



Supporting Food Design Processes: *Development of Food Design Cards*

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Food design is a relatively new discipline that requires designers to become familiar with several areas that are not currently covered in many design curricula, such as agriculture, the food industry, culinary processes and the hospitality industry. To inspire, enrich and facilitate food design processes, we developed and tested a card set reflecting the richness of the food design field. After literature review, we clustered findings into seven main categories: agriculture, industrial processing, distribution & marketing, kitchen management, eater, consumption situation, and policy & legislation. Each category is represented by five topic cards and one overview card. The card set is accompanied by instructions for six exercises. Testing the card set among individual designers and student groups showed that it was considered useful in multiple stages of the design process. In the beginning of the design process, it was used to gain overview and to inspire. Along the process, it enhanced brainstorming, facilitated discussions, and was used to create scenarios and refine ideas. In later stages, the variety of topics was helpful in evaluating whether all important design aspects had been considered.

Keywords – Card Set, Creativity, Design Tools, Food Design, Multidisciplinary.

Relevance to Design Practice – The card set can support the creative process in multiple areas of the food domain. It brings together design expertise with multiple disciplines relevant for the food context.

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Introduction

Food design is a new design discipline. Although it may not be possible to provide a very precise definition, food design has been defined provisionally as the discipline that connects food and design: design applied to food and eating, or food and eating investigated from a design perspective (Zampollo, 2016). In a more descriptive way, Fabio Parasecoli proposed that “Food Design includes ideas, values, methods, processes and activities aiming to modify, improve and optimize individual and communal interactions with and around food, including but not limited to edible materials, objects, experiences, natural and built environments, services, systems and networks” (quoted in Zampollo, 2016, p.7). The broadness of these definitions suggests that food designers can develop alternatives for how farmers and the food industry grow, harvest, process, and distribute foods, for how consumers purchase, transport, store, cook, and eat foods, for how restaurants create menus, develop new dishes and serve them, and for the multiple roles that foods can play in people’s lives, in social relationships, in local communities and society at large, to name a few.

For most designers who want to work in the food domain, this creates the challenge to get to know agriculture, food industry, culinary processes and the hospitality industry, because many of the current educational design programs do not offer a specialization in food design. Likewise, most current designers are unfamiliar with using foods as materials, even though foodstuffs hold interesting properties and design challenges (Ayala, 2015; Bruns Alonso, Klooster, Stoffelsen, & Potuzáková, 2013; Lemma, Allione, De Giorgi, Bruno, & Stabellini, 2012; Rognoli, Bianchini, Maffei, & Karana, 2015).

Some designers already work with food industry. In cases where food companies have hired designers as internal staff, the majority have joined the packaging department, where they can be involved in three-dimensional (3D) packaging design, graphic design or communication design. In cases where food companies work with external design agencies, designers mostly work on products in which foods can be prepared or served, such as a beer tap or a beer glass, but not on the food itself (Schifferstein, 2016). For future designers to become more involved in innovating the food itself, they need to obtain more specific knowledge on food products, including the technology of food production and preparation, hygiene and safety issues, food consumption, the role of food in society and food waste disposal (Bordewijk & Schifferstein, 2020; Schifferstein, 2017). Only when they get acquainted with this domain-specific knowledge, they will be able to act as equally knowledgeable partners in design and innovation projects.

When designers do become involved in food innovation, they tend to broaden the scope of projects. As a consequence, the food experts involved in these projects typically will encounter specialists with disciplinary backgrounds they are unfamiliar with. With their communication skills and their working knowledge of

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each of these disciplinary areas, designers can play an important role in facilitating and structuring the cooperation between people with different backgrounds. In addition, they can facilitate the integration of the knowledge that is necessary to develop successful new food design concepts (Schifferstein, 2016). We want to support this expansion in scope by developing a card set that describes the most important areas and topics that are relevant for food design projects. By providing physical tokens that can be easily manipulated, the card set can help in creating overview and in facilitating discussion among experts from different disciplines and, thereby, contribute to the integration of knowledge from different departments into a coherent proposition.

Although the focus of the current paper is the role of the designer and how the card set can support the designer who works in the food domain, the card set should support all professionals involved in the innovation project. Because so many disciplines are relevant for the food context, every expert can only be a specialist in a small part of the domain. Hence, all participants will benefit by becoming aware of the other relevant disciplines and can try to build bridges in order to evaluate projects from multiple perspectives. In addition, the card set may support a new, more creative process of generating new concepts and thus introduce another way of working in food innovation. Therefore, we see a role for the card set in the food industry, food policy development, food legislation, and several other professional areas.

Card Sets as Design Tools

In the field of engineering design, Lindahl (2005) found that designers have three main purposes when using a method or tool: to facilitate communication during the process, contribute with structure, and integrate knowledge and experience as a know-how backup. In terms of requirements, he found that the design method or tool should be easy to adopt and implement, facilitate designers

to fulfil specified requirements, reduce the risk that important elements in product development are forgotten, and reduce the total time needed to complete the task. Similarly, in the field of eco-design Lofthouse (2006) found that designers tend to look for guidance, information and education. She indicated that a tool should preferably contain many examples, be as visual as possible, and contain the smallest amount of text in everyday language. Using the tool should not take too much time, and at the same time it should fit with the designers' regular ways of working. Although these requirements were derived in a specific design context, they seem to apply for the field of food design equally well.

