Cues of pregnancy decrease female physical attractiveness for males

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Abstract

To increase their reproductive success, ancestral males must show preferences for fertile females. Gravid females are infertile, and, thus, should be less preferred by males compared with non-gravid females. We investigated this idea by manipulating salient cues of pregnancy with a sample of Slovak females who were rated by males. Physical attractiveness of putatively pregnant females was lower compared with non-gravid females. In line with the idea that pursuing short-term and long-term relationships creates different costs to males, physical attractiveness of putatively pregnant females was lower for short-term compared with long-term possible relationship. Older males and uncommitted males rated females as more attractive compared with younger and committed males. Our results suggest that putatively pregnant females are less attractive due to the costs of selecting an infertile partner, or due to male unwillingness to invest in biologically unrelated children.

Keywords Female fertility · Female attractiveness · Sexual selection · Parental investment

Introduction

Physical cues of female fertility, defined as the probability of present reproduction, are attractive for contemporary males (Bovet 2018; Rhodes 2006). The preference for a low waist-to-hip ratio (WHR) (Andrews et al. 2017; Butovskaya et al. 2017; Furnham et al. 2005) and low body mass indexes (weight/body weight^2; BMI) (Lassek and Gaulin 2016, 2019) results from male preference for women at peak residual reproductive value, defined as expected future reproductive potential (Schmitt 2014). Moreover, high WHR (Singh 2002) and being overweight reduces female fertility (Imterat et al. 2019; Zaadstra et al. 1993).

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Pregnancy is associated with an increase in both BMI (Suitor 1991) and WHR (Soltani and Fraser 2000) which probably decreases female physical attractiveness for males. Moreover, pregnant women have null fertility and decreased residual reproductive value, because with each birth, the average hunter-gatherer woman loses a sixth of her reproductive value (Sugiyama 2015). Perception of female residual reproductive value could be mediated by male age and by commitment in a romantic relationship. Indeed, male physical attractiveness decrease as age progresses (Maestripieri et al. 2014) and uncommitted males are more sensitive to cues of fertility (Miller and Maner 2010) and have lower mating standards (Prokop and Fedor 2013; Prokop and Pekárik 2016). For instance, single males perceived raped women in would-be scenarios as more attractive than males in a committed relationship, suggesting that the mating opportunities mediate men's perception of females with low mate value (Prokop and Pekárik 2016). It also appears that single individuals are more attentive toward opposite sex and spend more time looking at attractive alternatives than committed males (Maner et al. 2008).

It is assumed that some bodily cues, particularly WHR, are cues of pregnancy to males (Furnham et al. 2001; Singh 1993), but no study explicitly investigated effects of female's pregnancy on perceived physical attractiveness to males. We hypothesized that young females showing salient cues of pregnancy are considered less physically attractive to males than females lacking cues of pregnancy (Hypothesis 1). If mate preferences are passed onto the next generation (Fisher

1915), the offspring is likely to possess mating preferences desired on mating markets and successfully reproduce. Male with preferences for females with high residual reproductive value can produce offspring with high-quality partner(s). Consequently, his genes are transferred to the offspring who will have high chances of effective mating and will spread the genes further.

Attractiveness of females showing cues of pregnancy is expected to be lower particularly for short-term, compared with long-term relationship (Hypothesis 2), because males possess different costs and benefits involved in pursuing a long-term or a short-term relationship (Buss and Schmitt 1993). For instance, males can benefit more from attempting to attract multiple mates because it could enhance their reproductive success (short-term mating strategy). Under certain circumstances, for example when a male has low mate value, it is beneficial to engage in monogamous, long-term mating strategy (Schmitt 2008). Gravid females are infertile (Bovet 2018) and the female body is a signal of immediate sexual receptivity (Confer et al. 2010; Currie and Little 2009). Thus, gravid females are expected to be less attractive for short-term relationships than for long-term relationships. The residual reproductive value of gravid females differs from zero, suggesting that such females could be more attractive for a long-term rather than for a short-term relationship. Furthermore, we suggest that older and single males perceive pregnant females as more attractive than younger and committed males (Hypothesis 3 and 4).

