

The assessment of consumer sensitivity to animal welfare: An application of Rasch Model

by Enrico Gori*, Ting Fa Margherita Chang**, Luca Iseppi***, Beniamino Cenci Goga****, Maria Francesca Iulietto*****, Paola Sechi***** and Maria Antonietta Lepellere*****

Abstract

The sensitivity has become a mass phenomenon, still in expansion. The European Commission, during last decade, carried out several surveys on food quality and animal welfare. This research, using data from a survey conducted on 320, respondents and applying the Rasch model on 14 selected questions (items), wants to develop a measure that appears representative of a latent variable defined as ‘Sensitivity towards Animal Welfare’. The ability to measure the individual level of this ‘Sensitivity’ therefore represents an interesting and important result, especially if there are correlations between this variable and other variables characterizing the opinions and habits of individuals, both in general and in relation to consumer decisions.

Key words: animal welfare, Rasch Model, Rasch-Andrich Thresholds, consumer behavior, consumption, sensitivity.

* University of Udine, Department of Economic and Statistic Science, Via F. Tomadini, 33100 Udine, Italy, 0432-249312. E-mail: enrico.gori@uniud.it.

** University of Udine, Department of Agricultural, Food, Environmental, and Animal Sciences, Via delle Scienze, 206, 33100 Udine, Italy, 0432-558316.

*** University of Udine, Department of Agricultural, Food, Environmental, and Animal Sciences, 206, 33100 Udine, Italy, 0432-558305.

**** University of Perugia, Department of Veterinary Medicine, Via S. Costanzo, 4, 06126 Perugia, Italy, 075-5857929.

***** University of Perugia, Department of Veterinary Medicine, Via S. Costanzo, 4, 06126 Perugia, Italy, 075-5857935.

***** University of Perugia, Department of Veterinary Medicine, Via S. Costanzo, 4, 06126 Perugia, Italy, 075-5857934.

***** University of Udine, Department of Agricultural, Food, Environmental, and Animal Sciences, Via delle Scienze, 206, 33100 Udine, Italy, 0432-558081.

Riassunto

La valutazione della sensibilità del consumatore al benessere animale: un'applicazione del modello di Rasch

La sensibilità nei confronti degli animali è diventata un fenomeno di massa, in continua espansione. La Commissione europea, nel corso dell'ultimo decennio, ha svolto diverse indagini sulla qualità degli alimenti e sul benessere degli animali. Questa ricerca, utilizzando i dati di un sondaggio condotto su 320 soggetti e applicando il modello di Rasch su 14 domande selezionate, vuole sviluppare una misura che sia rappresentativa di una variabile latente definita come "Sensibilità verso il benessere degli animali". La possibilità di misurare a livello individuale questa "sensibilità" rappresenta quindi un risultato interessante e importante, soprattutto se ci sono correlazioni tra questa variabile e altre variabili che caratterizzano le opinioni e le abitudini degli individui, sia in generale che in relazione alle decisioni dei consumatori.

Parole chiave: benessere animale, Modello di Rasch, Soglie di Rasch-Andrich, comportamento del consumatore, sensibilità.

1. Introduction and objectives

As early as 1840, the sensitivity towards animals was a valid reason to found associations that dealt with their welfare and to report to the public any mistreatment. This sensitivity, developed both in Europe and overseas, should have to wait more than a century to be successful as a mass phenomenon, still expanding today. The UK was the first country in the world to implement laws to protect animals. The first act dates back to 1822 and it concerns the animal welfare. The British government has thus laid down that animals are sentient beings and confirmed its commitment to the highest standards of animal welfare. The Animal Welfare Act, a revision of laws to protect animals which replaced the previous, came into force in England and Wales in 2007. In parallel, the European Commission (EC) pointed out as "Farm animal welfare is an emotional issue surrounding the consumption of meat and its protection is important to European citizens" (EC, 2007). The formal discipline that deals with animal welfare has always been passed by the British Government with Brambell, 1965 Report (see also Carenzi and Verga, 2009). In the report are identified "five freedoms" that need to be insured to animals related to health: the physical environment, fear and stress, and the manifestation of behaviors. But the demand for welfare-friendly products has increased in recent years. The EC, during last decade, carried out several surveys on food quality and, on detail, the Eurobarometer

survey in 2006 demonstrated an evident consumers' interest in animal welfare friendly products (Sechi et al., 2015).

Not surprisingly that scholars talk about Ecological hoofprint as a way to conceptualize the large, growing and uneven biophysical imbalance of global animal production (Weis, 2010: 138) starting from the use of cereals and oil seeds in feed to continue with the inefficiencies of the feed in food processing cycle, to finish with the increasing impacts that the expansion of that production has on world hunger (land use for energy production vs. the food), landscape, and on the availability of water and the atmosphere. Last but not least "... the nature of factory farming points deeper into the systematized violence of capitalist industrial agriculture" including animal productions (Weis, 2010: 139; Rifkin, 2008).

A recent European Slow Food survey showed the consumer concern about the impact on human health and on the environment of the production and consumption of meat (in almost 80% of respondents), but also ethical reasons have an important place in individual decisions in relation to meat consumption and animal welfare (Slow Food, 2013). Ninety per cent of respondents are willing to pay more for animal-friendly products and change the store to buy them even though the labels often do not allow the consumer to make informed choices. Two attitudes that should encourage producers to change their farming practices and retailers to make room for animal welfare friendly products.

The methodology of the questionnaire was also used for a Community project called Welfare Quality (Special Eurobarometer, 2005, 2006 and 2007). The survey was carried out by TNS Opinion and Social, interviewing face-to-face 29,152 citizens in 25 member states and four accession and candidate countries between 6 September and 10 October 2006 (Toma et al., 2012).

