CHAPTER 7

Systems Intelligence and Our Daily Bread

Laila Seppä

> From time immemorial, the human race has explored the
> world in search of food. Hunger has been the force behind
> its onward march. Hunger is still the source of mankind's
> energies, good or bad, the reason for its advance, the origin
> of its conflicts, the justification of its conscience and the
> currency of its labours.
>
> Toussaint-Samat (1987, p. 3)

In this chapter the systems intelligent features and other aspects of our
daily bread are discussed, highlighting the way in which sensory properties
are important in selecting food for consumption. However, the sensory
evaluation process is only part of the whole system of food consumption. In
systems intelligence we believe that every detail counts on the whole and
every part of the system interact with each other and the system. Moreover,
the food system is changing all the time. As food is being consumed, the
interactions of food components with the human body and emotions as well
as with social and eating contexts determine the ultimate perception and
liking of that particular food.

Introduction

FOOD IS ONE of the basic elements of our daily life.[1] If we are in good health
and not fasting, eating is what we do several times every day. Food is present
in our daily and weekly routines. Many name cooking as one of their primary
hobbies and books and television shows about cooking are popular. Wine-and-
cheese-tasting evenings are successes, too. Despite all that, most of us pay little
attention to eating. Or more precisely, to the dimensions of eating. Is food just
food, or is there something more to it?

---

[1]In this chapter, the word "food" includes, besides the actual food, also beverages as well as
raw ingredients and meals, unless otherwise stated.

Food can be defined as a material consisting essentially of protein, carbohydrate and fat used in the body of an organism to sustain growth, repair, vital processes and to furnish energy[2]. However, food is much more than the sum of its energy and nutrients. There are a considerable number of features and nuances in and around food that cause us to select a particular food for consumption. Belitz et al. (2004, p. ix) describe: "Foods are materials which, in their naturally occurring, processed or cooked forms, are consumed by humans as nourishment and for enjoyment. The terms nourishment and enjoyment

Foods are materials which, in their naturally occuring, processed or cooked forms, are consumed by humans as nourishment and for enjoyment.

introduce two important properties of foods: the nutritional value and the hedonic value." Furthermore, there is also the social aspect of food. A dinner made from the simplest of ingredients but eaten with the best and dearest friends tastes like a feast. On the other hand, a banquet among enemies has practically no taste at all or the taste of saw-dust at best. And every time food is little different: Each apple and fish has its own shape and colour. There are thousands, probably even millions of flavour and odour components to be found in food, many of them still undiscovered. And yet, hunger is the ultimate driving force behind food acceptance.

The concept of systems intelligence can be understood as intelligent behaviour in the context of complex systems involving interaction and feedback (Hämäläinen and Saarinen 2007). A system is characterized by the interconnections of its elements, such as emotional, physical and social features, as well as the internal nature of these elements. A food system has at least two kinds of systems intelligent characteristics. Food is collected, prepared and eaten in a system, which consist of various psychological, symbolic and social behaviours. The system is changing all the time, and as the food is being consumed, thoughts, emotions and sensations within the system generate more thoughts, emotions, and sensations. Thus interactions of food components with human biology and social and eating contexts all determine what we like and what we eat.

Our physical bodies also act systems intelligently. That is not always so apparent, because there is so much abuse of our body by food, alcohol, medications and other substances. In situations of change, uncertainty or crisis, these systems intelligent characteristics become visible. As a new situation is evolving, people change their behaviour and adjust to the new system instinctively (Hämäläinen and Saarinen 2007). In addition to this, their physical bodies adjust to the new situation, too.

Writing a chapter on food is a serious challenge. Everybody knows something about food, but to say anything precise is demanding, as food system keeps changing. It is perhaps one of the most complex systems which exists. A complete chemical analysis (which is impossible because there is always more to study) does not tell much about the acceptability of a food. And even if the taste was delicious, it counts for nothing if the situation is not right. Practically everything

---

[2]http://www.britannica.com/eb/article-9034792/food [2008-03-31].

about food is relative, situation specific and full of paradoxes. However, systems intelligence is an excellent tool to handle paradoxes (Hämäläinen and Saarinen 2007; Kauremaa 2007).

Sterman (2002) describes how he has it difficult to define what systems dynamics is as it is so many things, and so much more. The same applies to a food system. It deals with chemistry, physics, engineering, ethics, ethnology, psychology, biology and history, to mention only a few disciplines. Thus the availability of food, food types, and food choices interacts with a wide range of socio-economic factors (Gesch 2005). Sterman (2002, p. 506) describes: "One of the main challenges in teaching systems dynamics is helping people to see themselves as part of a larger system, one which their actions feed back to shape the world in ways large and small, desired and undesired." This is what I try to do, too.

Food Acceptance

Actually, what is food? Well, it is something that we eat to get our bellies full and thirst quenched. It consists of biological components such as proteins, fats, carbohydrates and vitamins and some inorganic components and minerals, the most common of them being sodium chloride, table salt. However, even green grass contain some of these components but very seldom do we eat them on purpose. To be able to eat a particular food you have to be able to do that, that is, you have to accept that food as edible and suitable for you. This phenomenon is called *food acceptance*. It is determined by several (bio)chemical, physiological, personal, dietary as well as psychological, ethical and cultural criteria (Cardello 1996; Martins and Pliner 2005). Bergier (1987) divides culture related reasons for food acceptance into four categories:

Material factors. These include the abundance or scarcity of food globally or locally, seasonal availability, diversity of resources such as spices, sweeteners and other ingredients. Commercial, economical and political reasons fall into this category.

Social factors. Different groups of a society can have different eating habits for budgetary or availability reasons. In a hyper market there are much more alternatives than in a small village shop. On the other hand a busy city-single might not have many opportunities nor time to choose his or her meals.

Religious factors. Religious taboos prohibit certain kind of food either permanently or periodically, like during fasting. Religious rules can also demand or promote the consumption of certain foods for hygienic, symbolic or magic reasons.

Additional factors. These are traditions that sometimes originate even from the time immemorial. Anthropologist Levi-Strauss called them mythological reasons.

Systems evolve over time producing complex and often not-so-obvious responses and feedback (Sterman 2000; Hämäläinen and Saarinen 2007). According to Hazy et al. (2007) complexity usually refers to a high degree of systemic interdependence, which leads to non-linearity, emergent processes and other surprising dynamics. Bergier (1987) points out that the cultural background of food acceptance changes and develops alongside changes in political, social, demographical and economical structures of the society and its culture. New customs and norms do not replace older ones but are superimposed and thus enrich and complicate the food environment. GMO, organic foods and fair trade products are modern examples of politically motivated food acceptance, but the old questions like hunger or the price and quality of food have not vanished.

The systems intelligence concept reminds us that there is always an invisible system along with the apparent system (Hämäläinen and Saarinen 2007). Both the visible and invisible systems produce beliefs, which in turn produce behaviour and more beliefs. Many of these beliefs are based on human emotions and mental models, and these cause more effects on the system. Bergier (1987) mentions that horse meat was not banned by the medieval church. However, disgust towards horse meat in many cultures probably has its origin in mythology. Horse was a sacred animal for Romans and consecrated to Neptune. Besides, many people have horse riding as a hobby and feel that a horse is more like a pet than a domestic animal.

