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Importance of food labeling as a means of information and traceability according to consumers

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Abstract: Consumption patterns have considerably changed over recent years. We are witnessing more and more frequently to a lack of information (i.e. information asymmetry) between food producers and consumers, this generate in the consumer the latter need to access information related to processes of production of food and food distribution. Decision-making, in absence of further information, leads consumers to pay attention to food labeling. Food labels become the only tool for consumers to acquire additional information about products in order to make the purchase decision. In today's modern and globalized market, labels limitations can be partially overcome by using *Mobile Marketing* tools, such as the QR Code (Quick Response Code). Therefore the objective of this study is: (1) categorize profiles of consumers according to the importance given to various information patterns shown on food labeling; (2) discover consumer behaviors when making a purchasing decision based on food information they require in the label; (3) discover consumer profiles with regards to food quality and the use QR Code to acquire further information about food products. Two Italian regional capitals were chosen, as representative of Northern and Southern Italy, basing on the geographical division of the Country made by the ISTAT (Istituto Nazionale di Statistica). The interviews were carried out by telephone, using a questionnaire. Data collected were processed by Multidimensional Scaling We discovered eight profiles of consumers with different purchasing behaviors. Some consumer profiles, with lifestyles typical of contemporary life, use the QR Code to obtain additional information about food products. The innovative purchasing behavior identifies a consumer who is particularly interested in food quality and safety. Agri-food businesses that focus on quality productions could target the innovative profile and communicate further information trough the use of modern communication technologies.

1. Introduction

Consumption patterns have considerably changed over recent years. Consumers are progressively more and more aware of the issues related to food and impacts on the economy and the environment. They understand the close relationship between food quality , the environment and the wellbeing of society in general, so nowadays they are turning gradually toward those food products which are an expression of this interaction. Consumers perceive, evaluate, and choose each product on the basis of the range of food/environmental/social characteristics that it demonstrates (Lancaster, 1971), sometimes not all explicitly recognizable or conveyed by the producer. However, the process of consumption is not homogeneous: not all consumers have the same values and want the same features, however, despite agreeing with certain issues (for e.g. sustainability, social justice goals, etc.), they do not necessarily change their consumption behavior (Weinstein, 1988). A lack of information (i.e. information asymmetry) between producers and consumers, might prohibit consumers from making informed purchase decisions and not allow them to have insights into the implications of their purchase decisions on the food supply chain (Aprile *et al*., 2012). Indeed, food safety issues often arise from problems of asymmetric information between consumers and food producers with regard to product-specific attributes or characteristics (Ortega *et al*., 2011). Food labels become the only tool for consumers to acquire additional information about products for their purchase decisions; in fact, studies have shown that there is a relationship between the objective characteristics of the label and the reactions of consumers (Cavicchi, 2008; Bialkova and Van Trijp, 2010; Di Pasquale, 2011; Grunert, 2011; Veneziani *et al*., 2012; Vianelli and Marzano, 2012; Siriex *et al*., 2013). Each label conveys a set of characteristics (such as text, color, shape, etc.) that provides information about the product; however, the space available is always limited by the size of the package as well as by the regulations set out by law. In today's modern, globalized market, these limitations can be partially overcome by using *Mobile Marketing*, such as the QR Code (Quick Response Code), that combines the possibility to provide information with that of promoting and enhancing the value of the product and/

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or of the brand, thanks to new communication systems. *QR Mobile Marketing*, used for traceability of food products, transforms the physical identifiers (adhesives and labels on products, packaging, price tags, etc.) into something new and interactive, which can provide much information about the product's production process and general information about the Company (Shiang-Yen *et al*., 2010; Kwak, 2013). This system, applied to labels of food products, whether fresh or processed, can become a tool for the consumer to acquire more information about traceability, provenance, producer's background, production, breeding and cultivation techniques used, etc.

The purpose of this study was to determine what information, of that possibly provided on the labels of food products, consumers are particularly interested in knowing and what information consumers are looking for as added value as a guarantee of food quality and safety, e.g. traceability, absence of GMO, organic production, etc. More particularly, our aim was to (1) categorize profiles of consumers according to the importance given to various information patterns shown on food labeling; (2) discover consumer behaviors when making a purchasing decision based on food information they require in the label; (3) discover consumer profiles with regards to food quality and the use of QR Code to acquire further information about food products. Each consumer profile corresponds to a different, homogeneous market segment for similar purchasing behavior and socio-demographic characteristics.