Method

Participants

A total of 105 undergraduate male students participated in the research, but 5 bisexuals and 1 homosexual were removed. The age of the participants ranged between 18 and 49 yrs. (M = 26 yrs., SD = 7.4, N = 99). About half of the males (46/99) reported being involved in a romantic relationship, with the mean length of the relationship being 56 months (N = 46, SD = 75).

Manipulation of Pregnancy

Pregnancy in this study was manipulated exclusively by enlarging female's abdomen with a silicone belly (see details below). Other cues of pregnancy such as enlarged WHR, free body fat or hormonal changes, remained unmanipulated. We individually interviewed an additional sample of university student males (N = 17) with comparable age (M = 26 yrs., SD = 1.8, range = 24–29) to examine whether raters considered presented images with bellies as putatively pregnant women or obese (closed question). Pictures with putatively gravid females were presented on monitor (22″) and the order of pictures was random. No time limit was given for evaluating the pictures. Each male was asked whether he considers the female on the picture gravid or obese and responses were recorded by the interviewer.

Visual Stimuli

We took digital photographs (using a Nikon D3200 camera, 4000 × 6016 pixels) of ten female stimuli donors (undergraduate students, age 20–24) under standard light conditions and against a white background. Females were wearing white t-shirt and were photographed from the left side to maximize the salient features of the enlarged abdomen. Each donor was photographed from a distance 3 m with and without wearing a silicone belly (two images of each participant; see Fig. 1 for an example set). The camera was located ∼ 120 cm from the ground, pointed straight towards the participant. Focal length was 60 mm, exposure setting was automatic, shutter speed 1/10–1/25 s, aperture was f3.2 - f3.5 and ISO speed was 400.

All t-shirts were of the same brand and their size matched the individual requirements of the donors. A silicone belly (2 kg weight) bought through AlliExpress, recommended for faking the third trimester of pregnancy was used for the experiment. Stimuli donors were instructed to adopt a neutral facial expression, with no make-up or other form of conspicuous beautification, with hair back and to look directly at the camera with their hands at their sides. The images have been edited in the Adobe Photoshop CS5 Version 12.0 software where we used the crop tool to adjust the width and length of the picture. We also used the build-in feature (content-aware fill) to replace unwanted background objects. This feature is based on the automated filling of the blank area where the new graphic is created by algorithm taken in consideration the neighbor pixels around the blank area. Exposure, brightness, hue, vibrance and the color saturation has been at the end adjusted in order to get the final result. Exposure, brightness, hue, vibrance and the color saturation are the most common settings to be edited in order to prepare an image for a further use as the output image gets more of the natural light, clearer lines and more vibrance color. All the mentioned adjustments have been applied to the targeted images in the batch by using "Action" feature. This enabled us to record all the desired changes while editing only one image and later on use it to adjust all the remaining images at once using "Batch" feature in the "Automate" module of the Photoshop Window Tab. The final resolution of the presented pictures is 1434 × 3648. Pictures has been edited in the software and delivered in the .png format to keep the image quality.

Donors were all of Caucasian origin and were paid for their participation (10 €).

Fig. 1 An example of a female photographed with (**a**) and without (**b**) the silicone belly. The face of the female target was intact in the experiment, but black bars covering the eyes is used here to protect privacy

Table 1 Results of CLMM on males' ratings of females

Fixed effect terms	Estimate	Lower CI	Upper CI	z value	odds ratio	p
Age	0.108	0.049	0.166	3.615	1.11	< .001
Relationship_Yes	−1.336	−2.211	−0.46	−2.991	0.26	.003
Treatment_Nongravid	1.179	1.004	1.354	13.221	3.25	< .001
Term_Shortterm	−0.502	−0.711	−0.294	−4.73	0.61	< .001
Relationship_Yes:Term_Shortterm	−0.269	−0.523	−0.014	−2.067	0.76	.039
Treatment_Nongravid:Term_Shortterm	0.33	0.08	0.58	2.584	1.39	.01
Random effect terms	Variance	SD				p*
ID_Respondent	4.471	2.114				< .001
ID_Photo	0.478	0.692				< .001