The cultural background of food acceptance changes and develops alongside with changes in political, social, demographical and economical structures of the society and its culture.

Traditions have a powerful influence on what we prefer, what we like and what we eat. Globally people often eat what is available and cheap enough although they might not prefer it. Thus it would be a mistake to think that the most widely consumed foods are the most widely liked (Cardello 1996)[3]. The concept of *liking* refers to the immediate qualitative, *hedonic* evaluation of food, and the degree of experienced pleasure or displeasure. *Preference* is often used as a synonym for liking, but actually preference is better used to express choice (Mela 2001). A product may be preferred over another for reasons such as healthiness or price, even though it is not liked.

The social dimension of eating is of great importance. Gesch (2005) points out that food is a meeting point of the social and physical worlds. Most of traditional family routines are based around meals. Hämäläinen and Saarinen (2007, p. 14) note that "people influence one another far beyond what is the visible." In this process food creates connectivity over time and space. There are many traditional foods that are related to special events like weddings or birthday parties or celebrating Christmas or New Year (Cayot 2007). These occasions include gathering of relatives and friends enjoying each other's company and the many different dishes and delicacies. Consequently environmental cues, including but not limited to food itself, have an important role as a stimulus to eat. As Mela

---

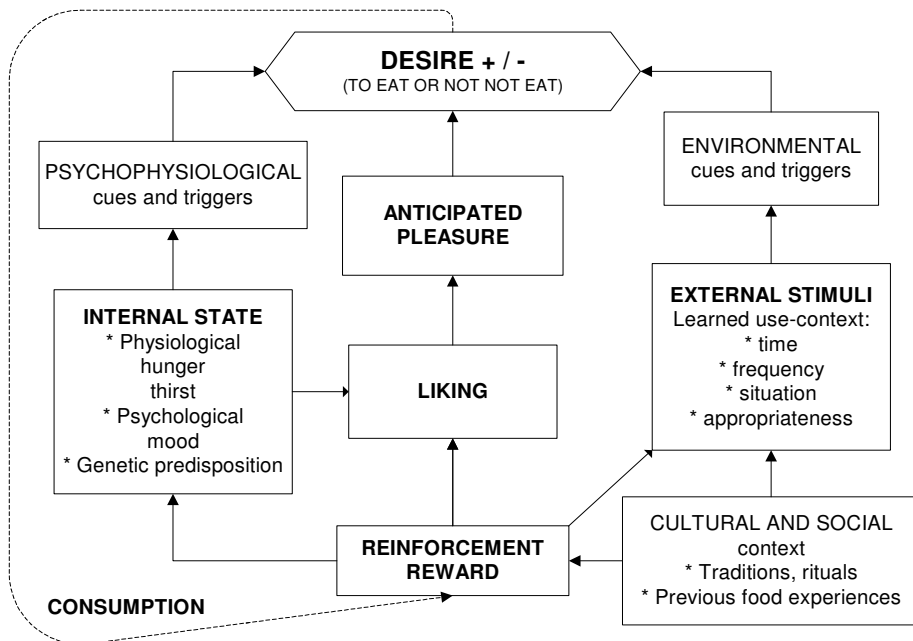[3]Actually, this applies to any article, such as clothes, shoes, cars or housing.

Figure 7.1: Flowchart describing the system of combined influences of internal state, external stimuli, liking and feedback from consumption in the desire for foods. Adapted and further developed from Mela (2001) and Mela (2006).

(2001) notes, we may like fish soup and wine, but have no desire to have them at breakfast. Thus desire can be strongly influenced by feelings of appropriateness. In order to understand why certain food stimuli are liked or desired, it is vital to study not only the immediate oro-sensory responses but also the system on wider perspective (Mela 2006). At any given moment a conscious feeling of the desire to eat a particular food is the outcome of several factors, illustrated in Figure 7.1.

Learning and Neophobia

Sterman (2000) states that all learning depends on feedback. This is true with food also, as learning plays an enormous role in food acceptance. When a person gets nauseous after eating certain food, it becomes disliked (Cardello 1996). This disliking, or rather disgust, can last a lifetime. And when it comes to eating habits, humans are often quite conservative. They are reluctant to consume unfamiliar foods, which is called neophobia (Logue 1991; Martins and Pliner 2005; Martins and Pliner 2006). This phenomenon is usually explained that it prevented our ancestors from ingesting potentially toxic or lethal substances. Food neophobia is shown to be stronger towards unknown food of animal origin than towards unknown food of nonanimal origin. This is confusing, because there are numerous toxic berries and other plant parts out there in Nature, while most of the animals

are edible. However, food of animal origin will usually be spoilt more rapidly than food of nonanimal origin. Spoilt meat and fish are toxic because of microbial contamination and can be extremely dangerous, whereas a plant once found to be safe usually stays safe[4]. Thus what at first glance seems to be contradicting turns out to be an excellent example of systems intelligent behaviour of our ancestors.

In modern societies where there are many safeguards against dangerous foods entering the food supply, food neophobia is not very useful anymore. On the contrary, it can be harmful and maladaptive, because it might restrict the number and types of food consumed (Martins and Pliner 2005). Children are usually quite neophobic. This is at least partly learned behaviour. Early exposure to a food can result in increased preference for that food (Logue 1991). Mustonen and Tuorila (2007) have demonstrated that neophobia in children can be reduced by sensory training. Fulton (2006) describes neophobia felicitously in her paper on medieval cookery and sweet taste:

> Now think about why you may have reacted this way, depending of course, on your culinary experience. What seems to have concerned you most? That some of the ingredients were unfamiliar or hard to get ... That some of them were not in your regular diet because you prefer not to consume them for spiritual or moral reasons ... That some of them did not seem to fit with each other ... Did you think at all about the color ... Or were you primarily concerned with doing without the sugar ... [Knowing the origins of the course w]ould you be more or less willing to try a taste? Why or why not?

Not only unfamiliar foods but also new technologies can cause anxiety, which is only partly based on scientific facts. Especially perceived safety is important in selecting food. Things and ideas that are unfamiliar cause suspicion and uncertainty (Logue 1991; Cardello 1996; Bäckström et al. 2003). Furthermore, food is considered personal, even an intimate issue and important to one's identity, like the old saying "we are what we eat" tells us. Tuorila (2001) divides new foods into five categories: Functional foods with beneficial health effects, genetically modified foods, nutritionally modified foods, organic foods and ethnic foods. Bäckström et al. (2003) demonstrate that organic and ethnic foods seem to be more trusted and are found safer and more pleasurable than new biotechnological foods. The underlying reason might be that organic and ethnic foods have already been tested by other people and do not represent real novelties in people's minds.

Food neophobia can affect the overall nutritional quality of an individual's diet. Especially with older people it might happen that when a certain favourite food is no more consumed (either for health or availability reason), nothing comes instead. However, humans exhibit both an interest and reluctance to eat novel foods, thus if the interest side is enhanced, nutritional status might get better. Hämäläinen and Saarinen (2006) introduce the concept of "system of holding back" which describes a situation when something is avoided for one reason or another, and consequently "the avoider's" own possibilities to interact diminish.