2. Materials and Methods

Sampling design

For this research, two Italian regional capitals were chosen, as representative of northern and southern Italy, based on the geographical division of the country made by the ISTAT (Istituto Nazionale di Statistica): Milan for the north (N_1) and Palermo for the south (N_2). A sample of consumers equal to n = 267 (with p = 95% and ε = 7%) was extracted using the *Stratified-proportional* sampling schema (with random extraction from each stratum) from the population of residents in the two cities. Population size was equal to $N_1 + N_2 = N$ = 1,917,088 (ISTAT, 2012), where N_1 = 1,262,101 and N_2 = 654,987 (proportional sub-sample sizes are n_1 = 176 and n_2 = 91). The sample units (i.e. respondents) were extracted randomly from the telephone directories of the two cities. Respondents had to be aged between 20 and 80 years, and those who did not fit with this requirement were asked not to continue the interview (Table 1). Education and income levels of respondents had to be proportionally equal among consumers in the sample.

Measurements

The interviews were carried out by telephone, using a proper questionnaire divided into two sections. The first section contained questions on consumer socio-demographic characteristics; the second listed 20 food attributes usually displayed in food labels (i.e. information about foods) and respondents were asked to score, using a scale of 1 (not at all) to 10 (a lot), the attributes in relation to their personal preferences (i.e. subjective importance) based on what they wanted to find in food labels. To evaluate preferences, consumers had to subsequently order the 20 scored attributes with the aim of ranking of them. The attributes were selected based on Caswell's classification of food attributes (Caswell, 2000) (Table 2). These attributes were categorized basing on consumer purchasing behavior variables (i.e. Purchasing Style, Perceived Quality); categorization is reported in Table 3.

Data analysis

Multidimensional scaling (MDS) is a set of data analysis techniques that display the structure of distance-like data as a geometrical picture (Young, F., 1985). MDS has its origins in psychometrics but now has become a general data analysis technique used in a wide variety of fields (Schiffman *et al*., 1981) including marketing studies. MDS portrays the structure of a set of objects from data that approximate the distance between pairs of the objects. The data, which are called similarities, dissimilarities, distances, or proximities reflect the amount of similarity (or dissimilarity) between pairs of objects or events (i.e. in this study the agreement in judgments between pairs of consumers). The graphical output is a representation which consists of a geometric configuration of points on a map (Cox and Cox, 2005). Each point in the configuration corresponds to one of the objects. Two points near each other indicate that there are similarities in the attributes for which the similarity (or dissimilarity) has been calculated (Rebollar *et al*., 2012). This configuration reflects the "hidden structure" in the data, and often makes data much easier to comprehend (Kruskal and Wish, 1984). In addition, the map of stimuli can be interpreted based on just a few dimensions corresponding to the attribute measured (Cox and Cox, 2005; Rebollar *et al*., 2012). The space is usually a two (or three) dimensional Euclidean space (but may be not Euclidean). Classic MDS may be

Table 1 - Sample stratification and sub-samples by range of age and cities (based on Population Strata size)

Range of age	Cities		%
	Milan (P_1 = 1.262.101; n_1 = 176)	Palermo (P_2 = 654.987; n_2 = 91)	
20-30	15	8	8.79
30-40	33	17	18.68
40-50	45	24	26.37
50-60	41	21	23.08
60-70	30	15	16.48
70-80	12	6	6.59
Total	176	91	100