In order to investigate the attitudes of consumers to ensure welfare to the farmed animals, it was prepared a questionnaire (52 questions) using the GoogleForms application, made accessible on-line (GoogleFor, 2016).

Food consumer is considered someone who is in charge or involved in buying food, preparing and/or eating food products. The survey was mainly related to the subgroup of consumers practicing food shopping and responsible of choices at the food market. The overall aim is to explore the attitude which drives consumers choices to prefer buying some foods. To effectively understand the data, it has to be considered that 'consumers' are an heterogeneous group with a high purchase variability. Food consumers' choices may reflect national cultural background, local attitudes and more specific characteristics of regions and socio-economic groupings; this aspect make

impossible to infer or generalise results. In addition, nowadays, consumers' choices could frame a political and ethical message moving to a new state of consumers as political agents. In a market with the widest range of choices, the consumers becomes responsible for products to buy (Harrison et al., 2005). The ethical consumption is clarified in Singer and Mason's (2006) book: *The Ethics of What we Eat*. What arises from this book is that American consumers most worrying risk is lack of information about the realities of 'industrial' farming practices and that this is precluding ordinary consumers from requesting for more 'ethically' produced foods while in Europe, consumers are more ethically involved. The debate on consumption practices tries to define the consumers as 'repetitive' or 'intuitive' (Hermes, 1993) or 'rational' (Miller et al., 1998; Glennie and Thrift, 1995) or 'critically reflexive' (Singer and Mason, 2006) or 'ordinary', referring to the advantages and disadvantages of all their purchases. This is why it is necessary to define not only what information are available to consumers but also *how* consumers could gather the required information for their choices.

A previous study, based on the same questionnaire, states that: "Among the totality, 62% of the people involved in the questionnaire expressed their willingness in buying high welfare animal-based products" (Cenci Goga, Fermani, 2010). From this analysis it appears that the sensitivity to animal welfare is very correlated with the levels of knowledge of the living conditions of the animals and with the weekly consumption of meat. Such predisposition becomes extremely representative of the attitude (critical) of consumers in respect of the trade in meat and their derivatives. The centerpiece of the discourse is that to improve the sensitivity to animal welfare is necessary to increase the knowledge of all aspects related to both the production-processing and distribution chain and the impacts that large-scale industrial production of meat, milk and animal products can determine on the environment and on the territory (Chang et al., 2014).

From the questionnaire were extracted 14 items and applied to them the Rasch method in order to develop a measure that appears representative of a latent variable defined as "Sensitivity towards Animal Welfare" (SWA). The ability to measure the individual level of SWA therefore represents an interesting and important result, especially if there are correlations between this variable and other variables characterizing the opinions and habits of individuals, both in general and on that of the consumer decisions. The fact that the SWA measured is highly correlated, for example, with the amount of meat consumed shows the external validity of the identified measure, while the construct validity is connected to the good adaptation to Rasch model.

2. Materials

The sample of the questionnaire was composed of 320 persons whose age and sex distribution is reported in Table 1.

Table 1 – Distribution of the sample by gender and age

	Number	Age <30	30 ≤Age≤50	50≤Age≤60	Age > 60
Female	192	127	50	12	3
Male	128	57	14	22	9
Total	320	184	64	34	12

The nationality of the subjects was 97% Italian, the educational qualification most frequent was the university degree (49.5%) followed by the high school graduation (34.2%). In the sample the family organization was the following: 41.1% married or cohabiting; 32.3 single; 26.6% other. Regarding employment, the sample presented this distribution: 36.1% employee; 16.9% freelance/self-employed; 30.1% student; 9.7% unemployed; 1.9% retired; 5.3% others.

The questionnaire is divided into four sections: a) the first is dedicated to the background of the consumer; b) the second focuses on knowledge of animal welfare and on the purchasing behavior of respondents with special attention to the conditions under which animals are kept, the perception of animal welfare, and the judgment of the consumer of the so-called animal welfare friendly products; c) the third section is concerned with the religious slaughtering. The definition of traditional slaughter was needed to permit even those who weren't aware of the different existing methods of slaughter to respond to questions about ritual slaughter; d) the last section was left open for any ideas or comments. In the first section the consumer's level of knowledge was outlined in a series of ten questions on general information, level of education, household composition, employment, and religious orientation. These questions allowed us to define the type of consumers and separate them into two categories: ordinary and ethically competent consumers.

The answers to the questions have been coded according to an ordinal scale (1, 2, 3, 4 ...) that associates the lowest values of the response score to the lowest level of SWA, while the highest values to those response score denotes on the contrary a highest degree of SWA.

The goodness of the adopted coding, as well as from the theoretical point of view, has been verified through analysis of the correlation between encodings and estimated measures (which must be positive) and through the good

ordering of the thresholds of Andrich (1978), for our case of polytomic encodings. In addition to each question some indices and characteristic plots are given that represent the goodness of the model fit.