In line with these requirements, many design researchers have developed card-based design tools to support their design process. Physical card sets are popular, because they provide new input to the design process in an inspiring way. Cards make the design process visible, more tangible, more intuitive, and less abstract. They provide an overview of the information, together with the flexibility to compare elements, evaluate them or combine them. They give designers the freedom to restructure information and determine priorities. This supports the clarification and the iterative development of ideas (Casais, Mugge, & Desmet, 2016; Lafreniere, Dayton, & Muller, 1999; Lucero & Arrasvuori, 2010). Furthermore, they can facilitate communication between the members of the design team and also with external parties, such as potential users or company management, because they offer a common language to facilitate shared understanding (Beck, Obrist, Bernhaupt, & Tscheligi, 2008). They help to keep the design team focused on the design process (Lucero & Arrasvuori, 2010). Card sets can help designers to grasp knowledge from additional domains and elaborate on a specific problem, in order to ensure that a design solution is in line with multiple perspectives on an issue. If a discussion becomes unproductive, cards can introduce new elements or a different view and thus enable a shift in focus that may help to invigorate the discussion. By presenting combinations of seemingly unrelated elements, cards can spark innovative ideas. And presenting information in a playful way can enhance creativity, because it takes pressure away from coming up with new ideas. Cards can also be used to evaluate, rate or bookmark ideas generated (Hornecker, 2010). Lucero, Dalsgaard, Halskov, and Buur (2016) summarized these benefits of using physical cards in three headings: cards are tangible idea containers, they trigger combinatorial creativity, and they enable collaboration.

In their survey of card-based design tools, Wölfel and Merritt (2013) evaluated card sets on the basis of their intended purpose and scope, duration of use and placement in the design process, the type of usage instructions, the degree of customization, and the formal qualities of the set. On the basis of their analysis, these authors distinguished between three different types of card sets: (1) general purpose/repository cards that offer a method repository or aim to stimulate inspiration or lateral thinking and that can be used throughout the entire design process, (2) customizable cards that are typically used in participatory design and that encourage non-designers to contribute to the creative process, and (3) context-specific cards that are developed primarily to focus on a specific design agenda or context. The latter type of card sets

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are mainly used at a specific point in the design process with an explicit set of usage instructions. In our case, we aim to develop such a context-specific card set that introduces the richness of the food design field to the participants of food innovation projects. Besides developing a physical design representing and describing the various relevant topics, we will also propose a set of instructions indicating how these cards can be used.

Using Card Sets for Food Design

Recently, Zampollo and Peacock (2016) described the development of the *Thoughts for Food* card set, which is specifically aimed at activating themes regarding the ideal eating situation for the preparation phase of the food design process. Examples of themes are sharing, immersion, changes, and curiosity. Their card set fits the category of general purpose/repository cards that are aimed primarily at stimulating creativity and obtaining inspiration in order to generate new ideas in the early stages of product development. In contrast, our card set will be particularly helpful in getting an overview of the many different aspects that are important for the project. It can stimulate product developers to elaborate on the aspects that are relevant and specific for food projects. Hence, we think that our card set will probably be particularly valuable in the later stages of product development, where existing ideas are screened and concepts are improved.

Whereas a stimulating tool might be useful for generating new food ideas, the current card set should assist in taking the design process a step further by reminding designers to consider a multitude of aspects that either need deliberation, can enrich their proposition, can enhance design details that yield competitive advantage in a saturated market, and that inspire evaluation from the viewpoints of multiple stakeholders. Hence, due to the differences in aim, our card set is likely to deviate substantially from the *Thoughts for Food* set. In fact, both sets could be useful in different stages of the food design process and they could fulfil complementary roles. Whereas the *Thoughts for Food* set may spark innovation and generate creative ideas for product concepts, the *Food Design Cards* may help to enrich and evaluate these ideas and develop them into engaging and realistic new product propositions.

Ideally, the new card set should be suitable for usage in multiple contexts (at food companies, in design agencies, and in an educational context at multiple types of schools, including food science, gastronomy, food service, and design schools) to support and teach food innovation processes. It should introduce a range of topics that will allow participants to broaden their horizon and invite them to explore unknown topics. The broadness of the range of topics makes it suitable for application in multiple contexts and education programs, because the familiar topics will create a sense of recognition, while the unfamiliar topics will make participants aware of additional stakeholders and will spark interest for relevant topics outside their focal areas.

We strive to make the set self-explanatory for usage in any of these contexts. Anyone who takes the initiative to introduce the card set in a creative session can determine which knowledge gaps may require additional time for investigation and

discussion. In professional settings, the overview of all relevant topics will stimulate the inclusion of stakeholders from all relevant departments and disciplines, and will help to clarify their respective contributions. In addition, we expect the set to stimulate an open discussion on the respective arguments and support a clear decision-making process. This is in line with Brown (2008), who suggests that using design methods helps companies to enhance 1) systemic thinking, 2) a human-centered approach, 3) iterative validations, and 4) tangible communication with multidisciplinary experts to create sustainable business models.

In this paper we explore the value of the new card-based design tool to help designers with challenges they encounter in the food realm. We will design the first version of a card set and test it with several groups of participants. On the basis of these tests, we will improve our design and we develop a number of usage instructions to go with the card set. This improved card set with instructions will then be tested further by designers both in individual and in group challenges.

Development of the Food Design Cards

Because we explicitly wanted to incorporate the richness of the food design field in the card set, we started out with a review of papers published in the *International Journal of Food Design*. This recently started academic journal provides a platform for a cross-disciplinary approach to food design, soliciting contributions combining any food discipline (e.g., agricultural production, food science, culinary arts, hospitality, food culture, food marketing) with one or more design disciplines (e.g., design theory, design history, design education, industrial design, graphic design, packaging design). The early papers that appeared in this journal helped us to define the foundations of the food design area. In particular, we made use of the special issue on food design education (Biderman, 2017; Campagnaro & Ceraolo, 2017; Massari, 2017; Parasecoli, 2017; Perrone & Fuster, 2017; Reissig, 2017; Reynolds, 2017; Schifferstein, 2017), because these papers together provided a multifaceted view on the topics that teachers from multiple disciplinary backgrounds would like to convey to their food design students, and on the variety of ways in which they approached the subject matter. Hence, this literature review provided us with a broad coverage of topics that was supported by a number of current experts in this relatively new field. In addition, it provided insights in the scientific disciplines included, the stakeholders identified in the field, the activities they performed, and so on.

