Consumers' Demand for Pork Quality:
Applying Semantic Network Analysis

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Abstract

Consideration of consumers' demand for food quality entails several aspects. Quality itself is a complex and dynamic concept, and constantly evolving technical progress may cause changes in consumers' judgment of quality. To improve our understanding of the factors influencing the demand for quality, food quality must be defined and measured from the consumer's perspective *(Cardello, 1995).* The present analysis addresses the issue of food quality, focusing on pork—the food that respondents were concerned about. To gain insight into consumers' demand, we analyzed their perception and evaluation and focused on their cognitive structures concerning pork quality. In order to more fully account for consumers' concerns about the origin of pork, in 2004 we conducted a consumer survey of private households. The qualitative approach of concept mapping was used to uncover the cognitive structures. Network analysis was applied to interpret the results. In order to make recommendations to enterprises, we needed to know what kind of demand emerges from the given food quality schema. By establishing the importance and relative positions of the attributes, we find that the country of origin and butcher may be the two factors that have the biggest influence on consumers' decisions about the purchase of pork.

Keywords: cognitive structures, concept mapping, food quality, network analysis, semantic networks, spreading activation network model.

1 Introduction

Saturated markets and increasingly homogeneous products characterize European food markets. Food quality provides an opportunity for product differentiation. From the perspective of firms, the selection of demand-oriented marketing activities may be relatively arbitrary *(Kotler and Armstrong, 1994, p. 48).* Consequently the subjective view of the consumers should be considered. This paper deals with food quality from the consumer's perspective. Our study concerns consumers' demand for food quality in general, and pork quality in particular.

Following *Cardello (1995),* food quality from the consumer's perspective is a perceptual and an evaluative construct that is relative to the person, place of purchase, and purchase situation. Against this background, consumers' cognitive processes are taken into account. Schema theory and the 'spreading activation network' model can explain these insights theoretically. Methodologically, a variation of concept mapping can be used to survey consumers' information structures. This paper presents the results of a consumer survey that took place in Germany in 2004.

The paper proceeds as follows. In the next section, the problem statement and research questions are presented. The third section briefly defines food quality from a consumer's point of view. Section 4 explains the theoretical background of information processing. Section 5 presents the results of the consumer survey. In section 6, we describe the schema theory and network-analysis of consumers' demand for pork quality, which was studied to give recommendations to enterprises. The last section gives concluding remarks and research limitations.

2 Problem statement and research questions

In actuality, quality refers to aspects of the food product and the basic production process that can be measured and documented in an objective way. But the quality that consumers associate with a food product is often not equivalent to this objective quality evaluation *(Scholderer and Bredahl, 2004)*. For consumers, quality is a subjective concept whose association is based on psychological processes *(Steenkamp, 1990)*. Consequently, consumers' cognitive structures of knowledge in memory are a key factor in developing a useful understanding of consumer behaviour and demand *(Olson and Reynolds, 1983)*. Hence, consumers' perception and evaluation of quality must be analyzed, because although users' individual perceptions can be measured, the individual perceptions can differ among users *(Grunert et al., 1996)*.

Therefore, it is essential to know the following:

- What information with respect to which attributes are stored in memory?

- How are these attributes linked to each other?

More precisely, as our study was focused on the quality of pork, we aimed also to provide answers to the following questions:

- Which quality attributes do consumers associate with pork quality?

- Which quality cues are used by consumers concerning pork quality?

- What is the best measure of the cue and attribute importance within the network?

- What is the relationship between the search, experience, and credence quality attributes concerning pork quality?

- What kind of demand emerges from the quality attributes?

We conducted a consumer survey of households in January 2004. This paper presents results from the survey and uses the survey data to analyze demand for food quality through the

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consumers' internal information. So far, to our knowledge, few studies have analyzed the schemas and semantic networks of consumers related to their perception and evaluation of food quality. In this study we wanted to elucidate these networks. Research within this field is important because empirical studies *(e.g., Grunert et al., 2004)* have shown that customers have difficulties in evaluating meat quality. Furthermore, only a limited number of studies have focused on how the consumer generally perceives pork quality *(Bryhni et al., 2002).*

3 Defining food quality from a consumer's perspective

As this article analyzes consumers' demand for food quality, section 3 describes the concept of food quality from a consumer's perspective (3.1) and provides findings from recent studies concerning consumers' inferences with regard to meat quality (3.2).

3.1 Concept of food quality

In recent years, the concept of food quality has received a lot of attention from food producers and retailers as well as from public authorities and health educators *(Brunso et al., 2004).* The scientific literature reflects this interest *(Holm and Kildevang, 1996).* For example, *Steenkamp (1990)* defines the concept of 'perceived quality' while *Slovic (1987)* describes consumers' risk perceptions and risk communication. *Bremner (2000)* discusses a practical approach to defining the term 'quality'. But although there have been many attempts to clarify and define the concept, there is still no general agreement on the term *(Brunso et al., 2004; Grunert et al., 1996, p. 76).* From a food scientist's perspective, e.g., a nutritionist or food technologist, food quality can be considered a well-defined concept, because the scientists can revert to a multitude of standardized, instrumental tests to quantify food quality. At the same time, food quality can be considered the least well-defined concept in the food industry today, because food scientists represent

only a small percentage of people concerned with food quality *(Cardello, 1995).* Consumers decide what is 'good' and what is 'poor' *(Lawless, 1995).* Although the consumer's definition of food quality drives the food industry's economy, "it is precisely the consumer's definition of food quality about which we know the least and which we are most challenged to quantify" *(Cardello, 1995).*

Nevertheless, there are by now several definitions that treat the consumer as the starting point. Both *Cardello (1995)* and *Steenkamp (1990)* define the concept of perceived quality to stress that consumers' quality evaluation is dependent on their perceptions, needs, and goals. *Brunso et al. (2004)* and *Grunert et al. (1996, 2005)* differentiate between various types of food quality and assume that the focus should be on the differentiation between objective and subjective quality. They refer to product- and process-oriented quality (e.g., fat content, organic production standards) as well as food control as 'objective quality' because it can be measured at the product itself. In contrast, user-oriented quality, referred to as 'subjective quality', is based only on measures of the users' individual perceptions, and these can differ for the same product among users *(Grunert et al., 1996, p. 76).*

We will follow these approaches to analyze consumers' perception and evaluation of food quality. Finally, we want to uncover the subjective definition of pork quality of consumers and the resulting demand.