---

[4]See for instance McLauchlin and Little (2007) on the concepts of food poisoning and hygiene.

Often the reason for avoidance is fear, as also with neophobia. But if the system of holding back is overcome, excitement and desire for more sensations is back, and perhaps new favourite foods and lifestyles are found.

Dienstbier and Zillig (2002) review the concept of toughness. The theory of toughness could perhaps be applied to food liking and learning as well as to culinary and gastronomical enthusiasm. Toughness is about the harmony and interactions between physiological and psychological systems. All the major physiological systems within a human body (or any living organism) interact, so that the state of one system will influence most of the other systems. This corresponds with systems intelligence, where we believe that every detail counts on the whole, and every part of the system interacts with each other and the system (Hämäläinen and Saarinen 2007). Toughness

Things and ideas that are unfamiliar cause suspicion and uncertainty. Especially perceived safety is important in selecting food.

theory emphasises the significance of training effect on systems. Most of us probably know the effect of spicy food. The first time it might taste too hot, but perhaps on the third or fourth time we start to like it. Perhaps we develop a growing interest in other spicy and exotic foods, too. Thus gradually the system of holding back diminishes and uplifting culinary sensations come instead.

Sensory Dimension

There are five basic tastes: salty, sweet, sour, bitter and umami[5]. The main senses used to evaluate food are taste and smell (odour), which together form the concept of *flavour*. Furthermore, visual, textural and auditive cues are important in food selection and evaluation (Cardello 1996). All of them affect our daily digestion and nutrition. First, when we see, smell, or even think about food our digestion system starts working[6]. The secreting saliva participates in the initial breakdown of food by affecting flavour release (which causes more saliva to secrete), diluting flavours and tastes, dispersing and starting the break down of nutrients and lubricating oral tissue (Engelen et al. 2007). All sensory stimuli adapt after a period of stimulation. Most taste compounds exhibit a wide variety of qualitative interaction when mixed with other components. Taste suppression or unexpected taste and smell experiences can occur when two or more flavour components interact (Cardello 1996).

Most sensory stimuli, but especially food, elicit a hedonic, pleasure dimension in addition to the basic dimensions of quality, magnitude and duration of the sensory experience (Cardello 1996). Pleasure is a totally subjective phenomenon and not directly measurable as such. The degree of liking (or disliking) is called

---

[5]"Umami is a savoury taste imparted by glutamate and ribonucleotides, including inosinate and guanylate, which occur naturally in many foods including meat, fish, vegetables and dairy products ... Umami plays an important role making food taste delicious." See http://www.umamiinfo.com/what_exactly_is_umami/ [2008-05-13]

[6]Most of us probably remember the Pavlov's dogs from Biology or Psychology classes at school.

hedonic response. It is context specific and can be measured with hedonic ratings, which are self-reports of subjective experiences (Tuorila 1987). Maximal hedonic responses usually correspond to the concentration of active component typical for the product which people have come accustomed to (such as sugar level in juice).

Babies are born with positive hedonic responses to sweetness (e.g. Logue 1991; Mela 2001). As it happens, mother's milk is sweet. How systems intelligent of Nature! Newborn babies dislike sour and most bitter taste stimuli. Ability to sense salty stimuli develops in a few months. There is contradicting evidence whether there is an inborn, unlearned hedonic response to odours recognised as pleasant or unpleasant by adults. However, newborn babies seem to recognise their mothers by the smell (of milk, most probably), which most mothers and midwifes know from experience.

Our body and physiology are amazingly built so that basically our body will tell what is good for us – if we are willing and able to listen to it. In any given moment, a factor called homeostasis tries to maintain a physiological balance in the body (e.g. a feeling of thirst is experienced after high salt intake or sweating in sports). On the other hand, homeostasis is not the only driving force in our eating habits. Earlier we discussed toughness theory and learning (Dienstbier and Zillig 2002). For example, certain kind of learning can lead to specific neuro-endocrine system modifications which in turn lead to specific impacts on personality, performance and health. Continuous under- or overeating will eventually lead to changes in psychology and physiology.[7] Unbalanced eating is associated with numerous diseases, but the interactions with eating, homeostasis, sensory experiences, health and diseases are extremely complicated and beyond the scope of this chapter.

Psychology and Food Acceptance

The development and maintenance of food acceptance is controlled by a myriad of affective, personal, cultural and situational factors. When individuals are asked to indicate why they choose the foods they do, *sensory* and *pleasure* factors (particularly taste) and healthiness are the motives most often cited (Martins and Pliner 2005; Martins and Pliner 2006). Foods are rejected if they are known or believed to possess negative sensory properties (bad taste, smell etc., commonly referred as *distaste*) or if they are believed or known to promote harmful consequences, in either short- or long-term (rejection based on *danger*). These danger-reasons include fear of allergic reactions, avoidance of junk food and demand for organic or otherwise special food. Avoidance based on danger can become in excess, in hypochondriac proportions.

On the other hand, some culinary traditions have severe risks, the most famous is probably a dish called fugu[8], which if not properly prepared is deadly poisonous. The same applies to some mushrooms like false morel[9]. Also some common practices of preparing food are harmful. Barbecuing a steak causes multiple carcinogenic and teratogenic components to emerge on the surface of

---

[7]See for instance Gesch (2005) and Schlosser and Wilson (2006) for further references.
[8]Made of tropical puffer fish or blow fish (*Tetraodontidae*).
[9]*Gyromitra esculenta.*

the meat (Belitz et al. 2004). The more taste, the more of these components, unfortunately. However, most of us do not give up barbecuing, the danger seems too distant. Also excess salt, sugar or fat in food is harmful and reduction of those components in most western diets would improve the nutritional and health status of the population. Cayot (2007) reminds us that eating with pleasure leads to satiety more rapidly and may be important for the well-being and health of the population.

Forces – both intrinsic and external – acting against the change in food intake are often powerful enough to obstruct the impact of health education (Tuorila 1987; Cardello 1996; Schlosser and Wilson 2006). Basically, people resist too strong and pushy nutritional guidance, because eating is considered a very personal matter. Food has also ability to evoke intense hedonic reactions as a reward and give motivation to eat more. Some of the food marketing practices are quite foxy and crooked, for example giving promises of instantaneous weight loss or more friends and better looks. Cardello (1995) points out that although nutritional quality is important in food acceptance, the perception of nutritional value is critical. Similarly perceived safety is more important than real safety.

Here we notice that mental models are major criteria in food acceptance. To succeed, health education should dig into the mental models that dominate the selection of foods and lifestyles. People often adjust to what they *believe* is the system and their actions reflect the assumed nature of that system (Hämäläinen and Saarinen 2006). The systems intelligent approach could be a useful tool in working on their mental models, as it wants to take an insider's view of the system. This might express itself in something as simple as a few words uttered in the proper place

People often adjust to what they believe is the system and their actions reflect the assumed nature of that system.

and time, and suddenly the real meaning of what the health educator is saying would break through.

