Physiology & Behavior 294 (2025) 114884

Contents lists available at ScienceDirect

Physiology & Behavior

journal homepage: www.elsevier.com/locate/physbeh

Not so different anymore? Women's and men's disgust sensitivity becomes similar with increasing age

Anne Berthold [a,*], Angela Bearth [a], Jeanine Ammann [b], Michael Siegrist [a]

[a] Consumer Behavior, Institute for Environmental Decisions (IED), ETH Zurich, Switzerland
[b] Agroscope, Research Group Economic Modelling and Policy Analysis, Ettenhausen, Switzerland

ARTICLE INFO

Keywords:
Sex
Age
Disgust sensitivity
Neophobia
Contamination fear

ABSTRACT

Previous research provides ample evidence that women experience more disgust than men. The most prominent explanation for these effects is that women are more careful and sensitive about their health due to the possibility of harming potential offspring. Given that the probability for women to give birth is decreasing after a certain age (i.e., menopause), we assume that differences between men and women might be smaller or even faded away over time. To test this hypothesis, we revisited several data sets (in total N = 28′059) containing information about sex, age, and variables related to disgust. The predicted pattern was found for food disgust sensitivity, food neophobia, health-wise worries about food, and contamination fear. In all presented studies, the scores of younger women were higher compared to those of younger males, but after a certain age, sex differences were less pronounced or even non-existent. We discuss how considering the factor *age* together with individuals sex helps us to gain more insight in the dynamics of disgust and vulnerability.

1. Introduction

1.1. The protective function of disgust

Feelings of disgust primarily serve the function of protecting the organism against harmful substances by means of a disease-avoidance mechanism [1]. In fact, disgust typically leads to avoidance behavior, inhibiting individuals from getting in contact with or too close to sources of pathogens (e.g., spoiled food, feces, vomit) or toxins [2]. The emotion disgust and its antecedents have been studied for a long time [3] and in the meantime it became known as a universal phenomenon [2,4]. Moreover, several studies demonstrated that individuals experience different levels of disgust, and that these interindividual differences in disgust sensitivity were related to other personality variables for example sensation seeking and neuroticism (e.g., [5–7]).

Disgust sensitivity was often found to differ between women and men (e.g., [8]) and is also depending on the individual's age [1].

1.2. Disgust sensitivity of women and men

In the literature, there is ample evidence that women experience higher levels of disgust compared to men. This sex difference was shown across countries and with various disgust measures [5,6,8–15]. The elevated level of disgust for female participants was for example demonstrated using the FDS-short-scale [16,17], and was found in eight countries (Australia, England, France, Germany, Mexico, Spain, Sweden, and the USA). Moreover, food disgust sensitivity measured with the FDPS also confirmed this sex difference for China and Switzerland [18]. Tyber and colleagues [15] reported sex differences across different domains of disgust (i.e., sensitivity to pathogen, moral, sexual disgust).

There are several reasons, why women might be more disgust sensitive specifically towards potential harmful stimuli (e.g., pathogens). One prominent explanation is the evolutionary-based approach. The sex difference, or more specifically the increased sensitivity of women to disgust-inducing stimuli or risks, is linked to their important role in reproduction [14]. Disgust acts as a measure needed to protect the potential unborn child from for example food that might have detrimental effects on the offspring. Research of Fessler et al. [19] as well as Żelaźniewicz, and Pawłowski [20] provide evidence for this assumption in observing higher disgust levels during the first trimester of pregnancy, when maternal and fetal vulnerability are greatest. The authors explain this finding with the immunosuppressive effects of hormones related to

* Corresponding author at: Institute for Environmental Decisions (IED), Universitätstrasse 22, CH-8092 Zurich, Switzerland.
E-mail addresses: aberthold@ethz.ch (A. Berthold), abearth@ethz.ch (A. Bearth), jeanine.ammann@agroscope.admin.ch (J. Ammann), msiegrist@ethz.ch (M. Siegrist).

https://doi.org/10.1016/j.physbeh.2025.114884
Received 26 November 2024; Received in revised form 14 March 2025; Accepted 15 March 2025
Available online 17 March 2025

pregnancy, which are strongest during the first trimester, and they suggested that the elevated disgust sensitivity compensates for the reduced immune system. Similarly, in another recent study by Dlouhá and colleagues [21] the disgust levels of pregnant and non-pregnant women were compared revealing that pathogen-related disgust is elevated in the critical early period of the pregnancy. Kaňková et al. [22] investigated the associations between disgust sensitivity and maternal immune activity indices in the first trimester of pregnancy – based on their findings they also concluded that women's disgust sensitivity is increased to compensate for potential immune-related disorders in mother and child. Aside from the health of the mother, unborn children are of course profiting from a more careful mother as there is for example empirical evidence that various (foodborne) infections can lead to miscarriages and stillbirths [23].

Disgust sensitivity is not only increased for pregnant women. There is also evidence for the influence of female hormones (e.g., progesterone) and the disgust perception of non-pregnant (or not-yet-pregnant) women: Miłkowska and colleagues [24] reported that changes in disgust sensitivity were related to hormonal changes in the different stages of the menstrual cycle (for a review, see [25]). Similarly, Żelaźniewicz et al. [26] analyzed hormonal levels and white blood cell count across the menstrual cycle and concluded that women's sensitivity regarding disgust presumably is highest, when immunosuppression is at maximum due to the hormonal influence (and as an important precondition for achieving a successful pregnancy).

Altogether, it seems reasonable to assume that women are in general more disgust sensitive than men - at least, as long as their fertility is increased. In theory, it is likely that disgust sensitivity is less necessary and thus declining, the older women get (i.e., as their fertility is declining). However, with increasing age other reasons come into play that encourage people to be more cautious independently from their sex.

1.3. Disgust sensitivity across the adult ages

People of older age are known to be more vulnerable to infectious diseases ([27]; for a review, see [28]) and they themselves are aware of their higher physiological vulnerability [29]. It is probable that they compensate for that with an increased level of disgust [1]. Further evidence for the reluctance of older people towards potential harmful stimuli can be found in research reporting that higher age was going along with increased food neophobia [30]. It is likely that the effect of age on disgust perception is domain specific: that is, a person's age might be a relevant factor in certain areas of disgust while being irrelevant for other disgust facets. Evidence for this assumption can be found in recent research of Schwambergová and colleagues [31], who reported positive correlations for example regarding age and pathogen or moral disgust but not regarding age and sexual disgust.