3.2 Previous research on meat quality

To market successfully, it is important for the industry to analyze which parameters influence demand for their products *(Bryhni et al., 2002).* For the European food industry, quality is a key factor because the high quality of a product is the basis for success in this highly competitive market *(Du and Sun, 2005).* However, much of the discussion on quality in the food industry is

related to product- and process-oriented quality and quality control, while—as mentioned above—the consumer subjectively evaluates perceived quality *(Brunso et al., 2004).* Consequently, it has become increasingly important to optimally align the quality of food with consumer demands, expectations, and desires *(Bryhni et al., 2002).* Following *Henson (2000),* the translation of the quality perceptions of consumers into physical product and process attributes requires knowledge and understanding of the overall quality evaluation of consumers. For example, meat should be safe, lean, and healthy and it should taste good *(Verbeke and Viaene, 1999).*

Steenkamp (1990) defines perceived product quality as an evaluation based on quality cue perception in relation to relevant quality attributes. Hence, during product perception and evaluation of food quality, several cues are used. The cue utilization involves a process of making inferences about products from cues available at the point of sale. In the case of pork, it is of particular interest to identify the cues currently used by consumers to evaluate quality, as well as to analyse the relative importance assigned to each *(Acebrón and Dopico, 2000).* Results from different empirical studies demonstrate some inferences consumers make in evaluating food quality with respect to the quality of meat. *Grunert (2002)* showed that the colour of meat is used to infer tenderness. Muscle colour, at the point of purchase, indicates freshness and anticipated palatability to consumers*,* whereas pieces of meat cut in unequal sizes or poorly trimmed were expected to be of low quality *(Bredahl and Poulsen, 2002).* Furthermore, the meats' country of origin and colour are in general the most helpful cues for predicting eating quality of fresh meat. Country of origin is not only an indicator for eating quality but also for the safety of meat *(Becker, 2001).* Nevertheless, consumers infer mostly positive inferences from the label "organic", and these refer not only to concern for the environment and health but also to animal welfare and even better taste *(Bech-Larsen and Grunert, 2001; Bredahl and Poulsen, 2002).* To

summarize, the quality of pork is mostly linked with wholesomeness, freshness, leanness, juiciness, taste, and tenderness *(Bredahl et al., 1998).*

4 Theoretical background

In the next section, we describe the theoretical background for uncovering the cognitive structures that consumers hold on pork quality. From there, we can derive the cues used for perception and evaluation of pork quality. Therefore, we discuss schema theory and the spreading activation network model to analyse the concepts related to pork quality as well as their relation to each other. Furthermore, we take an economics-of-information approach into account to categorize the concepts into search, experience, and credence quality attributes. This is helpful, because before the purchase only search quality attributes can be perceived and so we need to know from which search quality attributes the consumer infers important experience and credence quality attributes.

Several approaches have been suggested in social and economic sciences to measure user-oriented quality *(Grunert et al., 1996, p. 76).* If food quality is a consumer-based perceptual and evaluative construct, the primary level of measurement must be at the level of the individual consumer *(Cardello, 1995).* For that reason we chose schema-theory, semantic networks and the spreading activation network model to uncover the individual consumer quality perception and the relationship between physiological product characteristics.

The following part 4.1 explains the impact of the schema theory and the spreading activation network model with regard to consumers' information processing. Part 4.2 discusses the use of quality attributes.

4.1 Schema theory and spreading activation network model

The most important aspect of consumer demand for marketers to understand is how consumers make decisions. To make decisions, consumers use information. If any information is to influence consumers' decision-making, it must be processed by their cognitive systems. Information-processing models explain how the cognitive system processes information. Reduced to its essence, consumers' decision-making involves the cognitive processes of interpreting relevant information in the environment to create personal meanings or knowledge; integrating this knowledge to evaluate products; and, finally, retrieving product knowledge from memory to use in integration and interpretation processes *(Peter and Olson, 1996, p. 58; Engel et al., 1995, p. 472)*.

As each person actively processes and interprets information in a unique way, it is important to analyse consumers' cognitive structures individually *(Engel et al., 1995, p. 472)*. Any information that an individual is exposed to is organized in memory through schemata to give meaning to stimuli and to enable interpretation and comprehension of any situation as new, familiar, or unique *(Erasmus et al., 2002)*. Schemas can be activated in decision-making situations, and they influence consumers' cognitive processes.

Schemata are networks composed of a set of attributes *(Jonassen et al., 1993, p. 6)*. The nodes in the network represent concepts (attributes), while the links connecting the nodes represent the type and strength of the association between concepts *(Cowley and Mitchell, 2003)*. The schemata concept can be seen as a theoretical representation of the cognitive structure created by past experiences *(Olson, 1978)*. In this context, most of us have a well-developed schema for food quality containing characteristics such as freshness, butcher, or country of origin. In perceiving and evaluating food quality, consumers prefer attributes that correspond to concepts al-

ready stored in memory *(Grunert, 1981).* Thus, consumers' quality assessment depends highly on their knowledge concerning certain quality attributes *(Olson, 1978).*

How much information and what information will be retrieved by consumers are affected by the organization of information *(Cowley and Mitchell, 2003).* In turn, the organization of internal information can be explained by the spreading activation network model of memory. In long-term memory, information is represented as a network of associations among concepts. Through the network structure information is then retrieved by spreading activation from concepts in working memory *(Anderson, 1983a).* Activation can spread from these concepts to associated concepts in the network. The more something is processed, the easier it is to retrieve *(Anderson, 1983b).* According to *Cowley and Mitchell (2003)* activating a node results in a flow of activation through the links from that node to all connected nodes. When the activation of a node surpasses the threshold level, the related concept will be retrieved. The greater the strength of a link, the more activation passes through it to the connected node. In this model the nodes in the network represent concepts such as attributes, while the links connecting the nodes represent the type and strength of the association between concepts. For example, consumers use quality labels to evaluate the production process of a product. Consequently, there are linkages (logical associations or beliefs) between these two concepts. Such interferential beliefs are often formed without much conscious analytical thinking, apparently automatically as a function of one's past experiences *(Olson, 1978).*

4.2 Utilisation of quality attributes

Most approaches analyzing subjective quality assume that quality perception is multidimensional because the quality is perceived by combining a number of quality attributes of the product *(Brunso et al., 2004).* Within the consumers' evaluation process it is important to determine,

which kinds of attributes are chosen *(Trommsdorff, 2003, p. 295)*. The attributes are product information as well as environmental information.

Food products are mainly characterized by experience and to an increasing extent by credence quality attributes; they are only to a limited degree characterized by search quality attributes *(Nelson, 1970, 1974; Darby and Karni, 1973)*. Accordingly, consumers have to form quality expectations when making purchase decisions *(Grunert, 2002; Brunso et al., 2004)*. In the case of experience and credence quality attributes, consumers will try to infer the quality from alternative indicators such as a reliable brand name or certificates *(Grunert, 1997)*.

