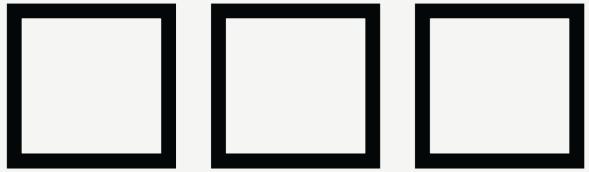

Food Poetry
A future vision for 3D food printing
-
MSc. Thesis
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2017

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Food Poetry: A future vision for food printing
30-08-2017
Integrated Product Design

Executive Summary
This graduation thesis is about finding a meaningful application for the emerging technology of 3D food printing within the cultural context of urban Japan. The method was based on Verganti's Design driven innovation to (re)define the meaning of the product. The analysis phase deconstructed the product into its physical capabilities and its current meaning. These key qualities were then clustered and examined within the Japanese context. This part of the research was based on desk research, own past experiences and a stay in the context that resulted in interviews with experts and observations. The research concluded that there was not a need in nutrition assistance, but in nurturing the mental health as factors such as high societal pressure, loss in genuine intimacy and a need to escape were evident.

This resulted in the vision of food poetry which seeks to share memories through food by addressing the senses using the ingredients that correspond to that memory. The physical outcome is the concept of a food haiku; a food composition that consists out of three edible snacks, representing the most important elements of that memory, a written haiku and a specially designed case that enhances the experience. In addition, as food printing requires the skills of both ingredient / cooking knowledge and 3D modeling, a complete product service system was then proposed. The service consisted out of three stakeholders; each having their respective roles in the process of creating and receiving a food haiku. Lastly, the concept's value was evaluated with interviewees from the Japanese context. The conclusion was that the concept was a modernization of various traditional rituals and was deemed as valuable for the new generation.

How to read the report:

Goal

These blocks describe what is aimed to be achieved in the chapter.

Method

These blocks describe which actions were taken to achieve the goal of the chapter.

Conclusions

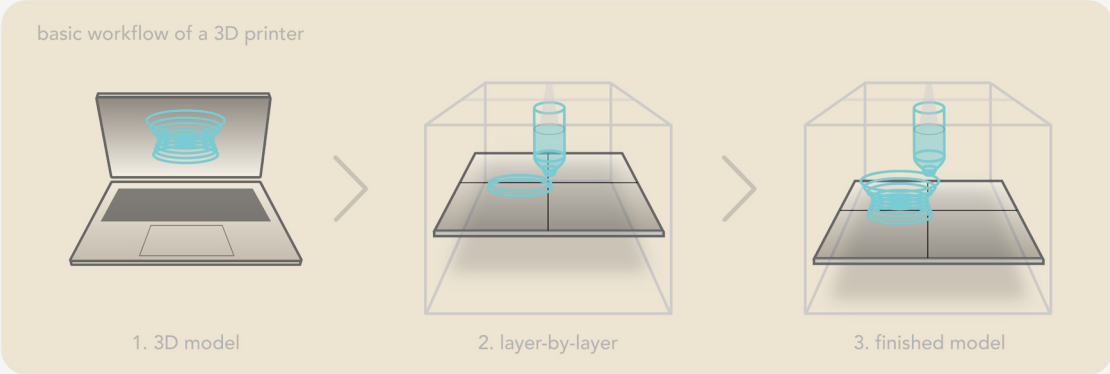
These blocks will summarize the most important findings of the entire chapter that will be used as input for the design.

Experts / Users

These blocks will indicate the interaction with experts or users and describe its process and results.

1.0

Project Brief & Method



3D Food Printers

3D printers use a method that builds a complex geometry up layer by layer following a digital blueprint. Originating from industrial application, it has now found its way into the food sector. With claims that 3D food printers could the solution to end global food scarcity (Tran, 2016), the yet-infant application has received a great amount of media attention. Rather than a need risen out of public demand, it is a technology-pushed innovation. Although its utilitarian benefits are researched and published, its meaning — the emotional value of both machine and printed food — have yet to be established.

Objective

The objective of this Master's thesis is to create a vision for 3D food printers by defining its beneficial meaning and performance within a cultural context and to develop a demonstrator that embodies this vision to a functional level. The vision will be crafted by integrating the research insights of the technological and sociocultural developments explored by 'key interpreters' — experts in relevant fields researching new meanings and technologies.

In essence, this project pursues two basic questions:

Where does it fit in our lives?
-
How will it be able to make good food?