There are also findings showing even a negative association between disgust and age [5,32]. It is discussed that the decrease in disgust towards certain stimuli across the lifespan might be the result of habituation processes [1,33]. The repeated exposure to disgust stimuli is assumed to lead to decreased disgust responses towards those elicitors. There is evidence for this reasoning in the literature: For example, research with medical students showed that the continued exposure to dead bodies was associated with reduced disgust towards disgust elicitors related to death, and overall domain-specific death disgust sensitivity [34] while no reductions were found regarding other disgust domains (e.g., interpersonal disgust elicitors).

Summing up, the findings and proposed relationships regarding age and disgust are mixed. Given the higher vulnerability associated with age, a positive relation between age and disgust is likely (as a consequence of compensating for the vulnerability). However, the expectation of less disgust sensitivity with age also appears plausible because of habituation processes and mere exposure. Both explanations seem reasonable and thus, these effects could exist simultaneously but mask each other. The findings of Ammann et al. [10] can be interpreted in that way. The authors found that older people indicated only slightly more food disgust sensitivity when judging pictures displaying potentially disgusting food stimuli than the younger participants. The repeated exposure to food products and, specifically, to food-related disgust elicitors could have reduced an otherwise increased disgust sensitivity associated with aging to only a weak increase.

Independently from the counteractive forces determining the relation between age and disgust, we propose that individuals' sex together with their age most likely plays an important role in shaping the disgust responses in those areas of disgust involving pathogens or any other potential health impairment. While initially, women of younger age are expected to experience higher levels of disgust than males of an equal age (due to a potential pregnancy), this sex difference is supposed to decline over time. One might even expect that women will be less disgust sensitive as soon as their fertility is reduced – however and parallel to the decreasing fertility, the female body becomes more vulnerable over time as a consequence of aging (as is the case for men). Because of these two opposing processes (i.e., fertility reduction and aging), the sensitivity of women might not change notably across the lifespan, while the level of disgust sensitivity for men is most likely increasing with age (due to the increased vulnerability associated with aging). Finally, the disgust sensitivity of older men and women will then most likely be on a similar level.

1.4. Disgust sensitivity, food neophobia & the fear of becoming contaminated

Unsurprisingly, disgust sensitivity is closely related to other variables, such as food neophobia [35] or the fear of becoming contaminated as demonstrated in previous research [36,37]. Especially for vulnerable individuals (like older adults or pregnant women), it seems a good strategy to be more sensitive about unfamiliar food products and regarding their feelings of disgust in order to avoid a potential contamination with harmful substances. Research of Olatunji and colleagues [36] provide evidence that individuals with more fear of becoming contaminated indicate more disgust towards a variety of stimuli, especially in the hygiene domain. Based on the intertwinement of disgust sensitivity, food neophobia, and contamination fear, we hypothesized the following: women report higher levels of disgust, neophobia, and contamination fear than men – however, as they age through the course of life, women and men will become more similar.

2. Overview of the present research

The present research is addressing the simultaneous influence of the demographic variables age and sex on disgust perception. We hypothesized and tested if the differences between women and men regarding disgust sensitivity, food neophobia and the fear of contamination are depending on the participants' age. Since women's high disgust sensitivity is explained by their role in reproduction (i.e., bearing children), we expected that differences between men and women would be found for younger individuals and decline across age (due to the declining probability of a pregnancy). To test this assumption, we reanalyzed available data sets featuring the variables of interest: age, sex, and measures of disgust that are related to perceived vulnerability (i.e., food disgust sensitivity, food neophobia, food worries regarding health, fear of becoming contaminated). We selected data sets with large samples and a broad age range to test our hypothesis.

In the following, we present our analyses based on a data set from the Food-panel 2.0, on data from the Eurobarometer (from the year 2005), and from two additional studies that have already been published. Overall, the data supports our assumption that there is an interaction of individuals' sex and age. All data sets are available on request via mail or/and online (e.g., Eurobarometer data 64.1: https://data.europa.eu/data/datasets or https://search.gesis.org/research_data/ZA4413)

2.1. Study 1: FOOD-panel 2.0 – food disgust sensitivity

The Food Panel Switzerland 2.0 (wave 2, 2018) served as data set for the first test of our assumptions – a longitudinal study about the dietary behavior of the Swiss population [38]. To test the hypothesis, we analyzed the influence of age and sex on food disgust sensitivity measured with the FDS-short, which had received good/high reliability scores (i.e., Cronbach's α's) in various studies [16,17,39,40]. We expected that the averaged FDS scores would vary as a function of sex and age.

2.1.1. Materials and methods

We reanalyzed data from the Food Panel Switzerland survey wave 2[1] (2018, $n = 2287$), in which the Food Disgust Scale (FDS) was included. The mean age of the wave 2 sample was 58.9 ($SD = 15.2$, Range = 21–94) and consisted of 1229 women with a mean age of 56 years ($SD = 15$) and 1058 men with an average age of 62 years[2] ($SD = 15$).

The **FDS-short** [40] measures disgust sensitivity in the food domain. The short version of this scale is composed of eight food-related items describing more or less disgusting situations or products related to food (e.g., animal flesh, poor hygiene; item example: *"To put animal cartilage into my mouth."*). The items are rated on a 6-point scale from 1 (=*not disgusting at all*) to 6 (=*extremely disgusting*). The items were averaged (Cronbach's α = .78) and the sample had a mean score of 3.5 ($SD = .98$, Range = 1–6). Higher scores represent more disgust sensitivity.

2.1.2. Results and discussion

The data was analyzed using SPSS (version 28), Hayes' (2017) PROCESS Macro (v3.5) and JASP (version 0.14.1). To consider the potential moderating role of age in combination with the participants' sex, we conducted regression analyses including the interaction term age x sex on the dependent variable disgust sensitivity (FDS). The analysis revealed significant main effects of sex and age, as well as a significant interaction of both (see Table 1). According to the results, women (vs. men), as well as older (vs. younger) participants indicated a higher disgust sensitivity.

