Factors affecting stated liking for meat products: Focus on demographics, oral responsiveness, personality, and psycho-

Factors affecting stated liking for meat products: focus on demographics, oral responsiveness, personality, and psycho-attitudinal traits

Caterina Dinnella[a], Fabio Napolitano[b], Sara Spinelli[a], Erminio Monteleone[a], Corrado Pacelli[b], Ada Braghieri[b,*]

[a]*Department of Agricultural, Food, Environment and Forestry (DAGRI), University of Florence,50144 Florence, Italy*
[b]*School of Agricultural, Forestry, Food and Environmental Sciences, University of Basilicata, Potenza, Italy*

* Corresponding author.
E-mail address: ada.braghieri@unibas.it (A. Braghieri).

ABSTRACT

Demographics, anthropometrics, oral responsiveness to sensory stimuli and psycho-attitudinal traits were collected from a representative Italian population sample (n=2384; 58% women, age 18-60 years) and considered as possible explanatory variables affecting meat liking. Differences in motives underlying individual variation in liking for meat were independently investigated by gender. Three groups of subjects were identified based on liking ratings: Slightly Likers, Likers and Lovers. Both common and gender-specific variables affecting liking for meat were identified. The interest in food (including its rewarding function) and eating experience, low food neophobia and relatively high Body Mass Index characterized meat Lovers irrespective to gender. The careful food selection and the food comforting function further characterized women meat Lovers. Men Slightly Likers were characterized by the interest for health-related food aspects, importance assigned to naturalness and restrained eating. Markers of oral responsiveness were ineffective for describing variation in liking for meat.

Key words: gender, age, PROP status, food neophobia, psycho-attitudinal traits

Introduction

Individuals largely vary in their dietary habits, food preferences and intake within a culture vary due to the interplay among several person-related dimensions that are biological, physiological, psychological, and socio-cultural (Sobal et al., 2006). The large body of available finding depict a complex interplay among several personal dimensions in shaping meat eating behaviour. Understanding the nature and causes of variation in meat liking and consumption would help the

development of effective strategy to help the transition to more sustainable dietary patterns of meat eaters (Çınar et al., 2022).

Socio-demographic and economic characteristics strongly associated with meat consumption with those living in rural area, having low education levels and women living in household with children consuming more red meat than their counterparts (Sares-Jäske et al., 2022). A lower adherence to Mediterranean diet and an increased meat consumption has been reported for Italian population living in more rural and less affluent regions (Predieri et al., 2020). The strong association of gender with meat preference and consumption is widely reported, with women on average consuming less meat than men (Daniel et al., 2011) for reasons mainly related to gender stereotypes and social norms (Çınar et al., 2022; Mesler et al., 2022). Age negatively associates with meat consumption and preference (Predieri et al., 2020) and health related concerns appeared the main factors affecting this behaviour (Roberts et al., 2018).

The enjoyment of meat sensory qualities is reported by consumers as important factors affecting meat consumption and purchase decisions (Braghieri et al., 2009; 2016). Individuals substantially vary in their chemo- and somatosensory perceptions and diet-related differences have been highlighted. The fungiform papillae density on the tongue (FPD) and the response to the bitter taste of 6-n-propylthiouracil (PROP status) are the most well-researched phenotypic markers of responsiveness to oral stimulations (Piochi et al., 2018; Tepper et al., 2017). Systematic investigations on association of phenotypic markers of oral responsiveness with liking for meat and consumption are relatively scarce and results controversial. Responsiveness to PROP was found either negatively (Cliceri et al., 2018) or positively (Choi, 2015) associated to vegetarian diet while no differences were observed in choice of fat-rich meat according to PROP status (Spinelli et al., 2020).

The importance of individual variation in personal values, psychological traits and attitudes on meat consumption and on propensity to the transition towards reduced meat consumption has been largely investigated. Meat consumption is positively associated to higher levels of conservative ideologies (power and security) (Milfont & Sibley, 2016; Hopwood & Bleidorn, 2019), to lower openness to experience and conscientiousness (Keller and Siegrist, 2015) and to diet extraversion (Pfeiler & Egloff, 2020). The higher importance assigned to specific aspects of food-related lifestyle (i.e., ways of shopping, food quality, social relationships), has been reported for meat-eaters in comparison with vegetarians (Grunert, Brunsø, & Bisp, 1997). Reasons related to healthiness are reported as possible motivations for lower meat consumption, while habits and appropriateness were indicated as motivations for higher consumption by meat-eaters (de Boer et al., 2017). Association between food neophobia and meat consumption are controversial. Higher food neophobia was reported among consumers who are unwilling to reduce their meat intake (Heilkema & Lund, 2021), and negative

relationship between food neophobia and poultry consumptions have been reported (Siegrist et al., 2013).

The present study aims at identifying the main variables affecting stated liking for meat in a representative sample of adult Italian meat consumers. A within gender approach was adopted to highlight both common and gender-specific variables explaining differences in liking for meat. Associations between stated liking for meat and age, body mass index (BMI) and oral responsiveness markers (PROP status and fungiform papillae density, FPD) were considered. The role of individual variation in psycho-attitudinal traits was investigated collecting data from several questionnaires: Health and Taste Attitude Scales (HTAS), Food Neophobia (FN), Food Related Lifestyle (FRL), Dutch Eating Behaviour Questionnaire (DEBQ), Sensitivity to punishment (SP) and reward (SR) and Portrait Value Questionnaire (PVQ).

Material and Methods

1. Overview of the experimental plan

The data analysed in the present study are a selection from those collected during the Italian Taste Project (see Monteleone et al., 2017 for a complete overview of data collection).

The study was conducted in agreement with the Italian ethical requirements on research activities and personal data protection (D.L. 30.6.03 n. 196). The study protocol was approved by the Ethics Committee of Trieste University. The respondents gave their written informed consent at the beginning of the test according to the principles of the Declaration of Helsinki.

2. Participants

Participants (n=2384; age range: 18-60 years; gender: 58% women) were recruited on national base by announcements, advertisements in national and local media and words of mouth. All respondents were meat eaters according to their self-reported diet type (vegetarian and vegan were excluded). Six subjects did not fill in the questionnaire on liking for meat and meat products thus leaving a final number of respondents of 2378 (women 1380; men 998). One hundred seventy-eight subjects from two of the units participating in the project were excluded from analysis on PROP responsiveness and fungiform papillae density due to the different data distribution and the significant operator effect on papillae count leaving a total number of 2206 respondents.

3. Markers of oral responsiveness

3.1. PROP responsiveness

Responsiveness to PROP was assessed using a 3.2mM PROP solution (6-n-propyl-2-thiouracil, European Pharmacopoeia Reference Standard, Sigma Aldrich, Milano, IT) (Prescott et al., 2004). Two identical 10 ml samples, each coded with a three-digit code, were presented to assessors (Masi et al., 2015). The General Labeled Magnitude Scale (gLMS; 0 = no sensation–100 = the strongest imaginable sensation of any kind) (Bartoshuk et al., 2004) was used to assess the intensity of bitterness. A more detailed description of this procedure is reported in Dinnella et al. (2018).

The average bitterness score across the two PROP samples was used for each subject. The cut-offs from previous studies (Hayes et al., 2010) were used to categorize subjects as non-tasters (NT: PROP bitterness on gLMS < moderate, 17), medium tasters (MT: PROP bitterness on gLMS ≥ moderate, 17 and < very strong, 53), super tasters (ST: PROP bitterness on gLMS ≥ very strong, 53) .

3.2Fungiform Papillae density (FPD)

Digital pictures of the tongue stained with household blue food colouring were recorded using a digital microscope (MicroCapture, version 2.0 for 20×-400×) (Masi et al., 2015). For each participant, the clearest image was selected, and the number of FP was counted in two 0.6 cm diameter circles, one on the right side and one on the left side of the tongue, 0.5 cm away from the tip and 0.5 cm away from the tongue midline. The number of FP was manually counted by two researchers independently, according to the Denver Papillae Protocol (Nuessle et al., 2015), and the average of these two scores was computed for each subject. Then, the individual FPD was calculated by reporting the number of FP to a unit area of 1 cm^2.

4. Questionnaires

4.1 Stated liking for and familiarity with meat products

Stated liking for and familiarity with 19 meat products, selected from the IT-Food Preference Questionnaire (ITFPQ) and IT-Food Familiarity Questionnaire (IT-FFQ) (Monteleone et al., 2017), were measured. In both questionnaires, the presentation order of items was randomised across participants. Stated liking for the 19 meat products was measured using the 9-point hedonic scale (1 = extremely disliked; 5 = neither liked nor disliked; 9 = extremely liked) (Peryam & Pilgrim, 1957), with the added option "never tasted it". Participants expressed their familiarity with meat products using a 5-point scale (1=I do not recognize it; 2=I recognize it, but I have never tasted it; 3=I have tasted it, but I don't eat it; 4=I occasionally eat it; 5=I regularly eat it) (Tuorila et al., 2001).

4.2 Food-related lifestyles, attitudes and eating behaviours

The *Food Related Lifestyle* (FRL) was used to characterize consumers by how they view food and drink as a means by which to attain their basic life values (Grunert et al., 1998). The Italian version validated by Saba et al. (2019) was used.

The *Health and Taste Attitude Scales* (HTAS) questionnaire (Roininen et al., 1999), validated in Italian by Saba et al., 2019, was used to assess orientations toward the health and hedonic characteristics of foods.

The *Dutch Eating Behavior Questionnaire* (DEBQ) (van Strien et al., 1986) was used to assess eating in response to emotional and external factors and restrained eating. The Italian version validated by Dakanalis et al. (2013) was used.

4.3. Psychological and personality traits

The short version of the *Portrait Value Questionnaire* (PVQ) was used to describe individual differences in personal values (Schwartz, 2003).

Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) (Torrubia et al., 2001) in the Italian version (Spinelli et al., 2018) was used for assessing the responsiveness of the two brain systems that control the behavioural activation system (BAS) and the behavioural inhibition system (BIS).

Food neophobia scale (Pliner & Hobden, 1992) (FN) validated in Italian (Laureati et al., 2018) was used to assess food neophobia, defined as the reluctance to try and eat unfamiliar foods.

5. Data analyses

Chi-square tests were used to test differences in age distribution (three classes C1: 18-30 y.o.; C2: 31-45 y.o.; C3: 46-60 y.o.) by gender. Fisher's exact test was run to test the significance by cell (significance level fixed at p=0.05).

Two-way ANOVA models were used to assess the main effects of gender (M and W), age class (C1, C2 and C3) and their interaction on PROP bitterness ratings and FPD.

Reliability of food attitude, personality and psycho-attitudinal scales was assessed by calculating Cronbach's α as a measure of internal consistency. The value of 0.60 was set as the lowest acceptable limit for the satisfactory internal consistency of the measure (Mohamad et al., 2015).

Two-way ANOVA models were used to assess the main effects of gender (M and W), age class (C1, C2 and C3) and their interaction, on stated liking for meat products.

Data were then analysed disaggregated by gender. Internal preference maps (IPMs) were computed to investigate individual differences in liking for meat products in women and man, independently. Subjects who assigned the same liking ratings to all the items (women=8; men=5) were excluded from IPM computation (women=1372; men=992).

Women and men were independently grouped in three clusters based on the limits of the percentile distribution of individual mean liking ratings (Slightly likers-SLk: <first quartile; Likers-Lk: interquartile; Lovers - Lv: > third quartile).