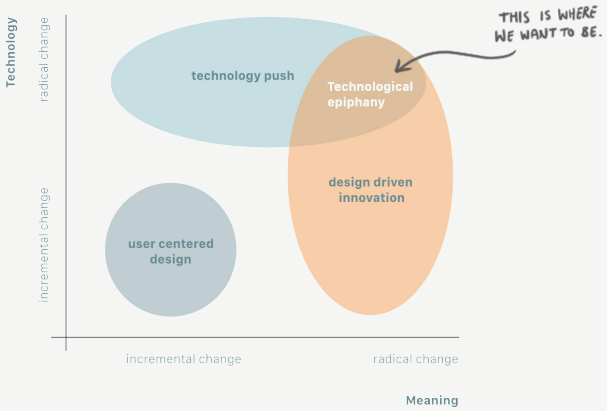
Cultural Context: Urban Japan

This thesis will focus on near-future urban Japan as the sociocultural context due to her pervasiveness with technology and robotics in daily life (Wagner, 2009), her unique food culture and keen interests of the graduate student.

> **“People do not buy products but meanings. People use things for profound emotional, psychological, and sociocultural reasons as well as utilitarian ones.” (Verganti, 2009, p.19**

Design driven innovation by Roberto Verganti

The theory states that innovation happens on both performance (functionality through technology) and meaning (product sense and language). The radical innovation of meanings is referred to ‘design-driven innovation’ because it is driven by a firm’s vision about possible breakthrough yet unknown meanings and product languages that people could love (and were simply waiting for) (Verganti, 2009, p.71). Verganti states that a product will have a long term success and competitive advantage when the firm celebrates a ‘technological epiphany’ — the interplay between radical technology-push and design-driven innovation. (Verganti, 2009, p.77). This theory is highly fitting for this case of a technology-pushed innovation.



Approach

The complete project outline is laid out on pg.2-3. Following the Design Driven Innovation method (Verganti, 2013) The research and design process is divided into four main phases to achieve and implement the innovation:

1) Observing (Chapter 2)

This phase houses the first two research questions:

1. What are the key components of 3D food printing that relate to the given context?

2. How do these key components relate to the context of modern urban Japan?

It will lay a knowledge foundation by doing preliminary research in the given sociocultural context and technology field.

2) Listening (Chapter 3)

This phase houses the third research question:

3. How do contextual factors develop and redefine the key components of the 3D food printing technology?

Acquiring knowledge about possible new meanings of products within the given social-cultural context by listening to ‘key interpreters’ — researchers (not necessarily in the same field) who discuss and propose new meanings and technologies and communicate insights, interpretations, and proposals through artworks, studies, speeches, prototypes, and products. (Verganti, 2009, p.136)

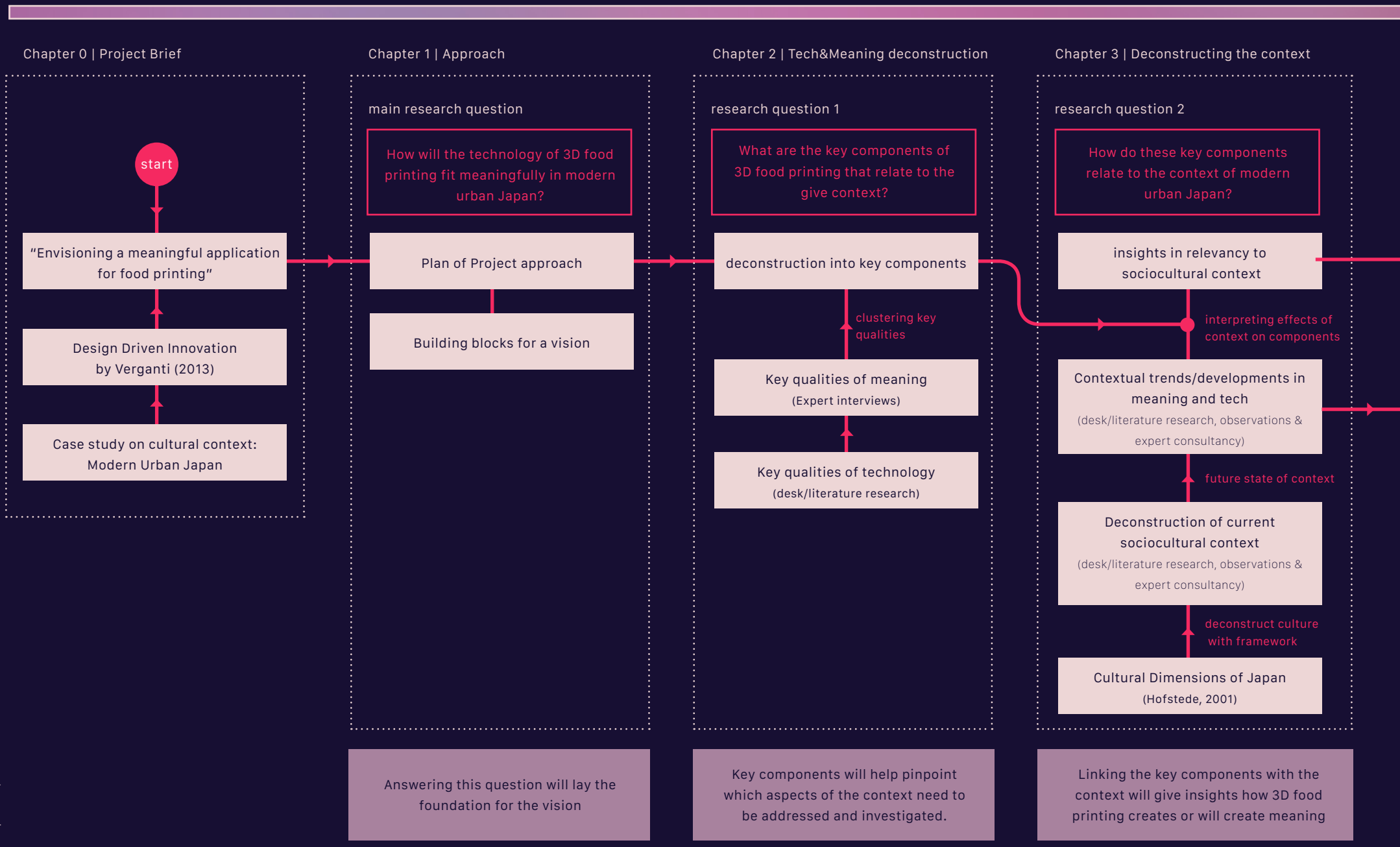
3) Interpreting (Chapter 4 - 5)