We also analysed several existing card sets and other tools that were developed to support different types of design processes (e.g., Daae & Boks, 2014; Deng et al., 2014; Golembewski & Selby, 2010; Halskov & Dalsgaard, 2007; Hornecker, 2010; IDEO, 2018; Lucero & Arrasvuori, 2010; Benenson, 2018; MethodKit, 2018; Taylor, 2018; van Boeijen, 2015; van Kuijk, 2010; Yilmaz, Daly, Seifert, & Gonzalez, 2016; Zampollo & Peacock, 2016) in order to see how information was presented in these tools and to get an impression on how card sets were used in other design processes. In addition, we used this information to establish the criteria that we would use to evaluate the card set.

Gathering and Clustering Raw Data

The *Food Design Cards* should cover the food system across the borders of different disciplines. We started out by distinguishing between four important areas in the food domain: food science, food service, food studies, and food business. With food science we refer to the physical, biological, and chemical processes that affect food during production and processing. Food service refers to all kinds of activities related to cooking, eating, and presenting food. Food studies focus on the relationships between food and social contexts within the arts, humanities, and social sciences. Food business refers to ways of making the food system profitable.

After defining these areas, a large amount of raw data was collected within each area by an extensive search through the latest journal papers, books, and online resources. These raw data were then clustered in order to derive umbrella terms within each of the four food system areas. For example, under the term Food studies at the 1st level, we identified the terms Individual, Interpersonal, Community, and Society at the 2nd level. Each of these terms was then subdivided at the 3rd level, and these could be subdivided once more, so that the basic structure of the

hierarchy of terms consisted of four levels in the classification (Table 1). Terms that were not supported by enough data could be supplemented in the next steps.

Deciding on the Final Terms for the Highest Level Categories

The various categories of the card set should be mutually exclusive and should ideally cover all the data. Furthermore, the categories should connect the various phases of a food system in a natural way. Therefore, the classification in the previous section was restructured and relocated under new categories.

In the first attempt to revise the classification, we tried to divide the data by distinguishing between eating in and eating out, and then breaking down the data set based on the chronological stages of eating in or out (Schifferstein, 2017). However, these two top categories could not be represented as part of a single system, as they tended to reveal two separate systems.

In the second attempt, we started with 5W, 1H (What, Who, Why, Where, When, How) as categories and then divided these topics into activities of the food system, such as produce,

Table 1. An example of the classification of terms within one of the four areas of the food domain.

First category	Second	Third	Fourth (examples)
Food studies (relationship between food and human)	Individual	Feeling (Psychological)	The food I ate before (breakfast, lunch, dinner) Stress (want to eat spicy food) Pleasure (how to indulge myself) Healthy (relieve guilty mind)
		Heredity	Allergy Food neophobia
		Ritual (Eating Habit)	Working schedule Environment (family) Experience (taste)
		Principle	Health (diet, ingredient) Environment (organic, vegetarian, vegan) Efficiency (time, material) Religion (Hinduism)
		Age	From infant to old age
		Status	Worker, student, CEO
	Interpersonal	Family	Tradition (traditional recipe) Bonding (ritual eating together) Holiday (Thanksgiving)
		Friends	Friendship
		Co-worker	Business
	Community (Region)	Local characteristic	Local product (pasta, cheese) Myth Movement (Slow food)
	Society (Culture)	Discipline (Law & Policy)	Nutrition facts (for food business) Process (for food business) Import & Export (FTA) Welfare Incentive (farm bill) Education (elementary, middle, high, college)
		Economy	Food shortage (hunger)
		History	Religion (halal) Development, trend (integrate new: internationalization, tourism, franchise) Tradition (keeping good custom: Chinese medicine)

process, distribute, marketing, consume, and control. However, this yielded too many terms that were closely connected between the categories. For instance, a *person with dietary restriction* under the Who category would be closely linked to *health & safety* under the Why category.

Finally, we decided to take the various elements of the food system as the basis for our classification and this appeared to work out well. We improved and refined the names and definitions of the category labels by including a large amount of records from our data collection. Each category was supposed to be approximately equally large, covering a similar number of topics. Eventually, the 7 categories of the card set were defined as *agriculture*, *industrial processing*, *distribution & marketing*, *kitchen management*, *eater*, *consumption situation*, and *policy & consideration*.

Description of Topics on the Card

The card set was now divided in 7 broad categories that covered all basic areas relevant for food design. Each category was identified with a different colour. The number of topic cards in

each category was limited to five in order to prevent information overload (Figure 1). The card titles aimed to cover all basic and important topics in a category, including some trends that might gain importance in the near future.

In addition to the title a visual icon was depicted and a question was added that clarified the topic of the card. Selected topics were transformed into essential questions to help designers become more inspired (Deng et al., 2014). For instance, the topic *Geography* was rephrased as the question *what are the factors that affect agriculture?* On the back of each card, six to eight examples were given that illustrated different elements of the topic and that were possible answers to the question. For instance, in response to *what are the factors that affect agriculture?* we included *season, climate, transport, weather, soil, market, and technology* as examples. As an example, Table 2 describes the category *Agriculture*, with the topics and examples that belong to this category. The information for all seven categories was arranged in this table format. Two professors and three students of TU Delft helped to rewrite the contents to make it more comprehensible.