Chi-square tests were used to test differences in age distribution (three classes C1,C2 and C3) between clusters. Fisher's exact test was run to test the significance by cell (significance level fixed at p=0.05).

Two-way ANOVA model was used to assess the main effects of cluster (SLk, Lk and Lv), age class (C1, C2 and C3) and their interaction on BMI, familiarity score (computed by summing up familiarity ratings with meat product for each subject, range 19-95), PROP ratings, FPD, personality and psycho-attitudinal scale scores.

Binomial logistic regression was used to predict the SLk and Lv cluster memberships using personality and psycho-attitudinal scale scores, PROP ratings, FPD, BMI and age classes as predictors.

A *P* value of 0.05 was considered as threshold for statistical significance.

The XLSTAT statistical software package, version 19.02 (Addinsoft), was used for data analysis.

Results

1. Participant characteristics

1.1 Sociodemographic, self-reported health status and anthropometric measures

Table 1 shows the socio-demographic characteristics, the self-reported health status, and the BMI of respondents. No significant differences in age distribution between genders were observed (P=0.451) and the number of respondents by age class was similar. Most of the respondents self-reported a good health condition (82.82%), which is consistent with the low self-reported percentage of food allergies (7.39 %) intolerances (8.99%) and chronic diseases (13.69 %). The good health condition of the sample was further confirmed by the higher percentage of normal weight respondents (64.33%). Significant differences in BMI distribution by gender were observed (p<0.0001), the percentage of normal weight and underweight individuals was higher in women than in men, while the percentage of obese and overweight individuals was higher in men than in women.

The general structure of the population made it possible to consider this sample as representative of the healthy Italian adult population.

1.2 Markers of oral responsiveness

Gender (F= 8.40, P=0.004) and age (F=59.53, P<0.0001) significantly affected FPD, whereas no significant interactions were observed (F= 0.77, P=0.462). Women showed higher values than men (W:23.69±0.48, M:21.45±0.57). The FPD decreased with age (C1:27.38±0.59, C2:22.28±0.71 and C3:18.04±0.65). Significant effects of gender (F=45.00, P<0.0001) and age (F=9.40, P<0.0001) were observed on PROP bitterness ratings while their interaction was not significant (F=1.02, P=0.360).

Women rated PROP bitterness higher than men (W:43.38±0.73, M:36.07±0.86). The higher age classes reported lower PROP bitterness ratings, with significant differences between the first two age classes and the third class (C1:42.48±0.89, C2:39,94±1.06 and C3:36.76±0.97).

These results are in line with previous evidence showing that both gender and age modulate interindividual variations of phenotype markers of oral responsiveness (Shen et al., 2016; Fischer et al., 2013; Tepper et al., 2017) thus confirming the reliability of subject characterization for oral responsiveness.

2. Questionnaire

2.1 Food Attitude questionnaires

Mean scores and Cronbach's α values of the food attitude questionnaire domains are reported in Table 1 of supplementary materials (Table 1S). Cronbach's α computed on FRL questionnaire subscales showed that all the subscales of the "*Ways of shopping*" domain (α≥ 0.63), the subscales *Health* (α =0.81), *Organic products* (α=0.78) and *Freshness* (α =0.73) of the "*Quality aspects*" domain and the *Self-fulfilment in food* subscale (α=0.67) of "*Purchasing motives"* domain showed satisfactory internal consistency and were retained for further analysis. The internal consistency of HTAS questionnaire subscales was satisfactory (α≥0.72), except for *Pleasure* subscale that was discarded. The three subscales of DEBQ all showed satisfactory internal consistency (α≥0.83).

2.2. Psychological and personality trait questionnaires

Mean scores and Cronbach's α values from psychological and personality trait questionnaires are reported in Table 2 of supplementary materials (Table 2S). Only *Benevolence* (α=0.65), *Hedonism* (α=0.70) and *Achievement* (α=0.67) subscales of PVQ questionnaire reached a satisfactory internal validity and were considered for subsequent analyses.

The two SPSRQ subscales (α=0.84 and α=0.77, for SP and SR, respectively) and FN scale (α=0.87) fulfilled the satisfactory level of internal consistency.

3. Stated Liking for meat and meat products

3.1 Gender and age effect

Table 2 reports the effects of gender and age on mean stated liking for 19 meat products. All the meat products, with the only exception of *Liver*, were well liked with the mean score above 5 ("neither liked nor disliked"). Gender significantly affected liking for most of the meat products, except for *bresaola*, *breaded meat* and *Parma ham*. Men reported mean stated liking values higher than women for most of the meat products. Only stated liking for *chicken breast* and *cooked ham* were higher in women than in men. Age significantly affected stated liking for meat products with the only

exceptions of *lamb chop*, *bresaola* and *mortadella*. In general liking decreased with age. *Liver* represents the only exception with liking rated higher by the oldest in respect to the younger classes. Interactions gender x age were significant only for *beef carpaccio* (F=3.33, P=0.036), *breaded meat* (F=3.61, P=0.027) and *liver* (F=7.57, P=0.001). Men from age classes C1 and C2 rated liking for carpaccio higher than women while no difference by gender was found in age class C3. Women from the youngest age class C1 liked breaded meat higher than women from C2 and C3; in the case of men, liking for breaded meat was the lowest in the oldest age class while C2 and C1 did not significantly differ. Liking for liver was not affected by age in men while the younger age classes (C1 and C2) rated liking for liver lower than the oldest class (C3) in women.

3.2 Internal preference mapping

Given the systematic differences in mean stated liking values according to gender, IPMs were computed to describe individual differences in liking pattern for meat products for woman (Figure 1 A and B) and men (Figure 2 A and B), independently.

The first two dimensions of the IPMs computed on individual stated liking ratings accounted for 37.32% of explained variance for woman (F1: 25.67% and F2: 11.57%) and 35.39 % for men (F1: 23.2% and F2: 12.17 %). The large majority of the products were closely associated with each other on F1 (on the right side of the maps), in opposition to *liver* and in a much lesser extent to *kebab*, *spicy salami*, *lamb chops* and *hamburger* for both women and men, to *bacon* only for women and to *baked ham* only for men; the opposition *lamb chop*/*spicy salami*, and *lamb chop/ kebab* was observed on F2 in women and men, respectively (Figure 1A and 2A). The correlation loading plots show the respondents mostly positioned along F1 and clearly associated to the most part of meat products (Figure 1B and 2B). In general, IPMs showed common liking patterns for both woman and men characterized by a general orientation towards the meat products with the only clear exception of *liver*.

3.3 Subject clustering on mean stated liking

Descriptive values of mean liking rating distribution of the whole sample and derived clusters (Cl1<1st quartile limit; Cl2 interquartile; Cl3> 3rd quartile limit) were independently computed for woman and men (Table 3). Descriptive data indicated a relatively wide rating range in Cl1 both for men (range1.3-6.6) and women (range 1.0-6.2) and median values of 6.2 in men and 5.6 in women (close to the scale label "slightly like"). This indicates that meat products were in general well accepted by Cl1 members but with some exception, hence this group was named "*Slight Likers*" (SLk). Mean stated liking data show a narrow variation range in both Cl2 (men range: 6.7-7.8; women range: 6.2-7.5) and Cl3 (men range: 7.8-9.0; women: 7.5-9.0). Median values indicate that subjects belonging to Cl2 definitively like all meat products (women median 6.9; men median: 7.3, close to

the scale label moderately like) and were named "*Likers*" (Lk). Subjects from Cl3 showed median values of 7.9 for women and 8.1 for men (close to the scale label "like very much"), this group was defined as *"Lovers*" (Lv).

4. Cluster characterization

4.1 Differences among clusters in age, BMI, and familiarity with meat

Distribution of age classes among clusters did not significantly change in women (P=0.328) while was significant different in men (P<0.0001). In men SLk, the presence of subject from the oldest age class (C3) was higher and that of subjects from the younger classes (C1 and C2) was lower than expected. On the other hand, the presence of older subjects was lower and that one of younger subjects was higher than expected in men Lv group.

The effects of cluster and age class on BMI and on familiarity scores with meat were independently assessed on women and men (Table 4). BMI significantly differed among clusters (women F=13.27; P<0.0001; men F=9.93; P=0.000). Subjects from Lv group showed BMI higher than both Lk and SLk either in women and in men. BMI significantly increased with age both in women (F=47.21; P<0.0001) and men (F=61.90; P<0.0001). No significant interactions cluster*age class were found (p≥0.064). Mean familiarity scores were relatively high, ranging from 68.7 to 78.9, thus indicating the regular meat consumption in all clusters. A significant cluster effect on familiarity score was found (W: F=127.75; P<0.0001; M:F=38.87; P<0.0001). Lv group showed the highest and SLk the lowest familiarity score. Age affected familiarity score in women only, with C2 class showing the highest value (F=9.12; P=0.000). No significant interactions cluster*age class were found (P>0.57).

4.2 Differences among clusters for oral responsiveness markers

Cluster did not affect responsiveness to PROP and FPD, both in women and men (P≥0.167). Markers of oral responsiveness were negatively affected by age class (W: FPD F=35.38; P<0.0001; PROP F=4.66; P<0.010; M: FPD F=25.88; P<0.0001; PROP F=5.60; P=0.004). Interactions cluster*age were never significant with the only exception of PROP in women SLk from age class C2 who rated PROP bitterness significantly lower than Lk and Lv (P=0.025).

4.3 Differences among clusters for psycho-attitudinal traits

The effect of cluster, age class and their interactions were independently tested for women and men on the reliable scales of attitudinal (Table 3S and 4S, supplementary materials) and psychological/personality (Table 5S, supplementary materials) trait questionnaires.

Food Related Lifestyle Questionnaire -FRL: Clusters significantly differed in several food related lifestyles both in women and in men (Figure 3). Both women and men Lv were found to give more importance than the other clusters to self-fulfilment in food (*"Purchasing motives"* domain), were

more interested in cooking and in looking for new ways of cooking ("*Cooking methods"* domain), more interested in novel foods ("*Quality aspect*" domain), they enjoyed more the shopping and used price as a criterion to buy food ("*Way of shopping"* domain). Women Lv were further characterized by the use of a shopping list in food purchases and by the importance assigned to convenience and advertisement ("*Way of shopping"* domain). Men SLk assigned more importance to organic products ("*Quality aspect*" domain) and rated *Women task* subscale higher compared to Lv and Lk. In general, aging associated to the preference for specialty shops for food purchase, and to the increased importance of organic production and health (with the only exception of men Lv) as food quality aspects. The enjoyment from shopping, the importance of price criteria and of novelty tend to decrease with age in women only. Cooking as a women task was rated higher only by the oldest women age class. The most part of cluster*age interactions were not significant.

Health and Taste Attitude Scales-HTAS: Cluster affected several domains of the questionnaire (Figure 4). *General Health Interest* was rated the highest and *Food as a Reward* the lowest by SLk both in women and men. Women Lv gave the highest ratings to *Craving for sweet food* while men SLk gave the highest ratings to *Interest in natural products.* A general increasing of health-related aspects and a decreasing of taste-related aspects with age were observed, more evident in women than in men. No significant interactions cluster*age were observed.