Crafting an own vision proposal for a radical new meaning and language by integrating knowledge extracted from the previous phase and self-produced novel interpretations. This phase will answer the main research question in the form of a vision — the embodiment of research insights translated into a more abstracted form using analogies.

4) Addressing (Chapter 6 - 8)

Turning oneself into a interpreter and share the vision on how people give meaning to things. This phase will include the product development and sharing the outcome of the graduation thesis on this online platform.

progress bar of project



progress so far

Chapter 4 | Interpreting

research question 3

How do contextual factors develop and redefine the key components of the 3D food printing technology?

producing novel interpretations

Vision and insights from key interpreters
(Expert consultancy and desk research)

Own ethics

Fusing research insights with own ethics and newly interpreted ones will give rise to a vision specifically for urban Japan

Chapter 5 | Crafting the vision

How will the technology of 3D food printing fit meaningfully in modern urban Japan?

The Vision

the relationship with the user

Interaction Qualities

added value within context

Reason of existence

Time frame

The vision translates all the valuable output into a more abstract way to convey the desired emotions.

Chapter 6 & 7 | Conceptualizing

How will the vision translate into a functional product?

Concept Design

Form Language

Functionality & Technology

User Experience

The concept design is the physical embodiment of the vision and defines the functionalities and user experience.

Chapter 8 & 9 | Addressing

How will this influence and change meaning?

"Cultural Prototype"

The Story [film medium]

Scenarios [visual/text]

Meaning [visual/text]

This action entails diffusing the vision to interpreters, thus eventually influencing how people give meaning to things.

chapter 2 | Deconstruction

Goal

Answering the first two research questions and laying a knowledge foundation on the subject

Method

The vision was embodied in a physical form of three snacks. This decision was made after an ideation phase and assessing on communicative ability, nature of food printers, eating behavior and fit with the traditional culture. The type of food was defined by determining the portion size, its place in the daily routine and the limitations in complexity.

The possibilities of the snacks were then explored by looking at the relationship between its properties and those of memories. Different methods for conveying scents have been assessed to decide on the most suited and effective method. The chosen method of cold smoking as been tested to validate its effectivity. After unsatisfying results, the choice has been revised. To further create a frame work for the snacks, different types of story elements have been identified by translating various memories into food haikus.

2.1

Technology Deconstruction

This chapter covers:
1) Market
2) Primary Functionalities
3) Printing Methods
4) Capabilities

Market

Implementing Additive Manufacturing (AM) in the food industry was an apparent step in the multibillion dollar market. The 2015 3D printing hype cycle, released by advisory firm Gartner Inc., represents the maturity and adoption of 3D technology and applications. (Lajoie, 2014) Although the first initiatives started as early as 2009, food printing (here referred as consumable products) entered the 2015 cycle as it evolved from lab experiments to viable business opportunities. Gartner predicts another 5 to 10 years of development before reaching a 'plateau of productivity' — the maturity level effective enough for consumers.