*Likelihood ratio tests of cumulative link models

Table 2 Descriptive statistics for males' ratings of females

Parameter		Mean	CI	n
Relationship	Yes	2.72	2.28–3.16	46
	No	2.94	2.55–3.34	53
Treatment	Nongravid	2.90	2.82–2.97	1980
	Gravid	2.22	2.15–2.28	1980
Term	Shortterm	2.47	2.40–2.54	1980
	Longterm	2.64	2.58–2.71	1980

Procedure

Ethical approval was received from the local Institutional Review Board. The participants were recruited for the study online via university website and the research was carried out online. Regarding the service used for data collection, we used free online survey available in Google Documents. Male participants were initially asked demographic questions (age, sexual orientation, relationship status and length) and then responded to the questions below the photographs. Participants were asked to rate each photograph (10 females without a silicone belly and the same 10 females with a silicone belly presented in random order) on a 7-point Likert scale according to perceived physical attractiveness of the body (Please rate the physical attractiveness of this person on 7-point scale, 1 = absolutely unattractive, 7 = extremely attractive) for *long-term* attractiveness by clicking on appropriate number (1–7). Duration of stimuli presentation was not
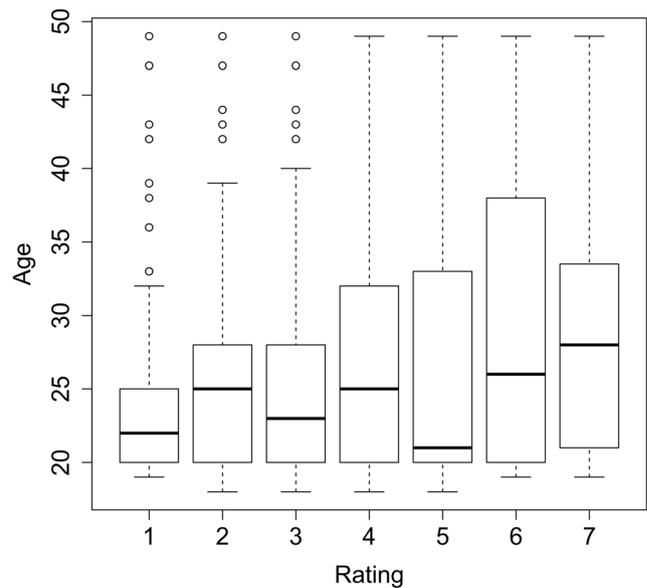