Dutch Eating Behaviour Questionnaire -DEBQ: External Stimuli ratings regularly decreased from Lv to SLk both in women and in men. Women Lv were also characterized by the highest *Emotional eating ratings* while men Lv were the lowest in *Restrained Eating*. DEBQ subscales were all affected by age both in women and in men: *External and Emotional eating* significantly decreased with age, while *Restrained eating* regularly increased. No significant interactions cluster*age were found.

Significant cluster effects were found on two out of three reliable *Portrait Value Questionnaire (PVQ)* subscales and on *Food Neophobia (FN)* score (Figure 6 A and B) common to both woman and men. *Hedonism* and *Benevolence* scores decreased from Lv to Slk, while FN score was significantly higher in SLk than in Lk and Lv.

No cluster effect was found on *Sensitivity to Punishment/Sensitivity to Reward Questionnaire (SP-SR Q)* subscales.

Age affected all the considered PVQ subscales both in women and in men, with scores decreasing by age; *Benevolence* was the only exception and was not affected by age in men. SP and SR scores were significantly higher in the youngest class in respect to the older ones both in women and in men. No significant age class effect was found on FN scale. No significant cluster*age interactions were found.

5. Variables predicting cluster memberships

In order to depict a general frame of the main factors driving liking for meat products a binomial logistic regression was applied to identify variables affecting the memberships to the two extreme clusters of SLk or Lv in women and men, independently. The null hypothesis test showed that the adjusted models computed for woman and men were significantly more powerful than the independent models (-2 Log (Likelihood) - women chi-square 367.65, P<0.0001; men chi-square 215.61, P<0.0001). The goodness of fit test showed an acceptable level of fit for women (Hosmer-Lemeshow test: chi-square 6.88, P=0.649) and for men (Hosmer-Lemeshow test: chi-square 11.39, P=0.181). The total percentage of correct classification was 82.14% for women (correct classification Lv 80.6% and SLk 83.6%) with an area under the curve (AUC) value for the ROC curve of 0.896. The total percentage of correct classification was 77.51% for men (correct classification: Lv 77.6% and SLk 77.4%) with an AUC value for the ROC curve of 0.857.

Several variables significantly contributed to the model computed for women and men. For women (Figure 7), the importance given to *Freshness* as quality attribute and the relatively higher *Food Neophobia* level actively predict the membership to the SLk group. Higher familiarity with meat products, *Enjoyment for shopping*, predisposition to buy natural foods without additives (*Health*) and *Self-fulfilment* as purchase motive all represented variables actively predicting women membership of the meat lover's cluster.

In men (Figure 8), higher age, the importance given to *Product information* while shopping, interest in *Natural Products*, eating styles influenced by weight control (*Restrained eating*) and in responses to anxiety and stress (*Emotional eating*), as well as a higher *Food Neophobia* level all predicted the membership of the cluster of the SLk. Meat lover membership was predicted by relatively higher BMI, familiarity with meat products, interest in *Price* and *Health* aspects while shopping, eating in response to external stimuli (*External eating)*, and the importance assigned to *Hedonism* as personal value.

Discussion

This study investigated factors affecting liking for meat products in a sample representative of Italian adult meat consumers. In general, all the meat products were rated higher than the neutral score ("neither like nor dislike") with the only exception of liver. Meat products considered in this study were representative of the most common meat-based dishes consumed across the country (D'Evoli et al., 2009), and the high consumer familiarity with such products accounts for their general high acceptance (Borgogno et al., 2015). Liver represents a traditional food of past regional cuisine (Monteleone & Dinnella, 2009), its consumption has regularly decreased in the last decades thus explaining the relatively lower stated liking observed for this product as compared with other meat

items. A significant gender effect on stated liking was found with women systematically rating meat products lower than men with only two exceptions (*chicken breasts* and *baked ham* were scored higher by women). These results are in line with the already documented differences in meat consumption and liking between gender (e.g., Ritzel and Mann, 2021) indicating that men prefer red and woman white meat (Schmid et al., 2017; Kubberød et al., 2002). The red meat consumption as a symbol of values related to the masculine identity (Timeo and Suitner, 2018), the women disgust with blood and the increased empathy for the living animal (Milfont & Sibley, 2016) together with the higher awareness for health and weight concerns have been advoked as possible explanations for differences in meat liking between gender. Internal Preference Maps indicated liking patterns common by gender which can be related to the wide spread of the considered meat products in the Italian gastronomy. In the present study, a general negative effect of age on stated liking for meat was observed. The intake and liking for animal protein-rich food is known to decline with age (Landi et al., 2019) mainly due to reductions in dental and physical abilities, and changes in living habits (Holman et al., 2020). The negative effect of aging on liking for meat products may be further explained by the increased importance of health-related aspects documented in the Italian older age class (Dinnella et al., 2020; Saba et al., 2019). Moreover, the easier overcoming of the "meat paradox" (meat-eaters enjoy the taste of meat but dislike the harming of animals that meat production inevitably involves) by younger age class due to their lower awareness of the animal-meat link (Benningstad and Kunst, 2020) may represent a further reason for meat liking decreasing with age.

In general, results from the present study and evidence from literature indicate that gender and the gender-specific attitudes and motivations play a major role in individual variation of liking for meat products. To investigate the finer differences in motives underlying individual variation in liking and consumption of meat, a gender-based analysis was adopted and women and men were independently grouped in three groups of Slightly likers, Likers and Lovers of meat products.

Age comparison among groups confirmed the general trend of meat liking decreasing with aging in men while no differences were observed in women. Familiarity with meat was positively associated with liking both in women and in men, with Slightly likers that declared the lowest familiarity and Lovers the highest. Age did not affected familiarity with meat in men while the women aged 30-45 showed the highest familiarity compared to the other classes.

Taken together these data depict a complex interplay between age, liking and familiarity with meat possibly related to different reasons in men and in women. In women, the increased familiarity observed in 30-45 y.o. class, despite the stability of liking for meat products across age groups, might

be related to environmental factors such as children and family caring (Merlino et al., 2018). The decrease of liking in older men population might be related to the weaken of masculinity stereotype hypothesized for the older men which might negatively impact on the enjoyment from eating meat (Ritzel and Mann, 2021) while the attachment to dietary habit might explain the stability in familiarity with meat (Modlinska and Pisula, 2018).

A positive association was found between stated liking for meat products and BMI, with meat Lovers showing a higher BMI irrespective to gender. Several evidence from existing data confirm the positive association of BMI with meat liking and consumption (Mancini et al., 2016) probably due to high protein and low fibre intakes (Spencer et al., 2003). BMI increased with age both in women and men remaining within the limits of normal/slight over-weight. Thus, these results further confirmed the general good health status of the population participating in the study.

Markers of oral responsiveness did not significantly change across meat-liking clusters. Data from literature are controversial and negative (Cliceri et al. 2018; Robino et al., 2016; Perna et al., 2017) or null (Spinelli et al., 2020) relationships between PROP responsiveness and meat liking and consumption have been reported. The complexity of the dimensions underlying food preference and choice, together with the multiple confounding factors in studies linking oral responsiveness to food intake can account for the controversial results on relationships between peripheral sensing system acuity and meat-eating behaviour and preference (Nolden and Fenney, 2020).

The adopted gender-based analysis approach allowed for identifying both common and specific psycho-attitudinal variables affecting meat liking variation in women and men.

Cluster significantly differed for several subscales of FRL questionnaire. The cluster of meat Lovers shared higher *Enjoyment from shopping* and importance given to *Price*, irrespective to gender. According to Verbeke & Vackier (2004), enjoyment associated to food shopping can be considered as integral part of the mere pleasure experience of eating meat reported as salient consumption decision motive by daily meat consumers. *Price* is an important extrinsic quality cue affecting consumers' purchasing decisions with a positive effect on expected quality (Lagerkvist, 2013; Merlino et al., 2018; Simon, et al., 2013). In the present study, women and men meat Lovers also share *Novelty* as a food quality aspect meaning that they enjoy trying never tasted food and food from different cultures. The importance given to food preparation both in terms of space and time (*Interest in cooking*) and in terms of recipe refinement (*Looking for new ways*) characterize women and men meat Lovers possibly as further aspects related to the general enjoyment of the eating experience. The higher value assigned to the *Self-fulfilment* in food preparation can be interpreted as an additional element related to the relevance given to the eating experience by meat Lovers. Meat liking in women

441 is also associated with increased importance assigned to *Advertising*, *Shopping list* and *Convenience*.
442 This may be also linked to the significant gender inequality affecting the Italian population, in which
443 most aspects related to food purchase and meal preparation are still women responsibility (Dinnella
444 et al., 2020; Maugeri et al. 2019). The important role of food preparation and eating experience
445 possibly induced women meat Lovers and Likers to trust advertising as additional quality cues to
446 select the best food option for the family needs. In addition, the careful planning of food purchase
447 and the relevance of convenience can be seen as useful aids for proper meal preparation despite time
448 constrains. Meat liking in men showed a negative association with the importance assigned to organic
449 production as food quality aspect, in agreement with the lower value attributed to organic products
450 by regular, highly involved meat consumers reported in previous studies (Reicks et al. 2011;
451 Borgogno et al., 2015).
452 Attitudes toward health and taste significantly changed according to liking for meat products. *General*
453 *health interest* was negatively associated with stated liking for meat both in women and men
454 respondents possibly related to the reduction of meat consumption and preference due to concerns
455 about the negative health outcomes of meat intake (Kayser, Nitzko, and Spiller, 2013; Bouvard et al.,
456 2015). The importance assigned to *Food as a Reward* domain by subjects with higher liking for meat
457 products possibly associates with the general pleasure dimension of eating meat characterizing these
458 groups according to results from FRL questionnaire. The *Interest in Natural products* (free from
459 additives and artificial flavours, low processing, vegetable intake and organic production) seems to
460 further underline the role played by food healthiness and safety concerns as hindrance for meat
461 appreciation in men only. The higher importance assigned to *Craving for Sweet food* by women meat
462 Lovers is aligned with the general frame of negative association of meat liking with health-related
463 food issues since the stronger is craving for sweet foods, the weaker is the positive attitudes towards
464 health (Saba et al., 2019).
465 Responses to DEBQ showed differences in eating styles among clusters. A high meat liking was
466 positively associated with eating in response to food-related stimuli, regardless of the internal state
467 of hunger or satiety (*External eating*) both in women and in men, in agreement with data on positive
468 association between external eating and meat consumption (Keller and Siegrist, 2015). The pleasure
469 of eating *per se*, with meat as integral part of a rewarding meals, which characterize both men and
470 women meat Lovers may account for higher intakes irrespective of the internal needs. Women meat
471 Lovers also reported a higher food intake in response to negative emotions and stress (*Emotional*
472 *eating*) in agreement with the frequently observed co-occurrence of external and emotional eating
473 (De Cock et al., 2016). In men, instead, worries on weight gain (Restrained eating) was reported by

men Slight Likers in agreement with the higher age and food health related concerns which characterize this subject group.

Food neophobia, defined as the reluctance to try novel food, showed a clear negative relationship with stated liking for meat both in women and in men. Recent data on a large population sample showed a significant detrimental effect of food neophobia on acceptance of commonplace foods and suggest that overall neophobic individuals like and enjoy food less than people with a lower food neophobia level (Jaeger et al., 2017, Laureati et al., 2018). In addition, food neophobia was related to the mental predisposition to disgust elicited, among others, by the animal origin and appearance cues (such as disgust with blood and raw meat) that may lead to the avoidance of meat (Tuorila and Hartmann, 2020). This negative relationship between food neophobia and meat liking well relates also with the negative association observed in this study between novelty as a food quality aspect and meat liking.