However, to find the right words necessitates looking into the world of the person receiving the information; *looking beyond the obvious.* Gesch (2005) tells about a project dealing with prisoners. It was found out that most of the inmates did not know what vitamins are, let alone knew which foods contained them. So how would it have been possible for them to eat healthy (before entering the facility)? Even ordinary people often fail to understand some details of nutrition. An acquaintance of mine who was little overweight did not understand why his wife kept urging him to eat more vegetables and to stop eating greasy sausages – until one day he realised that it was all about the energy *content*. Creative holism, discussed by Jackson (2006) emphasises the importance of managing problem situation from a variety of points of view and using different systems approaches in combination.

The knowledge or assumption of the nature or origin of the substance plays a role in food acceptance or rejection. Two types of these reasons can be named: *inappropriateness* and *disgust* (Martins and Pliner 2006). Rejections based on inappropriateness occur for items that are typically not classified as food within a given (or any) culture, such as clothing, paper, houseplants or other items of non-

food origin. Food served at a wrong time or situation is considered inappropriate, too (Mela 2001). Rejection based on disgust occurs because of what a food is or where it comes from or its social history (Martins and Pliner 2006). These foods have offensive properties: they are presumed to taste bad or have the capacity to contaminate other foods. For example, in many cultures there is a strong taboo against eating animals that have died of unknown reasons and the blood has not been drained (Bergier 1987)[10]. This has major health benefits as the animal might have died because of a zoonosis[11], and undrained meat also spoils easily.

Rozin et al. (1996) point out that rejection based on the idea of what the food is or its origin is, is probably the strongest emotional response people have to foods. Most cultures have at least some decayed dishes that other cultures find disgusting. Kurlansky (2002) mentions that Romans had dishes made of putrefied fish and offals, which most modern-day western cultures find appalling. Disgust serves also as a major component of moralization (Rozin et al. 1996). Vegetarism based on moral values is more likely to find meat disgusting than when vegetarism is chosen for health reasons. Disgust influences availability by eliminating certain products from the domain of choice.

Rejection based on the idea of what the food is or its origin is, is probably the strongest emotional response people have to foods.

However, in situations of great need, like severe famine or other imminent devastation, humans have the ability to overcome the barriers of distaste, danger, disgust and inappropriateness. During famine people have eaten materials like grass, leaves, soil, leather reins, rotten vegetables, rats and carcasses. Charlie Chaplin eating shoe soles in The Gold Rush has been (and unfortunately, still is) the reality for some. North European people have eaten bark from pine trees. Dutch people ate tulip bulbs to survive during WW II. In some cases, even cannibalism[12] has been reported when facing severe hunger (Reid 1974). These details are horrendous, but show how people have a strong will to survive. In order to survive they can overcome taboos and restrictions. Moreover, the body of a starving human being acts systems intelligently by going to a state of low consumption. There are real physical changes as all excess resources in the body itself, like most of the fat and muscle proteins, are used by that same body for survival[13].

---

[10]3. Mos 22:8 "That which dieth of itself, or is torn of beasts, he shall not eat, to defile himself therewith" and 5. Mos 14:21 "You shall not eat of anything that dies of itself: you may give it to the foreigner living among you who is within your gates, that he may eat it; or you may sell it to a foreigner".

[11]Zoonosis is an infectious disease that can be transmitted from animals to humans (and from humans to animals). See e.g. McLauchlin and Little (2007) and http://en.wikipedia.org/wiki/Zoonosis [2008-03-31].

[12]This is not to be confused with Cannibalistic tribes, which had cannibalism as accepted behaviour in their culture.

[13]For example fats and proteins stored in body's adipose (fat) and muscle tissues are used to provide energy for the heart and the brain, see e.g. http://www.britannica.com/eb/topic-563746/starvation and http://en.wikipedia.org/wiki/Starvation [2008-3-31].

Quality of Food

The quality of food has more sides than meets the eye at the first glance. Historically, there have been more problems with the quantity than with the quality of food, although the overall quality has not been very good either. In ancient times the diets of common people were monotonous and unbalanced most of the time. As Bergier (1987) describes, the bread was hard and rough, there was very little choice in vegetables and the meat was tough and had gamy flavour[14]. Crusades resulted in the introduction of spices and new dishes, as did the great exploration voyages some centuries later. Also the invention of better kitchen stoves improved the quality of food. Thus the situation became gradually better. However, we should beware of regarding our ancestors as primitive. Already in the ancient times there were regulations regarding the state of meat and other foodstuffs on sale (Toussaint-Samat 1987; Fulton 2006). Toussaint-Samat (1987, p. 539) reminds us that there were more bath-houses in medieval Paris than public baths in the 19th century or even in the beginning of the 20th! There is also evidence that the content of some nutrients in grain and vegetables used to be higher before the time of modern industrialised agriculture (see e.g. Gesch 2005). Our ancestors did not eat highly processed food either (e.g. white raffinated flour or soft drinks).

Quality is a relative concept and should not be examined in isolation. Especially with biological material everything affects everything. Food quality goes hand in hand with food acceptance and liking. As Cardello (1995) says: "It is relative not only to who is doing the evaluation, but to a wide range of situational and contextual factors." Cardello quotes H. Clarke, who said in 1870[15]: ". . . food quality is a relative concept that is inappropriate for evaluation by anyone other than the average consumer of that food." Mr Clarke also noted a basic truth: the quality of a food product depends on the circumstances of the place and situation where it is consumed. A portion of canned meat is well suited on a sea voyage, but would be inappropriate at a fine meal in a first class restaurant. Said Mr Clarke: "Those to whom an article is truly acceptable are those who cannot get anything at all so good."

The quality of a food product depends on the circumstances of the place and situation where it is consumed.

Cardello (1996) divides food quality based on food acceptance behaviour into four measurement levels: Physical, sensory, perceptual and hedonic levels. Physical level consists of the physical and chemical structure of food. Sensory, perceptual and hedonic levels are intertwined. Sensory level consists of basic sensations and hedonic level tells how much (and how) that food is liked. Perceptual level consists of flavour, texture and appearance profiles such as how the food looks, smells and tastes. Texture is a multifaceted feature and can be examined by hand (touching or breaking), eyes, ears and mouth. Chewing the food might give specific

---

[14]Flavour and toughness in meat is the result of animal breed, nutrition and butchering practices. Sloppy butchering and poor handling of meat may cause unpleasant off-flavours and toughness. Both ante and post mortem conditions affect the overall quality of meat; see for instance Lawrie and Ledward (2006).
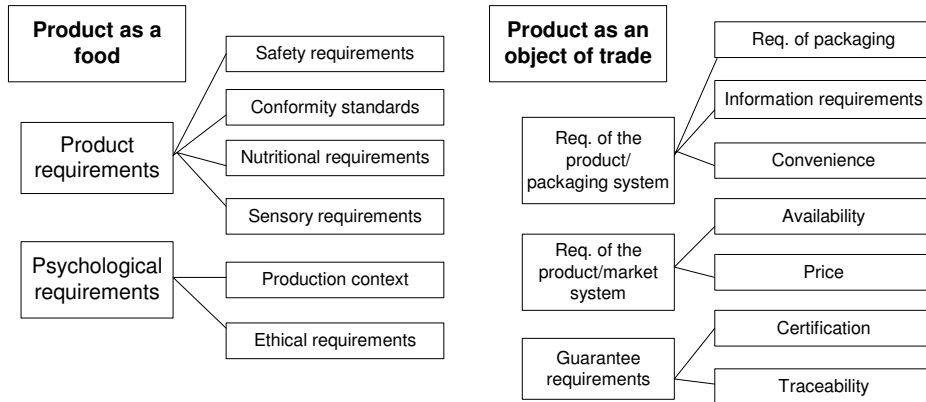
[15]In volume 1 of The Food Journal, 1870.

