	Win 25	Win 45			Win 2	Win 50
Decision 3:	Win 25	Win 45			Win 2	Win 55
Decision 4:	Win 25	Win 45			Win 2	Win 60
Decision 5:	Win 25	Win 45			Win 2	Win 65
Decision 6:	Win 25	Win 45			Win 2	Win 70
Decision 7:	Win 25	Win 45			Win 2	Win 75
Decision 8:	Win 25	Win 45			Win 2	Win 95
Decision 9:	Win 25	Win 45			Win 2	Win 135
Decision 10:	Win 25	Win 45			Win 2	Win 215

D.4 Second rating of advertisements

D.4.1 Screen 1:

Before you start the second task, we would like you to look at six different advertisements for [randomize: juice/perfume/body lotion]. Each advertisement will be shown for 10 seconds.

D.4.2 Screen 2:

What is your attitude toward this advertisement?

Bad	1—2—3—4—5—6—7	Good
Unpleasant	1—2—3—4—5—6—7	Pleasant
Unfavorable	1—2—3—4—5—6—7	Favorable

[Participants are not able to continue before the advertisement has been shown for at least 10 seconds, and they have answered all three questions.]

D.4.3 Screens 3-7:

[Screen 2 is repeated until six different advertisements have been shown. Participants in the control group are shown six advertisements with no person. Participants in T1 are shown three advertisements with a fully dressed woman and three advertisements with no person. Participants in T2 are shown three advertisements with a half-naked woman and three advertisements with no person.]

D.5 Math performance under piece-rate payment

D.5.1 Screen 1:

For Task 2 you will be asked to calculate the sum of five randomly chosen 2-digit numbers, such as the following:

$$10 + 15 + 20 + 25 + 30 = \square$$

You will be given 5 minutes to calculate the correct sum of a series of these problems. You cannot use a calculator to determine this sum, however you are welcome to write the numbers down and make use of the provided scratch paper. You submit an answer by clicking the OK button with your mouse. When you enter an answer the computer will immediately tell you whether your answer is correct or not, and you will get a new sum to calculate. We refer to this as the *Piece-rate task*.

If the *Piece-rate task* is the one randomly selected for your profit, you will get 10 kroner per correctly solved problem. Your profit does not decrease if you provide an incorrect answer to a problem.

D.5.2 Screen 2:

[A series of math problems of the form: $XX + XX + XX + XX + XX = \square$]

D.6 Math performance under tournament payment

D.6.1 Screen 1:

For Task 3 you will again be given 5 minutes to calculate the correct sum of a series of five 2-digit numbers. However for this task your payment depends on your performance relative to that of a group of other participants. Each group consists of four randomly grouped people that participate in this study. We refer to this as the ***Tournament task***.

If the ***Tournament task*** is the one randomly selected for payment, your profit will depend on the number of problems you solved compared to the three other people in your group. The individual who correctly solves the largest number of problems will receive 40 kroner per correct problem, while the other participants receive no profit. You will not be informed of how you did in the tournament until all tasks have been completed. If there is a tie, the payment will be split equally between the tied participants in the group.

D.6.2 Screen 2:

[A series of math problems of the form: $XX + XX + XX + XX + XX = \square$]

D.7 Third rating of advertisements

D.7.1 Screen 1:

Before you start the fourth task, we would like you to look at six different advertisements for [randomize: juice/perfume/body lotion]. Each advertisement will be shown for 10 seconds.

D.7.2 Screen 2:

What is your attitude toward this advertisement?

Bad	1—2—3—4—5—6—7	Good
Unpleasant	1—2—3—4—5—6—7	Pleasant
Unfavorable	1—2—3—4—5—6—7	Favorable

[Participants are not able to continue before the advertisement has been shown for at least 10 seconds, and they have answered all three questions.]

D.7.3 Screens 3-7:

[Screen 2 is repeated until six different advertisements have been shown. Participants in the control group are shown six advertisements with no person. Participants in T1 are shown three advertisements with a fully dressed woman and three advertisements with no person. Participants in T2 are shown three advertisements with a half-naked woman and three advertisements with no person.]

D.8 Math task, choice between piece-rate and tournament payment scheme

D.8.1 Screen 1:

As in the previous two tasks, you will be given 5 minutes to calculate the correct sum of a series of five 2-digit numbers. However, you will now get to choose which of the two previous payment schemes you prefer to apply to your performance in this task. You can thus choose between two payment schemes:

Piece-rate: If you choose the piece-rate, and this task is randomly selected for payment, you get 10 kroner per problem you solve correctly in the 5 minutes.

Tournament: If you choose the tournament, and this task is randomly selected for payment, your payment depends on your performance relative to that of a group of other participants in the Tournament task, the task you just completed where all participants participated in a tournament. Each group consists of four randomly grouped people. If you correctly solve more problems than any of the other three participants did during the Tournament task, then you receive 4 times the profit from the piece rate, which means you will get 40 kroner per correct problem. You will receive no earnings for this task if you choose tournament in this task and do not solve more problems correctly than the others in your group did during the previous task. You will not be informed of how you did in the tournament until all tasks have been completed. If there is a tie the payment will be equally split.

Which payment scheme do you prefer for the fourth task?

☐ Piece-rate

☐ Tournament

D.8.2 Screen 2:

[A series of math problems of the form: $XX + XX + XX + XX + XX = \square$]

D.9 Additional questions

Please fill out this questionnaire. When you have completed the questionnaire, and pressed continue, the experiment will be over and you will get paid.

Sex: ☐ Male ☐ Female

Age:

Nationality:

Occupation:

Field of study (if student):

Are you sexually attracted to: ☐ Males ☐ Females ☐ Both ☐ Neither?