Values that people found important for their life were assessed trough PVQ and were significantly different according to stated liking for meat. Meat Lovers considered both the preservation and enhancement of the welfare of close people (*Benevolence*) and pleasure gratification for him/herself (*Hedonism*) important values for their life. It is possible to hypothesize that the importance assigned to both values is related to the significance of food and eating as pleasant and rewarding experience for themselves as well as a sign of care and affection for close people.

The straight comparison between the two extreme groups of Slightly Likers and Lovers allowed for identifying similarities and differences between women and men in main factors predicting the cluster membership. The high familiarity with meat products and the importance assigned to "health" (in terms of lack of preservatives and additives) as FRL subscale in the quality aspect domain are common predictors of the Lover membership, while food neophobia predicts the membership to the Slightly Liker clusters. The enjoyment in food purchase and the self-fulfilment in food preparation are predictors of the membership to Lover cluster for women only, which could be related to the traditional value of food as important family caring aspect for women belonging to this group, while the importance assigned to freshness, including the commitment in fresh food preparation characterizes Slightly liker women. The increased BMI, the careful selection of food based on price criteria, aspects related to the pleasure of eating *per se* and personal values related to the gratification of himself, are predictors of the membership the Lover cluster for men. Aging, the importance of food composition and nutritional value, including its naturality, together with a restrained eating style and the comforting use of the food to deal with stress and negative emotions characterize Slightly liker men.

Taken together the information from the present study would help the development of meat alternatives optimized for different consumer groups. Alternatives for people strongly attached to meat consumption should meet expectations for rewarding eating experiences, including food shopping and preparation. Price and novelty do not represent a barrier to meat alternative consumption in this subject group. Standing the substantial gender inequality in home and family care, meat alternatives for women meat lovers should also meet family needs and time constrains. On the other hand, the transition to novel and more sustainable food is hindered by high neophobia level in people characterized by reduced meat liking and consumption. Special care is needed in meat alternatives development for this consumer group, effort should be devoted to balance the novelty of alternative composition with familiar and reinsuring formulation context. Moreover, meat alternative acceptance by people less attached to meat consumption could take advantage from information on their naturalness and positive health related outcomes. These latter aspects being particularly relevant for the older men population.

Conclusions

The present investigation on a large population of healthy Italian meat consumers allowed to explore the importance of factors from several dimensions on stated liking for meat products. Demographic aspects, such as gender and age, were confirmed as key factors in meat product appreciation. Conversely, variables describing individual differences in oral responsiveness to sensory stimuli were ineffective to describe variation in stated liking for meat products thus suggesting a weak causal relationship between the pure sensory perception and preference and intake of such as familiar food. The investigation of attitudinal and psychological traits independently by gender allowed the identification of differences and similarities in motives underlying individual variation in liking for meat products. Both common and gender specific barriers and facilitators for meat appreciation were identified that would represent valuable information for the development of personalized strategy to help the transition toward more sustainable diet style in meat consumers.

Acknowledgments

This work is part of the Italian Taste project, a conjoint study of the Italian Sensory Science Society (SISS). The authors are grateful to all volunteers for participating in this study and to all the SISS members that participated in the collection of the data. The Authors gratefully thank A.M Riviezzi for her expert technical assistance.

References

1. Bartoshuk, L. M., Duffy, V. B., Green, B. G., Hoffman, H. J., Ko, C.W., Lucchina, L. A., Marks, L.E., Snyder, D.J., Weiffenbach, J.M. (2004). Valid across-group comparisons with labeled scales: the gLMS versus magnitude matching. *Physiology & Behavior, 82,* 109–114.
2. Benningstad, N., & Kunst, J. R. (2020). Dissociating meat from its animal origins: A systematic literature review. *Appetite, 147,* 104554.
3. Borgogno, M., Favotto, S., Corazzin, M., Cardello, A.V., Piasentier, E. (2015). The role of product familiarity and consumer involvement on liking and perceptions of fresh meat. *Food Quality and Preference, 44,* 139–147.
4. Bouvard, V., Loomis, D., Guyton, K.Z., Grosse Y, Ghissassi FE, Benbrahim-Tallaa L, Guha N, Mattock, H., Straif, K. (2015). International Agency for Research on Cancer Monograph Working Group, Carcinogenicity of consumption of red and processed meat. *Lancet Oncology, 16,* 1599-1600.
5. Braghieri, A., Girolami, A., Carlucci, A., Piazzolla, N., Riviezzi, A. M., & Napolitano, F., 2009. Sensory properties affecting acceptability of "bresaola" from Podolian young bulls. Journal of Sensory Studies, 24, 677–697.
6. Braghieri, A., Piazzolla, N., Carlucci, A., Bragaglio, A., Napolitano, F., 2016. Sensory properties, consumer liking and choice determinants of Lucanian dry cured sausages. Meat Sciences, 111, 122–129.
7. Choi, S. E., 2015. Comparisons of 6-n-Propylthiouracil (PROP) Sensitivity, Food Liking and Food Intake between Vegetarian and Non-Vegetarian Women. *Journal of Obesity & Weight Loss Therapy*, 5, 2.
8. Çınar, Ç., L.W. Wesseldijka, A.K. Karinena,b, P. Jernc, J.M. Tybur (2022). Sex differences in the genetic and environmental underpinnings of meat and plant preferences. *Food Quality and Preference, 98,* 104421.
9. Cliceri, D., Spinelli, S., Dinnella, C., Prescott, J., Monteleone, E. (2018). The influence of psychological traits, beliefs and taste responsiveness on implicit attitudes toward plant- and animal-based dishes among vegetarians, flexitarians and omnivores. *Food Quality and Preference, 68,* 276-291.
10. Daniel, C. R., Cross, A. J., Koebnick, C., & Sinha, R. (2011). Trends in meat consumption in the United States. *Public Health Nutrition, 14,* 575-583.
11. Dakanalis, A., Zanetti, M.A., Clerici, M., Madeddu, F., Riva, G., Caccialanza, R. (2013). Italian version of the Dutch Eating Behavior Questionnaire. Psychometric proprieties and measurement invariance across sex, BMI-status and age. *Appetite, 71,* 187–195.

12. de Boer, J., Schösler, H., Aiking, H. (2017). Towards a reduced meat diet: Mindset and motivation of young vegetarians, low, medium and high meat-eaters. *Appetite, 113,* 387-397.
13. De Cock, N., Van Lippevelde, W., Goossens, L. et al. (2016). Sensitivity to reward and adolescents' unhealthy snacking and drinking behavior: the role of hedonic eating styles and availability. *International Journal of Behavioral Nutrition and Physical Activity, 13,* 17. https://doi.org/10.1186/s12966-016-0341-6
14. D'Evoli, L., Salvatore, P., Lucarini, M., Nicoli, S., Aguzzi, A., Gabrielli, P., & Lombardi-Boccia, G., (2009). Nutritional value of traditional Italian meat-based dishes: influence of cooking methods and recipe formulation. *International Journal of Food Sciences and Nutrition, 60(S5),* 38-49.
15. Dinnella, C., Monteleone, E., Piochi, M., Spinelli, S., Prescott, J., Pierguidi, L., Gasperi, F., Laureati, M., Pagliarini, E., Predieri, S., Torri, L., Barbieri, S., Valli, E., Bianchi, P., Braghieri, A., Caro, A.D., Di Monaco, R., Favotto, S., Moneta, E. (2018). Individual Variation in PROP Status, Fungiform Papillae Density, and Responsiveness to Taste Stimuli in a Large Population Sample. *Chemical Senses, 43,* 697–710, https://doi.org/10.1093/chemse/bjy058.
16. Dinnella C., Spinelli S., Monteleone E. (2020). Attitudes to Food in Italy: Evidence from the Italian Taste Project. In: Meiselman H. (eds) Handbook of Eating and Drinking. Springer, Cham. https://doi.org/10.1007/978-3-030-14504-0_138.
17. Fischer, M.E., Cruickshanks, K.J., Schubert, C.R., Pinto, A., Klein, R., Pankratz, N., Pankow, J.S., Huang, G.H., (2013). Factors related to fungiform papillae density: the Beaver Dam Offspring Study. *Chemical Senses, 38,* 669–677.
18. Grunert, K. G., Brunsø, K., & Bisp, S. (1997). Food-related life-style: Development of a cross-culturally valid instrument for market surveillance. In L. Kahle, & C. Chiagouris (Eds.), Values, lifestyles and psychographics (pp. 337–354). Hillsdale, NJ: Erlbaum.
19. Grunert, K.G., Brunsø, K., Bisp, S. (1998). Food-related life style: Development of a cross-culturally valid instrument for market surveillance. In Values, Lifestyles, and Psychographics; Kahle, L., Chiagouris, C., Mahwah, N., Eds.; Psychology Press: Philadelphia, PA, USA, 337–354.
20. Hayes, J.E., Sullivan, B.S., and Duffy, V.B. (2010). Explaining variability in sodium intake through oral sensory phenotype, salt sensation and liking. *Physiology and Behavior, 100,* 369–729 380.
21. Hielkema, M. H., & Lund, T. B. (2021). Reducing meat consumption in meat-loving Denmark: Exploring willingness, behavior, barriers and drivers. *Food Quality and Preference, 93,* 104257.

22. Holman, B.W.B., Fowler, S.M., & Hopkins, D. L. (2020). Red meat (beef and sheep) products for an ageing population: a review. International Journal of Food Science and Technology, 55, 919-934.
23. Hopwood, C. J., & Bleidorn, W. (2019). Psychological profiles of people who justify eating meat as natural, necessary, normal, or nice. *Food Quality and Preference, 75*,10–14.
24. Jaeger, S.R., Rasmussen, M.A., Prescott, J. (2017). Relationships between food neophobia and food intake and preferences: Findings from a sample of New Zealand adults. *Appetite, 116,* 410-422. doi: 10.1016/j.appet.2017.05.030. Epub 2017 May 19. PMID: 28533158.
25. Kayser, M., Nitzko, S., and Spiller, A. (2013). Analysis of Differences in Meat Consumption Patterns. *International Food and Agribusiness Management Review, 16,* 43-56.
26. Keller, C., & Siegrist, M. (2015). Does personality influence eating styles and food choices? Direct and indirect effects. *Appetite, 84,* 128–138.
27. Kubberød E., Ueland O., Rodbotten M., Westad F., Risvik E. (2002). Gender specific preferences and attitudes towards meat. Food Quality and Preference, 13, 285–294.
28. Lagerkvist, C. J. (2013). Consumer preferences for food labelling attributes: Comparing direct ranking and best-worst scaling for measurement of attribute importance, preference intensity and attribute dominance. *Food Quality and Preference, 29*, 77–88.
29. Landi, F., Calvani, R., Picca, A., Tosato, M., D'Angelo, E., Martone, A.M., Serafini, E., Ortolani, E., Savera, G., Salina, S., Marzetti, E. (2019). Relationship between cardiovascular health metrics and physical performance in community-living people: Results from the Longevity check-up (Lookup) 7+ project. *Journal of Gerontology and Geriatrics, 67*, 62-66.
30. Laureati, M., Spinelli, S., Monteleone, E., Dinnella, C., Prescott, J., Cattaneo, C., Proserpio, C., De Toffoli, A., Gasperi, F., Endrizzi, I., et al., (2018) Associations between food neophobia and responsiveness to "warning" chemosensory sensations in food products in a large population sample. *Food Quality and Preference, 68,* 113–124.
31. Mancini, P., Marchini, A., Simeone, M. (2016). Eating behaviour and well-being: an analysis on the Aspects of Italian daily life. *Agriculture and Agricultural Science Procedia, 8,* 228 – 235.
32. Masi, C., Dinnella, C., Monteleone, E., & Prescott, J. (2015). The impact of individual variations in taste sensitivity on coffee perceptions and preferences. *Physiology & Behavior, 138,* 219–226.
33. Maugeri, A., Barchitta, M., Fiore, V., Rosta, G., Favara, G., La Mastra, C., . . . Agodi, A., (2019). Determinants of adherence to the Mediterranean diet: Findings from a cross-sectional study in women from Southern Italy. *International Journal of Environmental Research and Public Health,* 16, 2963. https://doi.org/10.3390/ijerph16162963.