3. Method: Rasch models as basis for Fundamental Measurement

Campbell (1920) showed that scientific measurement requires an ordering system and the kind of additivity illustrated by physical concatenation. Campbell called this “fundamental measurement”. Thurstone (1927), with his Law of Comparative Judgment produced results that are successful instances of fundamental measurement. The concept of order and additivity recurs in Guilford’s (1936) definition of measurement. The main consequence of additivity is the maintenance of the unit of measurement and hence of the invariance of comparisons of measures across the scale. Guttman (1950) formulated a criterion for judging whether data were good enough to build a scale. The data must demonstrate a joint order shared by items and persons. The Danish mathematician Georg Rasch (1960) found that he could obtain an invariance of test item characteristics over variations in persons only if the function through which persons and items interact has linear form (Rasch, 1960: 120). Such property is known as specific objectivity: the comparison between two stimuli should be independent of which particular individuals were instrumental for the comparison; and it should also be independent of which other stimuli within the considered class were or might also have been compared. Symmetrically, a comparison between two individuals should be independent of which particular stimuli within the class considered were instrumental for the comparison; and it should also be independent of which other individuals were also compared, on the same or some other occasion. Rasch showed that invariance could be maintained only when data satisfy a probability response model:

$$(1) \text{ Dichotomous Rasch model: } \ln \left(\frac{P(X_{ij} = 1)}{P(X_{ij} = 0)} \right) = \alpha_i - \beta_j, \quad X_{ij} \in \{0,1\},$$

where X_{ij} is the response of person I to item j , α_i is the ability” of the person (level of the latent trait), and β_j is the difficult of the item (expressed on the same scale of the latent trait), that produce a joint order of response probabilities similar to the joint order defined by Guttman (Rasch, 1960, p. 117).

Rasch discovered that the minimally sufficient statistics from which to estimate person and item measures were simply the unweighted sums of right answers for persons and for items, which is the score. Later on Luce and Tukey (1964) introduce the concept of “conjoint measurement” and showed that it could produce results that satisfy Campbell’s fundamental measurement: in particular, the way to produce such kind of measurement is to gather data (items and persons) such that the 'effects' of different factors are additive (p. 4). The Rasch’s models can do exactly this as shown by Perline et al. (1979). Subsequently Andersen (1977) showed that the sufficient statistics, which allows the Rasch model for dichotomously scored items to produce fundamental measurement, may be extended to response formats with more than two ordered categories (Andrich, 1978; Wright and Masters, 1982):

$$(2) \text{ Rating Scale model: } \ln \left(\frac{P(X_{ij} = k)}{P(X_{ij} = k - 1)} \right) = \alpha_i - \beta_j - \tau_k,$$

$$X_{ij} \in \{0, 1, 2 \dots K\},$$

where τ_k is a “threshold” that measure the difficulty to reach category k , identical for every item

$$(3) \text{ Partial Credit model: } \ln \left(\frac{P(X_{ij} = k)}{P(X_{ij} = k - 1)} \right) = \alpha_i - \beta_j - \tau_{jk},$$

$$X_{ij} \in \{0, 1, 2 \dots K\}$$

where τ_{jk} is a “threshold” that measure the difficulty to reach category k for the item j .

In particular Andrich Threshold is an estimate of the Rasch-Andrich model parameter, F_j . Use this for anchoring in Winsteps. (This corresponds to F_j in the $D_i + F_j$ parametrization of the “Rating Scale” model, and is similarly applied as the F_{ij} of the $D_{ij} = D_i + F_{ij}$ of the “Partial Credit” model.) The bottom category has no prior transition, and so that the measure is shown as NONE. This parameter, sometimes called the Step Difficulty, Step Calibration, Rasch-Andrich threshold, Tau or Delta, indicates how difficult it is to observe a category, not how difficult it is to perform it. The Rasch-Andrich threshold is expected to increase with category value. Disordering of these estimates (so

that they do not ascend in value up the rating scale), sometimes called “disordered deltas”, indicates that the category is relatively rarely observed, i.e., occupies a narrow interval on the latent variable, and so may indicate substantive problems with the rating (or partial credit) scale category definitions. These Rasch-Andrich thresholds are relative pair-wise measures of the transitions between categories. They are the points at which adjacent category probability curves intersect. They are not the measures of the categories.

The Rasch models are the formal measurement model required to construct fundamental measurement from dichotomous or ordinal data. In particular, the matrix of expected response probabilities table derived from any set of Rasch item and person estimates will satisfy fundamental measurement axioms as defined by Guttman scaling (1950). Because Rasch models satisfy fundamental measurement axioms, the key point in any application is if data adhere “sufficiently” to the model. Although the procedures for determining whether the matrix of actual response frequencies adheres sufficiently to the Rasch expected response probabilities are still an open problem (Bond, 2003; Linacre, 2009) the possibility of this comparison allows, in principle, to reject the theory on which data are collected and items constructed: that is the theory relative to the problem considered (construction of an ability scale, depression scale and so on). This allows what Carl Popper (1934) calls “falsifiability” of a theory, a fundamental requisite to build scientific theories. Under this respect Rasch models are scientific twice: firstly, because they are the only one that satisfy fundamental measurement axioms and secondly because they provide a way (comparison between actual frequencies and expected response probabilities) to falsify the theory used to build the measurement. Therefore, we may say that other approaches to construct measurement are not scientific: the axioms of fundamental measurement are routinely violated for example in IRT models (Karabatsos, 1999a, b; 2000), and True Score model (Allen, Yen, 2002) is not falsifiable.

4. Results

The Rasch model, using 14 items Y13, Y17, Y21, Y24, Y29, Y30, Y33, Y36, Y38, Y40, Y41, Y47, Y50 and Y53 corresponding to questions 31, 17 and so on (see the Appendix at the end for the list) selected from the questionnaire, allowed us to get the measure of a latent variable defined SWA. This variable is correlated with the levels of knowledge of the living conditions of animals and improves with the increase of information on animal husbandry systems.

The possibility of measuring the level of the individual SWA is therefore an important result, especially in the case in which there is correlation between the SWA and other variables that characterize the opinions and habits of individuals. No differential item functioning was observed by age or sex.

The external validity of the SWA is demonstrated by its correlation with the choices and opinions of individuals as consumers: particularly with the increase of the SWA the weekly consumption of meat is reduced to the point that the highest levels of the SWA are associated to the total absence of consumption of such property; high levels of the SWA are also indicative of a critical attitude towards the market and of the food chain (including processing and trade) of meats and their derivatives (Chang et al., 2015). Construct validity is related to the good fit to the Rasch model.