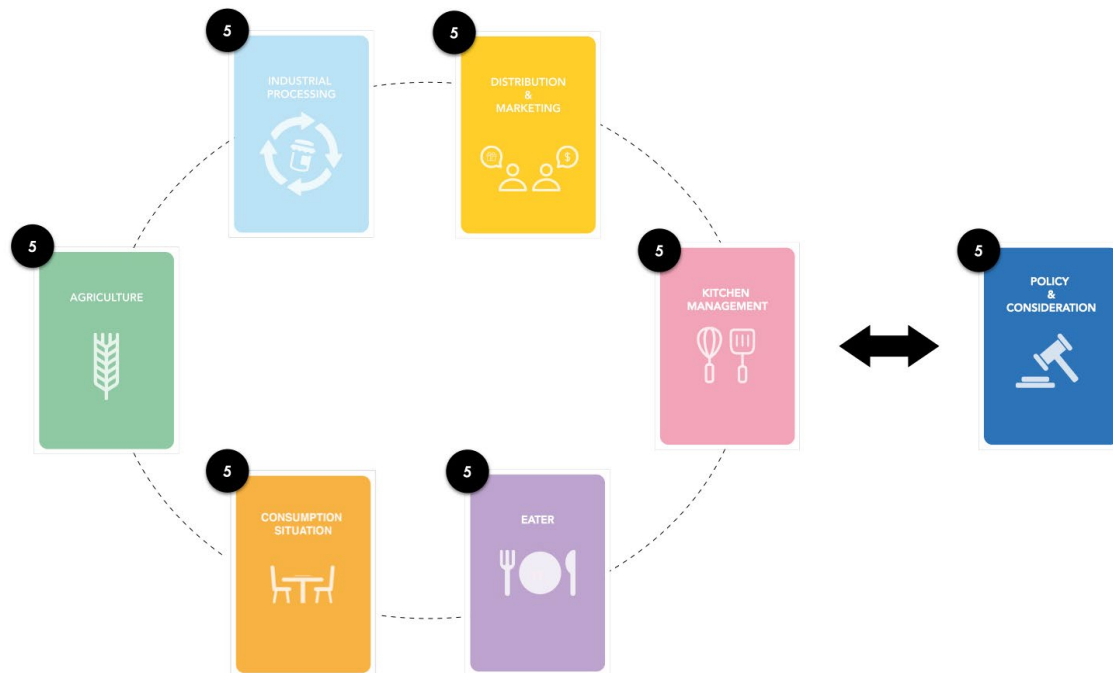


Figure 1. The seven categories of the card set in the original design.

Table 2. Description of contents in the Agriculture category.

Category	Topics + Inspiring questions	Examples
Agriculture	Geography What are the factors that affect agriculture?	Season, Climate, Transport, Weather, Soil, Market, Technology
	Improvement How can you cultivate and breed effectively?	Irrigation, Pesticides, Greenhouse, Vaccine, Genetically engineered, Fertilizer, Natural enemies
	Urban farming How can you cultivate and breed in urban cities?	Rooftop garden, Micro-farming, Community garden, Hydro-culture, Indoor farming, Pot farming
	Sustainable farming How can you make agriculture sustainable?	Improving animal life, Preventing water loss, Nutrient management, Preventing soil erosion, Reduce chemical use, Preventing pollution
	Self-sufficient farming Why not do farming by yourself?	Independent life, Distrust food industry, Personal well-being, Hobby, Enjoy farming, Sustainability

Design of the Individual Cards

The contents of the cards could function as a trigger that might raise awareness of certain issues. The aim of the card set was to expand participants' knowledge about the food domain; we wanted them to gain a wider perspective on the food area. In addition, it could help participants to communicate with people from multiple disciplines and to avoid stereotypes. It should be helpful in refining ideas with critical thinking.

In addition, the usability of the cards was deemed important. For instance, the information should be easily accessible and understandable and should not restrict the creative design process in any way. Therefore, all the texts were kept simple, using only a few words. Similarly, the icon on each card was kept abstract and simple, in a clean graphical style, and thereby gave the users the liberty to associate freely on the topic.

The fronts of the card only contained the topic title, the icon, and the clarifying question. The fronts were meant to be used during the initial stages of the creative process, where ideas were generated using the main areas that needed to be considered in food design processes. The card fronts were used to explore the food system across the board and to get inspired. The image used conceptual icons rather than an explicit picture, in order to create the freedom to embrace different perspectives without fixating on a certain image. By combining cards from different categories, different types of ideas could be joined in a single design.

The main goal of the back of each card was to refine initial ideas. This part showed concrete examples regarding the topic of the card. These examples were short and randomly scattered. It enabled users to choose example words and integrate these with their ideas, without any predefined order or priority. The inspiring question on the front gave them an opportunity to come up with diverse ideas, while the explicit examples on the back helped to shape these ideas into concrete concepts. It helped them to tackle different topics in more detail, to elaborate and refine the ideas. In second instance, the examples could be used to challenge initial design ideas. Users might add examples if they thought important examples were missing.

In summary, the main deck consisted of 35 cards, divided in 7 categories of 5 cards each, approximately 85 mm by 120 mm in size.

Instructions

We conducted two workshops with groups of 4-6 Master students using prototypes of the card set in order to create guidelines to support the use of the set. In all workshop sessions, students were asked to generate ideas for new food products or services in specific contexts. In the end, this should result in an idea, specifying the 5W, 1H aspects (What, Who, Why, Where, When, How).

Through these workshops, we found out that it was important to familiarise the participants with the deck of cards before the workshop. Otherwise, participants would try to make sense of all the different cards. For instance, the participants could be provided with an overview of the card topics. Alternatively, the session could start with a specified activity, such as a card game, in which the cards were introduced.

We would like the cards to enhance the participants' workflow and creativity during idea generation, discussing initial ideas, and refinement of ideas. Hence, the cards should function as conversation starters. For example, during idea generation participants could select 5 cards from different categories that they considered the most relevant topics for the task at hand. Subsequently, participants could brainstorm about each topic and write down ideas on sticky notes. Then they could explain these ideas to the group and cluster them. During idea generation participants should only see the fronts of the cards, otherwise they might get distracted by all the possible details. After clustering and selecting ideas, the backs of the cards could be used for developing ideas further and for critically evaluating ideas from various perspectives. This could be done, for instance, by randomly picking some cards and challenging the favourite idea.

Based on these insights, we decided to develop a set of general instructions containing basic information about the background, aim and structure of the card set. In addition, we created instructions for six games that would facilitate using the



Figure 2. The front (category, topic title, icon & question) and the back (category, topic title, example keywords) of an individual card in the original design.

card set for the food design process. Many card sets provide game rules to provide structure to the innovation process (e.g., Lucero & Arrasvuori, 2010; Mora, Gianni, & Divitini, 2017). Our game rules were obtained by considering the instructions given in other card sets and by consulting methods of creative facilitation (e.g., Tassoul, 2009). Two of these games were intended to support ideation, whereas the other four were primarily helpful for idea refinement. Each game consisted of a verbal instruction with one or two visuals.