34. Merlino, V.M., Borra, D., Girgenti, V., Dal Vecchio, A., Massaglia, S., (2018). Beef meat preferences of consumers from Northwest Italy: Analysis of choice. *Meat Science, 143*, 119–128.
35. Mesler RM, Leary RB, Montford WJ. (2022). The impact of masculinity stress on preferences and willingness-to-pay for red meat. *Appetite, 171,* 105729. doi: 10.1016/j.appet.2021.105729. Epub 2021 Oct 5. PMID: 34619245.
36. Milfont, T. L., & Sibley, C. G. (2016). Empathic and social dominance orientations help explain gender differences in environmentalism: A one-year bayesian mediation analysis. *Personality and Individual Differences, 90,* 85–88.
37. Modlinska, K, & Pisula, W. (2018). Selected Psychological Aspects of Meat Consumption-A Short Review. *Nutrients. 10,* 1301. doi: 10.3390/nu10091301. PMID: 30223443; PMCID: PMC6165406.
38. Mohamad, M. M., Sulaimanb, N. L., Sern, L. C., & Sallehd, K. M., (2015). Measuring the Validity and Reliability of Research Instruments. *Procedia-Social and Behavioral Sciences, 204,* 164–171. https://doi.org/10.1016/j.sbspro.2015.08.129.
39. Monteleone, E., & Dinnella, C. (2009). Italian meals. In H. L. Meiselman (Ed.), Meals in science and practice: Interdisciplinary research and business applications. Boca Raton: Woodhead Publishing Limited. 359-276.
40. Monteleone, E., Spinelli, S., Dinnella, C., Endrizzi, I., Laureati, M., Pagliarini, E., ... Tesini, F. (2017). Exploring influences on food choice in a large population sample: The Italian Taste project. *Food Quality and Preference, 59,* 123–140.
41. Nolden, A.A., & Feeney, E. L., (2020). Genetic Differences in Taste Receptors: Implications for the Food Industry. *Annual Review of Food Science and Technology, 11,* 183–204.
42. Nuessle, T. M., Garneau, N. L., Sloan, M. M., & Santorico, S. A. (2015). Denver papillae protocol for objective analysis of fungi form papillae. *Journal of Visualized Experiments: JoVE,* e52860. http://dx.doi.org/10.3791/52860.
43. Peryam, D. R., & Pilgrim, F. J. (1957). Hedonic scale method of measuring food preferences. *Food Technology, 11,* 9–14.
44. Perna, S., Riva, A., Nicosanti, G., Carrai, M., Barale, R., Vigo, B., Allegrini, P., Rondanelli, M., (2017). Association of the bitter taste receptor gene TAS2R38 (polymorphism RS713598) with sensory responsiveness, food preferences, biochemical parameters and body-composition markers. A cross-sectional study in Italy. *International Journal of Food Sciences and Nutrition,* https://doi.org/10.1080/09637486.2017.1353954

673 45. Pfeiler, T. M., & Egloff, B. (2020). Personality and eating habits revisited: Associations between
674 the big five, food choices, and Body Mass Index in a representative Australian sample. *Appetite*,
675 *149*, 1-9.
676 46. Piochi, M., Dinnella, C., Prescott, J., & Monteleone, E. (2018). Associations between human
677 fungiform papillae and responsiveness to oral stimuli: Effects of individual variability, population
678 characteristics, and methods for papillae quantification. *Chemical Senses, 43,* 313–327.
679 https://doi.org/10.1093/chemse/bjy015
680 47. Pliner, P., & Hobden, K. (1992). Development of a scale to measure the trait of food neophobia
681 in humans. *Appetite. 19,* 105-120.
682 48. Predieri, S., Sinesio, F., Monteleone, E., Spinelli, S., Cianciabella, M., Daniele, G. M., Dinnella,
683 C., Gasperi, F., Endrizzi, I., Torri, L., Gallina Toschi, T., Bendini, A., Pagliarini, E., Cattaneo, C.,
684 Di Monaco, R., Vitaglione, P., Condelli, N., & Laureati, M. (2020). Gender, Age, Geographical
685 Area, Food Neophobia and Their Relationships with the Adherence to the Mediterranean Diet:
686 New Insights from a Large Population Cross-Sectional Study. *Nutrients, 12,* 1778.
687 https://doi.org/10.3390/nu12061778
688 49. Prescott, J., Soo, J., Campbell, H., Roberts, C. (2004). Responses of PROP taster groups to
689 variations in sensory qualities within foods and beverages. *Physiology & Behavior, 82,* 459–469.
690 50. Reicks, A.L., Brooks, J.C., Garmyn, A.J., Thompson, L.D., Lyford, C.L., Miller, M.F., (2011).
691 Demographics and beef preferences affect consumer motivation for purchasing fresh beef steaks
692 and roasts. *Meat Science, 87,* 403–411.
693 51. Ritzel, C., & Mann, S. (2021). The Old Man and the Meat: On Gender Differences in Meat
694 Consumption across Stages of Human Life, Conference, August 17-31, 2021, Virtual 315917,
695 International Association of Agricultural Economists.
696 52. Roberts, K., Cade J., Dawson J., Holdsworth, M. (2018) Empirically derived dietary patterns in
697 UK adults are associated with sociodemographic characteristics, lifestyle and diet quality.
698 *Nutrients 10,* 177. https://doi.org/10.3390/nu10020177.
699 53. Robino, A., Mezzavilla, M., Pirastu, N., La Bianca, M., Gasparini, P., Carlino, D., Tepper, B. J.
700 (2016). Understanding the role of personality and alexithymia in food preferences and PROP taste
701 perception. *Physiology & Behavior, 157,* 72–78.
702 54. Roininen, K., Lähteenmäki, L., & Tuorila, H. (1999). Quantification of consumer attitudes to
703 health and hedonic characteristics of foods. Appetite, 33, 71–88.
704 55. Saba, A., Sinesio, F., Moneta, E., Dinnella, C., Laureati, M., Torri, L., Peparaio, M., Saggia
705 Civitelli, E., Endrizzi, I., Gasperi, F., Bendini, A., Gallina Toschi, T., Predieri, S., Abbàh, S.,
706 Bailetti, Proserpio, L., Spinelli, S. (2019). Measuring consumers attitudes towards health and taste

and their association with food-related life-styles and preferences. *Food Quality and Preference, 73,* 25–37. https://doi.org/10.1016/j.foodqual.2018.11.017.

56. Sares-Jäske, L., Valsta, L., Haario, P., & Martelin, T. (2022). Population group differences in subjective importance of meat in diet and red and processed meat consumption. *Appetite, 169,* 105836
57. Schmid, A., Gille, D., Piccinali, P., Bütikofer, U., Chollet, M., Altintzoglou, T., Honkanen, P., Walther, B., & Stoffers, H. (2017). Factors predicting meat and meat products consumption among middle-aged and elderly people: evidence from a consumer survey in Switzerland. *Food & Nutrition Research, 61, 1,* 1308111.
58. Schwartz, S. H. (2003). A Proposal for Measuring Value Orientations across Nations. Chapter 7 in the Questionnaire Development Package of the European Social Survey. Website: http://www.europeansocialsurvey.org/index.php?option=com_docman&task=doc_view&gid=126&Itemid=80
59. Shen, Y., Kennedy, O.B., Methven, L. (2016). Exploring the effects of genotypical and phenotypical variations in bitter taste sensitivity on perception, liking and intake of brassica vegetables in the UK. *Food Quality and Preference, 50,* 71–81.
60. Siegrist, M., Hartmann, C., Keller, C. (2013). Antecedents of food neophobia and its association with eating behavior and food choices. *Food Quality and Preference, 30,* 293–298.
61. Simon, H., Simon, Z., Zatta, D., & Fassnacht, M. (2013). Price management. I: Strategia, analisi e determinazione del prezzo. 29, Milano. Italy: FrancoAngeli1–343.
62. Sobal, J., Bisogni, C. A., & Jastran, M. (2014). Food choice is multifaceted, contextual, dynamic, multilevel, integrated, and diverse. *Mind, Brain, and Education, 8,* 6–12.
63. Spencer, E.A., Appleby, P.N., Davey, G.K., Key, T.J. (2003). Diet and body mass index in 38000 EPIC-Oxford meat-eaters, fish-eaters, vegetarians and vegans. *International Journal of Obesity, 27,* 728-34. doi: 10.1038/sj.ijo.0802300.
64. Spinelli, S., De Toffoli, A., Dinnella, C., Laureati, M., Pagliarini, E., Bendini, A., Braghieri, A., Gallina Toschi, T., Sinesio, F., Torri, L., Gasperi, F., Endrizzi, I., Magli, M., Borgogno, M., di Salvo, R., Favotto, S., Prescott, J., Monteleone, E. (2018). Personality traits and gender influence liking and choice of food pungency. *Food Quality and Preference, 66,* 113-126.
65. Spinelli S., Dinnella C., Tesini F., Bendini A., Braghieri A., Proserpio C., Torri L., Miele N.A., Aprea E., Mazzaglia A., Gallina Toschi T., Monteleone E. (2020). Gender Differences in Fat-Rich Meat Choice: Influence of Personality and Attitudes. *Nutrients, 12,* 1374; doi:10.3390/nu12051374.

66. Tepper, B.J., Melis, M., Koelliker, Y., Gasparini, P., Ahijevych, K.L, Tomassini Barbarossa, I. (2017). Factors Influencing the Phenotypic Characterization of the Oral Marker, PROP. *Nutrients, 9,* 1275.
67. Timeo, S., & Suitner, C. (2018). Eating meat makes you sexy: Conformity to dietary gender norms and attractiveness. Psychology of Men & Masculinity, 19(3), 418–429. https://doi.org/10.1037/men0000119.
68. Torrubia, R., Ávila, C., Moltó, J., Caseras, X. (2001). The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) as a measure of Gray's anxiety and impulsivity dimensions. *Personality and Individual Differences, 31*, 837–862.
69. Tuorila, H., Lahteenmaki, L., Pohjalainen, L., & Lotti, L. (2001). Food neophobia among the Finns and related responses to familiar and unfamiliar foods. *Food Quality and Preference, 12,* 29-37.
70. Tuorila, H,. and Hartmann, C. (2020). Consumer responses to novel and unfamiliar foods. *Current Opinion in Food Science, 33,* 1–8.
71. van Strien, T., Frijters, J. E. R., Bergers, G. P. A., & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders, 5,* 295–315.
72. Verbeke W, & Vackier, I. (2003). Profile and effects of consumer involvement in fresh meat. *Meat Sci., 67,* 159-68. doi: 10.1016/j.meatsci.2003.09.017.