Up to now, there are 26 identified initiatives identified (Appendix A), ranging from DIY open source projects to Kickstarter campaigns to professional equipment. This chapter will identify the technology currently available. There will be no distinction in consumer or professional market offerings.

As for the appearance, the models seems to be either: 1) fully enclosed 2) hardware enclosed with work area exposed or 3) fully exposed.

Hype cycle for 3D Printing by Gartner Inc 2015

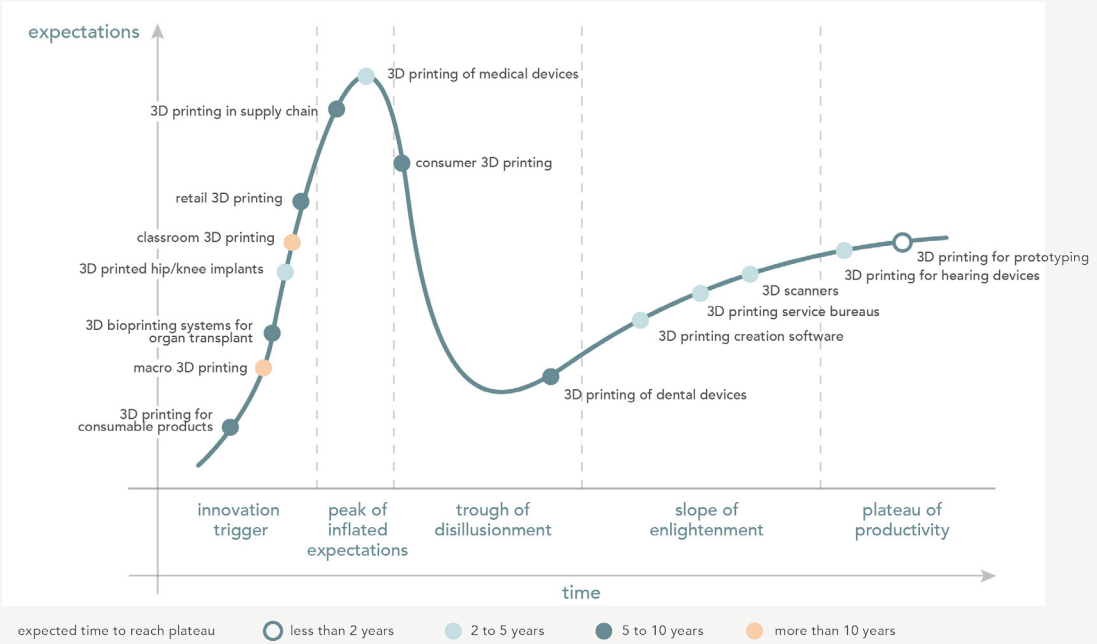
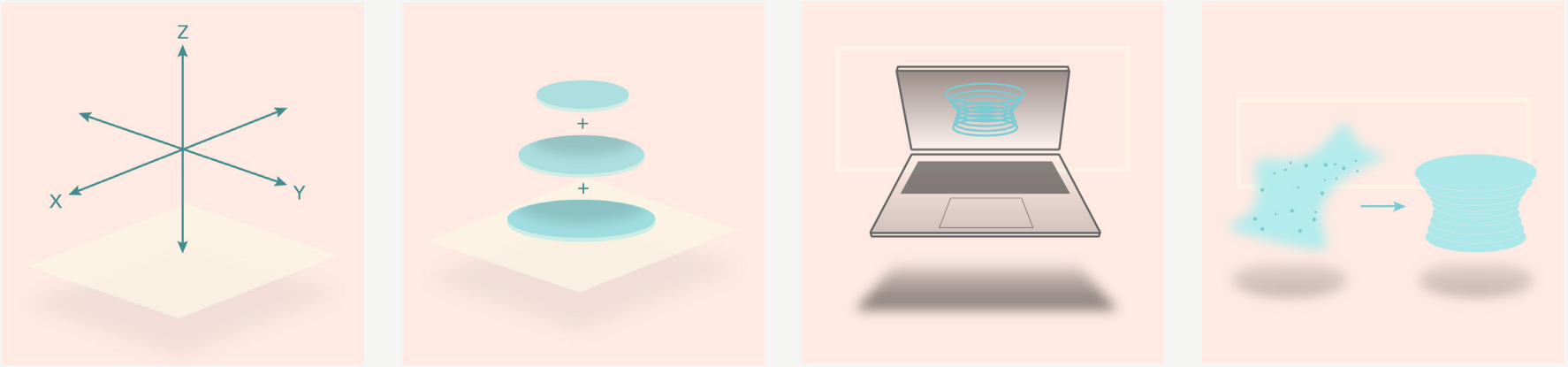


figure. 2.1.1 Hype cycle for 3D Printing by Gartner Inc (2015)

The fully incapsulated models such as the ChefJet Pro by 3D systems and Foodini by Natural Machines are designed for the home kitchen and even resemble an oven or microwave. The print is completely closed off from any external factors, making it safe for home use and allowing to check on the progress through a glass panel.