The ideation methods consisted of:

- Random 3: Randomly pick one card each from 3 differently coloured topic piles. Think of an idea or concept that connects all three topics.
- Clustering: Find the cards that represent the most important questions that need to be addressed. Brainstorm ideas and write them on sticky notes. Cluster the answers to form concepts.

The refinement methods included:

- Aligning the group: Discuss each card and determine its importance for the concept. Place the card either on the important or the unimportant side. If you do not agree, place it in the middle. The important pile can then function as a first to do list.
- Prioritizing: Draw a grid with “importance of the topic for the project” (y) and “urgency of the topic to be addressed” (x). Now sort the topic cards into the grid. This will help you see which topics need to be addressed first, which can wait, and which can be addressed if there is still time.
- Timeline: Draw a timeline for your project and choose the cards that are relevant. Sort the cards into the phases of your time plan. Also think about who can take care of which topic.
- Have you thought of ...? : Distribute the cards evenly among all team members. One member takes the position of the devil’s advocate. He or she chooses a card and asks a question beginning with “Have you thought of” The others try to answer the question.

User Testing

Consecutive user tests were conducted in three contexts. First, we invited individual students and professional designers to use the card set with instructions in food design projects, either as a personal project, a course requirement, or as their final graduation project. After another revision, we used the updated card set in a group assignment with Master students. The final card set was also used in three different assignments with Master students during the progression of an elective course in food design.

Test in Individual Projects

The aim of the test was to evaluate how the participants would use the card set to work on their food design challenges, either when working on their own or when involving others in a creative session. Participants were recruited at the faculty of Industrial Design Engineering at TU Delft, through social media, bulletin boards, and personal connections. Participants were asked to

prepare a question or brief they wanted to work on and to bring working materials such as sticky notes, pen and paper. They were asked to read the instructions and try out two of the games before freely engaging in their process.

If the researcher could attend the designer’s creative session, she gave a brief introduction to the study and discussed formalities about audio and video recording. Next, she would let the participant use the card set in a natural way, and would only ask clarification questions if needed. Subsequently, she conducted a short oral interview about the experience of the participant. If she was unable to attend the session, either due to practical limitations or to confidentiality issues, the participant replied to the interview questions either orally in a separate interview, or in writing.

The general questions about the card set in the interview concerned what the card set was used for, how it was used, whether it helped to produce relevant design ideas or not, whether it functioned well with designers and non-designers, and how it could be improved. The questions about the games addressed which games were used, and whether the instructions were clear, useful, and fun to do.

Six participants were Master students of Industrial Design Engineering, who were in their final year or had recently completed the program. Four followed the Master Design for Interaction and two followed the Master Integrated Product Design. Although we recruited six student participants originally, two of them did not complete the task: After looking through the set they decided not to use it, because the card set did not seem to fit with their plans. Typically, this occurred in cases where projects were already quite focused on a particular topic, but not yet at the end stage where designers would need to take all sorts of topics into consideration for a market launch. In the end, observations were made in three student projects, of which two were also videotaped, and oral feedback was received in one additional student project.

In general, the observations in the student projects showed that participants did not read the instructions attentively and did not want to read more. They stated that the instructions felt very open and they did not see this as a problem. However, they wondered whether non-designers might want more guidance from instructions and whether a facilitator might be needed when working with non-designers. Even though the set consisted of many cards, participants liked to read through all the cards in order to see what kind of ideas this would elicit regarding their design brief. As a consequence, participants tended to lose quite a lot of time at the start of the session by going through all the cards. Hence, they tended to spend more time than anticipated on their first use. All three observed participants seemed to get very much immersed in the card set and largely forgot time.

The observations showed that the card set was useful in gaining overview when trying to define a project brief and addressing all different kinds of topics. Designers generally found the set very useful in the first stage of food design projects, where the scope was still quite wide. Furthermore, the card set continued to be of use at any time in projects that had a wide scope (e.g., speculative projects). Also, the card set proved useful when evaluating whether the design took the whole food system

into consideration and reflected all the necessary topics (e.g., legislation). The value of the card set was limited for designers who had a narrowly defined brief or had already focused on a concrete topic. In these cases, broad considerations of implications for multiple contexts or stakeholders were not applicable. Designers with these projects were looking for more in-depth information and found the information on the cards too general.

Overall, the student participants were positive about the card set and its instructions. They found the card set open enough to suit multiple contexts, while it also provided enough guidance to enable all design students to use it in their project. Criticisms were generally specific to a single participant and their topic, and we used these remarks to fine-tune the topics on the cards set further.

The card set was also evaluated by a professional food designer and her business partner, who performed design projects regularly for industrial clients. This designer was also trained in Industrial Design Engineering and had over 20 years of experience in food design projects. She provided both oral and written feedback.

The professional designer and her business partner saw the main value in the card set at the start of the design project, using it to set the scope of the design assignment. Because the card set covered many topics, it gave a broad overview of all the different topics that the innovation could focus on. It made sure that all possible strategic directions were considered, before a choice was made together with the client. Hence, the card set was valuable for the process, because it made sure that all different and possibly important aspects had been considered at the start. During the project, however, more specific information would be needed as sources of inspiration that could not be provided by the card set. During the process, the designers needed to find new insights and inspiration on specific product details. Therefore, this design team typically developed a new, customized inspirational tool during the course of each project.

After the individual tests, we wanted to reduce the amount of time card users spent to create an overview of the topics represented in the set. Therefore, we added 7 summary cards that provided an overview of all five topics within a category (Figure 3). In addition, because some of the participants reported that they had trouble distinguishing the 7 categories on the cards, the sections displaying the categories were contrasted with the overall design in the redesign (Figure 4). Also, the category *policy & consideration* was renamed into *policy & legislation*. The final design is free to be used for non-commercial purposes and is available for download from <https://delftdesignlabs.org/food-design/>. *Food Design Cards* are also available for purchase through this website.