Figure captions

Fig. 1. Score (A) and correlation loading (B) plots for F1 and F2 of Internal Preference Mapping on liking ratings for 19 meat products in women.

Fig. 2. Score (A) and correlation loading (B) plots for F1 and F2 of Internal Preference Mapping on liking ratings for 19 meat products in men.

Fig. 3. Mean score of FRL questionnaire subscales (ws: ways of shopping; qa: quality aspects; cw: cooking ways; pm: purchasing motives) significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

Fig. 4. Mean score of HTAS questionnaire subscales (GHI: general health interest, NP: interest in natural products, RF: food as a reward; CS: craving for sweet foods) significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

Fig. 5. Mean score of DEBQ subscales significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

Fig. 6. Mean score of PVQ subscales and FN questionnaire significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

Fig. 7. Standardized regression coefficients from logit for women: factors driving the memberships to the cluster of Slightly likers (SLk) or Lovers (Lv). Model was computed coding Lv=0 and SLk=1; variables with negative regression coefficient positively associate with the Lv membership while variable with positive regression coefficient positively associate with the SLK membership.
* Indicates $P \leq 0.05$

Fig. 8. Standardized regression coefficients from logit for men: factors driving the memberships to the cluster of Slightly likers (SLk) or Lovers (Lv). Model was computed coding Lv=0 and SLk=1; variables with negative regression coefficient positively associate with the Lv membership while variable with positive regression coefficient positively associate with the SLk membership.
* Indicates $P \leq 0.05$

Figure

Click here to access/download;Figure;Figures 1-8 REV .pdf

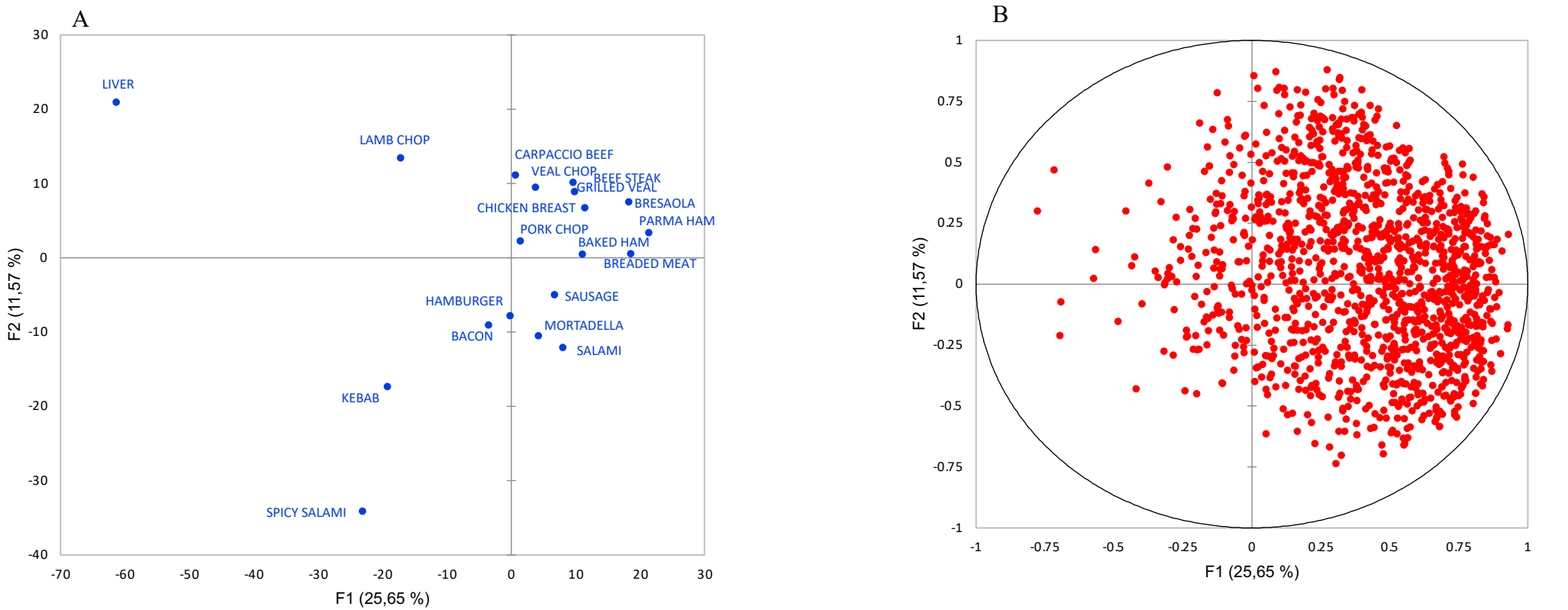

Figure 1. Score (A) and correlation loading (B) plots for F1 and F2 of Internal Preference Mapping on liking ratings for 19 meat products in women.

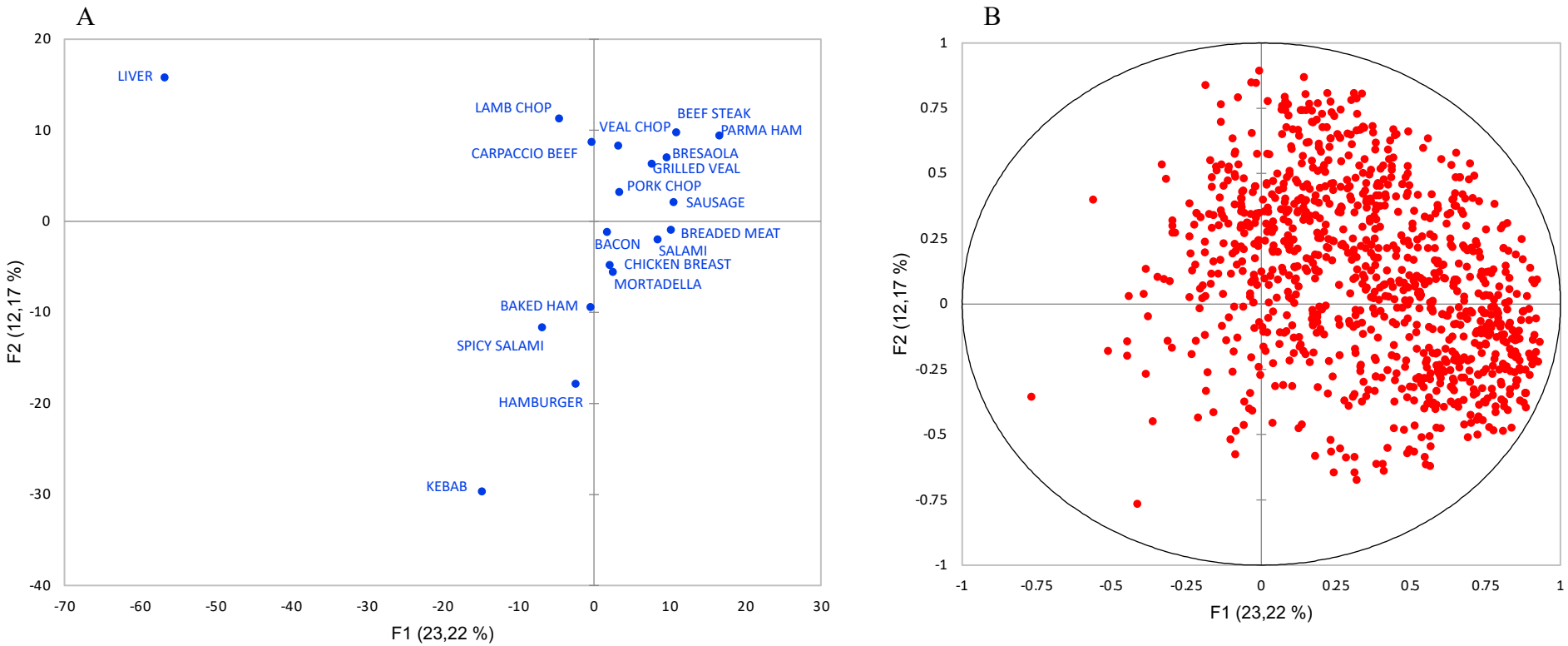

Figure 2. Score (A) and correlation loading (B) plots for F1 and F2 of Internal Preference Mapping on liking ratings for 19 meat products in men.

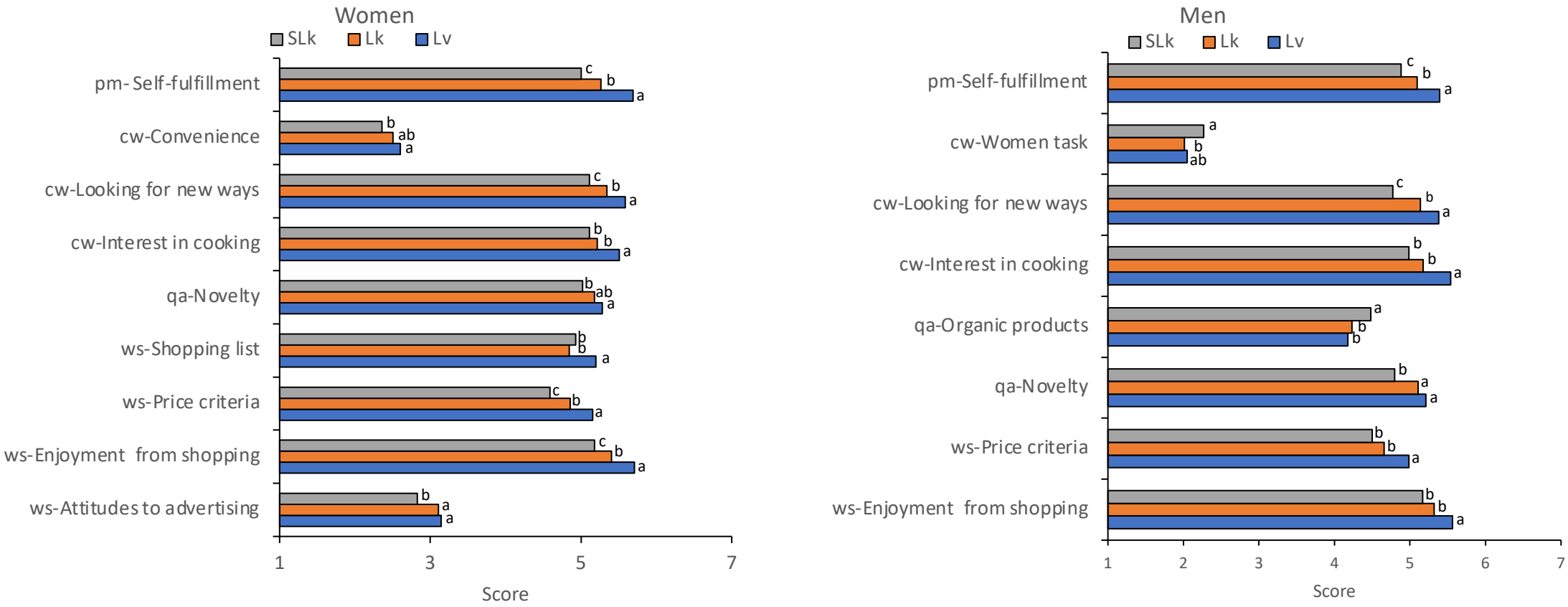

Figure 3. Mean score of FRL questionnaire subscales (ws: ways of shopping; qa: quality aspects; cw: cooking ways; pm: purchasing motives) significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