The nature of the interaction was analyzed in more detail with an additional bootstrap-analysis using Hayes' (2017) PROCESS macro for SPSS (Model 1). The analysis running with 5000 bootstrapped resamples provided us with the 95 % confidence intervals (CI). A CI not containing zero is indicative of a significant effect. We analyzed the conditional effects of the predictor sex at different values of the moderator age as is usually done for the simple slopes approach [41]. For the younger participants (one standard deviation below the mean ~ M-1SD = 43.7) and the middle-aged participants (M = 58.9), we found that women reported higher levels of disgust than men ($t_{young} = -4.74$, $t_{middle} = -4.24$, both $p < .001$) with the following bootstrap scores: $B_{young} = -.28$, SE(B) = .06; 95 % bias-corrected CI = [−.40, −.16] & $B_{middle} = -.17$, SE(B) = 0.04; 95 % bias-corrected CI = [−.25, −.09]. However, as can be seen in Fig. 1, no significant sex difference was present in case of the older participants (one standard deviation above the mean ~ M + 1SD = 74.1, $t_{old} = -1.18$, $p = .237$, $B_{old} = -.07$, SE(B) = .06, CI = [−.18, .04]).

A further bootstrap analysis based on sex as the moderator showed that the disgust sensitivity about food increased significantly with age in case of both men ($B_{men} = .017$, SE(B) = .00; $t_{men} = 8.29$, $p < .001$, CI = [.013, .021]) and women ($B_{women} = .010$, SE(B) = .00; $t_{women} = 5.48$, $p < .001$, CI = [.006, .013]). A closer inspection of Fig. 1 and the bootstrap data suggests, however, that the increase seems to be steeper for men.

Altogether, these findings provide evidence that participants age moderates the influence of the participants' sex on the disgust perception. In line with our hypothesis, the sex difference became smaller and diminished with older age. To bolster our findings in terms of replicability and validity, we tested our hypothesis on other data sets with different dependent variables.

Table 1
Multiple regression analysis on the participants' disgust sensitivity (FDSshort-score) with the predictors sex, age and sex x age interaction.

	B	SE	β	t	p	95 % CI	
Sex	−.587	.166	−.298	−3.53	<.001	−.913	−.261
Age	.010	.002	.152	5.47	<.001	.006	.013
Interaction: Sex x Age	.007	.003	.231	2.59	.010	.002	.012

Notes. N = 2287, adjusted $R^2 = 0.043$, sex coded as 0 = women, 1 = men,.

2.2. Study 2 – food disgust sensitivity and food neophobia

Study 2 was originally conducted to analyze the influence of packaging on food product perception [42]. Aside from the evaluation of the products, the online questionnaire included the variables food disgust sensitivity (i.e., FDS) and food neophobia as inter-individual difference variables. Both variables were recently found to be related to perceived vulnerability to diseases – the driving force of disgust and neophobia [35]. Since the wish to avoid vulnerability/infectability is most likely the crucial determinant for the increased sensitivity of women as compared to men, disgust sensitivity and food neophobia seem to be potential candidates to test our assumption that sex differences are depending on the age of the individuals. Accordingly, we tested for an interaction of age x sex on these two variables.

2.2.1. Materials and methods

The online study[3] was run in 2022, and 321 German speaking

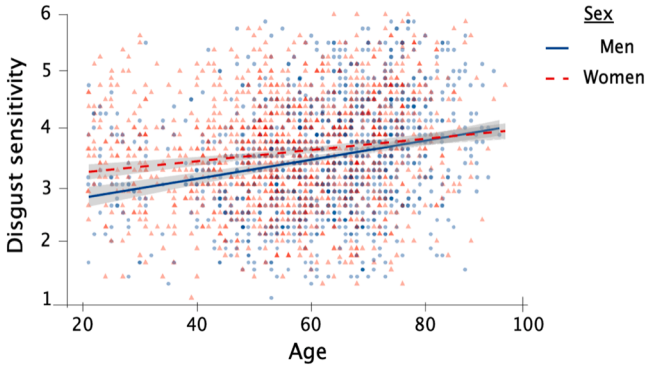

Fig. 1. displaying disgust sensitivity (i.e., FDSshort) as a function of sex and age.

[1] The *Swiss Food Panel 2.0* is a follow up longitudinal project of the first panel (2010-2014). To assess the data, paper pencil questionnaires on eating behavior with varying variables across the years where send out to randomly selected household addresses from the telephone book in the German-speaking and French-speaking parts of Switzerland via mail. For more information see here: https://cb.ethz.ch/research/projects/food-panel.html

[2] The age difference between women and men was significant ($t(2285) = -8.71$, $p < .001$)). Note that the factor age is part of the subsequent analyses as this is one of our main predictors of interest. The inclusion of the variable entails that it is automatically controlled for any age differences between the two sexes – the results would therefore be similar if both subgroups would be of equal age.

[3] In Study 2, a convenience sample of German speaking participants was recruited via a broad range of sources (e.g., mailing lists, social media).

participants took part in the study. Seven participants did choose other sex options than men, or women and two statistical outliers were omitted. Accordingly, our subsequent analyses based on a sample of 312 participants with a mean age of 48.0 years ($SD = 18.3$, range = 18–90): 208 women with a mean age of 42 years ($SD = 17$) and 104 men aged on average 59 years ($SD = 16$).[4]

The FDS was again assessed with eight items (alpha = .67). For the assessment of food neophobia, only half of the original neophobia scale (see for example [30]) was chosen due to space constraints. Thus, participants answered 5 items (e.g., *"I am afraid to eat food that I have never tried before."* alpha = .73) on a scale from 1 = totally disagree to 7 = totally agree. For each scale the respective items were averaged. Both scales, food neophobia and FDS correlated significantly ($r = 0.35$, $p < .001$). The mean scores of the sample were FDSmean = 3.5 ($SD = .84$, Range = 1–5.5) and food neophobia mean = 2.7 ($SD = 1.13$, Range = 1–6.6).

2.2.2. Results and discussion

Again, a regression analysis with the averaged FDS-scores revealed main effects of age and sex, and a significant interaction of both (see Table 2). As in Study 1, disgust scores increased with age and were higher for women vs. men. The pattern of the interaction resembled those of Study 1: for the younger participants (M-1SD = 29.7) we found the usual effect that women indicate more disgust sensitivity than men ($t_{young} = -3.50$, $p < .001$) with the following bootstrap scores: $B_{young} = -.66$, SE(B) = .19; 95 % bias-corrected CI = [−1.03, −.29]. For the middle-aged participants (M = 48.0) and for the subsample with the oldest age (M + 1SD = 66.4) no significant sex difference was present: $t_{middle} = -1.76$, $p = .079$, $B_{middle} = -.21$, SE(B) = .12; CI = [−.44, .02] and $t_{old} = 1.81$, $p = .071$, $B_{old} = .24$, SE(B) = .13, CI = [−.02, .51].