Table 2 - Attributes selected

Caswell's classification	Our classification
Intrinsic quality attributes	
1. Food Safety Attributes	
• Foodborne	
• Pathogens	
• Heavy Metals and Toxins	
• Pesticide or Drug Residues	
• Soil and Water Contaminants	
• Food Additives, Preservatives	
• Physical Hazards	
• Spoilage and Botulism	
• Irradiation and Fumigation Other	
2. Nutrition Attributes	
• Calories	• Calories/kilojoules content
• Fat and Cholesterol Content	• Nutritional information
• Sodium and Minerals	• Ingredients
• Carbohydrates and Fiber Content	• Probiotic product
• Protein	• Nutritional properties
• Vitamins	
• Other	
3. Sensory/Organoleptic Attributes	
• Taste and Tenderness	
• Color	
• Appearance/Blemishes	
• Freshness	
• Softness	
• Smell/Aroma	
• Other	
4. Value/Function Attributes	
• Compositional Integrity	• Shelf life and best before dates
• Size	
• Style	
• Preparation/Convenience	
• Package Materials	
• Keepability	
• Other	
5. Process Attributes	
• Animal Welfare	• Organic products
• Authenticity of Process/Place of Origin	• Production zone
• Traceability	• Traceability
• Biotechnology/Biochemistry	• Genetically modified organism (GMO)
• Organic/Environmental Impact	
• Worker Safety	
• Other	
Extrinsic Quality Indicators and Cues	
1. Test/Measurement Indicators	
• Quality Management	• Organic certification
• Systems	• Quality certification (POD, PGI, DOC, etc.)
• Certification	
• Records	
• Labeling	
• Minimum Quality Standards	
• Occupational Licensing	
• Other	
2. Cues	
• Price	• Price
• Brand Name	• Brand
• Manufacturer Name	• Territory of origin of the product
• Store Name	• Green economy product
• Packaging	• Traditional product
• Advertising	• Easy to cook product
• Country of Origin	• Information on promotions and discounts
• Distribution Outlet	• Food preservation methods
• Warranty	
• Reputation	
• Past Purchase Experience	
• Other Information Provided	

Table 3 - Variable description and Variable code

N.	Variable description	Variable code
1	Shelf-life and Best before dates	Shelf_life_Bestbefore_dates
2	Ingredients	Ingredients
3	Nutritional information	Nutritional_information
4	Production zone	Production_zone
5	Genetically modified organism (GMO)	Genetically_modified_organism_GMO
6	Organic products	Organic_product
7	Green economy product	Green_economy_product
8	Probiotic product	Probiotic_products
9	Food preservation methods	Food_preservation_methods
10	Kalories/kilojoules content	Kalories_kilojoules_content
11	Price	Price
12	Brand	Brand
13	Nutritional properties	Nutritional_properties
14	Territory of origin of the product	Product_territory_of_origin
15	Traceability	Traceability
16	Organic certification	Organic_certification
17	Quality certification (POD, PGI, DOC, ecc.)	Quality_certification
18	Traditional product	Traditional_product
19	Easy to cook product	Easy_to_cook
20	Information on promotions and discounts	Promotions_discounts

Metric or *Nonmetric*. In Non Metric MDS data can be at the ordinal level of measurement (ordinal data), moreover data may be complete or incomplete, symmetric or asymmetric, and it is possible to measure similarities or dissimilarities. For these reasons in this study nonmetric MDS was the most appropriate. The nonmetric MDS uses quantitative data models to describe qualitative data. Nonmetric MDS tries to find a configuration of points that minimizes the squared differences between the optimally scaled proximities and the distances between the points. In other words, coordinates have to be found that minimize the so-called stress, which. MDS programs automatically do to obtain the MDS solution. Among the different versions of stress in literature, Kruskal (1964) provided some guidelines for the interpretation of the stress value with respect to the goodness of fit of the solution. According to Kruskal's findings, stress decreases as the number of dimensions increases (thus a two-dimensional solution always has more stress than a three-dimensional one). There are two additional techniques commonly used for judging the adequacy of an MDS solution: the screen plot and the Shepard diagram.

Among the different MDS techniques, the Alternating Least squares SCALing (ALSCAL) method (Takane *et al*., 1977) was used in this study to analyze the data obtained. This model appeared the most suitable in this case because it can analyze data that are nominal, ordinal, complete, or with missing observations, conditional or unconditional, symmetric or asymmetric, replicated or un-replicated, continuous or discrete (Takane *et al*., 1977). The ALSCAL method uses the Euclidean model as a basis to compute optimal distances between objects in a n-dimensional stimulus space (Kruskal and Wish, 1978). To determine the badness-of-fit between the hypothesized structure and the original data, ALSCAL method minimizes the loss function called S-STRESS (SS), which is minimized using an alternating least squares algorithm (Cox and Cox, 2005). A value of zero indicates a perfect fit (Kruskal and Wish, 1978), but Kruskal and Wish (1984) consider the solution to be acceptable when the S-STRESS values are less than 0.1 (Rebollar *et al*.,, 2012). R-square is a squared correlation index that indicates the proportion of variance of the optimally scaled data that can be accounted for by the MDS procedure; according to literature, values of 0.60 or better are considered acceptable. While R-square is a measure of goodness-of-fit, stress measures badness-of-fit, or the proportion of variance of the optimally scaled data that is not accounted for by the MDS model (Cil, 2012). Stress values of less than 10% are considered acceptable.