Test in Group Project

The updated card set was tested in a group exercise, forming an assignment in the Master elective course Food & Eating Design. All participants were in their final year of the Master education. In the assignment, the design students used the card set to develop a number of design briefs: opportunities, questions, or problems that they found interesting to investigate in the food domain and were formulated in a way that left enough room for multiple types of design solutions. Examples of such challenges included “how to make grocery shopping more efficient and less time consuming for people with dietary restrictions”, “how to enhance the food experience through environment-friendly packaging”, and “how to offer people healthy, balanced and customizable meals, that are convenient to prepare and consume”. A week later, they presented the top 3 of their design opportunities in class.

The assignment was performed by 11 groups of 3-5 students, each composed of 1-3 design students and 1-2 non-designer friends. They started the session by choosing two games they wanted to play. They could also invent an additional game themselves.



Figure 3. Example of a category overview card, showing the five topics in the category kitchen management.



Figure 4. Revised design of a topic card, with the category name in contrast.



Subsequently, they could use the card set in any way they wanted to perform their assignment. After the session, each group filled out an evaluation form about their experience using the card set for the group assignment. The feedback form consisted mainly of open questions addressing the difficulty of the assignment, the way they used the card set, its usefulness, and suggestions for improvement of the card set and its instructions. After reading the feedback from the students, a discussion session was held to clarify unclear feedback and ask for more details if needed.

In general, the students found the card set helpful in formulating their design briefs. They found the structure clear (category–topic–example) and appreciated the broadness of the set. Some students indicated that the number of cards and topics was overwhelming at first, but after taking some time to get to know the set and read instructions, they found it useful in supporting their process. They mostly used the set to generate ideas and to become inspired, but also to facilitate discussion, create scenarios and refine their ideas. The broadness of the topics was generally seen as an added value reminding them of issues to be considered. However, students who were unfamiliar with some of these indicated that they might not use them for defining their topic, if they lacked necessary background knowledge. Some students commented that the topics mentioned on the cards were not specific enough to specify the exact topic of the design brief—they were too general for that. The game that was chosen most often as an introduction to their assignment was *Random 3*. For this assignment, students found it helpful to pick a number of cards of their liking, make combinations, and then tried to formulate a related problem, or in some cases also tried to come up with possible solutions.

The design students observed that non-designers tended to approach the design challenge in a somewhat different way. If the designers focused on the product or the final solution, the non-designers would focus on the context or on the process, or vice versa. However, this disparity might also have been caused by the fact that the designers in some cases already started working on the assignment before they involved the non-designers. The designers also observed that the non-designers tended to take some extra time to understand how the card set worked, because they were not familiar with working with these types of tools to support their process. Some non-designers were really impressed by how the set could easily help them generate many out-of-the-box ideas and became very enthusiastic about having such tools to support their work. In many cases, the groups appointed a facilitator to instruct the group, explain the procedure, and keep track of time. Especially in groups with non-designers, the role of the facilitator could be important to manage the creative session and bridge the experience gaps between participants with different backgrounds, to make sure everyone could fully participate in the process.

With respect to the design process, the students indicated that they thought the cards could be useful at multiple stages in the process: (1) as inspiration in the beginning of the design process, (2) to enhance brainstorming for ideas for solution directions, or (3) to check if they covered all important design aspects at the end of the process.

Using the Cards Several Times during a Single Project

The final card set was also tested during three stages of a design project performed during the Master elective course Food & Eating Design. This project was performed on an individual basis and was the main deliverable for the course. All participants were in their final year of the Master education and none of them had participated in the previous tests. The aim of each assignment varied according to the stage of the project.

Ideation Exercise

The first assignment was intended to familiarise the students with the card set and to discover its potential in supporting idea generation. Students were divided into six groups of four students and were instructed to follow the instruction of the *Random 3* exercise. Each group performed at least three rounds of 20 min. each. In each round they picked three cards with different colours and tried to come up with as many ideas or concepts that would connect these three cards. For each round, they noted down the number of ideas they had generated, they described their best idea in a few lines of text and they made a sketch. Each group ($N = 6$) also filled out a small questionnaire in which they indicated how difficult and how much fun it was to perform the exercise (each on a 5-point scale). In addition, an open question format was used to assess how they used the card set, what made the task challenging, what they saw as the main benefits of using the card set, whether they would use the card set again, and whether there was anything they wanted to improve.

The results showed that some groups found the task easy ($N = 2$) and some found it difficult ($N = 3$); some found the task fun to do ($N = 2$), others found it just okay ($N = 4$). The groups differed substantially in the mean number of ideas they generated in the three rounds, which varied from 2.0 to 7.7. The variation between the three repetitions per group was never more than 3. Apparently, the number of ideas depended largely on group composition and their process, rather than on the three cards they selected. Groups indicated that it was often quite challenging to link all three cards. Some groups first started out by linking two cards and then later included the third one. In some cases, they used the back of the cards with detailed examples to get inspiration for ideas. Some groups decided to pick a new card in case they could not come up with ideas. Others restricted their card selection to the cards that were of most interest to them. The main benefits of the exercise were its helpfulness in sparking ideas and broadening up the thinking process by going through the many topics included in the card set. Students also appreciated the clear structure and logic in the set—they indicated that this approach might be useful for developing sets for other areas as well.

One of the ideas that a group of students generated was based on the cards Consumption Situation: Prepared Meal, Eater: Beliefs and Values, and Policy & Legislation: International Trade. The idea consisted of a chocolate bar, wrapped in a package that looked like a boarding pass, showing the origin of the chocolate and the distance it had travelled. A percentage of every bar purchased would go directly to the cocoa bean farmer. Another

idea tried to integrate the cards Agriculture: Sustainable Farming, Distribution & Marketing: Package, and Consumption Situation: Atmosphere. The product idea consisted of a package of vegetables for a dish for multiple persons that also contained seeds of each of the vegetables. After enjoying the meal together with friends, each of the friends would take home one of the sacks of seeds. After three months, they would come together again to prepare a meal with the vegetables they each grew. The third idea brought together the cards Policy & Legislation: Food Education, Distribution & Marketing: Access, and Kitchen Management: Type of Food Service. It consisted of a healthy food pie. The centre of this transparent food pie contained a sweet, high-calorie part that you could only reach by eating the outside part of the pie. However, by the time you reached it, you would already feel full, so you would not eat it anymore. Another idea integrated Consumption Situation: Place, Kitchen Management: Storage & Waste, with Agriculture: Urban Farming. It consisted of a system of growing, cooking and serving food for a retirement home. The elderly who lived in the home could help in the vegetable garden, help in the kitchen, and eat the meal together, which provided them with meaningful and connecting activities and healthy meals, enhancing both their physical and mental health. The ideas discussed show that some of the concepts the students generated were highly innovative, whereas others could be created now, or might already exist.