The pieces of information that are used to form quality expectations are called quality cues *(Steenkamp, 1990)*. It is common to differentiate between intrinsic and extrinsic quality cues *(Northen, 2000)*. Intrinsic quality cues refer to physical characteristics of the product, for example, colour, form, brightness, or smell *(Bech et al., 2001, p. 99)*. Extrinsic cues are related to the product without being a part of it, for example, quality labels such as price, brand, or retail outlet *(Verbeke et al., 2005)*. In situations of uncertainty, and this is common in the case of food quality, the consumer predominantly reverts to extrinsic quality cues *(Tolle, 1994; Grunert et al., 1996, p. 73)*.

The way consumers perceive quality before a purchase may be related to various physiological product characteristics *(Bredahl et al., 1998)*. However, consumers' use of cues to infer food quality can be rather misleading. That explains why there is often a low degree of correspondence between expected and experienced quality. To simplify the quality expectations of their products, producers could offer brands or labels. But their use for communicating specific quality attributes must be related to specified objective product characteristics. Producers have to make intrinsic, difficult-to-evaluate product attributes extrinsic and visible *(Brunso et al. 2004)*.

Finally, consumers' quality expectations play an important role in their evaluation of food *(Cardello, 1995).*

In the following section, we present the results of the survey to uncover the cognitive structures concerning pork quality so that we can determine consumers' demand for pork quality.

5 Methodology and empirical results

In spring 2004, a consumer survey was conducted to analyse consumers' perspectives with respect to their cognitive structures concerning pork quality. The data were collected in Kiel, Germany.

To elicit consumers' semantic networks, a variation of concept mapping was used. The method of concept mapping is generally utilized in the field of educational and counselling research *(Joiner, 1998; Lord, 1994).* It is a technique for representing knowledge in graphs. Knowledge graphs are networks of concepts and consist of nodes (representing concepts) and links (representing relations between concepts) *(Jonassen, 1993, p. 154).* We followed *Joiner (1998)* and transfer concept mapping from educational science to marketing science to reveal consumers' semantic networks.

A random sample of 67 consumers was interviewed regarding the research topic, 'pork quality', using a variation of concept mapping. The respondents received handouts with the key concept, 'pork quality', given in the centre of the paper. Additionally, they received the eight concepts: freshness, leanness, marbling, butcher, price, seals of approval, taste, and country of origin on cards to simplify the procedure. These concepts were deduced from different empirical studies since the 1980s *(for a review, see Engelage, 2002).* Moreover, the participants were asked to add concepts that they associated with 'quality of pork'. Finally, they had to create a

semantic network, by linking the concepts to each other. After drawing their own networks, the participants had to weight the concepts based on whether they were important or not. They were also asked to value the concepts themselves: whether they were positive or negative. Furthermore, they were asked to write down whether the relations were strong, neutral, or weak. Figure 1 shows an example of an individual network from the survey.
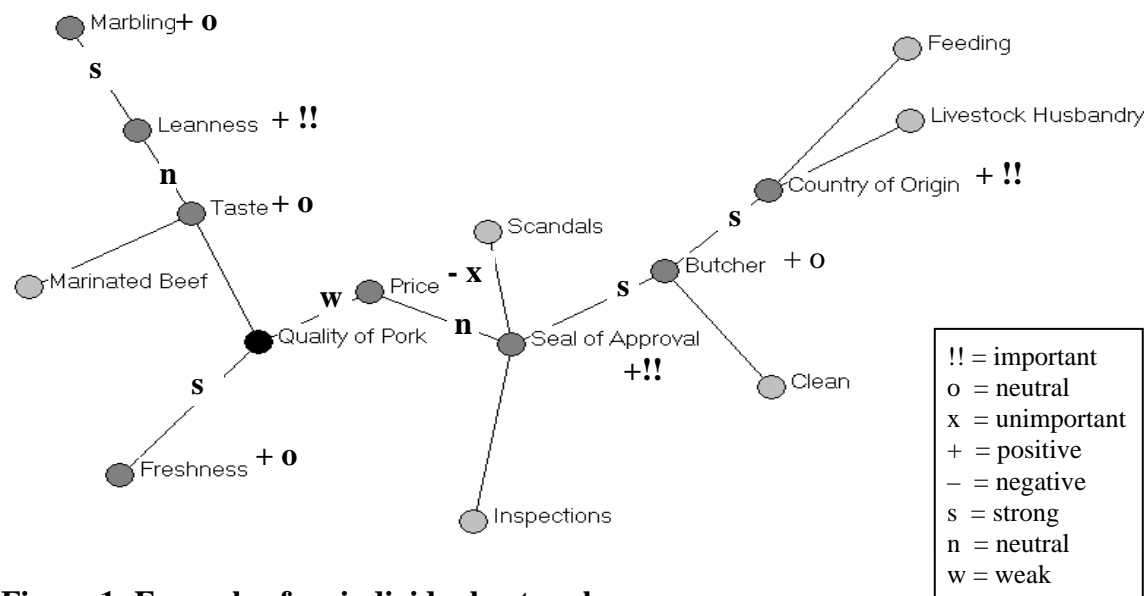

Figure 1: Example of an individual network

Figure 1 depicts that the participant used the eight predetermined concepts and added six of his own concepts. His graph is connected and is acyclic (contains no cycles). This composition is called a tree *(Wasserman and Faust, 1999, p. 119)*. Only three concepts have a direct link (first-level link) to the quality of pork. In this example, it is evident that the predetermined concepts seem to be the root and the new concepts given by the participant himself are the branches, except for freshness. Furthermore, it is of interest that only the predetermined concepts and their relations have been evaluated. For example, country of origin is rated as important and positive. Furthermore, country of origin has a strong relationship to butcher. Price is the only concept

rated negative and unimportant with regard to pork quality. In this context, it is remarkable that the concept 'scandals' is not evaluated.

5.1 Descriptive statistics

This technique leads to a massive amount of data. Table 1 shows that the number of concepts per interviewee ranges from 5 to 27. The participants gave a total of 975 concepts, 484 of which were the predetermined ones and 491 being concepts added by the individuals. The mean is 14.5 concepts per respondent, 7.2 predetermined and 7.3 added by the individuals. The standard deviation is 4.8 concerning the total number of concepts. The results clarify the heterogeneity and complexity of the quality concept from a consumer's perspective. (The data were analyzed with SPSS.)

Table 1: Descriptive statistics

	N	Min.	Max.	Sum	Mean		Standard deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Standard error	Statistic	Statistic
No. of concepts used	67	5	27	975	14.55	.584	4.778	22.827
No. of predetermined concepts used	67	0	8	484	7.22	.215	1.757	3.085
No. of individual concepts used	67	0	21	491	7.33	.556	4.551	20.709

5.2 Empirical results following schema theory and spreading activation network model

In this section, we answer the following questions: (1) Which kinds of attributes with respect to associations are related to quality of pork? (2) How are these attributes related to each other? (3) How important are the single attributes within the network? We use schema theory and the spreading activation network model to interpret the results. For the quantitative interpretation of the quality knowledge, we use the methods of social network analysis for the aggregated network.