The vector model (Davison, 1983) was used to interpret the dimensions of preference in function of observable attributes. This model helps to interpret the dimension of the space of similarities using the attributes which make up the similarities between the stimuli. Following the explanation of the vector model made by Rebollar *et al*. (2012), the attribute-vector is displayed as a line in the space representing consumer preferences based on personal purchasing behavior which the projection of each stimulus corresponds to with the degree of importance assigned by respondents. If two stimuli (i.e. points or objects) are strongly related to each other, then the stimuli projections will coincide very closely and the correlation between them will be quite high. When two objects lie in the same direction, this also indicates a high correlation between the two. When the points that represent the vector are close to a dimension and far from the centre, these are important for explaining that dimension. If a point is midway between two dimensions, this indicates that this attribute explains both dimensions. If an object is close to the center of the stimulus space, this means that it is not important in the explanation of the dimension in this space (i.e. it does not depend on either of the two dimensions). This configuration reflects the "hidden structure" in the data, and often makes data much easier to comprehend (Kruskal and Wish, 1984). This model allowed consumer's preferences (i.e. information contents required in food labels) to be ordered based on the respondents' attribute evaluations. It also made it possible to determine which attributes present a high correlation in the evaluation of the stimuli. Furthermore, it was possible to group the objects on the basis of the distances on the map, highlighting characteristics that were statistically correlated, directly or inversely (Kruskal, 1964; Young *et al*., 1978). In this study these groups represent different consumer's profiles correlated by the information required in food labels (preferences).

The data was processed using the statistical software SPSS (version 21).

3. Results

The preference classification of food attributes based on respondents' ranking is shown in Figure 1. The S-stress of the configuration in the space of the first two dimensions was 0.09102, indicating a good fit in those dimensions. The R-square value was 96%, confirming the good fit in the two dimensions. The figure shows how food attributes required by consumers in food labels were classified according to the dimensions. Dimension 1 differentiates the attributes regarding quality information required by respondents; Dimension 2 is particularly important in this space because it differentiates attributes according to the respondents' purchasing styles. If we look at correlation values in the figure it is possible to graphically analyze similarities (and dissimilarities) of different points and groups of them representing preferences. Different groups of preferences represent similarities in respondents' rankings, and therefore these segments of preferences, similar (homogeneous) inside, are the discovered profiles of consumers. These profiles are characterized by quality information required (namely "Quality") and purchasing styles (namely "Behavior").

Dimension 1 shows two major groups of variables, one in the left part of Figure 1, with respect to the vertical axis (located at zero point), and another in the right part of the axis. Also Dimension 2 has two major groups, one in the lower region and the other in the upper region with respect to the horizontal axis passing through the zero point. The results highlight four main aggregations of points, derived from the combination of variations of the two dimensions. These aggregations have been named as: 1. Extra; 2. Regular; 3. Classic; 4. Innovative (see Fig. 1 and Table 4). Furthermore, it's possible to note four other sub-groups of variables identified in Figure 1 and Table 4: 5. Traditional; 6. Basic; 7. Niche; 8. Prime. Two of these sub-groups, namely Niche and Prime, seem particularly interesting because variables are independent from Dimension 2, and correlation is almost equal to zero.

4. Discussion and Conclusions

Analysis of the results revealed eight profiles of consumers homogeneous for similar preferences of food product attributes required in food labels. Profiles with characteristics and purchasing behaviors are listed in Table 4. According to this classification, the first profile, "1. Extra," includes consumers interested in nutritional/health aspects (e.g. traceability, organic cultivation, GMO-free, etc.) and other attributes like area of production and origin of the product. Profile "2. Regular" represents consumers that base their purchases on regular and general information about food; information about nutrition and product origin are also important. The "3. Classic" profile refers to a consumer who purchases according to brand, price, ease of food preparation, food preservation methods, and health features such as calorie content. The "4. Innovative" profile is interested in personal health and issues like environmental protection and animal welfare; this consumer looks for food quality, food certifications, food safety, and traceability. Profile "5. Traditional" requires information on energy content of food, food preservation methods, and promotional information. Profile "6. Basic" is a consumer who chooses exclusively on the basis of brand and product price. Profile "7. Niche" chooses mainly traditional products that are well-known and familiar; probiotics and healthy/functional foods are of interest. The profile "8. Prime" is a consumer who is interested in primary elements of food products, like best-before date and ingredients, but these primary elements also include other attributes (variables) of food which are closely related to the "made-in" concept, i.e. "territory of origin" and "traditional product" which may provide benefits to health.