The latter two model categories are intended for the makers experimenting with printing edibles and possibly for commercial purposes. Exposing the parts gives an appearance of an unfinished product or an industrial tool. Furthermore, exposing the work area for the prints could bring up food safety and hygienic issues - if not used in a controlled kitchen environment.



XYZ-translation
Within the given boundaries, the head of the printer maneuvers on an X, Y and Z plane following the electronic blueprint of the 3D model.

Layer by layer
The digital 3D model is sliced into 2D profiles that the printer rebuilds in correct order.

Digital blueprint
The actuators of the printers are driven by a digital G-code generated based on a 3D CAD model.

Material construction
The material transitions during deposition from the initial input state (e.g. semi-liquid or powder) to the desired output state (e.g. crystallized) through a binding mechanism.

figure. 2.1.2 Primary functions of 3D Food Printing

Primary Functionality

Next to the primary functionalities depicted in figure 2.1.2, secondary functionalities are:

Digital files

Having a digital recipe file executed by a kitchen appliance brings numerous opportunities into the kitchen. The file can virtually be executed infinitely by the machine, resulting in identical prints if the ingredients are nearly identical as well.

Connected

Being connected to the internet even takes a step further. The file can be shared endlessly as well as downloading from all available offerers. Sharing the recipe would enable users without any skills to still produce an replica of the original dish. Furthermore, being connected means that the 3D food printer will be able to initiate the print job remotely and planned ahead.

Quantified

Having the nutritional value known, volumes are quantified in the CAD file and thus determining its exact currently holding nutrients. In combination with a feedback system of some sorts, this will be able to bring transparency to the intakes (for medical, dietary or personal reasons).

Printing Methods

By making variants on the conventional AM methods, these have been tailored down to handle the edible materials optimally. The most commonly-used methods are in the food printing industry are: (1) Material extrusion and (2) Powder Binding deposition

1) Material Extrusion

The majority of 3D food printers currently available implement the Fused Deposition Modeling method with a syringe-based puree extrusion system. The pureed food ingredients are loaded in a cylinder (extruder) and extruded out of the nozzle by an acting hydraulic piston. The binding of the material happens through either the rheological material properties (deformation and flow of matter) or solidification upon cooling (Godoi, 2016). The first binding mechanism is the case

with ingredients such as processed cheese, frosting, dough or meat puree. The viscosity of the material has to be low enough for extrusion yet high enough for structure support after deposition. The latter binding mechanism is applied in chocolate printing, usually at working temperatures from 28 C to 40 C (Hao et al., 2010).

2) Powder Binding Deposition

After extrusion processes, powder binding deposition is the second most popular system in 3D food printing. which have in common the powder deposition in bed. This method covers the platform with a layer in which the printer binds the designated points of the 2D profile. The platform lowers one layer thickness and receives another powder layer. This process repeats until the 3D model has been established. (Diaz et al., 2014). This method can be apply each layer containing different food material components and requires an additional step for removing the unfused material at the end of the construction (Godoi, 2016).

Binding the powders is done by three mechanisms: selective laser sintering, selective hot air sintering and liquid binder jetting.

In selective laser sintering and hot air sintering, the layers of powder are fused together upon application of a heat source, infrared laser and hot air, respectively (Godoi, 2016).

In liquid binding, although the name suggest a liquid phase, there is no phase change of the powder during layer solidification: a liquid binder is overprinted onto layers of powder that are accumulated consecutively, as in directed fusion (Wegrzyn et al., 2012).