The validation of the model relies on the goodness of fit indices, on the reliability indices and Cronbach α , on the unidimensionality of the construct that is demonstrated by the principal component analysis of standardized residuals. Moreover, the model is validated by the ranking of the items and its agreement with what can be expected, in fact in Tab. 2 obtained by Winsteps Software are presented the difficulty parameters estimated for the different applications in descending order of difficulty.

Table 2 – Estimated parameters of difficulty for different items

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	MNSQ	INFIT ZSTD	OUTFIT ZSTD	PTMEASUR-CORR.	AL-EXP.	EXACT OBS%	MATCH EXP%	ITEM	G	
4	548	269	2.28	.13	1.15	1.7	1.16	1.7	.53	.61	67.7	69.3	Y24	0
7	579	269	1.77	.13	1.09	1.0	1.09	1.0	.55	.60	68.5	70.4	Y33	0
3	771	269	1.58	.09	.92	-.9	.91	-1.1	.72	.69	53.8	52.6	Y21	0
11	842	269	.65	.12	1.06	.7	1.04	.5	.60	.62	65.8	65.6	Y41	0
5	887	269	.58	.10	.94	-.6	.86	-1.3	.65	.62	61.2	60.8	Y29	0
14	489	269	.36	.18	1.09	1.0	1.05	.3	.36	.41	81.2	83.3	Y52	0
10	493	269	.23	.18	1.07	.7	1.04	.3	.36	.40	83.5	84.4	Y40	0
13	495	269	.16	.19	1.11	1.0	.97	.0	.35	.39	82.7	85.0	Y50	0
6	700	269	-.33	.14	.91	-1.2	.85	-1.3	.57	.52	75.4	72.3	Y30	0
2	693	269	-.42	.14	.88	-1.7	.80	-1.9	.59	.52	74.2	71.9	Y17	0
12	510	269	-.45	.22	.94	-.4	.66	-.9	.38	.34	90.4	89.8	Y47	0
1	982	269	-.81	.13	.91	-.9	.83	-1.0	.55	.51	74.2	73.0	Y13	0
8	525	269	-1.41	.30	1.10	.5	.70	-.5	.23	.25	94.6	95.1	Y36	0
9	537	269	-4.18	1.01	.97	.3	.12	-2.0	.13	.08	99.6	99.6	Y38	0
MEAN	646.5	269.0	.00	.22	1.01	.1	.86	-.4			76.6	76.6		
P.S.D	160.4	.0	1.52	.23	.09	1.0	.25	1.0			12.5	12.9		

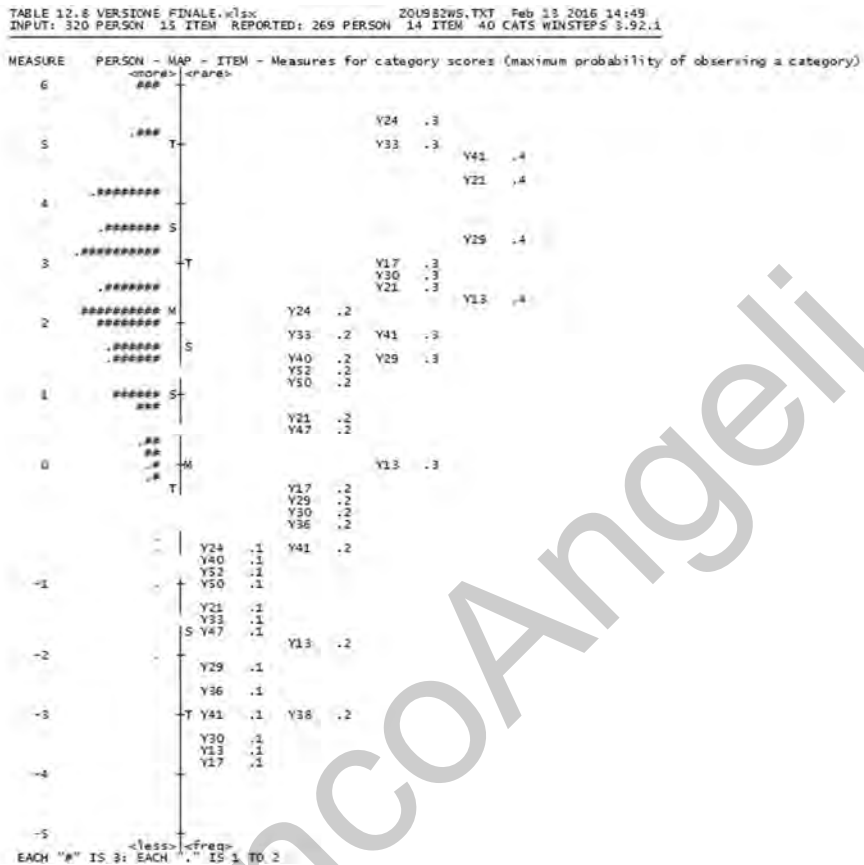
The more “difficult” item, with respect to which a response with high levels denotes greater SWA (see the column MEASURE and the column item of Tab 2), is the question 24 – When purchasing eggs, these originate for the most part from breeding hens: (higher code linked to the response “in organic breeding”), which presents a SWA parameter equal to 2.28; followed immediately afterwards by the question 33: Currently in stores and supermarkets, do you think that there is a sufficient choice of “welfare friendly” foods for consumers, with SWA parameter 1.77. Conversely the easiest item is the 38 – Would you buy animal products with higher animal welfare standards? The SWA parameter is – 4.18 indicating that answer “yes” to this question is very easy: in fact, just one person answers “no”.