Refining the Topic

The second assignment intended to help students find and refine the topic of their individual design project. Students were instructed to individually browse through the entire set of food design cards in search for aspects that related to their theme of interest, and to define their topic as precisely as possible. Subsequently, each student ($N = 24$) evaluated the usefulness of the card set in helping them to define their topic, by replying to a set of questions that were equivalent to the set used in the previous assignment.

The results showed that on average students rated their assignment as not easy, not difficult ($M = 2.8$, $SD = 0.88$) and as okay to do ($M = 3.3$, $SD = 0.68$). The students indicated that the card set provided a good overview of the food realm with its clear, logical structure. The broadness of the topics allowed a more holistic approach and made them think of topics they initially did not think about. It allowed them to evaluate the topic of their challenge from many different viewpoints, they could find new clues that widened their topic, work out concepts in more detail, and generate new possibilities. These aspects were considered the main benefits of using the card set for this task. Although a large part of the students indicated that they would use the cards again for a similar task, some of them indicated that they found the set more suitable for generating ideas than to define a topic. These students suggested that the cards were particularly useful if they had no idea where to start, when they were looking for inspiration for a completely new topic, or if they were stuck in the process and needed to think from different perspectives.

The more students had concrete ideas in their minds, the harder they found it to use the card set to define their design challenge. In this case, many cards seemed irrelevant and

contained only quite abstract, generic information, rather than rich, detailed material. Some students noticed that they did not know all the words on the cards, possibly because they were not yet familiar with all topics in the food domain. Some reported that the cards were restrictive and limited their free thinking. Given the large number of topics, the set also did not help in narrowing down the topic. Instead, students thought the set could be more useful when evaluating concepts in a later stage of the design process.

Examples of the challenges that students generated in this task included:

- I want to make people aware of the amount of water that is required to produce specific products.
- I want to inform bar and pub visitors on sustainable food.
- I want to help people eat healthy by reminding them to eat slowly.
- I want to help parents who want to introduce vegetables to toddlers.
- I want to stimulate the connection between two people who eat the same meal at the same place, but not at the same time.

Evaluate the Concept


The third assignment involved a group exercise, in which students used the card set to evaluate the concepts they had developed individually in their design projects. In groups of 4 or 5 they used the exercise *Have you thought of ...?* to critically evaluate whether they had considered all the aspects that might be relevant when designing for the food context. After the exercise, they handed in a description and sketch of their idea, and they summarized the 3-5 most important insights that they had derived from the exercise. In addition, each student ($N = 18$) evaluated the usefulness of the card set in helping them to refine their concept by replying to a set of questions that were equivalent to those used in the previous assignments.

The results showed that on average students rated their assignment as not easy, not difficult ($M = 2.7$, $SD = 0.83$) and as fun to do ($M = 3.6$, $SD = 0.59$). The large majority of students (88%) would like to use the card set again for this type of challenge. Many students also reported that the card set was more suitable for this task than it was for the previous assignment. The main benefit of doing this exercise with the cards was that it helped designers to consider aspects they had not thought of yet. It allowed them to consider whether they missed something and to assess whether this aspect was really important or not. This allowed them to make adjustments and to enrich their concept. Although a card might not seem relevant at first, it could jumpstart a discussion and introduce a new perspective. Students observed that the exercise could either be done individually or in a group. The advantage of doing it alone would be that they had more time to go through all the cards and carefully pick the ones they found most interesting. On the other hand, doing the exercise with people with different backgrounds and working on different projects would provoke interesting discussions and give extra inspiration. The topics on the cards made it easy for people in the group to become inspired and formulate questions for the others, and the design of the card

set provided a basic structure for the discussion, and also kept the atmosphere of the process light and playful. The main negative aspect mentioned was that some of the topics on the cards were not relevant for the design topic at hand. On the other hand, some other topics might be too obvious. If this happened repeatedly, the exercise could evoke feelings of annoyance or boredom. Some students found it easiest to apply the topics to their own project; when trying to apply it to the project of other students, they had trouble relating some of the topics to the project at hand, and found the card set too broad. An incidental student found the structure of the card set too rigid: although the questions provided different angles, the student found the topics quite abstract and found that they did not sufficiently stimulate deeper thinking.

To give some idea of the outcomes of the exercise:

- The student who wanted to inform visitors of bars and pubs on sustainable food created attractive presentations for different bites made of organ meat. A lot of organs from cows, sheep and pigs currently end up in cat and dog food, whereas they are well suited for human consumption. Consumers would be able to receive information on the background of their bites, for instance by scanning a QR code. Doing the exercise made the student more aware that the story behind these products was crucial for the success of the concept. Therefore, she now paid more attention to the way the story was told and the way this information was offered to consumers. Also, she added information on different aspects, such as nutritional facts (Figure 5). In addition, she thought about how she could create a brand experience and considered the kinds of restaurants that would be open to serving these products.



FRESH FORGOTTEN FLESH

Tongue-in-sleek

CALF TONGUE

How did Grandma make this?
The calf tongue was cooked in water, until the skin got loose, and then served in slices on a warm plate or added to a ragout.

Muscles, blood and protection
The tongue is a very good source of protein to strengthen your muscles. This organ is good for blood, because of the high amount of iron. And the mineral zinc supports your sickness protection.