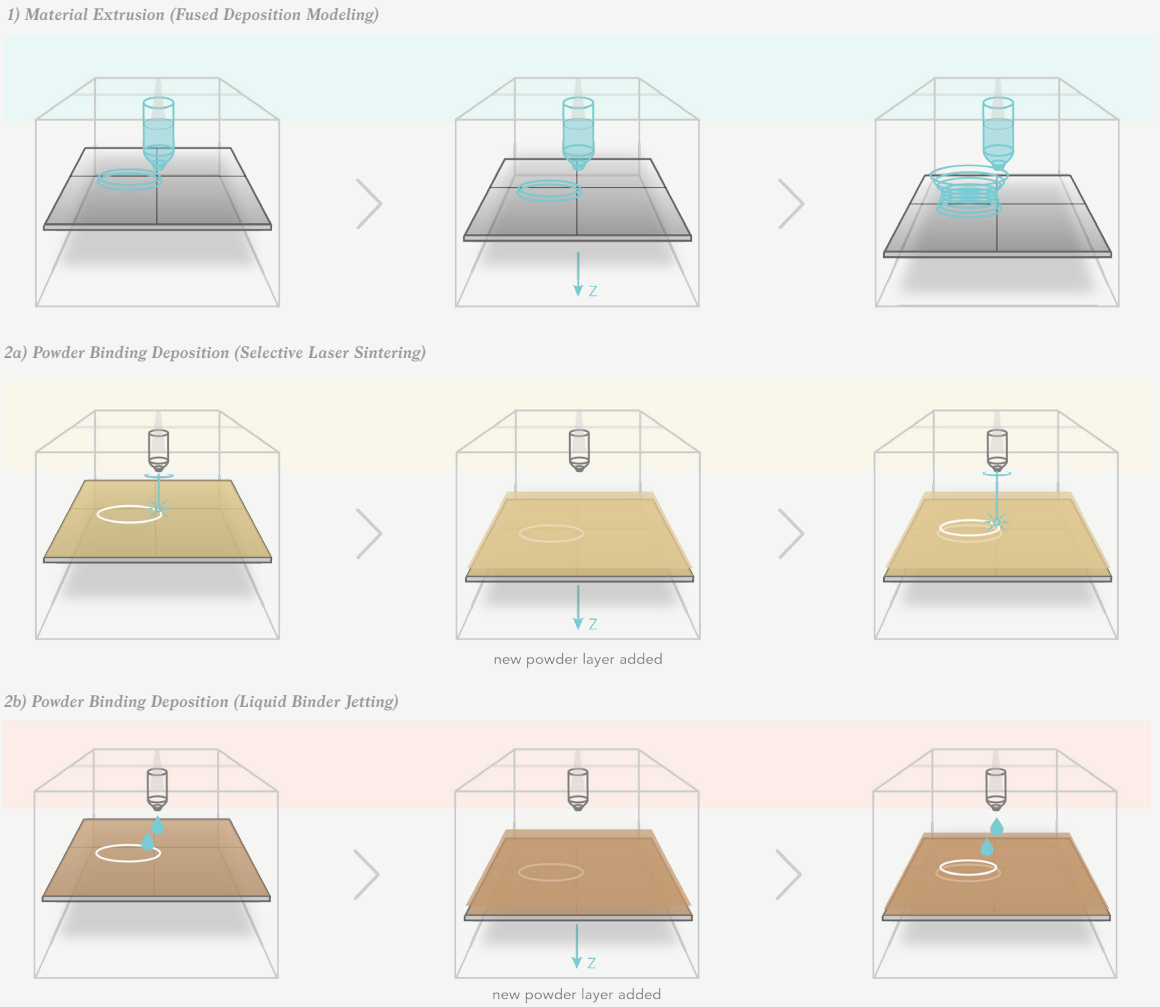


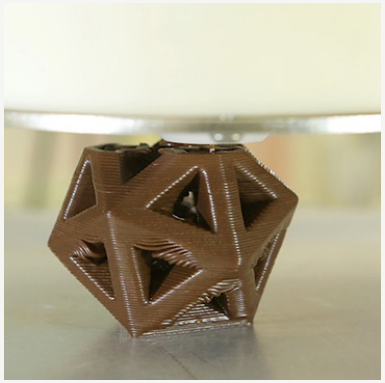
figure. 2.1.3 Three main food printing methods

Extruded pasta by Barilla & TNO

Selective Laser Sintering by TNO

Liquid Binder Jetting by 3D Systems

Hot Air Sintering by CandyFab 6000



Extruded chocolate by 3D Systems

figure. 2.1.4 Examples of various 3D printed edibles

Capabilities

1) Material Extrusion

With the deformation and flow properties being the primary requirement, FDM can celebrate virtually any kind of ingredient that can be pureed. However, the process of puréeing food breaks the macrostructure of the material, changing the texture and taste. (Lipton et al, 2010) Adding bonding elements (such as transglutaminase or agar), the 'purees' can form a new protein structure over time, whilst still being suitable for extrusion. With no phase change in the bonding process, the print results in a similar (if not identical) puree texture (with the exception of chocolate).

Powder Binding Deposition

The powder bed methods results in a brittle yet strong structure that allows complex shapes. Sintering methods primarily use sugars due to its fusing characteristics. Kjeld van Bommel at TNO experimented with cookies composed out of flour, sugar and fat. In addition, the experiment showed that alternative yet protein-rich ingredients such as milled freeze-dried mealworms can also be used. So far, liquid binding has only been applied to sugars. However, this method allows the most freedom in both structure complexity and coloring (by adding edible coloring ink to the binder).