Regarding the Table 2, the meaning of the information contained in the columns is the following: 1- ENTRY NUMBER, the number of the item; 2- RAW SCORE, the number of respondents answered correctly; 3- COUNT, the number of respondents who Answered to item (right/wrong); 4- MEASURE, the measure of difficulty calculated by the model of Rasch (in the table the items are sorted in descending order of difficulty); 5- S.E., standard error of the measure of difficulty; 6- INFIT and 7- OUTFIT give two basic statistics for the diagnostics of the Rasch model because they are based on the comparison between the observed responses of each individual to each item of the test and the expected responses based on the Rasch model; 8- PTMEASUR, index of point-biserial correlation between the score and the response. A significant correlation of each item with the score, assuming that all the items measure a single skill, is expected, as it was assumed in the Rasch model; 9- ITEM, labels of standardized items cataloged in the library.

In the case of this research, at least two of the thresholds required for these indexes are met: PTMEASURE > 0.4 , with INFIT and OUTFIT from 0.6 to 1.4, and ZSTD between -2 and 2.

Using Winsteps Software it was also possible to obtain an “item-map” (Fig. 1). It shows on a single graph and on the same SWA scale the locations of individuals and in particular their distribution, and the different modes of response to different items.

Figure 1 – The Pearson-Item Map



In Figure 1, the real axis in logit unit is placed at the center; the histogram distribution (the # symbol corresponds to 3 subjects) on the ability of the subjects (on the top of the most skilled individuals) appears on the left; the estimates, of the thresholds of difficulty (the suffix .1 denotes the transition from 0 to 1 response, the suffix .2 from category 1 to 2 and so on) for each item, they are placed on the right side. For example, Y24.3 shows the SWA level associated with that response (D24 - When you purchase the eggs, they originate for the most part from breeding hens: 3 – “in organic farming”) that is placed around a SWA level approximately equal to 5.5. At this level, the probability of responding with 3 to Question 24 is maximum.

As can be seen from Figure 1 the distribution of the individuals is moved much higher up than that of the items. This means that in order to obtain a

better estimate of the extent of the latent variable (SWA) it would be appropriate to be able to identify items with a higher level of difficulty that are able to denote high levels of SWA. For example, you could include questions like, “Would you be willing to adopt an abandoned animal?” Or “Would you be willing to adopt a disabled animal?” Probably the insertion of this kind of item may improve the accuracy of the measurements especially at the higher levels of SWA. The correlations between SWA and the items are all positive as shown and they range from .54 to .85.

In Figure 2 you will be shown for each question some indices and characteristic graphs showing the goodness of the model fit. In the attached tables, in addition to the absolute frequency and percentage of the various codes, the average value (estimated) of the SWA is calculated for individuals who have used the respective code to answer the question.

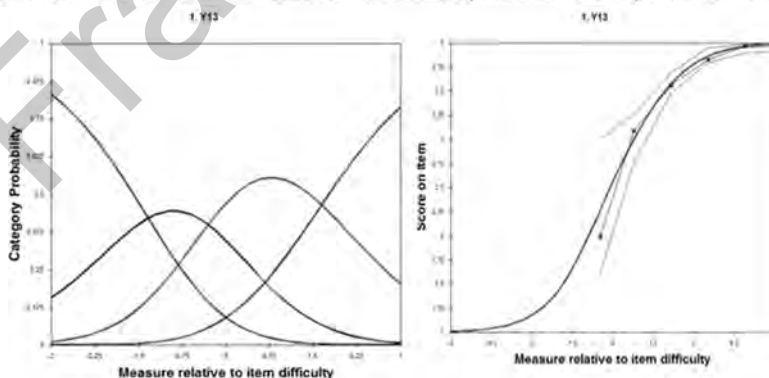
Figure 2 – Analysis of the Question 13

D13		cod ord	
Would you like to be more informed about the conditions under which animals are bred?			
No, certainly		1	1
No, probably		2	2
Yes, probably		3	2
Yes, certainly		4	3

ITEM DIFFICULTY MEASURE OF -.74 ADDED TO MEASURES

CATEGORY LABEL	OBSERVED SCORE	OBSERVED COUNT	OBSERVED %	SAMPLE AVRGE	EXPECT	INFINIT MNSQ	OUTFIT MNSQ	ANDRICH THRESHOLD	CATEGORY MEASURE
1	1	2	1	-1.44	-.59	.46	.37	NONE	(-3.38)
2	2	13	5	.37	.22	1.11	1.29	-1.34	-1.64
3	3	75	26	1.19	1.22	.92	.74	-.31	.04
4	4	196	69	2.64	2.64	1.06	1.03	1.64	(2.10)

OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.



Category probability curves illustrating the range over which each of the four categories is most likely to be chosen.

For example, for Question 13 - Would you like to be more informed about the conditions in which animals are bred? code 1 (associated with the “no answer, certainly”) has been used by individuals whose average SWA (estimated) is equal to - 5.2 (out of a total average 2.44), while the code 4 associated with the response “yes, certainly” has been used by individuals with an average SWA of 2.78.

The achievement of a good level of animal welfare is a shared need by the majority of Italian and European consumers to which increasing attention is being given (Bertoni, 2016). The concept of animal welfare, although it is not precisely defined, it is very often linked to sustainability, biodiversity and health issues. In recent years in many European countries, it was found that as the number of pet animals increased the number of people who abandoned or reduced meat consumption also increased. What are the causes that led to a reduction in the consumption of animal products (meat, milk, cured meats)? The reasons for the sharp decrease of meat consumption are varied: cultural reasons and new trends, such as meat-free diets. The meat-free diets are partly at the base of the food choices especially of classes with more disposable income, while for the poorer sections, there is a clear prevalence of other factors, including the economic factor certainly (Censis, 2016). The savings drives low-income families not to purchase the basic protein foods. A survey (Censis, 2016) reports that 16.6, 10.6 and 3.5 million of Italians in 2016 have reduced the consumption of meat, fish, and fresh fruits and vegetables respectively.