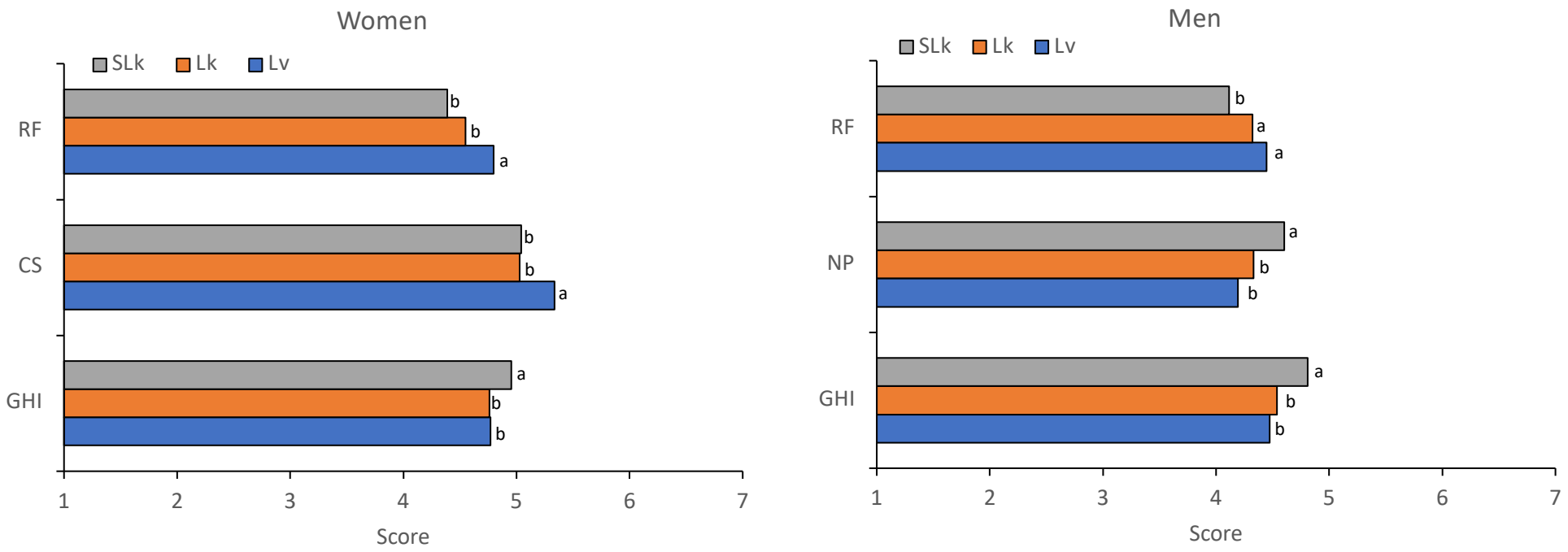

Figure 4. Mean score of HTAS questionnaire subscales (GHI: general health interest, NP: interest in natural products, RF: food as a reward; CS: craving for sweet foods) significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

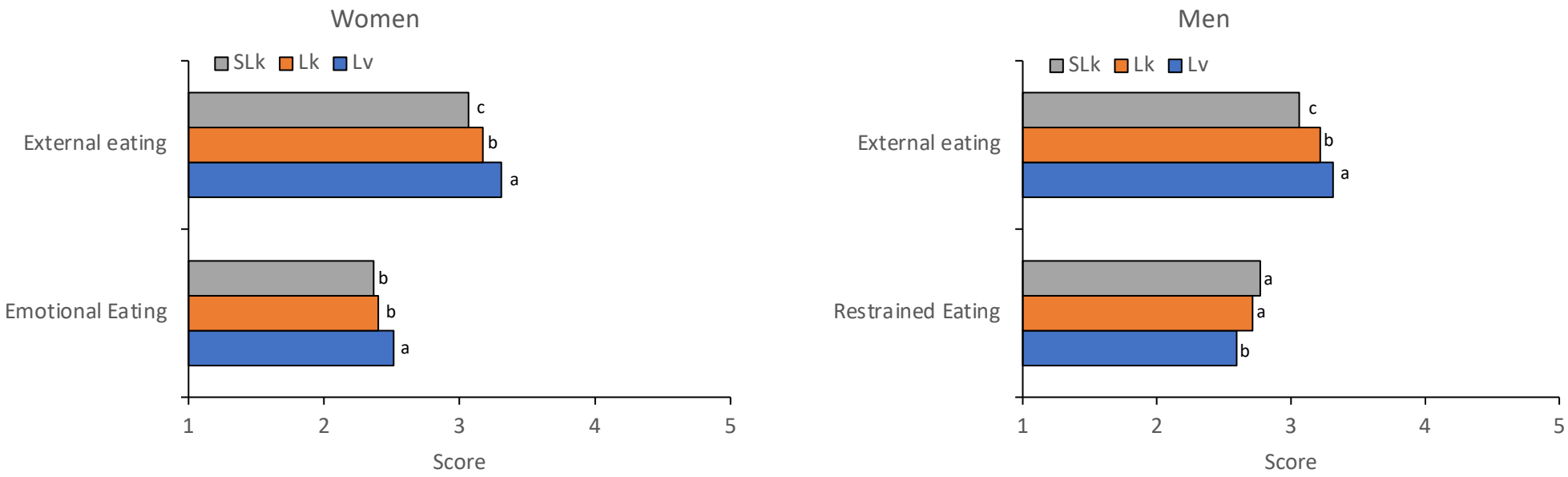

Figure 5. Mean score of DEBQ subscales significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

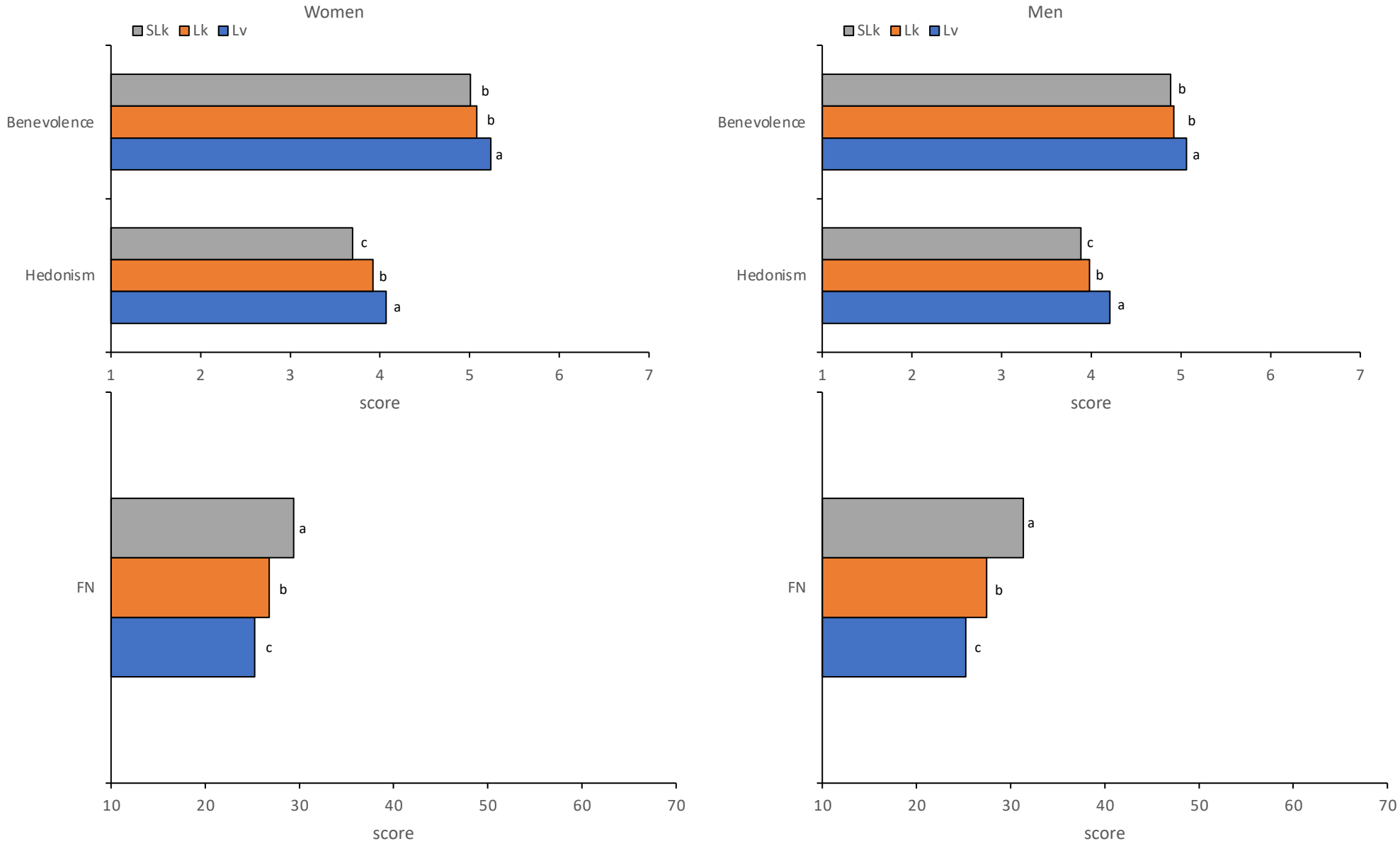

Figure 6. Mean score of PVQ subscales and FN questionnaire significantly differing across clusters (SLk: Slightly Likers; Lk: Likers; Lv: Lovers) in women and men. Different letters indicate significant differences ($p \leq 0.05$).