5.2.1 Quality attributes associated with pork quality

One of the research objectives was to analyze what information with respect to which attributes are stored in memory. Thus, to start with, figure 2 shows the direct associations (first-level link) with pork quality in percentages. In other words, every concept written down by the participants was included when there was a concrete link between the concept and pork quality.
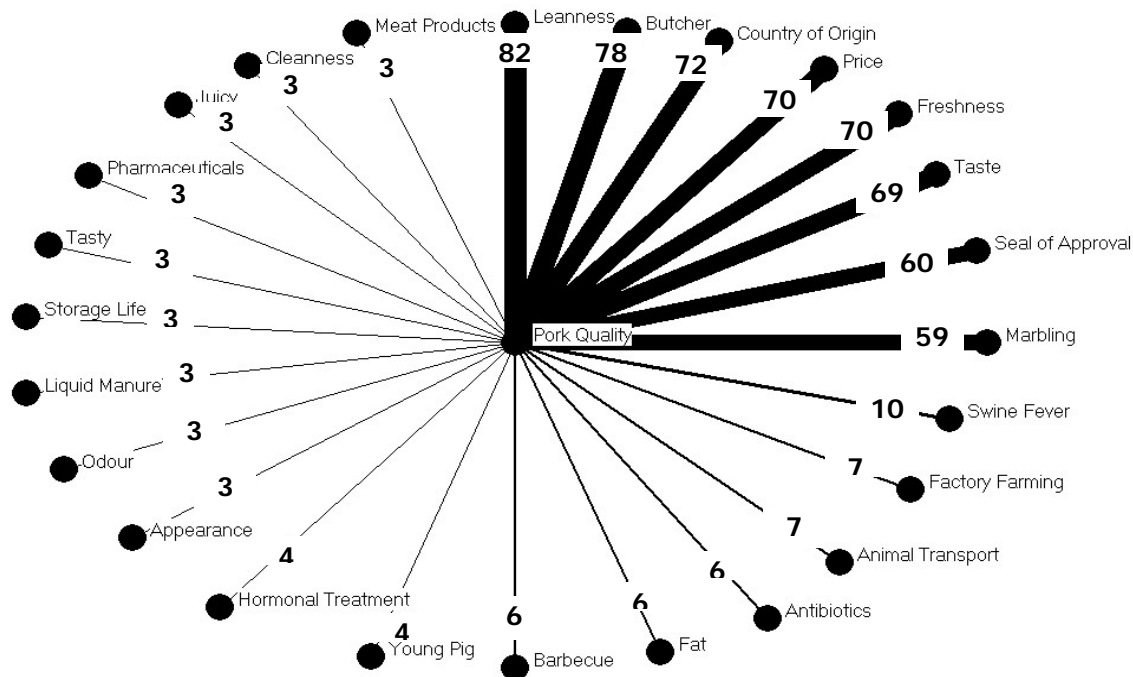

Figure 2: Associations with pork quality (%)

Note: The strength of the lines represents the percentage of respondents sharing these associations. Relations nominated by single respondents are excluded for lack of space. N=67.

Regarding the results of the predetermined eight concepts, leanness has the strongest direct relation with pork quality with 82%, followed by the attribute butcher with 78%. The attribute country of origin was mentioned by 72% of the respondents. Regarding the predetermined concepts, marbling has the weakest relation with 59%. With regard to the individual concepts, swine fever has the strongest link with 10%. Several concepts, such as appearance and odour, are

mentioned by 3% of the participants. Furthermore, individuals provided a large number of concepts named only once, such as animal, minced meat, and canteen. These concepts are excluded in the figure because of space restrictions.

With regard to the schema theory, we can conclude that the schema of pork quality is very heterogeneous. Nevertheless, it is dominated by the concept of fat content, even though it seems to be more important to consumers to have lean meat (82%) than marbled meat (59%). The butcher has the highest impact regarding the point of sale for meat. Although butcher was a predetermined concept, supermarket and discounter as a point of sale for meat are indeed mentioned as well, with 10.4% (supermarket) and 3% (discounter), but they are not directly associated with pork quality (see table 2). Furthermore, it is important to note that the concepts most frequently mentioned by the participants are the negative ones—swine fever, factory farming, animal transport, and antibiotics.

5.2.2 The aggregated network of pork quality: Relations between the quality attributes

After finding which attributes are the most frequent ones in the consumers' schema of food quality, we need to interpret their relations. Accordingly, we aggregated (summed up) the individual concept maps and analyzed them by means of Ucinet 6.0 *(Borgatti et al., 2002).* This shows the links between the single concentrated concepts. In this process, not only are the direct links between the mentioned concepts and pork quality included but all mentioned concepts and their links are as well. Figure 3 depicts the relations between quality of pork and the Top-15 concepts, as well as the linkages among these concepts. The Top-15 concepts are concepts mentioned by at least 10% of all respondents. To give more detail, table 2 shows the relations between the Top-15 concepts in percentages.
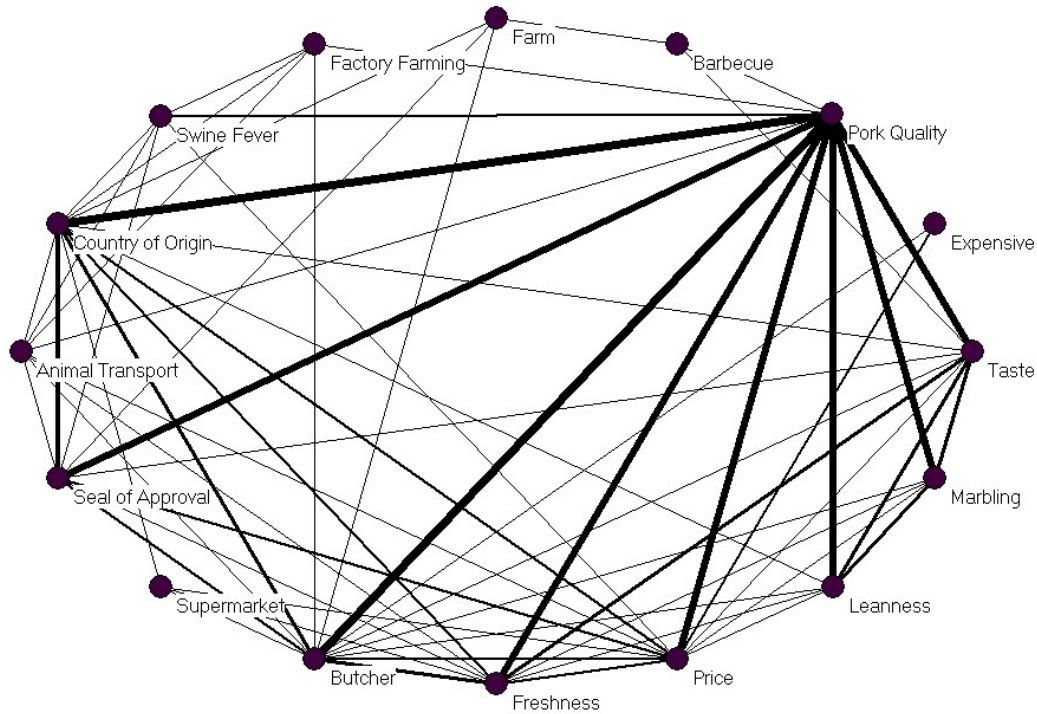
Figure 3: Top-15 network