At present Italy is the third largest beef producer in European Union ranks second as far as the per capita consumption, preceded only by France. From the point of view of the trade balance, however, Italy appears as a net importer of beef: the self-sufficiency rate is only about 60%. According to the latest ISMEA-Nielsen data (Consumer Panel), in 2015 household spending for the purchase of fresh beef has marked a drop of more than 6.5% yearly. In direct comparison with 2013, the spending on fresh bovine meat consumption in 2015, it was down 12% partially replaced by imports of frozen meat. Reducing meat consumption in recent years has been accompanied also by the reduction in milk consumption. From 2012 to today the drinking milk consumption in Italy fell by 220 million liters, and in the alone 2015 of 35 million (ISMEA 2016). This decrease depends upon dietary reasons, but also from ethical reasons. An increasing part of the population thinks that milk production involves an unacceptable stress for the animals.

The decrease in the consumption of the animal products is also indirectly caused by the meaningful impact on the environment of the livestock production. In fact, for every kg of meat produced the emission of GHG is equal to 2.85 Kg (FAO, 2013a). ‘The Cattle are the main contributor to the sector’s emissions with about 4.6 gigatonnes CO₂ eq, representing 65% of sector emissions’ (FAO, 2013b). In Italy 72.7% of CO₂ emissions originate to livestock farming. In addition to this it should be noted that the feed/meat conversion rates are much low for beef cattle: to produce 1 kg of meat are necessary 8 kg feed with considerable impacts on the ecological footprint.

5. Conclusions

The demand for welfare-friendly products has increased in recent years. The EC, during last decade, carried out several surveys on food quality and, on detail, the Eurobarometer survey in 2006 demonstrated an evident consumers’ interest in animal welfare friendly products (Sechi et al., 2015). Among the totality, 62% of the people involved in the questionnaire expressed their willingness in buying high welfare animal-based products (Cenci Goga, Fermani, 2010).

Previous studies showed that everyday practices of *shopping and eating food* seemed to exert a very strong influence over participants’ perceptions of farm animal welfare. The very fact that animal foods are ingested (literally taken into the body) helped to cement a strong link between food quality/safety and animal welfare in participants’ minds. This in turn led to many participants prioritising those animal welfare concerns, which they also perceived to have an impact on human health (such as animal diseases that were transmissible to humans, providing animals with natural, non-GM feeds, and avoiding the overuse of certain chemicals/medications). Furthermore, for many participants, labels such as ‘free-range’, ‘outdoor-access’ and ‘organic’ provided key reference points/indicators of higher animal welfare standards. However, more than this, we believe that these labels and their associated assurance schemes promote a particular version of animal welfare (based on naturalism) that fits in well with and perhaps even influences, consumers’ broader understandings of animal welfare issues (Cenci Goga, Fermani, 2010).

Mass media sources such as television, radio and newspapers were the most widely used by focus group participants to gain information about farm animal welfare, however most participants kept at least some critical distance, explaining that the media were generally more interested in sensationalist ‘scare’ stories than they were in presenting a balanced view of modern

farming. Finally, it is important to note that there are no simple links between the animal welfare information that consumers receive and consumer behaviour. This is because firstly, information must be properly absorbed before it can influence either explicit or more tacit-emotional feelings towards animal products. Secondly, even if information about farm animal welfare becomes incorporated into the sets of motivations which influence consumer behaviour, then it has to compete with a range of other concerns, many of which are more immediate and practical in nature, such as; familiarity and previous experience with a product; price; availability; convenience and so on.

From this study it appears that this measure is very correlated with the levels of knowledge of the living conditions of the animals, with the weekly consumption of meat and becomes extremely representative of the (critical) attitude of consumers towards the market linked to the meat trade and their derivatives. Rasch models are confirmatory in nature. We look for the agreement of data to the model. This ensure validity and the satisfaction of specific objectivity property which ensures that the difficulty parameter estimates are independent from the sample. The work wants to validate the items used to build the scale of measurement of SWA and pose the basis for future comparisons of difficulty item estimates across different studies. Is not possible to provide, at the present, the suggestions of policy but an increase of SWA in the population can to lead to a crisis in meat consumption. This situation could encourage the development of animal farms more respectful of animal welfare. Future research on SWA could concentrate on the eventual differences with respect the type of animals.

The series of ‘calamities’ that have befallen the farm animal population of Europe over the last decade have led to a ‘crisis in consumer confidence’. This in turn has given rise to scientific, ethical and political questioning about both the nature of modern, industrialized agro-food systems and how to regain consumer confidence in these systems (Chang, Iseppi, 2011; Piccinini et al., 2016). A key political strategy for rekindling European consumers’ trust in their food and agriculture has been the call for transparent and reliable information (Piccinini et al., 2014). However the matter of providing citizens/consumers with information about farm animal welfare (especially if the goal of that information is to encourage the increased purchase of welfare-friendly foods) is far from straightforward.

Our findings indicate that any information strategy designed to increase the consumption of welfare-friendly products must take into account not only consumers’ current explicit knowledge about farm animal welfare, but also the plethora of more tacit rules of thumb that attract consumers to certain products and deter them from others. In short, because consumption is often

non-reflective, any attempt to increase the consumption of welfare-friendly products must be sensitive to the immediacy of food purchases and to the 'emotional economy' (Roe, 2006) of food choices. Furthermore, one must appreciate the fact that not all food consumers are willing to take responsibility for ethical food issues, which they believe should be taken care of by the state.