Additionally, we tested if the pattern of results would be similar for the neophobia scores. The analyses showed that women indicated more neophobia than men and that age had no direct significant influence but was again moderating the effect of age (see Table 3). Similar to the pattern for the FDS scores, a sex difference was present for the younger subsample ($t_{young} = -2.28$, $p = .023$, $B_{young} = -.57$, SE(B) = .25; CI = [−1.07, −.08]), but not for the middle aged and older participants ($t_{middle} = -1.56$, $p = .119$, $B_{middle} = -.25$, SE(B) = .16; CI = [−.55, .06] and $t_{old} = 0.46$, $p = .645$, $B_{old} = .08$, SE(B) = .180, CI = [−.27, .44].

Further bootstrap analyses revealed that in case of men disgust sensitivity and neophobia increased significantly with age ($B_{menDISGUST} = .017$, SE(B) = .005; $t_{men} = 3.26$, $p = .001$, CI = [.007, .027], $B_{menNEO} = .025$, SE(B) = .007; $t_{men} = 3.69$, $p < .001$, CI = [.012, .039]). For women, however, neophobia remained at a similar level across age; while disgust sensitivity even decreased ($B_{womenDISGUST} = -.008$, SE(B) = .003; $t_{women} = -2.26$, $p = .024$, CI = [−.015, −.001], $B_{womenNEO} = .008$, SE(B) = .005; $t_{women} = 1.63$, $p = .104$, CI = [−.002, .017]).

The findings of this study are similar to those of Study 1, both providing evidence for our assumption that individuals' perception of food – specifically regarding food disgust and neophobia - is shaped by an interaction of their sex and age. Having found that the differences between women and men decrease with age – we decided to expand our research focus examining if the interaction of age and sex can also be found in an open access data set containing variables related to disgust and food healthiness concerns.

Table 2
Multiple regression analysis on the participants' food disgust sensitivity with the predictors sex, age and sex x age interaction.

	B	SE	β	t	p	95 % CI	
Sex	−1.384	.353	−.773	−3.92	<.001	−2.08	−.69
Age	−.008	.003	−.169	−2.26	<.001	−.02	−.01
Interaction Sex x Age	.024	.006	.856	3.97	<.001	.01	.04

Notes. N = 312, adjusted $R^2 = 0.040$, sex coded as 0 = women, 1 = men.

Table 3
Multiple regression analysis on the participants' food neophobia with the predictors sex, age and sex x age interaction.

	B	SE	β	t	p	95 % CI	
Sex	−1.106	.473	−.460	−2.34	.020	−2.04	−.18
Age	.008	.005	.121	1.63	.104	−.002	.017
Interaction: Sex x Age	.018	.008	.466	2.16	.031	.002	.034

Notes. N = 312, adjusted $R^2 = 0.042$, sex coded as 0 = women, 1 = men.

2.3. Study 3: Eurobarometer-data (2005) – health-wise worries about food

To test our assumption that individuals' sex and age would also have a joint influence on people's evaluation of food attributes that could potentially impair one's health. We selected an open access data set of the Eurobarometer-assessment from the year 2005 (Sep-Oct; 64.1; see also Europäische Kommission [43]) containing several items related to worries about the health-wise harmful influences of food.

2.3.1. Materials and methods

There are N = 24′567 participants with complete data regarding the food worries assessment in the data set.[5] This sample had a mean age of 47.6 years ($SD = 18.5$, Range 15–98) consisting of 14′155 women (with an average age of 47 years, $SD = 18$) and 10′412 men (mean age of 48years, $SD = 18$) .[6] Altogether 10 items were recoded and averaged to compute the food worries scale with higher scores representing a higher level of worry about food. The worries about the following topics related to food were rated on a 4-pt scale*: mad cow disease, genetically modified products, contamination with bacteria* (e.g. *salmonella in eggs), chemical substances while cooking, pollutants such as mercury or dioxins, residues in the meat like* e.g. *antibiotics or hormones, pesticide residues* (e.g., *in fruit), new viruses* (e.g., *avian flu), unhygienic conditions in dealing with food outside the home* (e.g., *in shops)*. The fifth answer option (= 'don't know/ no response') was not included in the averaged food worries-scale (alpha .92). The mean score of the sample was 2.8 ($SD = .70$, Range = 1–4).

2.3.2. Results and discussion

The multiple regression analysis with the dependent variable food worries revealed the expected effect of participants' sex indicating that women reported higher levels than men (see Table 4). There was no clear effect of age, but as in Study 1 and 2 the interaction of age x sex was significant. The bootstrap analysis showed significant sex differences across all three age groups (M-1SD=29.07, M = 47.5, M+SD = 66.03) ($t_{young} = -19.02$, $t_{middle} = -22.31$, $t_{old} = -12.56$, all ps < .001) with the following bootstrap scores: $B_{young} = -.24$, SE(B) = .01; 95 % bias-corrected CI = [−.26, −.21]/ $B_{middle} = -.20$, SE(B) = .01; CI = [−.22, −.18] and for the oldest subsample $B_{old} = -.16$, SE(B) = .01, CI = [−.18, −.13].

[4] As in Study 1 the male subsample was significantly older than the female subsample ($t(310) = -8.68$, $p < .001$).

[5] The *Eurobarometer* was developed to study the opinions of European citizens since 1974. Interviews including standard questions and specific questions are conducted face-to-face twice a year. For more information see here: https://www.gesis.org/en/eurobarometer-data-service/overview

[6] Although there was only of an age difference of <2 years, this difference turned out to be significant ($t(24565) = -5.37$, $p < .001$)) due to the big subsamples.

Table 4
Multiple regression analysis on the participants' food worry scores with the predictors sex, age and sex x age interaction.

	B	SE	*β*	*t*	*p*	95 % CI	
Sex	−.301	.025	−.213	−12.27	<.001	−.349	−.253
Age	.001	.000	.016	1.92	.054	.000	.001
Interaction: Sex x Age	.002	.000	.080	4.45	.002	.001	.003

Notes. N = 24′567, adjusted R^2 = 0.023, sex coded as 0 = women, 1 = men,.