Figure 3 depicts the strong relation between pork quality, country of origin, and seal of approval. We conclude that consumers use seals of approval to evaluate the meats' origin, which is a strong attribute in the schema of pork quality. Furthermore, butcher and expensive are related. This shows that butcher, one of the strongest attributes, is linked with the meats' price. This point is even stronger if supermarket is not linked with expensive or directly linked with pork quality.

Comparing supermarket and butcher in table 2 shows that butcher has a 32.8% relation with country of origin but only a 1.5% relation to supermarket. Furthermore, butcher has a relation with taste (6%) while supermarket has none. Freshness has a 29.9% relation with butcher and a 1.5% relation with supermarket. However, there are negative relations of 1.5% between butcher and animal transport as well as butcher and factory (no relations to supermarket).

Table 2: Relations between the Top-15 concepts

	Pork Quality	Butcher	Country of Origin	Price	Freshness	Taste	Leanness	Seal of Approval	Marbling	Swine Fever	Factory Farming	Animal Transport	Barbecue	Farm	Expensive	Supermarket
Pork Quality	-	77.6	71.6	70.1	70.1	68.7	65.7	59.7	59.7	10.4	7.5	6.0	6.0	0.0	0.0	0.0
Butcher	77.6	-	32.8	16.4	29.9	6.0	1.5	17.9	3.0	0.0	1.5	1.5	0.0	3.0	3.0	1.5
Country of Origin	71.6	32.8	-	11.9	14.9	6.0	3.0	35.8	0.0	4.5	7.5	1.5	0.0	6.0	0.0	1.5
Price	70.1	16.4	11.9	-	10.4	6.0	6.0	14.9	3.0	1.5	0.0	1.5	0.0	0.0	11.9	7.5
Freshness	70.1	29.9	14.9	10.4	-	29.9	7.5	4.5	3.0	0.0	0.0	1.5	0.0	0.0	0.0	1.5
Taste	68.7	6.0	6.0	6.0	29.9	-	28.4	3.0	22.4	0.0	0.0	0.0	6.0	0.0	0.0	0.0
Leanness	65.7	1.5	3.0	6.0	7.5	28.4	-	0.0	25.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seal of Approval	59.7	17.9	35.8	14.9	4.5	3.0	0.0	-	0.0	1.5	0.0	1.5	0.0	1.5	0.0	0.0
Marbling	59.7	3.0	0.0	3.0	3.0	22.4	25.4	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swine Fever	10.4	0.0	4.5	1.5	0.0	0.0	0.0	1.5	0.0	-	3.0	1.5	0.0	0.0	0.0	0.0
Factory Farming	7.5	1.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	3.0	-	1.5	0.0	0.0	0.0	0.0
Animal Transport	6.0	1.5	1.5	1.5	1.5	0.0	0.0	1.5	0.0	1.5	1.5	-	0.0	0.0	0.0	0.0
Barbecue	6.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	-	1.5	0.0	0.0
Farm	0.0	3.0	6.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	1.5		0.0	0.0
Expensive	0.0	3.0	0.0	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
Supermarket	0.0	1.5	1.5	7.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-

Among the relations, butcher has the strongest link with pork quality, followed by country of origin and price. This is different from what is shown in figure 2. In figure 2, only directly related attributes (first-level links) are depicted, where leanness is the most important attribute in the pork quality schema. With respect to all relationships, it is the sixth most important, and marbling is the eighth most important attribute. The order of the other predetermined concepts did not change. Taking the spreading activation model into account, this means leanness, butcher, country of origin, and price will be the first attributes activated when thinking of pork quality. Nevertheless, fat content seems to be important in general, because it influences the appearance of the meat and will otherwise activate the schema and lead to pork quality.

We must keep in mind that according to the spreading activation network model we have two scenarios:

1. The consumer thinks of pork quality, i.e., at the point of sale. He wants to buy a piece of pork and searches for a way to evaluate the quality. Because of the spreading activation, automatically all attributes directly related (first-level link) with pork quality will be activated. In this case, leanness, butcher, country of origin, and price as the first and most important attributes will be activated first. Thus, the consumer would search for meat, e.g., from Germany or from a specific region as locally produced meat. The price would be important, e.g., in the sense that a higher price means a higher quality. Furthermore, the consumer would search for lean meat. In this example, he would possibly prefer the butcher as the source for his meat.
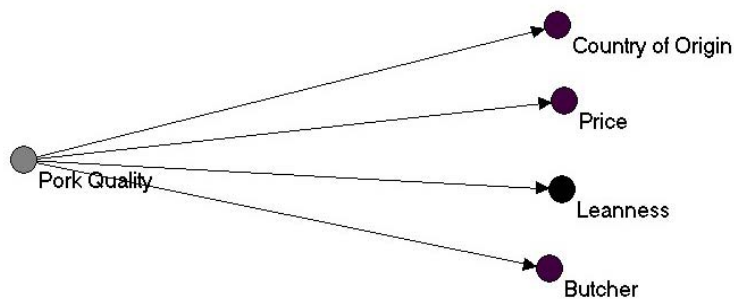
2. The consumer evaluates a piece of pork that is, for example, lean. If leanness is for this consumer a quality attribute, he will evaluate this piece of pork positively, because this time the activation spreads from leanness to pork quality.

5.3 Most important features of pork quality

Next, we want to address the question about which features of pork quality are perceived by consumers to be the most important.

With regard to the spreading activation network model, those concepts occurring near the centre have a high impact concerning marketing strategies, because they will be the first attributes activated evaluating pork quality. That is why we use another depiction from Ucinet 6.0 to research these effects more deeply. In figure 4, the predetermined eight concepts seem to have shorter distances with regard to the key concept, pork quality. The other concepts, such as supermarket, expensive, or factory farming, seem to be in the periphery. Furthermore, there are more relations among the predetermined concepts compared with the other concepts.