Information strategies must also take into account the fact that consumption practices occur along a spectrum from 'ordinary' to 'critical' consumption. At the 'ordinary' end of the spectrum (where we believe the majority of consumers are located most of the time) there seemed to be a demand for clarity, simplicity, trustworthiness (so that consumers could delegate responsibility and would not need to endlessly research the topic themselves), standardisation and a dual information system where simple product labels/logos could be backed up with more detailed information (e.g. on websites) if, and only if, required by consumers.

It is perhaps fair to say that whilst many consumers had concerns about farm animal welfare at slaughter, few were interested in receiving information about slaughter at the point-of-purchase. This in part might be due to a strategy of denial adopted by many consumers to avoid confronting their own personal ambivalences towards the killing of animals for food (Serpell, 1996). Furthermore, it is worth noting that marketing, by its very nature, is based on providing positive information (e.g. the naturalness and healthiness of a product, its good animal welfare, its great taste etc.) and many consumers, retailers and manufacturers agree that drawing attention to the method of slaughter on product packaging might severely affect the desirability of the product; irrespective of the 'humaneness' of the slaughter. Finally, it is worth highlighting the importance of information provision 'beyond the label'. In particular, we believe that it is vital to provide information and education about farm animal welfare issues both within schools and through websites and the media. In this way debates about farm animal welfare and, in particular, about 'acceptable' standards of farm animal welfare can take place in an arena unfettered by the commercial imperatives of product marketing.

References

- Allen M.J., Yen W.M. (2002). *Introduction to Measurement Theory*. Long Grove, IL: Waveland Press.
- Andersen E.B. (1977). Sufficient statistics and latent trait models. *Psychometrika*, 42: 69-81.

- Andrich D. (1978). A rating formulation for ordered response categories. *Psychometrika*, 43: 561-573.
- Bertoni G. (2016). *Etica e allevamento animale*. Milano: FrancoAngeli.
- Bond T.G. (2003). Validity and assessment: a Rasch measurement perspective. *Metodologia de las Ciencias del Comportamiento*, 5(2): 179-194.
- Brambell F.W.R. (1965). *Report of the Technical Committee to Enquire into the Welfare of Animals kept under Intensive Livestock Husbandry Systems*. London: HMSO.
- Campbell N.R. (1920). *Physics: The Elements*. London: Cambridge University Press.
- Carenzi C., Verga M. (2009). Animal Welfare: review of the scientific concept and definition. *Italian Journal of Animal Science*, 8(1 Suppl.): 21-30.
- Cenci Goga B.T., Fermani A.G. (2010). *La macellazione religiosa: protezione degli animali e produzione igienica delle carni*. Milano: Point Veterinaire Italie.
- Censis (2016). *Gli italiani a tavola: cosa sta cambiando*. Rapporto finale, Roma.
- Chang T.F.M., Iseppi L. (2011). Specialization versus Diversification in EU Economies: a Challenge for Agro-food? *Transition Studies Review*, 18(1): 16-37.
- Chang T.F.M., Droli M., Iseppi L. (2014). Does Smart Agriculture Go Downstream in the Supply Chain? *Italian Journal of Food Science*, 26(4): 451-457.
- Chang T.F.M., Iseppi L., Droli M. (2015). Extra-core production and capabilities: where is the Food Industry going? *International Food and Agribusiness Management Review*, 18(1): 105-126, February.
- EC (2007). *Attitudes of EU citizens towards animal welfare*. Special EUROBAROMETER 270.
- Evans A., Miele M. (eds.) (2007). *Consumers' views about farm animal welfare. Part I: National Reports based on Focus Group Research*. Welfare Quality Report Series No. 4.
- FAO (2013a). *Edible Insects. Future Prospects for Food and Feed Security*. Food and Agriculture Organization of the United Nations, Rome.
- FAO (2013b). *Tackling Climate Change through Livestock. A global assessment of emissions and mitigation opportunities*. Food and Agriculture Organization of the United Nations, Rome.
- Glennie P.D., Thrift N.J. (1995). 'Consumers, identities, and consumption spaces in early-modern England', *Environment and Planning A*, 28: 25-45.
- Guilford J.P. (1936). *Psychometric methods*. New York: McGraw-Hill.
- Guttman L. (1950). The basis for scalogram analysis. In: Stouffer et al. (Eds.). *Measurement and prediction*. New York: Wiley.
- Harrison R., Newholm T., Shaw D. (2005). *The ethical consumer*. London: Sage.
- Hermes J. (1993). Media, meaning and everyday life. *Cultural Studies*, 7: 493-506.
- ISMEA (2017). *Consumi alimentari domestici delle famiglie italiane - Periodo gennaio-dicembre 2016*. Roma.
- Karabatsos G. (1999a). Rasch vs. two- and three-parameter logistic models from the perspective of conjoint measurement theory. Paper presented at the *Annual Meeting of the American Education Research Association*. Montreal, Canada.
- Karabatsos G. (1999b). Axiomatic measurement theory as a basis for model selection in item-response theory. Paper presented at the *32th Annual Conference for the Society for Mathematical Psychology*. Santa Cruz, CA.