In the end, all methods produce a texture that is uniform throughout the entire print. Along with appearance, taste (including mouthfeel) is likely to be an important key for the success of future foods and, at the same time, one of the biggest challenges. (Sher, 2015)

Form complexity vs Nutritional Value

Concluding from these examples, there seems to be a correlation between nutritional value and design freedom. Whereas FDM-based edibles allow fresh ingredients, their rheological properties limits them from complex structures. The polar opposite is liquid binder jetting, where the design freedom is virtually endless but the ingredient is so far limited to sugar. The option in between is sintering that, although using sugars and fats to fuse the structure, allows powders of nutritional value.

2.2

Meaning Deconstruction

This chapter covers:
1) Creation Process
2)
3)

The Creation Process

Conventional and food 3D printers are merely a tool to attain the final product, the printed object. This chapter researches the current meaning of 3D printers through semi-structured interviews with three professionals. *(Appendix B)* Since 3D food printers have not yet been released on the market, it will be compared with existing consumer 3D printers.

Whether it's a 3D printer for home or professional use, the workflow is in its essence identical as all three interviewees shared the same process steps. The generic 3D printing process follows a linear model consisting out of eight steps: (1) 3D CAD model, (2).STL conversion, (3).STL manipulation/file transfer, (4) machine setup, (5) build, (6) removal, (7) post-processing and (8) application. (Gibson, 2010)

The Iterative Design Cycle

However, the aforementioned steps only describe the first half of an iterative design cycle that characterizes the design process. This process seeks the optimal form of the print to achieve the highest outcome (visual, performance, etc). It covers the entire process, from idea to the final product (often a functional prototype). The cycle is described by the interviewees as:

A. Preliminary Modeling (2D) (Optional)
The idea is sketched on any 2D medium, such as paper or a tablet, for a better understanding of the geometry. Interviewees indicate that this step is regularly omitted if the idea is relatively simple.

B. Preliminary Modeling (3D) (Optional)
The idea is made into a 3D physical shape using materials such as foam, wood or clay. This step is frequently skipped due to its time consuming nature.

C. 3D CAD Model (DESIGN)(Start of cycle)
Defining the geometry of the model using 3D CAD software.

D. Printing (BUILD)
The actual construction of the part(s)

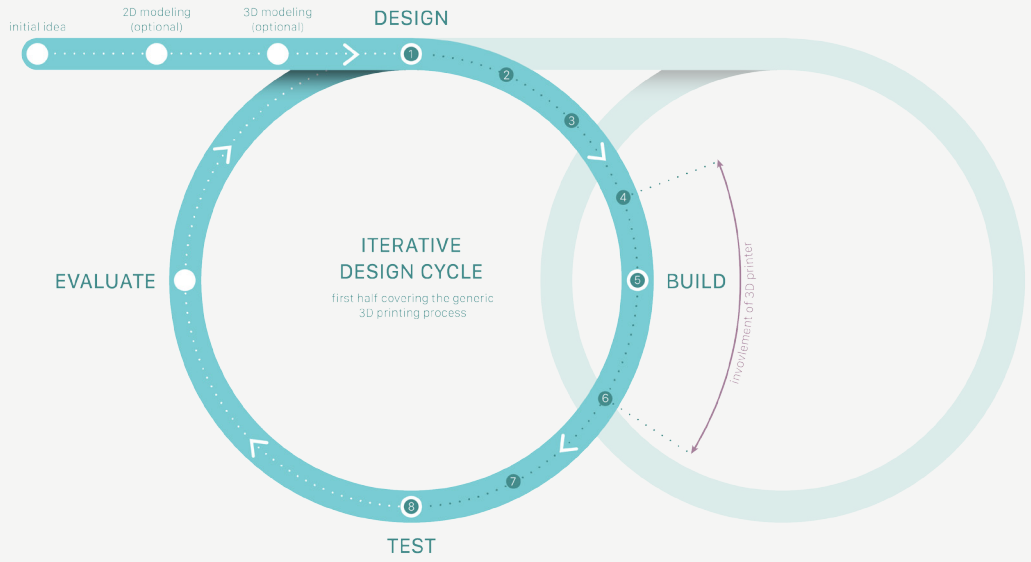
E. Testing (TEST)
The part is tested for its end purpose. This can range from a visual test (to see the quality of the print) to a performance test (to validate its behavior under certain conditions).

F. Evaluation (EVALUATE)
Evaluating the insights of the test will result in either design recommendations (adjustments in the CAD model or printer settings) or, if the outcome reached a desired state, completion of the design process.