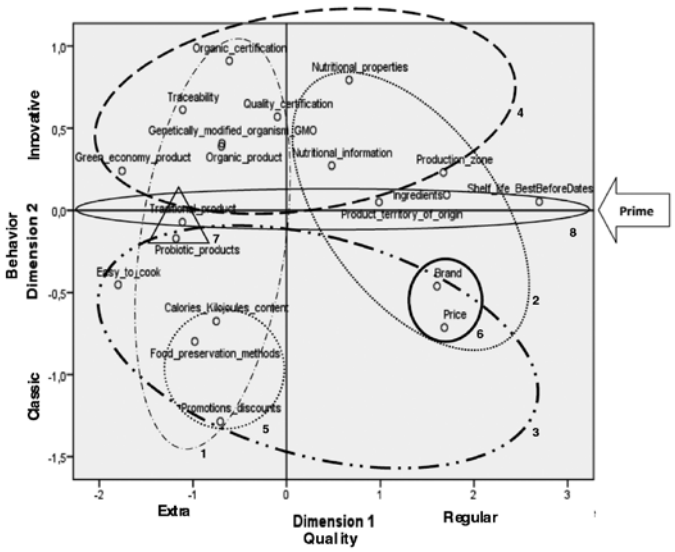

Fig. 1 - Preference classification of food attributes based on respondents' ranking.

The Classic purchasing behavior (profile 3) identifies a consumer who is less interested in innovation. In contrast, the Innovative purchasing behavior (profile 4) identifies a consumer who is particularly interested in food quality and safety. It is interesting to see that Innovative behavior represents consumers who have developed a new concept of product quality: not only intrinsic attributes but also ethics and health attributes, and information regarding quality certification and traceability.

Agri-food businesses that focus on quality productions could therefore target the Innovative profile and communicate further information through the use of modern communication technologies that facilitate the transfer of information via QR Code. This system can be used by producers, distributors, and retailers and it represents a new way to interact with the consumer. Thanks to a website link or to

Table 4 - Characteristics of discovered profiles

Profile	Variables	Quality information required (Quality)	Purchase Styles (Behavior)	Behavior
1. Extra	- Probiotic product - Traditional product - Organic product - Organic certification - GMO - Quality certification - Traceability - Calories/kilojoules content - Food preservation methods - Information on promotion and discount	Extra	From Classic to Innovative	Purchase mainly certified food products
2. Regular	- Price - Brand - Ingredients - Nutritional information - Nutritional properties - Territory of origin of the product - Production zone	Regular	From Classic to Innovative	Purchase basing on regular and general information
3. Classic	- Price - Brand - Calories/kilojoules content - Food preservation methods - Information on promotion and discount - Easy to cook	From regular to Extra	Classic	Little time available for preparing meals but health-conscious
4. Innovative	- Probiotic product - Nutritional information - Nutritional properties - Organic certification - Organic product - GMO - Quality certification - Traceability - Green economy product - Production zone	From regular to Extra	Innovative	Living well in harmony with the environment
5. Traditional	- Calories/kilojoules content - Food preservation methods - Information on promotion and discount	Extra	Classic	Combine classic information with saving
6. Basic	- Price - Brand	Regular	Classic	Very simple purchase decision based solely on price and brand
7. Niche	- Traditional product - Probiotic product	Extra	Classic or Innovative	Healthy tradition-bound
8. Prime	- Shelf life and best before dates - Ingredients - Territory of origin of the product - Traditional product	From extra to regular but very primary attributes	Classic or Innovative	Purchase based on primary elements of food products

videos with information about the food production process, food production area, traceability or alternative ways to use and store the product, this system allows producers to survey consumers' interest toward their products.

References

APRILE M.C., CAPUTO V., NAYGA Jr R.M., 2012 - *Consumers' valuation of food quality labels: the case of the European geographic indication and organic farming labels.* - International Journal of Consumer Studies, 36: 158-165.

BIALKOVA S., VAN TRIJP H., 2010 - *What determines consumer attention to nutrition labels?* - Food Quality and Preference, 21: 1042-1051.