Figure 7.2: Food quality as product requirements, adapted from Peri (2006).

crispy and crunchy sounds. Mouthfeel can be for example slimy, creamy or grainy. There has been a lot of effort to develop instrumental sensors to monitor sensory properties. Notwithstanding, human sensors are still today the most common instrument for food evaluation. The use of instrumental analysis is limited by the fact that usually they are based on a single dimension, while sensory properties are multidimensional parameters (Cayot 2007).

Peri (2006) introduces "The universe of food quality" model to describe the quality system of food, especially from the consumer point of view. It is a system of product requirements both material and immaterial. Dynamics of the quality system is a complex and many-sided relationship between processing conditions, product characteristics and consumer requirements.

Figure 7.2 presents this quality system as product requirements, which are related to the product itself, the production context and both the packaging and market systems. A serious failure to meet any of these 13 requirements can lead to the rejection of the product even if 12 properties are fully satisfied. On the other hand, deficiency in one requirement may be compensated by abundance of another. For example nutritional benefits may make a poor sensory quality acceptable. Even safety can be replaced.

It is obvious that many of these requirements apply to almost any form of business as not many fields of trade or business can act in a vacuum. All parts of the economy interact with each other, either directly or indirectly. For example, traceability of fabrics, shoes and garments is gaining more importance as a part of the campaign against child labour, just like traceability of meat is important in fighting animal diseases and in monitoring animal welfare. In complex systems like overall quality, systems intelligence might offer a new possibility to value all these requirements, as many of them are not comparable with each other as such. Through systems analysis, requirements can be given price-tags and further evaluated.

As stated above, consumers' opinion should be an important criterion for food quality. Although consumers' attitudes were briefly discussed in the 19th century,

the idea of sensory evaluation done by these same consumers was forgotten for over 100 years (Cardello 1995). Most sensory evaluation was thus done by experts, and still is especially in the coffee, tea, spice and wine industries. In these fields expertise is needed to distinguish nuances and set the correct price for each quality class. These classifications do not tell much about the degree of liking by ordinary consumers.

Although a lot of valuable information is gained via sensory evaluation by consumers, there are some pitfalls. When dealing with food, which is biological material and thus more or less prone to be micro-biologically or chemically spoiled, great care should be taken when planning changes in the recipe. For example, changes in sugar, fat or salt levels might cause problems in self-life and consistence of the prod-uct.[16] In addition, interpretation of the results of all behavioural studies (including sensory evaluations) must be done in extremely cautious way. In order to understand why a certain food is liked and gives promise of frequent consumption, a careful consideration of the dynamics of the acquisition process should be conducted. The real meaning of the changes in liking should be evaluated thoroughly (Zandstra et al. 1999; Mela 2006). A classical failure in this field was the attempt to sweeten Coca-Cola, which ended up with an economical and public image disaster (Dubow and Childs 1998). Notwithstanding, from the systems intelligent point of view, even failure has potential for future success, as "systems are the door to a potentially boundless space of possibilities" (Hämäläinen and Saarinen 2007, p. 24).

The interpretation of the results of all behavioural studies must be done in extremely cautious way.

Mental Models and Food Acceptance

Mental models affect – often unconsciously – the process of selecting, consuming and evaluating food. Hazy et al. (2007), Sterman (2000) and Sterman (2002) have discussed mental models thoroughly in technology and management situations. Many of their ideas can be applied to food acceptance and consumption as well.

Mental models can be described as a collection of routines or scripts for selecting possible action; they are invisible cognitive maps of a domain. Active modelling occurs well before sensory information reaches the areas of the brain responsible for conscious thought. Most people believe that their senses reveal the world as it is (Sterman 2000). On the contrary, our sensory and cognitive structures can reveal *only an image* of the real world. Earlier we discussed the disgust against a certain food after nausea. The reason for

Mental models are a collection of routines or scripts for selecting possible action; they are invisible cognitive maps of a domain.

---

[16]In their review article Ruusunen and Puolanne (2005) have discussed salt and other ingredients in meat products. For example simultaneous reduction of salt and fat might cause both sensory and technological problems that need to be solved.

nausea is often something else than the food eaten just before the attack. It might be gastric infection unrelated to food, or in case of food poisoning, incubation time might be several days[17], and the preceding food is therefore not to be blamed. Notwithstanding these facts, the food preceding sickness may remain for ever disgusting.

We make decisions that alter the real world, and these decisions are based mostly on the image of the world. To act and learn, we must use the limited and imperfect feedback available to understand the effects of our decisions (Sterman 2000). In earlier times, survival often depended on the ability to interpret reality rapidly. To be able to run instead of freezing was crucial when facing a threatening situation. But sometimes it was more dangerous to act than to stand aside, be it a poisonous plant or war expedition led by the king. However, without courageous individuals, no new worlds or ideas or foods would have been discovered.

We experience the real world through filters. The act of measurement brings along delays and errors, some known, some unknown. After all, measurement is an act of selection (Sterman 2000). Sometimes getting feedback is delayed. In a big city a shopkeeper might never know why his regular customer stopped coming; is the customer dead, has he moved or was there a severe disappointment of some kind? Information systems on the feedback can also get better, as for example the internet has aided the collection of feedback from the clients.

Every link in the feedback loops can be weakened or cut by a variety of structures, like physical or institutional features of the environment. These might reduce opportunities for change and prevent us from learning the consequences of our actions. Some are consequences of our culture (Sterman 2000). Rozin et al. (1996) contemplate that if a culture desires that something should be avoided, the best way is to make this something an object of disgust. Disgust is most probably communicated and acquired in social situations (Rozin et al. 1996, p. 101):

> Socialized individuals carry in their heads a set of negative attributes to a range of animal products and decayed foods; along with many non-food disgust elicitors . . . Expressions of disgust by others have major influence on an individual's food choices. And the acquisition of disgust, in a social context, is both a major feature of socialization and a major mechanism through which further socialization is accomplished.

Learning to occur, each link in the feedback loops should work effectively, but often they do not (Sterman 2000). Dynamic complexity, imperfect information, poor scientific reasoning skills, defensive routines and other barriers impair the feedback process. Also misperceptions of feedback limit our ability to understand the truth. After all, in most cases, things are not quite what they look like. An illustrative trial of misinterpreting the signals is white wine dyed to look like red wine (Morrot et al. 2001). The wine evaluators gave the wine characteristics of red wine, although they must have sensed the typical nuances of white wine. They relied more on their eyes than on their other senses.

---

[17]Incubation time e.g. for *Salmonella* is 5–72 hours, *Campylobacter* 1–10 days, EHEC (dangerous strain of *E.coli*) 1–14 days and Norovirus 12–24 hours (McLauchlin and Little 2007).

Our cognitive maps of the causal structure of systems are vastly simplified compared to the complexity of the systems themselves (Sterman 2000). We are unable to infer correctly the dynamics of all but the simplest causal maps. Most people do not generate sufficient alternative explanations, or consider enough rival hypotheses. According to Sterman (2000), the greater the dynamic complexities of the environment, the worse people perform relative to potential. This seems to be true with food also.