Fig. 3 Association between the rater's age and attractiveness ratings

time limited. Each stimulus has been presented while participant has been rating. All the stimuli were then presented again (in random order) and participants were asked to rate them on a 7-point Likert scale according to the perceived physical attractiveness of the body for *short-term* attractiveness. Definitions of the term were presented prior to rating following Little et al. (2008). The order of condition was randomized. The participants ratings of putatively gravid females for both long-term and short-term relationships (Cronbach α =
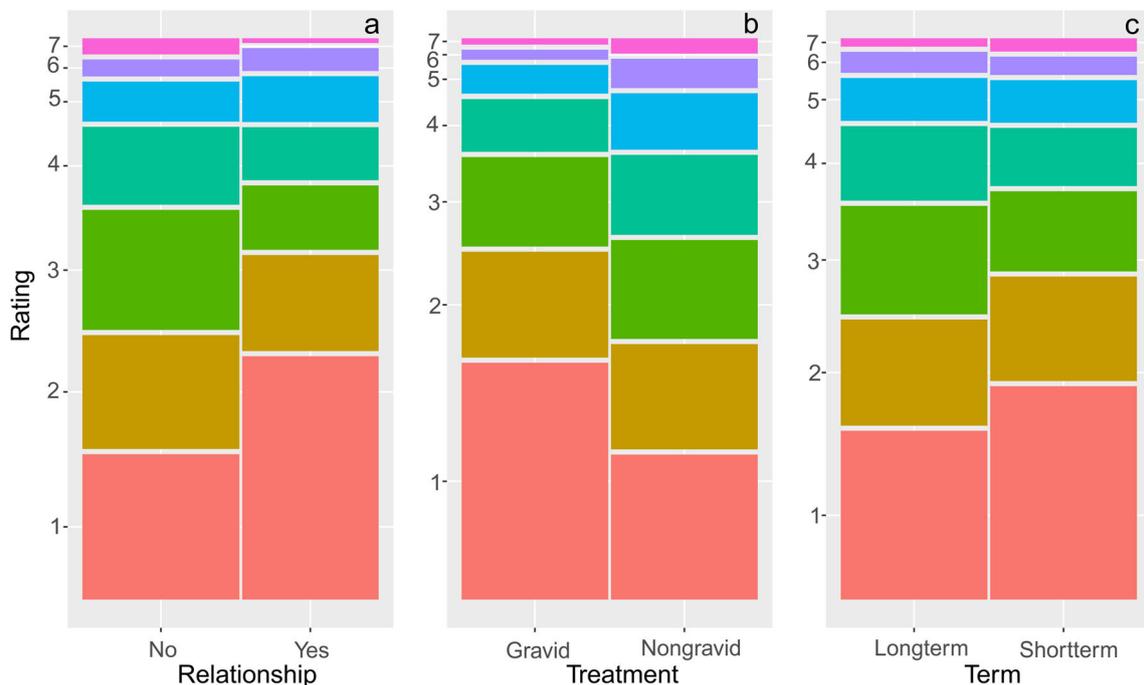

Fig. 2 Ratings of pictures with a) respect to participant's relationship status (involved in a romantic relationship or single), b) treatment (putatively gravid or non-gravid female) and c) type of rating (ratings for short-term or long-term relationship)
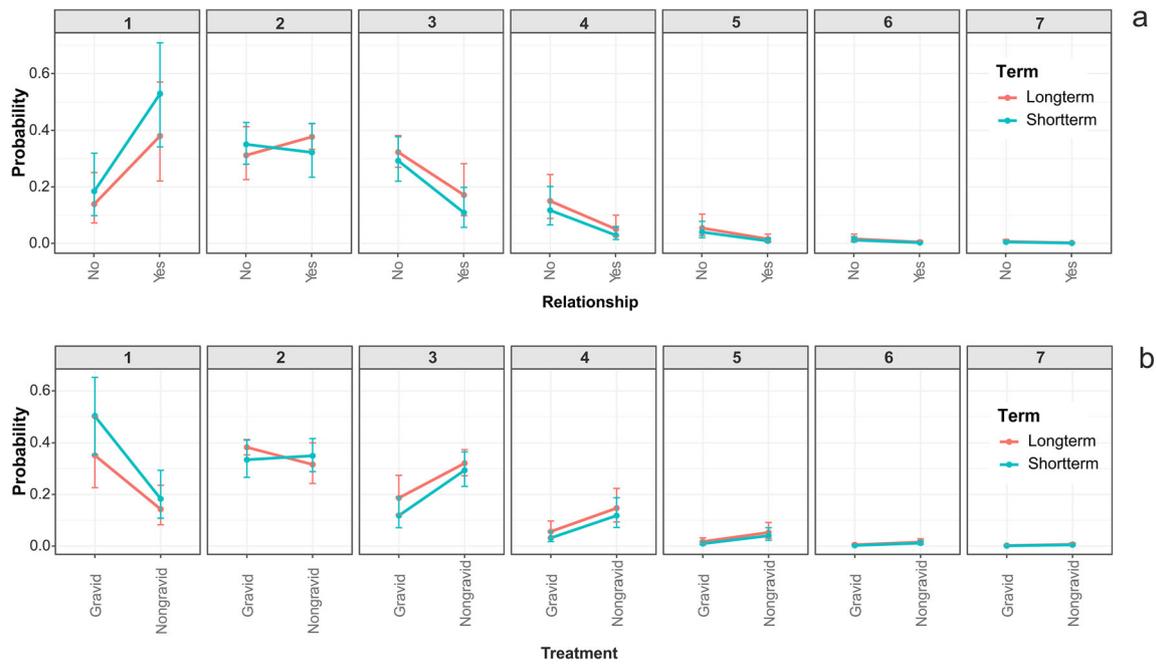
Fig. 4 Interaction effects of **a**) Relationship:Term, **b**) Treatment:Term. Error bars indicate 95% confidence interval; numbers 1–7 refer to rating scores