- Karabatsos G. (2000). A critique of Rasch residual fit statistics. *Journal of Applied Measurement*, 1(2): 152-176.
- Linacre J.M. (2009). Local Independence and Residual Covariance: A Study of Olympic Figure Skating Ratings. *Journal of Applied Measurement*, 10(2).
- Luce R.D., Tukey J.W. (1964). Simultaneous conjoint measurement: A new type of fundamental measurement. *Journal of Mathematical Psychology*, 1: 1-27.
- Miller D., Jackson P., Thrift N., Holbrook B., Rowlands M. (1998). *Shopping, Place and Identity*. London: Routledge.
- Perline R., Wright B.D., Wainer H. (1979). The Rasch model as additive conjoint measurement. *Applied Psychological Measurement*, 3: 237-256.
- Piccinini L.C., Lepellere M.A., Chang T.F.M., Iseppi L. (2014). Partitioned frames in discrete Bak-Sneppen models. *Italian Journal of Pure and Applied Mathematics*, 33: 461-488.
- Piccinini L.C., Lepellere M.A., Chang T.F.M., Iseppi L. (2016). Structured Knowledge in the Frame of Bak-Sneppen Models. *Italian Journal of Pure and Applied Mathematics*, 36: 703-718.
- Popper K. (1934). *The Logic of Scientific Discovery* (as Logik der Forschung, English translation 1959).
- Rasch G. (1960). *Probabilistic models for some intelligence and attainment tests*. Chicago: University of Chicago Press.
- Rifkin J. (2008). *Ecocidio. Ascesa e caduta della cultura della carne*. Milano: Mondadori.
- Roe E.J. (2006) Things becoming food and the embodied, material practices of an organic food consumer. *Sociologia Ruralis*, 46(2): 104-121.
- Sechi P., Baldinelli C., Iulietto M.F., Cenci Goga B.T. (2015). Animal welfare: data from an online consultation. *Italian Journal of food safety*, 4(1).
- Serpell J. (1996) *In the company of animals A study of human animal relationships*. Cambridge: Cambridge University Press.
- Singer P., Mason J. (2006). *The ethics of what we eat why our food choices matter*. Emmaus, Pennsylvania: Rodale.
- Slow Food (2013). *Sondaggio sui consumi di carne e sul benessere animale rivolto ai soci Slow Food europei*, -- http://www.slowfood.com/sloweurope/wp-content/uploads/ITA_sondaggio_benessere.pdf.
- Special Eurobarometer (2005; 2007). 229/Wave 63.2 3, Attitudes of consumers towards the welfare of farmed animals; 270/Wave 66.1 4 Attitudes of EU citizens towards Animal Welfare.
- Thurstone L.L. (1927). A law of comparative judgement. *Psychological Review*, 34: 273-286.
- Toma L., Stott A.W., Revoredo-Giha C., Kupiec-Teahan B. (2012). Consumers and animal welfare. A comparison between European Union countries. *Appetite*, 58: 597-607.
- Weis T. (2010). The Ecological Hoofprint and the Population Bomb of Reverse Protein Factories. *Food, Energy, Environment: Crisis of the Modern World-System*, 33(2/3): 131-152.
- Wright B.D., Masters G.N. (1982). *Rating scale analysis*. Chicago: MESA Press.

Internet sites

GoogleFor, -- <https://docs.google.com/spreadsheet/viewform?formkey=dElnNFN0cXp4MXVwd2pCNFFiMlI0SIE6MQ> (latest access June 22nd 2016).

-- <https://docs.google.com/spreadsheet/viewform?formkey=dElnNFN0cXp4MXVwd2pCNFFiMlI0SIE6MQ>.

-- <http://www.ismea.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/9959>.

-- <http://www.ismeamercati.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/724>.

Appendix. The selected items from the questionnaire on animal welfare

13. Would you like to be more informed about the conditions in which animals are farmed?

- Yes, certainly
- Yes, probably
- No, probably
- No, certainly

17. How do you consider, in general, the welfare of farm animals?

- very important
- important
- insignificant
- I do not care

21. When you purchase meat (poultry, beef, pork, fish, etc.), do you think about the welfare / protection of the animals from which these products were obtained?

- Yes, most of the time
- Yes sometimes
- No, very rarely
- No, I never consider it
- Never buy meat

24. When buying eggs, milk or meat, can you easily identify so-called “welfare friendly” products from the label? “Welfare friendly” means foodstuffs obtained from animals raised in a way respectful of animal welfare

- Yes, most of the time
- Yes sometimes
- No, very rarely
- Never

29. Can you tell me, on a scale of 1 to 10, how important is it to you that the welfare of farmed animals is protected? 1 means “not at all important to you”, 10 means “very important”.

- | | | | | | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

30. Do you think, in general, that the welfare of farm animals needs to be improved?

- Yes, certainly
- Yes, probably
- No, probably
- No, certainly
- I do not know

33. Do you think that stores and supermarkets have a sufficient choice of “welfare friendly” food for consumers? “Welfare friendly” means foodstuffs obtained from animals raised in a way more respectful of animal welfare

- Yes, certainly
- Yes, probably
- No, probably
- No, certainly
- I do not know

36. Do you think there is a link between quality / safety of food and animal welfare?

- Yes
- No

38. Would you buy animal products with the highest standards of animal welfare?

- Yes
- No

40. Would you be willing to pay more for “welfare-friendly” food in order to ensure greater respect for animal welfare?*

- Yes
- No

41. Would you be willing to change your usual place where you go shopping to buy more “welfare-friendly” animal food products?

- Yes, certainly
- Yes, probably
- No, probably
- No, certainly

47. Would you like to receive more specific information on farming systems and methods of transport of animals every time you buy a product of animal origin?

- Yes
- No

50. Would you be interested in receiving information on the method of slaughter used when buying food of animal origin?

- Yes
- No

52. Would you be better protected if the products derived from animals slaughtered according to religious rite had labeling which states this?

- Yes
- No

Please write any further ideas or comments in the following space.
Thanks for completing this survey. We will let you know the results of the survey.

FrancoAngeli