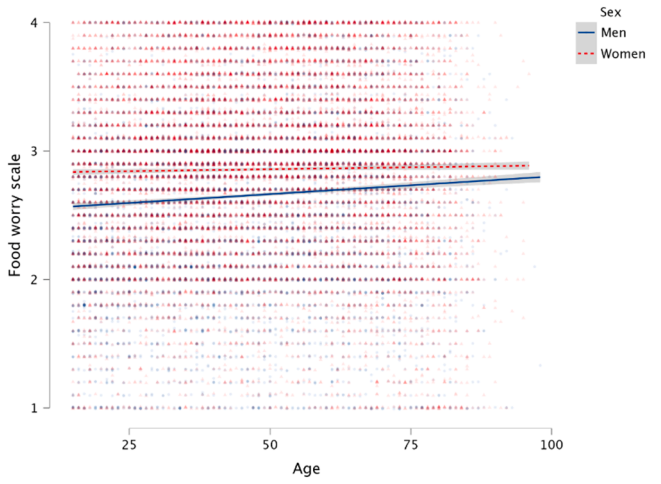

Fig. 2. Displaying health-wise food worries (Food worry scale) as a function of sex and age.

As can be seen in Fig. 2, the difference between women and men is getting smaller with age. Note, that even though the difference is decreased, women and men within the oldest subsample still differed significantly regarding their worries about food due to the huge sample size of the Eurobarometer data.

Additional analyses revealed that the worries about food increased significantly with age in case of men (B_{men} = .003, SE(B) = .00; t_{men} = 7.50, p < .001, CI = [.002, .003]), but not regarding women (B_{women} = .001, SE(B) = .00; t_{women} = 1.92, p = .054, CI = [.000, .001]).

Although, the present Study together with Study 1 and 2 already provide evidence for our assumptions, we decided to consult another data set to investigate, if the individuals fear to become contaminated is also influenced by the interaction of age and sex. Finding evidence on a variable like contamination fear would be even more convincing for our hypothesis that the underlying processes are related to individuals perceived vulnerability. Accordingly, we considered a data set containing a measure of contamination fear to clarify if differences between women and men diminish over time.

2.4. Study 4 – fear of becoming contaminated

Study 4 was originally conducted and published by Egolf et al. [39]. This research was based on a large paper and pencil questionnaire that included many variables on eating behavior and food disgust. The variable of interest for us was the contamination fear subscale of the Padua Inventory (COWC PI, [44,45]). Accordingly, we tested for an interaction of age and sex on this scale.

2.4.1. Materials and methods

The study was run in 2017 in Switzerland. Altogether 1181 participants took part in the original study.[7] Participants with missing values or chronical diseases were omitted. Accordingly, our analyses based on a sample of 893 participants with a mean age of 53.9 years (*SD* = 17.6, range = 20–96): 517 were women (with a mean age of 52 years, *SD* = 17) and 388 men (on averaged aged 56 years, *SD* = 17) .[8] The fear of becoming contaminated (Contamination obsessions and washing compulsions subscale COWC) was assessed with 10 items (e.g., *"I avoid using public telephones because I am afraid of contagion or disease."* α = .83) that were answered on a 5-point Likert-type scale ranging from 0 = not at all to 4 = very much. The mean score of the sample was 0.9 (*SD* = .70, Range = 0–3.6).

2.4.2. Results and discussion

A regression analysis with the averaged COWC-scores revealed main effects of age and sex, and as predicted a significant interaction of both (see Table 5). COWC scores increased with age and were higher for women than men. The pattern of the interaction resembled those of the other studies: in case of the younger participants (M-1SD = 36.4) we found that women indicate more fear of becoming contaminated than men (t_{young} = −2.31, p < .021) with the following bootstrap scores: B_{young} = −.155, SE(B) = .067; 95 % bias-corrected CI = [−.29, −.02]. For the middle-aged participants (M = 54.0) and for the subsample with the oldest age (M + 1SD = 71.53) no significant sex difference was present: t_{middle} = −1.16, p = .248, B_{middle} = −.054, SE(B) = .047; CI = [−.15, .04] and t_{old} = 0.72, p = .472, B_{old} = .047, SE(B) = .065, CI = [−.08, .18].

We additionally analyzed if the fear of becoming contaminated is changing across the age for women and men. The analyses revealed a similar pattern as in the other studies: for men the scores increased significantly with age (B_{men} = .005, SE(B) = .002; t_{men} = 2.29, p = .022, CI = [.001, .009]), but not for women (B_{women} = −.001, SE(B) = .002; t_{women} = −0.65, p = .514, CI = [−.001, .002]).

Table 5
Multiple regression analysis on the participants' contamination fear with the predictors sex, age and sex x age interaction.

	B	SE	*β*	*t*	*p*	95 % CI	
Sex	−.365	.153	−.262	−2.39	.017	−.665	−.065
Age	−.001	.002	−.029	−.65	.514	−.005	.002
Interaction Sex x Age	.006	.003	.251	2.16	.031	.001	.011

Notes. N = 893, adjusted R^2 = 0.004, sex coded as 0 = women, 1 = men.

[7] The sample of Study 4 was recruited by sending out paper pencil questionnaires to randomly selected addresses from the telephone book of the German-speaking part of Switzerland. Additional addresses were gathered from the commercial provider (Schober Group Switzerland) because of the underrepresentation of younger people listed in the telephone book.

[8] As in the other studies there was an age difference between women and men (t(891) =−3.45, p<.001).

2.5. Effect size analyses

For the present research, we used already pre-existing datasets focusing on different dependent variables. It is therefore difficult to determine and compare the effect sizes across the studies. A calculation of the effect size Cohens d for the interaction effects of the four studies, revealed the following effect sizes ranging from lowest to highest $d_{Study3Foodworry} = 0.06$, $d_{Study1FDS} = 0.11$, $d_{Study4contaminfear} = 0.13$, $d_{Study2-Neophobia} = 0.25$, $d_{Study2FDS} = 0.46$. Accordingly, the interaction effect seems to vary depending on the dependent variable and also most likely as a consequence of the different sample sizes. Nevertheless, since most of the effect sizes are below Cohens d of 0.40, we conclude that the effect appears to be only of small magnitude.

3. General discussion

Across the data of four studies, we found consistent empirical evidence that sex differences regarding disgust perception and related variables are depending on the age of the individuals. Consistent with the findings of previous studies, the analyzed data showed an increased disgust sensitivity, food neophobia, health-wise worries about food and a higher fear of becoming contaminated for women compared to men for the younger and middle-aged participants. These sex differences, however, were found to diminish with increasing age.