0.95 and 0.95, respectively) were highly consistent. Similarly, ratings of females without belly were highly consistent for both long-term and short-term relationships (Cronbach $\alpha =$ 0.94 and 0.93, respectively). Participation on rating pictures was unpaid and voluntary.

Statistical Analyses

The attractiveness rating was defined as a dependent variable in a Cumulative Link Mixed Model (CLMM) in R software 3.6.1 (R Development Core Team 2019) by applying the clmm function in *ordinal* package (Christensen 2019). Treatment (presence and absence of a silicone belly), the term (long-term and short-term condition) and involvement in a romantic relationship (yes or no) were categorical predictors

and the participant age was a continuous predictor (fixed effects). The identity of the participants and the identity of rated pictures were used as a grouping factors (random effects) to deal with correlation within the participant ratings. Syntax of final CLMM model is as follows: Rating ~ Age + Relationship + Treatment + Term + Relationship:Term + Treatment:Term + (1 | IDRespondent) + (1 | IDPhoto).

Results

100% of seventeen male raters considered presented images with bellies as putatively pregnant and none of them considered females on images as obese.
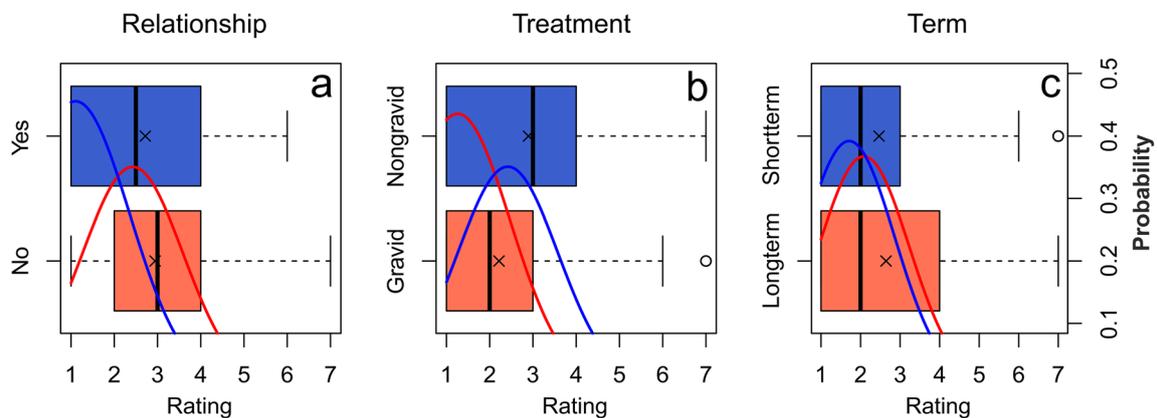

Fig. 5 Boxplots of ratings according to **a**) relationship, **b**) treatment, **c**) term; blue and red curves represent the distribution of rating probability from the model; x – mean value