5.3.1 Core/periphery structure of the aggregated network

To analyze this more precisely, we made an analysis in Ucinet 6.0. It simultaneously fits a core/periphery model to the data network and identifies which concepts belong in the core and which belong in the periphery *(Borgatti et al., 2002).* From *Borgatti and Everett (1999)*, one "view of the core/periphery structure is based on the physical centre and periphery of a cloud of points in Euclidean space. Given a map of the space, such as provided by multidimensional scaling, nodes that occur near the centre of the picture are those that are proximate not only to each other but to all nodes in the network, while nodes that are on the outskirts are relatively close only to the centre."

The results show that

1. Core class memberships are only pork quality, country of origin, and butcher.

2.   Periphery class memberships are seal of approval, price, taste, leanness, freshness, mar-
       bling, swine fever, factory farming, farm, barbecue, expensive, supermarket, and animal
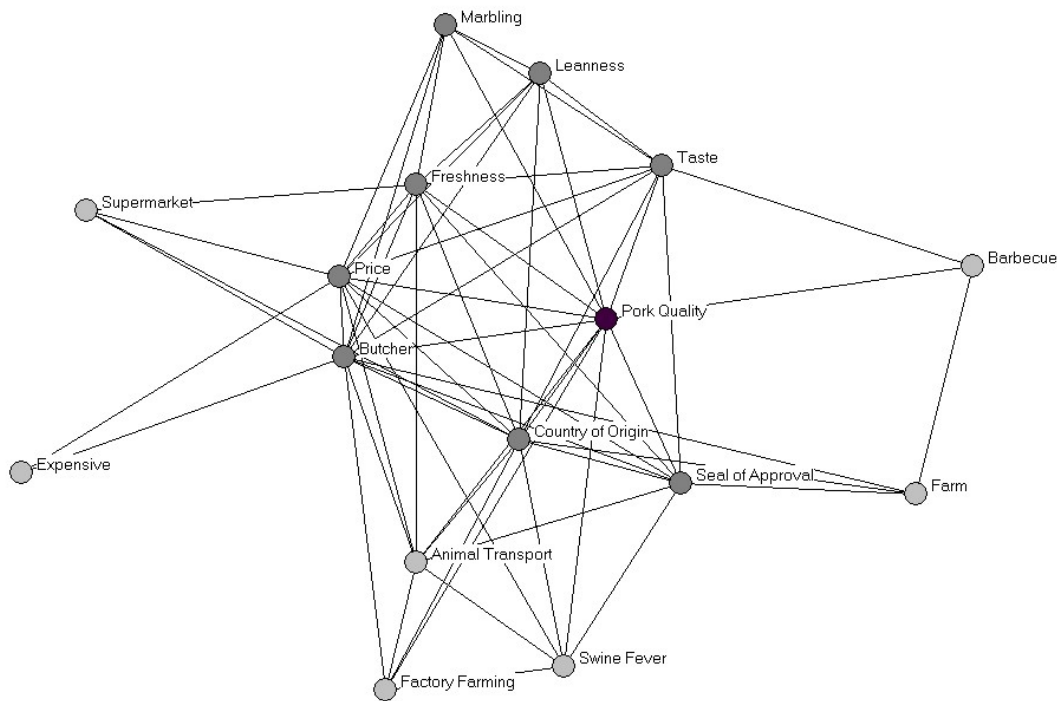   transport.

Figure 4: Conceptual network of the Top-15 concepts

The blocked adjacency matrix (figure 5) shows these outcomes. The single relations among each
concept are depicted (N=67).

       We should note that regarding the percentages of the relations in section 5.2, we would
have assumed four attributes (country of origin, price, leanness, butcher) to be most important
and activated first, while following this model, we have only two attributes (butcher, country of
origin) in the core, which should be activated first. From a theoretical point of view this seems

intuitively right, as consumers are only able to process a limited number of attributes at a time.
To investigate this more deeply, we take centrality indices into account.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Po	Bu	Co	Pr	Fr	Ta	Le	Se	Ma	Sw	Fa	An	Ba	Fa	Ex	Su
1	Pork Quality		52	48	47	47	46	44	40	40	7	5	4	4			
2	Butcher	52		22	11	20	4	1	12	2		1	1		2	2	1
3	Country of Origin	48	22		8	10	4	2	24		3	5	1		4		1
4	Price	47	11	8		7	4	4	10	2	1		1			8	5
5	Freshness	47	20	10	7		20	5	3	2			1				1
6	Taste	46	4	4	4	20		19	2	15					4		
7	Leanness	44	1	2	4	5	19			17							
8	Seal of Approval	40	12	24	10	3	2				1		1		1		
9	Marbling	40	2		2	2	15	17									
10	Swine Fever	7		3	1				1			2	1				
11	Factory Farming	5	1	5							2		1				
12	Animal Transport	4	1	1	1	1			1		1	1					
13	Barbecue	4					4								1		
14	Farm		2	4					1					1			
15	Expensive		2		8												
16	Supermarket		1	1	5	1											

Figure 5: Simple core/periphery model: Blocked adjacency matrix

5.3.2 Centrality indices of the aggregated network

In this section, we will use three different network indices: degree, closeness, and betweenness centrality *(Freeman, 1979; Wasserman and Faust, 1994).* These indices offer a sense of how important each node is in the network *(Henderson et al., 1998).* They focus on the attribute and are basics for network-modelling because they indicate the volume or strength of ties flowing from and to each node *(Iacobucci et al., 1996).* Using these indices of centrality, we are able to uncover particularly important nodes within the network that are influential in the spread and activation throughout the network. The importance of certain nodes is indicated based on their location within a network relative to other nodes *(Henderson et al., 1998).* In the current research, the centrality of a particular attribute node, e.g., freshness, represents the extent to which this

characteristic is perceived to be a prototypical or representative quality attribute. We will refer to social network literature to analyze the semantic network.

Degree Centrality

The first index used to describe the impact of the single attributes in the aggregated network is degree centrality, C_D. This index is perhaps the most commonly used measure of centrality *(Henderson et al., 1998)*. The degree centrality of an attribute in a network reflects the number of other attributes to which this attribute is related. An attribute with a high degree of centrality is described as a characteristic highly connected with many others. This one would be the 'major channel' in the spreading activation network for other contacts *(Freeman, 1979)*. For our data, highly central attributes would be those that demonstrate high activation volumes to and from other attributes; those with large linking shares. By contrast, attributes with low degrees are more peripheral to the network *(Iacobucci et al., 1996)*. The degree of a node, C_D, is defined as the number of other points that have a direct relation to that node. In other words, it is the number of adjacencies for a point, p_k *(Freeman, 1979)*:

$$C_D(pk) = \sum_{i=1}^{n} a(p_i, p_k),$$

where n = the number of nodes in the network and $a(p_i, p_k) = 1$ if and only if p_i and p_k are connected by a line; 0, otherwise.