For more information and recipes go to www.freshforgottenflesh.com

Figure 5. Information card on calf tongue, showing preparation method and nutrition facts by Trudie Bosse.

- The student who wanted to help parents introduce vegetables to their toddlers created three monster plates to be used at dinner time. The idea was that the toddler could play with the food by using it to add new parts to the monster or to feed the monster (Figure 6). By doing the exercise, she became aware that she needed to clarify the role of the parent better, particularly because some parents did not want their children to play with their food. Also, it became clear that she needed to rethink the material and the possible shapes, because the products should be cleaned properly between usage occasions.



Figure 6. Graphic designs for two monster plates by Hannah Goss.

Discussion

Food is an essential element for everyone's daily life, and the *Food Design Cards* help participants in food innovation processes to become more aware of the different possible perspectives on food. Hence, this type of design tool provides an essential piece of support for addressing all the different stakeholder needs and for guiding social innovations in the food industry of the future. The tests of our *Food Design Cards* demonstrated that card-based tools have the potential to inspire and support designers during their design process. It showed how designers could maximize their strengths by using design methods to tackle the challenges presented by a variety of current issues in the food area. In addition, we predict that our card set will be helpful to engage different food stakeholders in food innovation processes, including farmers, food manufacturers, scientists, chefs, consumers, and government officials.

In the design of the set, we made use of the requirements that typically apply to design tools and methods (Lindahl, 2005; Lofthouse, 2006), and we tried to optimize the design in several ways. First of all, we wanted the set to be broad and cover all relevant topics in the area of food design, but we also wanted to keep the size of the set limited. With the total number of 35 topic cards, we think we have reached a good balance between these two demands. Even though some participants tended to be overwhelmed at first, we tried to overcome this by adding the 7 category cards that help to create overview. In addition, the six games provide engaging ways to start the creative process and to familiarize oneself with the different topics in the set.

However, by providing many relevant topics, the descriptions of these topics and the examples remain quite abstract and general. Also, the pictograms we used are schematic and open for multiple

interpretations, in order to permit room for creativity. Hence, the designers who use the set will need their own creativity to define their challenge and to develop their solutions in more detail. They may find additional inspiration in more concrete examples of products or contexts that magazines, websites, or other creative tools provide. Although we added instructions on the use of the set and added a few games to start off the creative process, we kept these to a minimum in order to reduce the reading load before starting the process. We mainly wanted to stimulate designers and non-designers to engage in the creative process, without blocking them or restraining them in any way. The observations we did during our test sessions and the feedback we got from our participants indeed suggested that we largely succeeded in reaching this goal.

The design students who tested the card set found the set relevant for multiple stages in the design process, including (1) inspiration at the start of the design process to formulate the brief, (2) brainstorming to come up with ideas for solution directions, or (3) evaluating the final propositions to check whether they covered all important design aspects. In addition, the cards can facilitate communication between the members of design teams, because they make the discussion tangible. Hence, the cards seem to be most useful when designers do not have a clear picture in mind of where they want to go (at the start of the project or when they get stuck during the project) or when they have already developed a detailed concept and want to check whether they forgot something important. In the intermediate stages, however, when designers have chosen a direction and look for more detailed insights on their topic, the information on the cards may be too abstract and not provide enough concrete clues for forming their concept. Nonetheless, the possibilities to apply the card set were more elaborate than we had envisioned originally, and we were happy to see that participants viewed multiple possible uses.

In the Introduction, we suggested that the *Food Design Cards* and the *Thoughts for Food* card set (Zampollo & Peacock, 2016) might be useful in different stages of the food design process. Whereas the *Thoughts for Food* set stimulates creativity and evokes inspiration in order to generate new ideas in the early stages of product development, we expected the *Food Design Cards* mainly to be useful to screen and evaluate concepts that were already quite detailed. However, the user tests showed that the *Food Design Cards* can also be used at the initial stages of the design process, because the cards provide an overview of the many aspects that need to be considered when designing for the food domain. Hence, both card sets can fulfil a role in the first stages of product development, although these roles may differ. Whereas the *Thoughts for Food* set activates different ways of creative thinking that can spark imagination, the *Food Design Cards* connect the designer both with a structural overview of the food context and with the diversity of relevant topics in this context. It might be interesting to compare the usage of the two card sets in a subsequent study, in order to determine their possible roles and to ascertain their complementarity.

We would like the *Food Design Cards* to be easy to use, and we will continue to improve the user's experience. We want to provide participants with interesting challenges and we want to

stimulate participants to come out of their comfort zone. Therefore, we plan to develop more games and suggestions for using the *Food Design Cards* in the future. Furthermore, it might be necessary to update the cards from time to time if new technologies or trends occur. In the future it might be possible for users to add examples themselves on the website and to order personalized card sets. This would make it possible to have customizable sets for specific user groups. In addition, we might use this information to select new standard examples for the updated card set.

The benefits of physical creativity tools deviate from the advantages that may be offered by digital tools, which can be updated more easily. For computer-based creativity support tools, Shneiderman (2007) mentions the following desirable attributes: (1) support exploratory research, (2) enable collaboration, (3) provide history-keeping, and (4) have *low thresholds, high ceilings, and wide walls*, indicating that tools should be easy to use for novices, yet also provide the functionality that experts aspire. Because physical tools are constrained to a limited set of words and images, they cannot support wide explorations and they do not automatically keep track of the outcomes of all iterations and the corresponding insights. On the other hand, they help to create an overview and allow designers to focus their attention on the most important aspects of the design. Hence, they can help designers in avoiding the pitfalls of endless search without convergence, which can be an important strength compared to digital tools. Nonetheless, it might be interesting to explore whether the *Food Design Cards* can also form the starting point for a digital tool, thereby combining the advantages of physical with those of digital tools.

Although the *Food Design Cards* were developed specifically for design projects in the food realm, the way in which this card set was developed and structured may possibly serve as a template for card sets to be developed in other areas. Several students referred to the clear structure of the set and the use of colour coding that helped them obtain a comparatively quick overview of the focal area for their design challenge. Possibly, this approach may work for other design fields as well.

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