The explanation for this pattern of results is related to the women's evolutionary-determined role in reproduction [2,12,14,15,19] and also to the vulnerability perception that is associated with aging for both sexes. For women, it is of particular importance to reduce their risk of infections and to avoid risks during their reproductive years, which might lead to a higher level of sensitivity and more contamination fear compared to men [6,12,15,19]. However, at later stages in life the necessity to be cautious because of a potential pregnancy is reduced and consequently, the reason for the differences between women and men fades away. It is important to add, however, that the sensitivity of women might remain on the same level, because with increased age other factors come into play that influence the individual's vulnerability. These factors associated with aging and vulnerability are of course also relevant for men – therefore, their sensitivity (starting from a lower level as women) is supposed to increase as they get older, which was indeed found across all four studies.

The present research is based on different data sets, which featured similar, yet different measures and which were designed by different researchers with different research goals in mind and in different years. Despite these variations, we constantly found evidence for the hypothesized increasing similarity between women and men across the age span. The investigation of data from different years, ranging from 2005 to 2022, enabled us to check if the effects were caused by or limited to certain cohorts: in the Eurobarometer data of 2005 the older subsample are people from the 68er Generation, whilst in the data collected later the old(er) subsample is consisting of people from the Baby Boomer cohort and Generation X. Since the interaction of age and sex was found in all of these studies, we conclude that the effect is most likely not limited to any specific cohort.

Interaction effects of age and sex were found for the variables disgust sensitivity, food neophobia, health-wise worries about food and contamination fear. All these variables have in common that the underlying motive is the prevention of harm in a potential vulnerable situation. This is in line with the notion of previous research pointing out that vulnerability is the connecting element underlying neophobia and disgust perception [35] and is obviously also relevant regarding the fear of becoming contaminated. It could be promising, to test in future studies if the interaction of sex and age can also be found for other variables that are related to vulnerability perception (e.g., risk perception, risk aversion).

3.1. Disgust sensitivity after the menopause

According to the evolutionary explanation [14] for the increased sensitivity of females, women's levels of disgust should drop down after the menopause. The underlying biological explanation is that the sensitivity of women is linked to their fertility, procreation and protection of the unborn child and is therefore no longer required in case of older women. A woman's disgust perception might therefore decrease over time, while –according to the fertility approach – men basically are expected to stay at the same level over their course of life because they are fertile until old age. However, there are two reasons, why this reasoning is too short-sighted. First, recent research has shown that grandmothers are helpful for the survival of grandchildren [46,47]. The presence of grandmothers even shortened the time between the births of their grandchildren; most likely because grandmothers were helpful in raising the newborns. Thus, it seems even more important that older women stay healthy and pay attention to potentially harmful stimuli or situations, which can sometimes be more difficult due to the age-related increased likelihood for infectious diseases [27]. Since people become more vulnerable with increasing age, they should be more cautious – regardless of their gender. This reasoning is reflected in our findings showing that in case of men a higher age is associated with higher disgust sensitivity. In most studies no relationship between age and sensitivity was found for women – most likely because the *decreased* vulnerability due to the declining likelihood of pregnancy and the *increased* vulnerability due to aging balance each other out. Eventually, men and women will reach similar levels of disgust when they get older.

In a nutshell, both older men and women play vital roles in society and do (from an evolutionary point of view) contribute a lot for example, by raising grandchildren. Given their importance, it is plausible that their disgust sensitivity is increased to avoid infections that might be more likely due to their older age. Future studies are warranted to disentangle these processes more thoroughly – especially since the roles of men and women have evolved throughout the last century going along with an increased parental investment of fathers in Western Societies [48].

3.2. Limitations and future studies

The present results are based on re-analyses of already preexisting data sets. Accordingly, none of these studies was specifically designed to probe the hypothesized interaction of age and sex. This, however, could also be considered as an advantage of our research given that the potential influence of demand effects can be excluded. For the future, we, however, recommend studying the interaction of age and sex in more detail. To shed more light on the phenomenon, an examination of other factors like the number of pregnancies/ children across the life span or a longitudinal assessment of disgust sensitivity across a larger time frame could be helpful.

In the present research, the male subsamples were on average slightly older than our female subsamples. We are not sure why that is, however, since we control for age (within the regression analyses) the findings would most likely be similar if the average age of both subsamples would be exactly the same.

Furthermore, though we already used the Eurobarometer-database, more studies with even more internationally diverse samples are needed to test if the effects are stable across cultures. Also, since we did only check for disgust sensitivity towards potential harmful stimuli (e.g., rotten food, pathogens), a more differentiated investigation with the various domains of disgust (e.g., moral or sexual disgust) would be helpful to shed more light on the phenomenon. Finally, since our dependent variables were self-report measures, it would be interesting to study if sex differences can be observed in the behavior of younger but not older individuals (e.g., regarding disgust maybe with measuring peoples' chosen distance from specific stimuli).

3.3. Conclusion

The present research provides evidence that women of childbearing age experience higher levels of disgust sensitivity and of other related variables than men. Moreover, the data shows that the differences between men and women diminish or even vanish in older age groups. In previous research, the increased female sensitivity was often explained by pointing to the likelihood of a potential pregnancy [14]. Our research contributes new indirect support for this reasoning by providing evidence that sex differences fade away with age (as the likelihood of pregnancy declines).

CRediT authorship contribution statement

Anne Berthold: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Conceptualization. **Angela Bearth:** Writing – review & editing, Conceptualization. **Jeanine Ammann:** Writing – review & editing, Conceptualization. **Michael Siegrist:** Writing – review & editing.

Declaration of competing interest

The authors declare that they had no conflict of interest with respect to their authorship or the publication of the article.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

The completion of this research would not have been possible without the possibility to gain access to the different data sets – thus, we are grateful to Dr. Christina Hartmann, Dr. Aisha Egolf, and Seraina Guion for sharing their data. We also would like to thank the EU institutions responsible for the Eurobarometer for allowing to work with their data sets.

Data availability

The data associated with this research are available upon request via mail and/or at [link: https://data.europa.eu/data/datasets or https://search.gesis.org/research_data/ZA4413].