Degree centrality measures network activity. A high degree centrality of a concept shows its high impact in the network. Therefore, we tend to say that concepts with a high degree centrality represent core attributes. The probability that they activate the semantic network is very high *(Collins and Loftus, 1975; Henderson et al., 1998)*. In terms of our aggregated network for pork quality in table 3, pork quality has the highest degree centrality, 384, because it has more

direct associations than do any of the other nodes. This is no surprise as pork quality is the key concept here. Conversely, the nodes farm and supermarket have a degree of only 8 because of their few connections to other nodes. The other concepts, country of origin, butcher, taste, and freshness, have the most direct associations. This suggests that even if only country of origin and butcher are in the core of the network, taste and freshness should be used for marketing activities as well.

Closeness Centrality

Closeness centrality, C_C, measures how close one concept is to all other concepts. A high closeness centrality indicates independence from the control potential of other nodes in the network or of the flow of activation from other concepts. Closeness is a measurement that defines an attribute as central according to the extent to which the attribute is close enough to many others to activate them directly. Therefore an attribute need not rely upon others to spread activation. If all attributes in a network are close to each other, activation originating with any attribute will flow through the rest of the network quickly; thus, high closeness centralities are associated with short times of activating the schema, low costs (e.g., for advertisement), and the like depending on the content of relational ties being modelled *(Freeman, 1979)*. With regard to the highly related attributes in the aggregated network, we have to keep in mind it is a summation of all individual networks. The individual consumer has lower values for closeness centrality; in most cases there will be not an activation of all attributes if only one attribute has been activated. The farness of a concept/attribute is computed as the sum over the lengths of the shortest distances between the focal attributes and all others in the network. Closeness is the reciprocal of farness *(Iacobucci et al., 1996)*. The index of closeness centrality is defined as

$$C_C(p_k) = \left[\sum_{i=1}^{g} d(p_i, p_k)\right]^{-1},$$

where $d(p_i, p_k)$ is the number of lines in the geodesic linking nodes i and k. The results for closeness centrality show that butcher has a higher degree than the key concept, pork quality. This shows once again the importance of the butcher, but, furthermore, it is interesting that, compared with degree centrality, pork quality does not have the highest score. So we can conclude that pork quality has the most direct associations, but butcher is closer to more attributes than is pork quality and can activate them faster than the key concept itself. Furthermore, it turns out that country of origin and price are again very important. They have the same score as pork quality. The results show that in this network we have high closeness centralities for all attributes (see table 3).

Betweenness Centrality

The shortest path that links two points, i and j, in a network is a 'geodesic'. Any point that falls on a geodesic(s) linking a pair of points stands between these two points *(Knoke and Kuklinski, 1982)*. Betweenness centrality is an indicator of control within a network. Furthermore for semantic networks we assume that a point with a high betweenness centrality has a higher probability of getting activated or of activating other concepts. The betweenness measure is defined in terms of probabilities; in cases where there is more than one possible path, it considers the probability of using a particular path *(Freeman, 1979)*. Betweenness centrality is computed as

$$C_B(p_k) = \sum_{i}^{n} \sum_{j}^{n} b_{ij}(p_k) \quad \text{for all } (i < j) \neq k \text{, and where } b_{ij}(p_k) = \frac{g_{ij}(p_k)}{g_{ij}}$$

where g_{ij} represents the number of geodesic paths from point i to point j that contain p_k. Therefore, $b_{ij}(p_k)$ represents the probability that p_k falls on a randomly selected geodesic connecting i and j.

Betweenness centrality reflects the likelihood that an attribute will be activated as associations spread throughout the network. A node being on many paths between other pairs of nodes is "between" many nodes and will have a high betweenness centrality index *(Henderson et al., 1998).* Table 3 shows that the concepts marbling, expensive, and supermarket are not between any pair of nodes. They have a betweenness centrality index of 0. Butcher has the highest betweenness centrality, followed by the key concept pork quality and price. This shows that even if price seems not to have such a high impact compared with its degree and closeness centrality, it has a high betweenness centrality and therefore can control the activation within the network. This is interesting because it underlines *Kuss and Tomzcack (2000)* who state that the price remains the most important quality attribute. Even if the consumer perceives and evaluates certain quality attributes as important concerning food quality, the price would be the determining factor regarding the purchase decision and demand.

Table 3: Centrality measures for the aggregated network

		Degree	nCloseness	nBetweenness
1	Pork Quality	384.000	83.333	10.683
2	Country of Origin	132.000	83.333	8.429
3	Butcher	131.000	88.235	15.667
4	Taste	118.000	71.429	4.127
5	Freshness	116.000	75.000	2.794
6	Price	108.000	83.333	10.270
7	Seal of Approval	94.000	71.429	2.651
8	Leanness	92.000	65.217	0.159
9	Marbling	78.000	62.500	0.000
10	Swine Fever	15.000	62.500	0.381
11	Factory Farming	14.000	60.000	0.159
12	Animal Transport	11.000	68.182	0.968
13	Expensive	10.000	51.724	0.000
14	Barbecue	9.000	51.724	0.476
15	Farm	8.000	57.692	1.333
16	Supermarket	8.000	55.556	0.000

NOTE: For valued data, the centrality index may be larger than 100%.

6 Demand for food quality applying schema theory and network analysis

Our results showed that, with respect to the direct relations, the intrinsic search quality attribute leanness has the strongest relation with pork quality (with 85%), followed by the search quality attribute butcher (81%) and the credence quality attribute country of origin (75%). However the results of the network analysis confirm that in the core/periphery model as well as regarding the centrality measures, country of origin and butcher are the most important attributes concerning pork quality. The impact of leanness is not as high in these analyses, as shown by the direct relations. This could be explained by the fact that fat as a cue is dysfunctional, because its objective relationship to relevant quality dimensions such as tenderness and taste is the opposite of what consumers assume *(Grunert, 2002).* That means there may be a strong direct relation to pork quality but the impact within the whole semantic network may be weaker.

The other major quality cue used when buying meat is, according to *Grunert (2002),* the point of sale. Gruner refers to quality uncertainty, which consumers appear to experience while purchasing meat. Consumers would rather trust an expert (the butcher) than forming a quality expectation on their own. This statement does conform to our results.