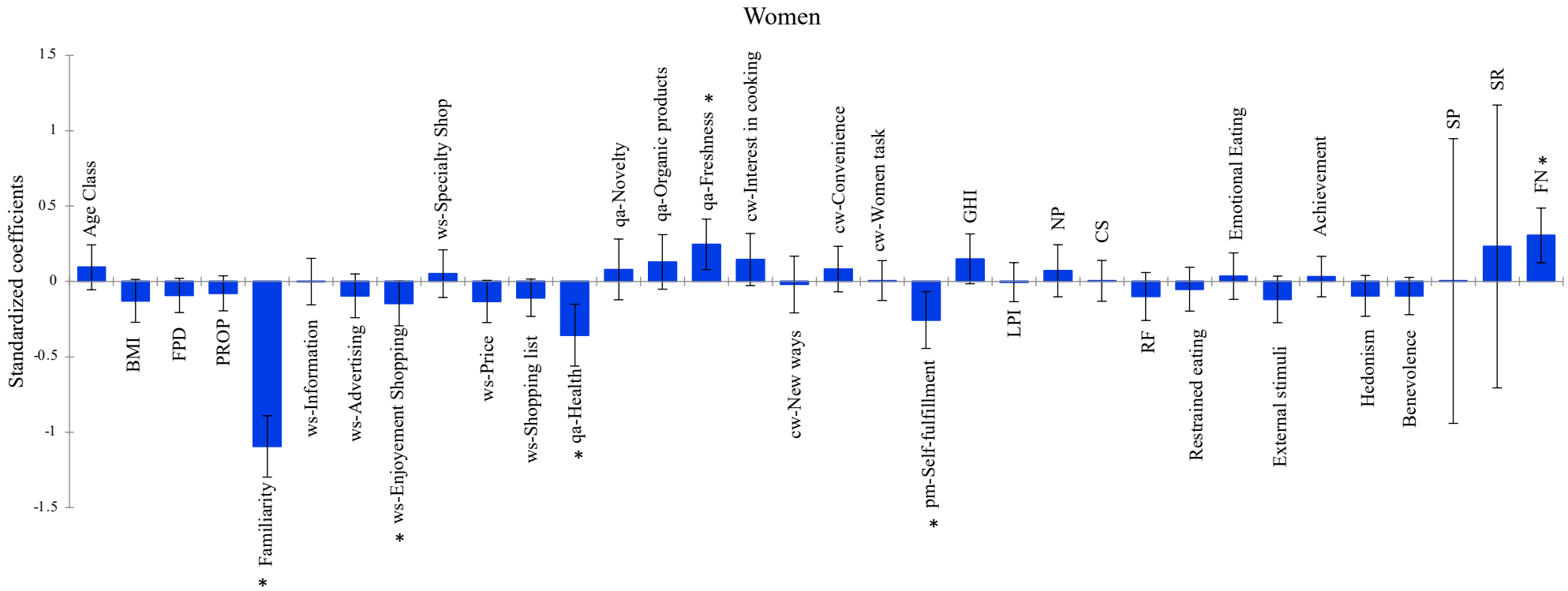

Figure 7. Standardized regression coefficients from logit for women: factors driving the memberships to the cluster of Slightly likers (SLk) or Lovers (Lv). Model was computed coding Lv=0 and SLk=1; variables with negative regression coefficient positively associate with the Lv membership while variable with positive regression coefficient positively associate with the SLK membership.

* Indicates $p \leq 0.05$

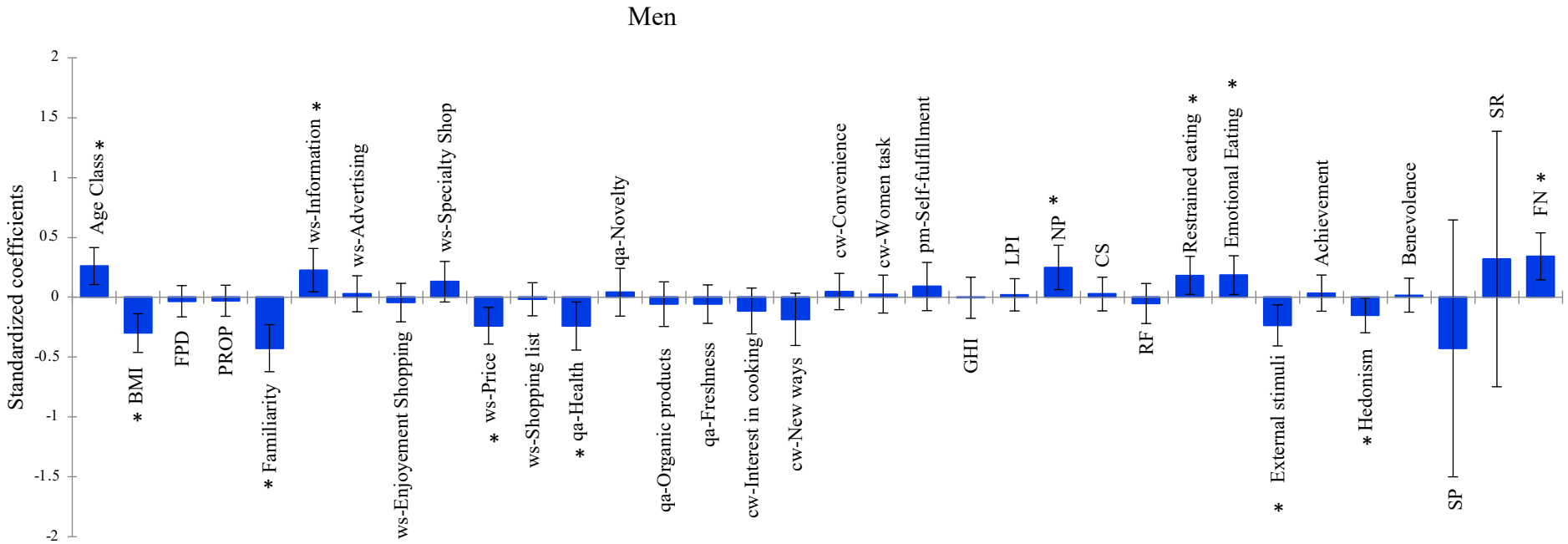

Figure 8. Standardized regression coefficients from logit for men: factors driving the memberships to the cluster of Slightly likers (SLk) or Lovers (Lv). Model was computed coding Lv=0 and SLk=1; variables with negative regression coefficient positively associate with the Lv membership while variable with positive regression coefficient positively associate with the SLk membership.

* Indicates $p \leq 0.05$

Table 1. Participant characterization: sociodemographic characteristics, self-reported health status and body mass index (BMI).

	Women (n=1383)	**Men** (n=1001)	**Total** (n=2384)
	%	%	%
Gender	58.01	41.99	100
Age class			
C1:18-30	37.74	40.16	38.76
C2: 31-45	28.63	26.87	27.89
C3: 46-60	33.62	32.97	33.35
Food allergies			
Yes	8.39	6.01	7.39
Food intolerances			
Yes	11.36	5.71	8.99
Chronic Diseases			
Yes	12.73	15.02	13.69
Health state			
1 Good	83.07	82.51	82.82
2 Fairly good	16.28	16.98	16.55
3 Bad	0.65	0.50	0.63
BMI (kg/m^2) [1]			
Underweight (<18.50)	6.30	1.00	4.08
Normal range (18.50–24.99)	70.91	55.21	64.33
Overweight (25.00–29.99)	16.28	34.97	24.12
Obese (≥30.00)	6.51	8.82	7.48

[1]Classification according to World Health Organization (WHO).

Table 2. Effects of gender, age and their interactions on stated liking for meat products (mean, F and p values). Significant effects are emboldened.

	Gender				Age class					Gender*Age	
	Mean Liking		F	p	Mean Liking			F	p	F	p
	M	W			C1	C2	C3				
Kebab	6.32a	5.86 b	23.25	< **0.0001**	6.43a	6.26a	5.58b	31.37	< **0.0001**	1.61	0.199
Hamburger	6.86a	6.57 b	13.36	**0.000**	7.45a	6.90b	5.79c	162.38	< **0.0001**	1.99	0.137
Lamb chop	6.99a	6.05 b	89.27	< **0.0001**	6.46	6.62	6.49	0.95	0.386	1.26	0.284
Pork chop	7.23a	6.72 b	48.53	< **0.0001**	7.16 a	6.95b	6.82b	8.47	**0.000**	1.67	0.189
Veal chop	7.29a	6.91 b	29.77	< **0.0001**	7.17a	7.20a	6.95b	4.95	**0.007**	2.32	0.098
Beef steak	7.75a	7.28 b	53.65	< **0.0001**	7.62a	7.56a	7.33b	8.27	**0.000**	2.57	0.077
Beef carpaccio	7.16a	6.72 b	28.28	< **0.0001**	7.07a	7.02a	6.72b	7.02	**0.001**	3.33	**0.036**
Bresaola	7.55	7.61	0.63	0.428	7.56	7.69	7.50	2.07	0.126	2.32	0.098
Grilled veal	7.44a	7.12 b	21.85	< **0.0001**	7.46a	7.37a	7.01b	16.89	< **0.0001**	0.14	0.867
Breaded meat	7.63	7.71	1.63	0.201	7.93a	7.68b	7.40c	25.02	< **0.0001**	3.40	**0.033**
Chicken breast	7.14b	7.23a	5.52	**0.019**	7.45a	7.24b	6.94c	24.43	< **0.0001**	1.10	0.333
Sausage	7.59 a	7.08 b	51.84	< **0.0001**	7.43a	7.46a	7.12b	9.47	< **0.0001**	0.41	0.666
Liver	5.39a	4.56b	47.99	< **0.0001**	4.76b	4.89b	5.28a	7.44	**0.001**	6.00	**0.003**
Mortadella	7.16a	6.93b	7.92	**0.005**	6.97	7.19	6.98	2.99	**0.050**	0.93	0.396
Parma ham	8.03	7.95	1.98	0.159	7.84b	8.17a	7.96b	10.47	< **0.0001**	0.33	0.715
Bacon	7.16a	6.51b	71.54	< **0.0001**	6.98a	6.92a	6.60b	9.66	< **0.0001**	2.55	0.079
Spicy salami	6.74a	5.63b	131.55	< **0.0001**	6.15ab	6.37a	6.03b	4.01	**0.018**	1.83	0.160
Baked ham	6.99b	7.19a	8.42	**0.004**	7.23a	7.22a	6.79b	20.30	< **0.0001**	0.19	0.829
Salami	7.49a	7.09b	29.22	< **0.0001**	7.23ab	7.42a	7.15b	4.32	**0.013**	0.25	0.782

Different letters by raw indicate significantly different values ($p \leq 0.05$) in gender or age classes.

Table 3. Descriptive statistics of liking data of women, men and derived clusters based on limits of percentile distributions.

	Women				Men			
	Total	Slightly Likers	Likers	Lovers	Total	Slightly Likers	Likers	Lovers
Observations n	1380	349	689	342	998	259	499	240
Minimum	1.00	1.00	6.18	7.53	1.26	1.26	6.71	7.83
Maximum	9.00	6.17	7.53	9.00	9.00	6.68	7.79	9.00
1st Quartile	6.17	5.00	6.63	7.73	6.68	5.68	7.00	8.00
3rd Quartile	7.53	5.89	7.21	8.32	7.79	6.47	7.53	8.42
Median	6.89	5.58	6.94	7.95	7.26	6.22	7.28	8.16
Mean	6.78	5.30	6.91	8.04	7.15	5.93	7.27	8.22

Table 4. Effect of age class (C1, C2 and C3), cluster (Slightly likers, Likers and Lovers) and their interactions on Body Mass Index (BMI) and on familiarity score (mean and p-values). Significant effects are emboldened.

	Women		Men	
	mean	p-values	mean	p-values
BMI				
Age class				
C1	22.01[c]		23.57[c]	
C2	22.92[b]		25.56[b]	
C3	24.62[a]	**<0.0001**	26.48[a]	**<0.0001**
Cluster				
Slightly Likers	22.50[b]		24.55[b]	
Likers	22.99[b]		25.06[b]	
Lovers	24.05[a]	**<0.0001**	25.99[a]	**<0.001**
Age*Cluster		0.064		0.579
Familiarity score (range 19-95)				
Age				
C1	73.21[b]		75.79	
C2	75.59[a]		75.88	
C3	73.76[b]	**0.000**	75.33	0.570
Cluster				
Slightly Likers	68.66[c]		71.49[c]	
Likers	75.02[b]		76.59[b]	
Lovers	78.88[a]	**<0.0001**	78.82[a]	**<0.0001**
Age*Cluster		0.756		0.570

Different letters by column indicate significantly different values ($p \leq 0.05$)