The best CLMM model was chosen by Akaike information criterion (AIC) with four fixed effects and two interactions (relation:term; treatment:term) included (Log Likelihood-ratio = −5010.6, AIC = 10,049.2) (Table 1). Likelihood ratio test showed random effect to be significant in the CLMM model ($p < 0.001$). The marginal r-squared 0.151 considers only the variance of the fixed effects, while the conditional r-squared 0.661 takes both the fixed and random effects into account. Females with a silicone belly received significantly lower rating scores than those without a belly (Tables 1 and 2, Fig. 2). Mean scores were higher when the ratings dealt with a long-term compared to short-term relationship (Tables 1 and 2, Fig. 2). Single males rated females as more attractive than those who were involved in a romantic relationship (Tables 1 and 2, Fig. 2) and the age of a rater positively correlated with perceived female attractiveness (Table 1, Fig. 3). Interaction terms suggest that males who were involved in romantic relationships rated females for short-term relationships lower than single males (Fig. 4). Moreover, gravid females received lower scores for short-term compared to long-term relationships (Tables 1 and 2). Differences between short-term and long-term ratings were indeed greater for putatively gravid females compared with non-gravid females (Fig. 4). Additional data are shown in Fig. 5.

Discussion

This study demonstrated that simulated pregnancy has a negative impact of females' bodily attractiveness rated by the opposite sex. Moreover, attractiveness ratings were mediated by the age and relationship status of the male raters, as younger males and those who were in committed romantic relationships showed higher standards for a potential mate than older and single males.

The lower physical attractiveness of putatively pregnant females (Hypothesis 1) follows an adaptationist view, because males manifest low preferences for female cues associated with low residual reproductive value (e.g., Andrews et al. 2017; Butovskaya et al. 2017). Interestingly, attractiveness ratings varied with respect to the length of a relationship which provides support for Hypothesis 2. Human males invest the most of all primates in offspring (Geary 2000; Puts 2010) and this investment continues throughout offspring dependence until their second decade of life (Gray and Anderson 2010). High paternal investment could be an ultimate explanation as to why males are unwilling to invest in biologically unrelated children (Daly and Wilson 1988). In other words, gravid females are considered attractive for long-term relationship rather than for short-term relationship, because their fertility will be restored after their actual pregnancy will be terminated. With respect to overall lower physical attractiveness of putatively gravid females, abdominal obesity could be

associated with certain diseases (Son et al. 2016; Zhang et al. 2008), and, indeed, males rated females with high WHR as less healthy (Furnham et al. 2001). This latter explanation is less likely, however, because male raters considered images of females with enlarged belly pregnant, not obese. Their most frequent arguments were that females on images are too young to be overweight and that their body parts (except for enlarged belly) were slim.

Older and single males were expected to have lower standards for the attractiveness of a potential partner than younger and committed males (Hypothesis 3 and 4). In contrast to these hypotheses, we did not find a specific difference in ratings of putatively pregnant females, but generally higher attractiveness scores obtained from uncommitted and older males. Indeed, uncommitted males rated females with a verbally manipulated lower mating value as more attractive than committed males (Prokop and Pekárik 2016). The present research provides evidence that uncommitted males and older males show lower standards for manipulated female bodily cues than males with a higher mate value.

Mean attractiveness of rated females was generally low. Although it can be speculated that more attractive targets would yield in different results, we were focused on *relative differences* in perception of salient cues of gravidity between the same females. According to the random effects explaining the most of data variance, it seems that there are probably more hidden individual differences between participants which needs to be addressed in future research. Finally, an additional sample of $N = 17$ males was asked whether the females on photographs were gravid or obese using closed question. In theory, this approach might produce an experimenter effect. Fortunately, however, their arguments outlined above supported our intention to create visual stimuli of gravid females.

In conclusion, decreased attractiveness of females displaying salient cues of pregnancy could be ultimately advantageous, because males avoid mating with infertile females. Moreover, avoidance of pregnant females decreases the probability of male investment in biologically unrelated offspring in the future. Further research would benefit from investigation of perception of gravid females partnered males as well as cues which could increase female attractiveness to males (e.g., enlarged breasts) during pregnancy.

Compliance with Ethical Standards

Ethical Approval This research has been approved by the Institutional Review Board at Comenius University. All procedures performed in studies involving human participants were in accordance with the ethical

standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest Authors declare no conflict of interest.

Informed Consent Written stimuli donor's consent was received before the research was carried out. After the research was completed, the male raters were debriefed regarding the research goals.

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