References

[1] M. Oaten, R.J. Stevenson, T.I. Case, Disgust as a disease-avoidance mechanism, Psychol. Bull. 135 (2009) 303–321, https://doi.org/10.1037/a0014823.
[2] V. Curtis, M. de Barra, R. Aunger, Disgust as an adaptive system for disease avoidance behaviour, Philosophical *Transactions of the Royal Society B: Biological Sciences* 366 (1563) (2011) 389–401, https://doi.org/10.1098/rstb.2010.0117.
[3] P. Rozin, A.E. Fallon, A perspective on disgust, Psychol. Rev. 94 (1) (1987) 23–41, https://doi.org/10.1037//0033-295x.94.1.23.
[4] V. Curtis, A. Biran, Dirt, disgust, and disease - is hygiene in our genes? Perspect. Biol. Med. 44 (1) (2001) 17–31, https://doi.org/10.1353/pbm.2001.0001.
[5] B.A. Druschel, M.F. Sherman, Disgust sensitivity as a function of the Big Five and gender, Pers. Individ. Dif. 26 (4) (1999) 739–748, https://doi.org/10.1016/S0191-8869(98)00196-2.
[6] J. Haidt, C. McCauley, P. Rozin, Individual-differences in sensitivity to disgust – a scale sampling 7 domains of disgust elicitors, Pers Individ Dif 16 (5) (1994) 701–713, https://doi.org/10.1016/0191-8869(94)90212-7.
[7] J.M. Tybur, R.E. de Vries, Disgust sensitivity and the HEXACO model of personality, Pers. Individ. Dif. 55 (6) (2013) 660–665, https://doi.org/10.1016/j.paid.2013.05.008.
[8] L. Al-Shawaf, D.M.G. Lewis, Exposed intestines and contaminated cooks: sex, stress, & satiation predict disgust sensitivity, Pers. Individ. Dif. 54 (6) (2013) 698–702, https://doi.org/10.1016/j.paid.2012.11.016.
[9] L. Al-Shawaf, D.M.G. Lewis, D.M. Buss, Sex differences in disgust: why are women more easily disgusted than men? Emotion Rev. 10 (2) (2018) 149–160, https://doi.org/10.1177/1754073917709940.
[10] J. Ammann, C. Hartmann, M. Siegrist, Development and validation of the food disgust picture scale, Appetite 125 (2018) 367–379, https://doi.org/10.1016/j.appet.2018.02.020.
[11] S. Clifford, C. Erisen, D. Wendell, F. Cantú, Disgust sensitivity and support for immigration across five nations, Politics Life Sciences 42 (1) (2023) 65–80, https://doi.org/10.1017/pls.2022.6.
[12] V. Curtis, R. Aunger, T. Rabie, Evidence that disgust evolved to protect from risk of disease, Proc. R. Soc. Lond. B Biol. Sci. 271 (Suppl 4) (2004), https://doi.org/10.1098/rsbl.2003.0144. S131-133.
[13] B.O. Olatunji, N.L. Williams, D.F. Tolin, J.S. Abramowitz, C.N. Sawchuk, J.M. Lohr, L.S. Elwood, The Disgust Scale: item analysis, factor structure, and suggestions for refinement, Psychol. Assess. 19 (3) (2007) 281–297, https://doi.org/10.1037/1040-3590.19.3.281.
[14] P. Prokop, M. Jančovičová, Disgust sensitivity and gender differences: an initial test of the parental investment hypothesis, Problems Psychol. 21st Century 7 (7) (2013) 40–48, https://doi.org/10.33225/ppc/13.07.40.
[15] J.M. Tybur, A.D. Bryan, D. Lieberman, A.E.C. Hooper, L.A. Merriman, Sex differences and sex similarities in disgust sensitivity, Pers. Individ. Dif. 51 (3) (2011) 343–348, https://doi.org/10.1016/j.paid.2011.04.003.
[16] J. Ammann, C. Hartmann, M. Siegrist, Does food disgust sensitivity influence eating behaviour? Experimental validation of the food disgust Scale, Food. Qual. Prefer. 68 (2018) 411–414, https://doi.org/10.1016/j.foodqual.2017.12.013.
[17] A. Egolf, M. Siegrist, J. Ammann, G. Pacheco-López, A. Etale, C. Hartmann, Cross-cultural validation of the short version of the Food Disgust Scale in ten countries, Appetite 143 (2019) 104420, https://doi.org/10.1016/j.appet.2019.104420.
[18] J. Ammann, A. Egolf, C. Hartmann, M. Siegrist, Cross-national comparison of the Food Disgust Picture Scale between Switzerland and China using confirmatory factor analysis, Food. Qual. Prefer. 79 (2020) 103756, https://doi.org/10.1016/j.foodqual.2019.103756.
[19] D.M. Fessler, S.J. Eng, C.D. Navarrete, Elevated disgust sensitivity in the first trimester of pregnancy: evidence supporting the compensatory prophylaxis hypothesis, Evol. Hum. Behav. 26 (4) (2005) 344–351, https://doi.org/10.1016/j.evolhumbehav.2004.12.001.
[20] A. Żelaźniewicz, B. Pawłowski, Disgust in pregnancy and fetus sex—Longitudinal study, Physiol. Behav. 139 (2015) 177–181, https://doi.org/10.1016/j.physbeh.2014.11.032.
[21] D. Dlouhá, J. Ullmann, L. Takács, K. Nouzová, H. Hrbáčková, J. Šeda, Š. Kaňková, Comparing disgust sensitivity in women in early pregnancy and non-pregnant women in the follicular and luteal phases of the menstrual cycle, Evol. Hum. Behav. 45 (2) (2024) 164–174, https://doi.org/10.1016/j.evolhumbehav.2024.01.006.
[22] Š. Kaňková, L. Takács, M. Krulová, J. Hlaváčová, K. Nouzová, M. Hill, C. Monk, Disgust sensitivity is negatively associated with immune system activity in early pregnancy: direct support for the Compensatory prophylaxis hypothesis, Evol. Hum. Behav. 43 (3) (2022) 234–241, https://doi.org/10.1016/j.evolhumbehav.2022.02.001.
[23] M.C. Bazaco, S.A. Albrecht, A.M. Malek, Preventing foodborne infection in pregnant women and infants, Nurs. Womens. Health. 12 (1) (2008) 46–55, https://doi.org/10.1111/j.1751-486X.2007.00275.x.
[24] K. Miłkowska, A. Galbarczyk, M. Klimek, K. Zabłocka-Słowińska, G. Jasienska, Pathogen disgust, but not moral disgust, changes across the menstrual cycle, Evol. Hum. Behav. 42 (5) (2021) 402–408, https://doi.org/10.1016/j.evolhumbehav.2021.03.002.
[25] E.T. Abrams, E.M. Miller, The roles of the immune system in women's reproduction: evolutionary constraints and life history trade-offs, Am. J. Phys. Anthropol. 146 (S53) (2011) 134–154, https://doi.org/10.1002/ajpa.21621.
[26] A. Żelaźniewicz, B. Borkowska, J. Nowak, B. Pawłowski, The progesterone level, leukocyte count and disgust sensitivity across the menstrual cycle, Physiol. Behav. 161 (2016) 60–65, https://doi.org/10.1016/j.physbeh.2016.04.002.
[27] S.R.M.M. Gillis, R. Kozak, M. Durante, M.E. Weksler, Immunological studies of aging. Decreased production of and response to T cell growth factor by lymphocytes from aged humans, J. Clin. Invest. 67 (4) (1981) 937–942, https://doi.org/10.1172/jci110143.
[28] R.A. Garibaldi, B.A. Nurse, Infections in the elderly, Am. J. Med. 81 (1) (1986) 53–58, https://doi.org/10.1016/0002-9343(86)90514-0.
[29] T.R. Prohaska, E.A. Leventhal, H. Leventhal, M.L. Keller, Health practices and illness cognition in young, middle aged, and elderly adults, J. Gerontol. 40 (5) (1985) 569–578, https://doi.org/10.1093/geronj/40.5.569.
[30] M. Siegrist, C. Hartmann, C. Keller, Antecedents of food neophobia and its association with eating behavior and food choices, Food Qual Prefer 30 (2) (2013) 293–298, https://doi.org/10.1016/j.foodqual.2013.06.013.
[31] D. Schwambergová, Š. Kaňková, J. Třebická Fialová, J. Hlaváčová, J. Havlíček, Pandemic elevates sensitivity to moral disgust but not pathogen disgust, Sci. Rep. 13 (1) (2023) 8206, https://doi.org/10.1038/s41598-023-35375-2.
[32] U. Berger, D. Anaki, Demographic influences on disgust: evidence from a heterogeneous sample, Pers. Individ. Dif. 64 (2014) 67–71, https://doi.org/10.1016/j.paid.2014.02.016.
[33] D.M. Fessler, C.D. Navarrete, The effect of age on death disgust: challenges to terror management perspectives, Evolut. Psychol. 3 (1) (2005) 279–296, https://doi.org/10.1177/147470490500300120, 3.
[34] P. Rozin, Hedonic "adaptation": specific habituation to disgust/death elicitors as a result of dissecting a cadaver, Judgm. Decis. Mak. 3 (2) (2008) 191–194, https://doi.org/10.1017/S1930297500001534.