Western people are having more and more opportunities to choose healthy foods, but they seem to make a lot of bad choices.

Western people have more and more opportunities to choose healthy foods, but they seem to make a lot of bad choices. Fulton (2006, pp. 194–195) highlights this dilemma:

> Food, although it may be bland or even 'tasteless', is never experientially neutral . . . We act on it, making it signify things that we want to say about our relationships to each other, and we judge others (not to mention ourselves) on how they respond to its relative absence or presence, for example, by eating 'too much' or 'too little' or, if they choose not to share their food, sometimes even by eating each other.

A Taste of History and Emergence

Food has interesting connections with other systems such as sociology, ecology and even world history. The power of food and food related substances is not to be underestimated as food has started wars, empires have been built and lost, and fortunes have been earned (Toussaint-Samat 1987; Kurlansky 2002, Fulton 2006). Food has been a popular item to tax. Materials like white sugar, tea and coffee have been objects of taxation. Perhaps the most cunning idea was to tax salt. Everyone needs salt. It was needed for preserving food before the age of refrigeration. It is essential for proper baking and cooking, and the human body also needs some salt. For example France was divided into four different salt taxation areas with very different tariffs. This unfairness was, no doubt, one of the reasons (of course, not the only reason) for the French revolution. Also the unfair taxation on tea was the tipping point that exploded the Independence war of the United States of America. Nobody dies without tea, but it is an important part of the daily routines for many.

Invaders or immigrants have brought their dietary customs with them, as if symbolically importing a little soil from their native land (Toussaint-Samat 1987). Many 19th century immigrants of Italian origin were near starvation in their new homeland in the United States (Bergier 1987). They thought that the anglo-saxon-type of food available was horrible and missed their cheeses, salami and olive oil from their homeland. Most of them were too poor to afford them. This era is vividly described in the movie Godfather II. When studying the situation of these immigrants, we find that something extraordinary happened: a food revolution. Indeed, the Italians were quite successful in introducing their food to the United States and later to the whole world. There are not many places

on this earth were pizza and pasta is not available. This is in accordance with systems intelligence: systems can be changed as they are not absolute; however oppressing the original situation might be (Hämäläinen and Saarinen 2007). And yet something more is needed: a touch of emergence.

Hazy et al. (2007) describe emergence as the coming-into-being of novel, higher level structures and processes. Emergence is an outcome of the dynamics generated out of the interactions between the lower level agents that constitute the system. Emergence does not happen by itself, it involves tending and encouragement from its component agents as well as from the higher level. Emergence would be something extraordinary, such as the school food projects[18] now emerging. In England also the Naked Chef Jamie Oliver has joined the campaign for better food at schools (Schloesser and Wilson 2006). It is not insignificant or meaningless that public faces stand for a cause. They set an emergent example to others. In systems intelligence we believe that the system can be changed through individuals. It is about making a difference by setting the system in motion; by creating a resonance in human hearts and wills (Hämäläinen and Saarinen 2005). However, as Hazy et al. (2007) note, emergence cannot be controlled, it happens if it happens, just like pizza and pasta conquered the hearts of people all over the world.

Emergence is the coming-into-being of novel, higher level structures and processes.

In many traditional kitchens, great care is taken to set the table and courses aesthetically. Visual cues are important in food acceptance and consumption (Cardello 1996). This was realised early in human history. Fortunes were spent on cutleries and services. Roman feasts were famous for luxurious settings and exotic dishes. The kings, noble men, prosperous merchants and wealthy burghers followed this tradition of gluttony through middle ages and later (Bergier 1987). Fulton (2006, pp. 188–189) depicts:

> No reader of medieval cookery books can fail to be amazed by the attention lavished by their authors on the correct presentation of foods. How the food looked was clearly a matter of concern not only for those who would prepare the more elaborate subtleties for the great feasts of the wealthy – ... roasted peacocks and swans served reassembled in their own feathers; ships and castles fashioned out of pastry and marzipan ... – but even for those making only the most humble of pottages.

As Fulton (2006) and Bergier (1987) note, the dishes of ordinary people were modest. While preservation of food was complicated, it was typical to have feasts after harvest or in late November after slaughtering the pigs for winter. Then also the lowest of the population had the chance to celebrate. Astrid Lindgren, the most famous Swedish author of children's books, describes the menu for a country feast in the beginning of the 20th century (1963, pp. 56, 65):

---

[18] http://www.foodforlife.org.uk/ [2008-03-31].

Up under the roof [of the food store] smoked hams and black puddings hung in long rows, a whole line of them, on a pole, for Emil's father was very fond of black pudding with bacon and white sauce. And there in a corner stood the bread chest full of delicious loaves, beside the cutting board, with all the yellow cheeses and crocks full of freshly churned butter. Behind the table was the wooden vat full of salted pork and next to it the big cupboard where Emil's mother had her raspberry juice and pickled cucumber and pear ginger and strawberry jam. But on the middle shelf of the cupboard were her delicious sausages ... There was calves liver and spare ribs of pork and meat balls and soused herring and salmagundi and stews and puddings and jellied eels as much as they could eat. And to end up with they had the most delectable curd cake with raspberry syrup and whipped cream.

The importance of aesthetics in setting and atmosphere is touchingly described by Gordon (1965) in his memoirs on Japanese prison camps in the Far-Eastern jungle. They did not have much, but the little they had they arranged beautifully on Christmas Day. They even conjured up Christmas pudding out of almost nothing. As Hämäläinen and Saarinen (2007, p. 31) note, of all the systems available to humans, the symbolic dimension is the most accessible when reaching out to the emergence of life-enhancing systems. This is verified by Gordon (1965); the beauty of small symbolic gestures changed the remorseless rules of the death camp. Simultaneously as they started taking care of the sick and the dying, their spirits rose. A starving man holding the hand of a dying fellow prisoner gave hope of decency and dignity to all of them. Many of us think we know what hunger is, but we do not! But there, in the camp a really hungry man was able to share his food with somebody else[19]. Consequently enthusiasm in caring for others and sharing the food multiplied, which in turn gave more hope to all of them, although the overall circumstances were getting worse.

The example of a death camp is beyond the grasp of most people. However, even in our everyday life there is a chance for groundbreaking gestures as systems intelligence has emphasis on the human element of the system, particularly in its invisible, symbolic and emotional aspects (Hämäläinen and Saarinen 2007). Systems generate thoughts and actions, and sometimes a person becomes something quite different from what he was before, just by listening to his heart and doing the right thing, like Martin Luther King (Seppä 2007). One almost hilarious example of systems intelligence in action with food related context is told by Kurlansky (2002). An engineer was digging for some metals in 1846 and came across ancient bodies in an old salt mine. Realising the importance of his findings he changed his career and started archaeological excavations. His endeavour became one of the finest examples of organising an excavation with detailed bookkeeping of the findings and their details.

---

[19]Only the working men were given their meagre daily rations, most of the sick had no rations at all.