CASWELL J.A., 2000 - *Analysing quality and quality assurance (including labeling) for GMOs.* - AgBio Forum, 3(4): 225-230.

CAVICCHI A., 2008 - *Qualità alimentare e percezione del consumatore*. - Agriregionieuropa, 15.

CIL I., 2012, - *Consumption universes based supermarket layout through association rule mining and multidimensional*

scaling. - Expert Systems with Applications, 39: 8611-8625.

COX T., COX, M.A.A., 2005 - *Multidimensional Scaling*. - Chapman & Hall, CRC, Second Edition London, UK, pp. 308.

DAVISON M.L., 1983 - *Multidimensional scaling.* - John Wiley & Sons, NY, USA, pp. .

DI PASQUALE J., 2011 - *Alimenti funzionali arricchiti. Profili di consumo e disponibilità a pagare* - Agriregionieuropa, 25.

GRUNERT K.G., 2011 - *Sustainability in the food sector: a consumer behaviour perspective*. - International Journal on Food System Dynamics, 2: 207-218.

KRUSKAL J.B., 1964 - *Non-metric multidimensional scaling: a numerical method*. - Psycometrika, 29: 209-229.

KRUSKAL J.B., WISH M., 1978 - *Multidimensional Scaling.* - Sage Publications, Beverly Hills, CA, USA, pp. 93.

KRUSKAL J.B., WISH M., 1984 - *Multidimensional Scaling*. - Sage Publications Beverly Hills, CA, USA.

KWAK S.B., 2013 - *Consumer-level food source information tracking, management, reviewing, and rating method and system*. - United States Patent Application Publication, US 2013/0018761 A1.

LANCASTER K., 1971 - *Consumer demand. A new approach*. - Columbia University Press, New York & London, pp.177.

ORTEGA D.L., WANG H.H., WU L., OLYNK N.J., 2011 - *Modeling heterogeneity in consumer preferences for select food safety attributes in China*. - Food Policy, 36: 318-324.

REBOLLAR R., LIDON I., SERRANO A., MARTIN J., FERNANDEZ M.J., 2012 - *Influence of chewing gum packaging design on consumer expectation and willingness to buy. An analysis functional, sensory and experience attributes.* - Food Quality and Preference, 24: 162-170

SCHIFFMAN S.S., REYNOLDS M.L., YOUNG F.W., 1981 - *Introduction to multidimensional scaling. Theory methods and applications.* - Emerald Group Publishing Limited, Bingley, UK, pp. 432.

SHIANG-YEN T., FOO L.Y., IDRUS R., 2010 - *Application of quick response (QR) codes in mobile tagging system for retrieving information about genetically modified food.* - In Proceedings of the 9th WSEAS International conference on Data networks, communications, computers, pp. 114-118.

SIRIEX L., DELANCHY M., REMAUD H., ZEPEDA L., GURVIEZ P., 2013 - *Consumers' perceptions of individual and combined sustainable food labels: a UK pilot investigation*. -International Journal of Consumer Studies, 37: 143-151.

TAKANE Y., YOUNG F.W., DE LEEUW J., 1977 - *Nonmetric individual differences multidimensional scaling: An alternating least squares method with optimal scaling features*. - Psycometrica, 42: 7-67.

VENEZIANI M., MORO D., SCKOKAI P., 2012 - *L'attitudine dei consumatori per gli alimenti funzionali*. - Agriregionieuropa,. 31.

VIANELLI D., MARZANO F.C., 2012 - *L'effetto country of origin sull'intenzione d'acquisto del consumatore: una literature review*. - Working Paper Series, Edizioni Università degli studi di Trieste(EUT), 2, pp. 34.

WEINSTEIN N.D., 1988 - *The precaution adoption process*. - Health Psychology, 7: 335-386.

YOUNG F., 1985 - *Multidimensional scaling*. - In: KOTZ S., N.L. JOHNSON (eds.) CAMPBELL B. READ, *Encyclopedia of statistical sciences*. *Lindeberg conditions - Multitrait-Multimethod matrices Volume 5.* John Wiley & Sons, London, UK, pp. 9686.

YOUNG F., TAKANE Y., LEWYCKYS R., 1978 - *A nonmetric multidimensional scaling program with several individual-differences options*. - Behavior Research Methods & Instrumentation, 10(3):451-453.