Most important for marketing recommendations is the result that country of origin has such a high impact within the pork quality network. As country of origin is a credence quality attribute, we need to communicate this by use of search quality attributes. Figure 6 shows that there is a strong relation between the extrinsic search cues seal of approval as well as butcher and the credence quality attribute country of origin. Over one-third (34.8%) of the respondents drew the linkage between country of origin and seal of approval and 33.3% drew the link between country of origin and butcher. That means approximately one-third of the respondents may use these cues to assess the origin of pork at the point of sale. The price, another important

extrinsic search cue, has a rather weak direct relation (first-level link) with country of origin but is strongly related with most of the other predetermined concepts. For example, price is 15.9% related with seal of approval and butcher. We have an important second-level link here.

The intrinsic search cues leanness and marbling are barely related with country of origin. Leanness has a relation of 2.9% with country of origin while marbling has none. Nevertheless these two attributes are highly related with the experience quality attribute taste: 27.5% of the respondents drew the linkage between taste and leanness and 21.5% drew the link between taste and marbling. The experience quality attribute freshness has a rather strong relation to country of origin, at 14.8%, whereas taste has a rather weak relation with country of origin, at 5.8%.
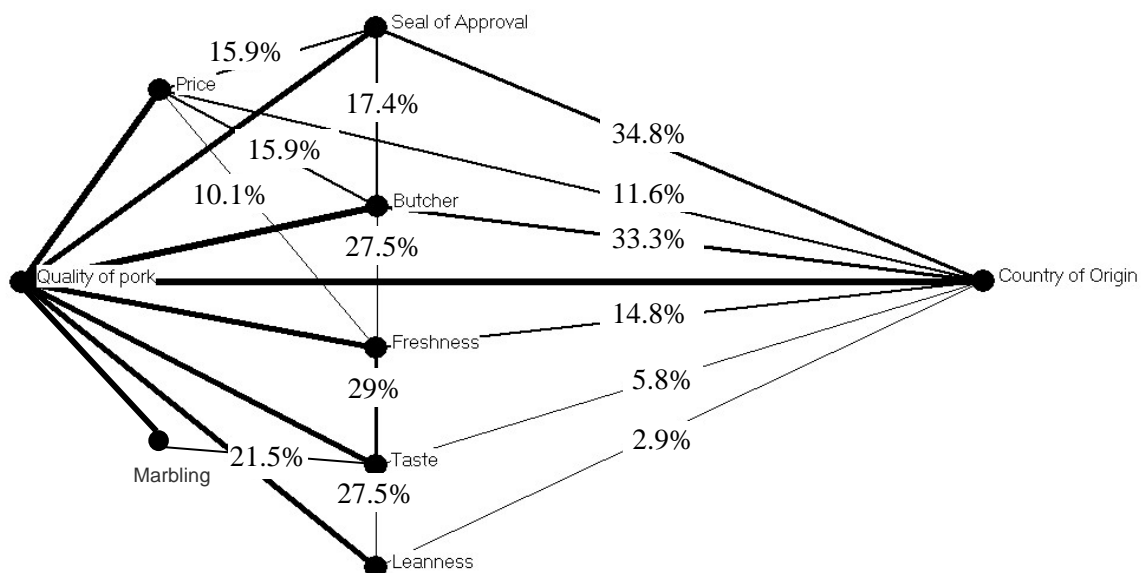

Figure 6: Important relations in the aggregated network (%)

With regard to marketing activities, extrinsic search cues such as seal of approval are useful to communicate the meat's country of origin. Furthermore, environmental attributes, such as

butcher, are important. In view of supermarkets and hypermarkets, a meat counter designed in a butcher-shop-style seems to be an important consideration.

7 Conclusion and research limitations

7.1 Conclusion

The substance and determinants of quality may be undefined, but their importance to firms and consumers is undeniable *(Parasuraman et al., 1985).* Food quality is a relative concept and a psychological construct that is both perceptually based and evaluative and can only be defined by the average consumer of that food *(Cardello, 1995).* Consequently, consumer demands have to be translated into product specifications that are actionable from the producer's point of view and that can be perceived by the consumer at the point of sale. In the case of food, this can be complicated because the way consumers evaluate quality before a purchase can be different from the way the quality is evaluated after consumption *(Bredahl et al., 1998).* Furthermore, consumers' use of quality cues for inferring expected quality can be rather misleading and seem to be quite irrational at times *(Brunso et al., 2004).* Unbranded products, such as fresh meat, make it much more difficult for the consumer to form quality expectations. Quality labels can give consumers another means of inferring experience and credence characteristics of food products *(Grunert, 2002).* The importance of cues for marketing recommendations lies in the inferences, for example, a consumer might infer the taste of a steak from the color or other aspects of the steak's appearance.

With the increasing extent of credence quality attributes, characterising food quality provides a challenge for communication about the products *(Grunert, 2002).* The consumer-oriented approach applies quality to fulfil customer requirements *(Grunert et al., 1996).* To meet these re-

quirements, quality is defined by the end-users' perception. Thus, individual cognitive structures are an important part of user-oriented quality *(Steenkamp, 1990)* and it is significant to know what information is stored in consumers' memory and how.

As the perception of quality can differ for the same product between customers, the perception has to be measured individually *(Henson, 2000).* In this case, the qualitative approach of concept mapping was chosen. This approach contributes to actual research in the field of consumer-oriented approaches towards food quality *(Grunert et al., 1996; Grunert et al., 2004; Steenkamp and van Trijp, 1996).* Concept mapping showed which knowledge elements dominate the consumer's mind and, alternatively, how strongly these knowledge elements are linked to each other. Furthermore, an economics-of-information approach was used to deliver deeper insights concerning consumers' evaluation of pork quality. As the quality evaluation affects the decision-making process and demand, identifying such relations moves us one step forward in developing consumer-oriented communication strategies and giving recommendations with respect to enterprises.

Accordingly, we have to deal with the question of how much and what information will be retrieved by consumers in a purchase situation. For that reason, a second survey was conducted at different retailers. These results will enable marketers to provide consumers with information they understand and are seeking.

7.2 Research limitations

As we used a supported version of concept mapping with predetermined concepts, it seems to be necessary to repeat the method in unsupported versions to compare the results. One might expect the number of used concepts to decrease and the heterogeneity of the concepts to increase. To avoid this, a version with two or four additional concepts may be helpful. Another improvement

would be a directed version of the concept maps. The direction of the links could give deeper insight into the relationship of the attributes and the spread the activation will take. Furthermore, the use of prepositions to describe the relations could be useful.

However, this method leads to a massive amount of data and it puts high demands on the interviewers and the interviewees due to its complex instructions. Because of that, we kept the procedure as simple as possible. Unsupported versions as well as directed links and the addition of prepositions will increase the demand on the respondents. Nevertheless, we carried out unsupported versions of concept mapping with students, which have been successful. Results are not yet available.

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