Conclusion

The status of the food industry has changed completely since the time of Napoleon, when the first canned products were introduced (Toussaint-Samat 1987). Before that, the main preservation methods were drying, salting and fermenting. Household refrigerators were introduced in the 1930s. Until recently, the food industry was needed to transform raw materials from agriculture to products (Cayot 2007). Now agriculture has to deliver raw materials to the food industry fitting their specific requirements, usually by contract cultivation. Pre-fabricated foods and ready-to-eat meals in special packings are more sophisticated than ever. This increases the time and distance between raw materials and final products. The food companies are growing bigger and bigger, as are the farms that supply the raw materials. One severe problem with a global food production system is the health risks it brings along. If something goes wrong (microbial contamination, overdose of pesticides or other toxic materials), consequences are widespread, even global (see for instance Schlosser and Wilson 2006 and McLauchlin and Little 2007).

One severe problem with a global food production system is the health risks it brings along. If something goes wrong, consequences are widespread, even global.

The question of food and its quality and quantity is complicated. Part of the world has excess, while the other parts are deprived, and the little they have is often of poor quality. Obviously there is a serious global problem with food demand and supply. Food was, and still is an instrument of power. The industrialised countries have plenty of food while the developing areas are sinking in inflation, poverty and starvation. And it is not just that the developing countries have corruption and huge military expenses. The industrialised countries dump, in the name of freedom and globalism, their left-overs into the third world countries, destroying the local economy (Korten 2001; Chossudovsky 2003). In many areas of the third world it is cheaper to buy multinational milk powder than fresh or bottled milk from the local producers. One report summarises it as follows (Raman, 2006): "Less obvious and less deeply addressed (until recently) are the problems stemming from barriers to access to international markets, the high agricultural subsidies in developed countries, and these countries' export of subsidized farm products that can threaten the incomes and livelihoods of small producers in developing countries."

There are tens of thousands of children who will never know the taste of strawberry, or ice cream, or go to sleep without hunger. Who will never know what it is to have choice.

While the structure of the society is under developed, it causes serious consequences at grass root level. As the local economy in the third world has almost non-existent logistical resources, a great deal of the yield and other food supply is eaten by somebody else; creatures like mice, rats, apes, insects, moulds and other

microbes. Figures vary between 40–50 %, even 70 %. That is half or even two thirds of the food originally available! Circumstances in many areas would need an honest change for better much sooner than now seems to be possible. The faulty arrogance does not promote systems intelligent behaviour and thus restrain the change for good.

However, one of the key ideas of systems intelligence is the philosophy of optimism and faith in life, as opposed to cynicism, which assumes there is an upper limit to everything that can be done and what people can become together (Hämäläinen and Saarinen 2007). The danger of using phrases like 'limits to growth' is that it might paralyze us, create an atmosphere of hopelessness and apathy. We are part of the systems, and as we are inside the systems that shape us, we are also shaping them. This means that our feelings – optimistic or pessimistic – actions and social relationships co-create the systems we live in. Thus I am in a situation that I have been creating, and the situation has created me. Consequently I am also responsible.

And in the world of natural catastrophes and wars there are tens of thousands of children who will never know the taste of strawberry, or ice cream, or go to sleep without hunger. Who will eat their meagre portions of some grains day after day and will never know what it is to have choice. I will never forget how my teacher (many, many years ago) discussed with her class the usual diet of a malnourished child. She asked us, the well nourished teen-agers: what did we think, what does this diet do to the brains of the child, will they ever function properly? And today, science is gradually coming to realize the enormous consequences of malnutrition, as it does not only concern those who are suffering now, but also those who come after them. Gesch (2005, p. 174) concludes: "While nutrition is widely accepted as influencing long-term health, we somehow manage to decouple

"While nutrition is widely accepted as influencing long-term health, we somehow manage to decouple that relationship from behaviour with the assumption that our behaviour is purely of free will." (Gesch 2005)

that relationship from behaviour with the assumption that our behaviour is purely of free will. This is despite the fact that we cannot by any means decouple nutrition from actual brain function."

One way of taking responsibility of the hunger of the world was the live concerts and songs by Bob Geldof and his colleagues[20]. A fine example of emergence in action. Most of us do not have the courage or resources Geldof had, but we all can do something. I am not saying that you should send your bread to Africa or take the next flight to a refugee camp or anything this radical. I am just suggesting that little modesty would do good every once in a while. If we found a middle-way between the extremes of starvation and excess eating then we might find a solution to the world's hunger and food related diseases (Gesch 2005). Nuances also become more visible when food is more simpler.

---

[20]http://en.wikipedia.org/wiki/Live_Aid
http://en.wikipedia.org/wiki/Band_Aid_%28band%29 [2008-04-25].

In addition to that we could consider the amount of food we are throwing away in our western world of refrigerators and best before-dates. Next time could we perhaps buy a little less of something? With minimal effort the amount of waste we are producing can be cut to half, or even three-quarters. The money we would save we could perhaps use to save the world. And maybe one day every child in the world has chance to taste ice-cream and experience the hedonic sensations it brings along. Miracles always start somewhere.

References

BELITZ, HANS-DIETER, WERNER GROSCH, AND PETER SCHIEBERLE. (2004). *Lehrbuch der Lebensmittelchemie.* English translation Food Chemistry (M. M. Burghagen transl.), 3rd rev. edition. Springer.

BERGIER, J. F. (1987). Food acceptance and cultural change: Some historical experiences. In *Food acceptance and nutrition*, eds. J. Solms, D. A. Booth, R. M. Pangborn, and O. Raunhardt. Food Science and Technology, A series of monographs. Academic Press.

BÄCKSTRÖM, ANNA, ANNA-MAIJA PIRTTILÄ-BACKMAN, AND HELY TUORILA. (2003). Dimensions of novelty: a social representation approach to new foods. *Appetite*, *vol. 40*: pp. 299–307.

CARDELLO, ARMANDO V. (1995). Food Quality: Relativity, context and consumer expectations. *Food Quality and Preference*, *vol. 6*: pp. 163–170.

CARDELLO, ARMANDO V. (1996). The role of the human senses in food acceptance. In *Food choice, acceptance and consumption*, eds. H. L. Meiselman and H. J. H. MacFie: pp. 1–82. Blackie Academic and Professional.

CAYOT, NATHALIE. (2007). Sensory quality of traditional foods. *Food Chemistry*, *vol. 101*: pp. 154–162.

CHOSSUDOVSKY, MICHAEL. (2003/1999). *Globalization of poverty.* Global Research.

DIENSTBIER, RICHARD A., AND LISA M. PYTLIK ZILLIG. (2002). Toughness. In *Handbook of positive psychology.* Oxford University Press.

DUBOW, JOEL S., AND NANCY M. CHILDS. (1998). New Coke, mixture perception and the flavor balance hypothesis. *Journal of Business Research*, *vol. 43*: pp. 147–155.

ENGELEN, LINA, PETRA A. VAN DEN KEYBUS, RENÉ A. DE WIJK, ENNO C. VEERMAN, ARIE V. NIEUW AMERONGEN, FRITS BOSMAN, JON F. PRINZ, AND ANDRIES VAN DER BILT. (2007). The effect of saliva composition on texture perception of semi-solids. *Archives of Oral Biology*, *vol. 52*: pp. 518–525.