[35] G. Santisi, P. Magnano, V.E. Scuderi, Food neophobia and Food disgust: the mediating role of perceived vulnerability to disease, Behav. Sci. 11 (5) (2021) 65, https://doi.org/10.3390/bs11050065.
[36] B.O. Olatunji, C.N. Sawchuk, J.M. Lohr, P.J. De Jong, Disgust domains in the prediction of contamination fear, Behav. Res. Ther. 42 (1) (2004) 93–104, https://doi.org/10.1016/S0005-7967(03)00102-5.
[37] J. Verwoerd, P.J. de Jong, I. Wessel, W.J. van Hout, If I feel disgusted, I must be getting ill": emotional reasoning in the context of contamination fear, Behav. Res. Ther. 51 (3) (2013) 122–127, https://doi.org/10.1016/j.brat.2012.11.005.
[38] M. Siegrist, C. Hartmann, Impact of sustainability perception on consumption of organic meat and meat substitutes, Appetite 132 (2019) 196–202, https://doi.org/10.1016/j.appet.2018.09.016.
[39] A. Egolf, M. Siegrist, C. Hartmann, How people's food disgust sensitivity shapes their eating and food behaviour, Appetite 127 (2018) 28–36, https://doi.org/10.1016/j.appet.2018.04.014.
[40] C. Hartmann, M. Siegrist, Development and validation of the food disgust Scale, Food. Qual. Prefer. 63 (2018) 38–50, https://doi.org/10.1016/j.foodqual.2017.07.013.
[41] L.S. Aiken, S.G. West, Multiple Regression: Testing and Interpreting Interactions, Sage, Thousand Oaks, 1991.
[42] A. Berthold, S. Guion, M. Siegrist, The influence of material and color of food packaging on consumers' perception and consumption willingness, Food. Humanity 2 (2024) 100265, https://doi.org/10.1016/j.foohum.2024.100265.
[43] Europäische Kommission (2012). Eurobarometer 64.1 (Sep-Oct 2005). *GESIS datenarchiv, Köln. ZA4413 datenfile version 1.1.0,* doi:10.4232/1.10969.
[44] G.L. Burns, S.G. Keortge, G.M. Formea, L.G. Sternberger, Revision of the Padua Inventory of obsessive compulsive disorder symptoms: distinctions between worry, obsessions, and compulsions, Behav. Res. Ther. 34 (2) (1996) 163–173, https://doi.org/10.1016/0005-7967(95)00035-6.
[45] P. Van Oppen, R.J. Hoekstra, P.M. Emmelkamp, The structure of obsessive-compulsive symptoms, Behav. Res. Ther. 33 (1) (1995) 15–23, https://doi.org/10.1016/0005-7967(94)E0010-G.
[46] S.N. Chapman, M. Lahdenperä, J.E. Pettay, R.F. Lynch, V. Lummaa, Offspring fertility and grandchild survival enhanced by maternal grandmothers in a pre-industrial human society, Sci. Rep. 11 (1) (2021) 3652, https://doi.org/10.1038/s41598-021-83353-3.
[47] J. Havlíček, P. Tureček, A. Velková, One but not two grandmothers increased child survival in poorer families in west Bohemian population, 1708–1834, Behav. Ecol. 32 (6) (2021) 1138–1150, https://doi.org/10.1093/beheco/arab077.
[48] M.E. Lamb, The history of research on father involvement: an overview, Marriage Fam. Rev. 29 (2–3) (2000) 23–42, https://doi.org/10.1300/J002v29n02_03.