FULTON, RACHEL. (2006). "Taste and see that the Lord is sweet" (Ps. 33: 9): The flavor of God in the monastic West. *Journal of Religion*, *vol. 86* (no. 2): pp. 169–204.

GESCH, BERNARD. (2005). The potential of nutrition to promote physical and behavioural well-being. In *The science of well-being*, eds. Felicia A. Huppert, Nick Baylis, and Barry Keverne: pp. 171–214. Oxford University Press.

GORDON, ERNEST. (1965). *Miracle on the river Kwai.* Fontana.

HÄMÄLÄINEN, RAIMO P., AND ESA SAARINEN. (2006). Systems intelligence: a key competence for organizational life. *Reflections, The SoL Journal*, *vol. 7* (no. 4): pp. 17–28. Also in Hämäläinen and Saarinen (2007): pp. 39–50.

HÄMÄLÄINEN, RAIMO P., AND ESA SAARINEN. (2007). Systems intelligent leadership. In *Systems intelligence in leadership and everyday life*, eds. Raimo P. Hämäläinen and Esa Saarinen: pp. 3–38. Espoo: Helsinki University of Technology: Systems Analysis Laboratory.

HAZY, JAMES K., JEFFREY A. GOLDSTEIN, AND BENYAMIN B. LICHTEN-STEIN. (2007). *Complex systems leadership theory: New perspectives from complexity science on social and organizational effectiveness.* Mansfield, MA: ISCE Publishing.

JACKSON, MICHAEL C. (2006). Creative holism: A critical systems approach to complex problem situations. *Systems Research and Behavioral Science*, *vol. 23*: pp. 647–657.

KAUREMAA, JOUNI. (2007). Beyond paradoxes: Bifocal thinking and systems intelligent leadership. In *Systems intelligence in leadership and everyday life*, eds. Raimo P. Hämäläinen and Esa Saarinen: pp. 80–91. Espoo: Helsinki University of Technology, Systems Analysis Laboratory.

KORTEN, DAVID C. (2001/1995). *When corporations rule the world.* Kumarian Press, Inc. Finnish translation.

KURLANSKY, MARK. (2002). *SALT. A world history.* Walker and Company. Finnish translation.

LAWRIE, RALSTON A., AND D. A. LEDWARD. (2006). *Lawrie's meat science* (7th ed.). Woodhead Publishing, CRC Press.

LINDGREN, ASTRID. (1963). *Emil i Lönneberga.* English translation Emil in the Soup Tureen, 1970/2001 (Lilian Seaton, trans.). Brockhampton Press, new edition publ. by Kvints, Stockholm.

LOGUE, ALEXANDRA W. (1991). *The psychology of eating and drinking.* Freeman, New York.

MARTINS, YOLANDA, AND PATRICIA PLINER. (2005). Human food choices: An examination of the factors underlying acceptance/rejection of novel and familiar animal and nonanimal food. *Appetite*, *vol. 45*: pp. 214–224.

MARTINS, YOLANDA, AND PATRICIA PLINER. (2006). "Ugh! That's disgusting!": Identification of the characteristics of foods underlying rejections based on disgust. *Appetite*, *vol. 46*: pp. 75–85.

MCLAUCHLIN, JIM, AND CHRISTINE LITTLE. (2007). *HOBB'S food poisoning and food hygiene* (7th ed.). Hodder Arnold.

MELA, DAVID J. (2001). Why do we like what we like? *Journal of the Science of Food and Agriculture*, *vol. 81*: pp. 10–16.

MELA, DAVID J. (2006). Eating for pleasure or just wanting to eat? Reconsidering sensory hedonic responses as a driver of obesity. *Appetite*, *vol. 47*: pp. 10–17.

MORROT, GIL, FRÉDÉRIC BROCHET, AND DENIS DUBOURDIEU. (2001). The color of odors. *Brain and Language*, *vol. 79*: pp. 309–320.

MUSTONEN, SARI, AND HELY TUORILA. (2007). *Sensory training decreases neophobia and encourages trying unfamiliar foods in 8-12-year-old*

children. Poster presented at the 7th Pangborn Sensory Science Symposium, Minneapolis, USA, August 12–16, 2007. Book of abstracts.

Peri, Claudio. (2006). The universe of food quality. *Food Quality and Preference*, *vol. 17*: pp. 3–8.

Reid, Pears Paul. (1974). *Alive: the story of the Andes survivors.* Mandarin. Finnish translation.

Rozin, Paul. (1987). The socio-cultural context of eating and food. In *Food choice, acceptance and consumption*, eds. H. L. Meiselman and H. J. H. MacFie: pp. 83–104. Blackie Academic and Professional.

Ruusunen, Marita, and Eero Puolanne. (2005). Reducing sodium intake from meat products. *Meat Science*, *vol. 70*: pp. 531–541.

Schlosser, Eric, and Charles Wilson. (2006). *Chew on this.* Penguin Books.

Seppä, Laila. (2007). Systems intelligence of forgiveness. In *Systems intelligence in leadership and everyday life*, eds. Raimo P. Hämäläinen and Esa Saarinen: pp. 155–169. Espoo: Helsinki University of Technology, Systems Analysis Laboratory.

Sterman, John D. (2000). Learning in and about complex systems. *Reflections*, *vol. 1* (no. 3): pp. 24–49. Orig.: Sterman John D. 1994. Learning in and about complex systems. *System Dynamics Review*, *vol. 10* (no. 3–4): pp. 291–330.

Sterman, John D. (2002). All models are wrong: Reflections on becoming a systems scientist. *System Dynamics Review*, *vol. 18* (no. 4): pp. 501–531.

Toussaint-Samat, Maguelonne. (1987). *Histoire naturelle et morale de la nourriture.* English translation History of Food, 1994 (Anthea Bell, trans.). Blackwell.

Tuorila, Hely. (1987). Hedonic responses and attitudes in the acceptance of sweetness, saltiness and fattiness of foods. In *Food acceptance and nutrition*, eds. J. Solms, D. A. Booth, R. M. Pangborn, and O. Raunhardt. Food Science and Technology, A series of monographs. Academic Press.

Tuorila, Hely. (2001). Keeping up with the change: Consumer responses to new and modified foods. In *Food Chain 2001 programme abstract*: pp. 38–40.

Zandstra, Elisabeth H., Cees de Graaf, Hans C. M. van Trijp, and Wija A. van Staveren. (1999). Laboratory hedonic ratings as predictors of consumption. *Food Quality and Preference*, *vol. 10*: pp. 411–418.

Internet References

Hämäläinen, Raimo P., and Esa Saarinen. (2005). Systems Intelligence, Workshop at MIT, 5 December 2005:
http://www.systemsintelligence.tkk.fi/SIatMIT.ppt [2008-04-25].

Raman, Meenakshi. (2006). Liberalization and interactions with the market: A survey of some experiences of rural producers in developing countries. TWN

Third World Network: www.twnside.org.sg/title2/par/
meena_paper_for_ifad_on_liberalisation_farmers_FINAL_27march06.doc

Author

Laila Seppä is a graduate from the Department of Chemical Technology, Helsinki University of Technology. She is currently writing her master's thesis on meat technology for the Department of Food Technology, University of Helsinki.