G. Iteration (DESIGN)
Implementing the design recommendations from the evaluation step and restarting the cycle.

Figure 2.2.1 shows that the 3D printer is only one step (although vital) in a complex process of turning an idea into a tangible object. Other steps require access to and knowledge of 3D CAD software, conversion and slicing software, construction expertise and even workshop experience for post-processing. Moreover, 3D printing is merely one of the various methods for reaching the outcome of a designed tangible object.

figure. 2.2.1 Diagram of the iterative design cycle

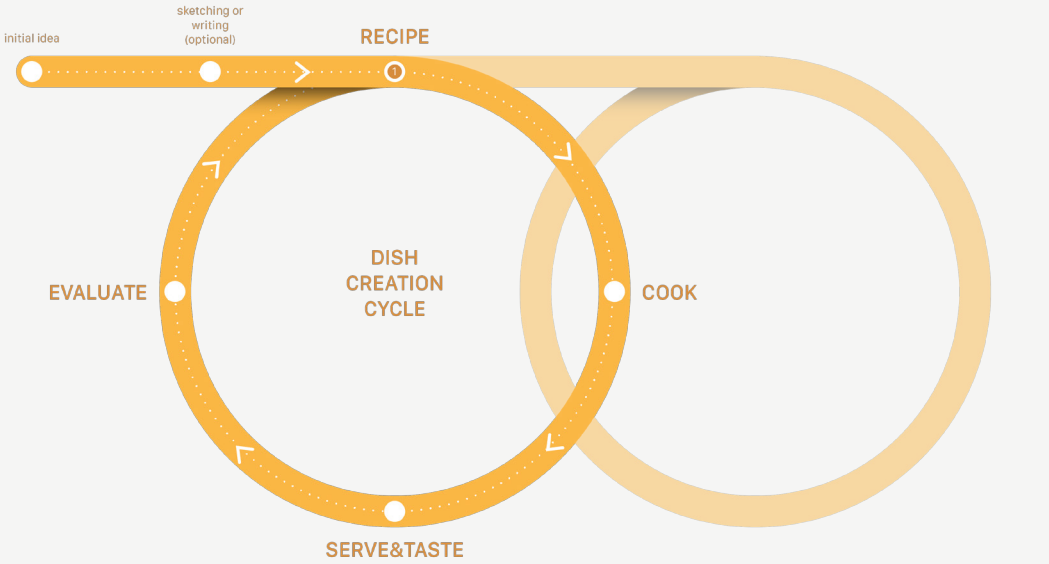


Creation Process

The creation of a dish is similar to the before-mentioned creation process (Chapter 2.2). Following the same steps in the iteration cycle, it seeks the perfect combination of components and characteristics. The instructions for the dish is written in a recipe which is done either starting from scratch or picking up the iteration cycle and reinventing an existing recipe. Considering a meal being built out of multiple dishes, a cooking process involving a 3D food printer will be either a hybrid process or exclusively unsupervised printing. Similarly for recipes, these will consist of traditional instructions as well as digital models and g-codes.

Similar to conventional 3D printing, a part of the process gets automated which opens up time for different tasks and also evokes more experimentation due to the shortened iteration cycle.

figure. 2.3.1 A diagram of the creation cycle of a recipe



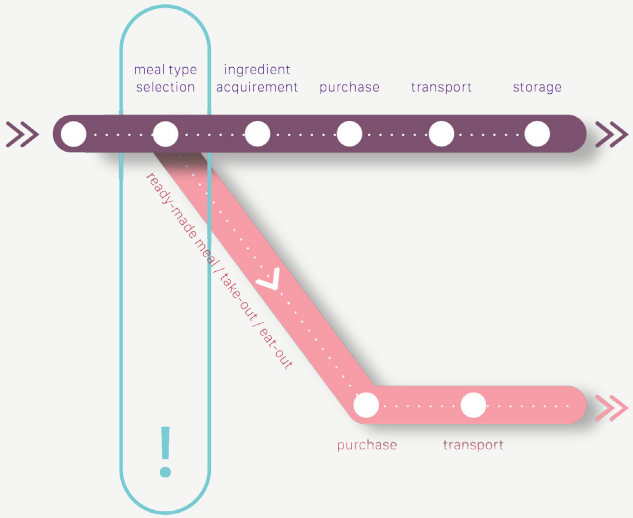


figure. 2.3.2 Preparing out of kitchen and outsourcing user flow

Replication Process (Recipe-based Cooking): Preparation, Cooking and Consuming

The generic cooking process *(complete overview in Appendix C.2)* is a customer journey that shows the meal preparation process after the recipe has been established by the chef (creator of the recipe and following the iterative creation process). The diagram is focused on the tasks of the users and thus focuses on two roles: the cook (preparing and making the food) and the consumer (person that eats the food). Having in mind that these roles can be fulfilled by the same person (such as the cook preparing the meal and also consuming it). Various steps in various situations may be not applicable due to outsourcing or being redundant.

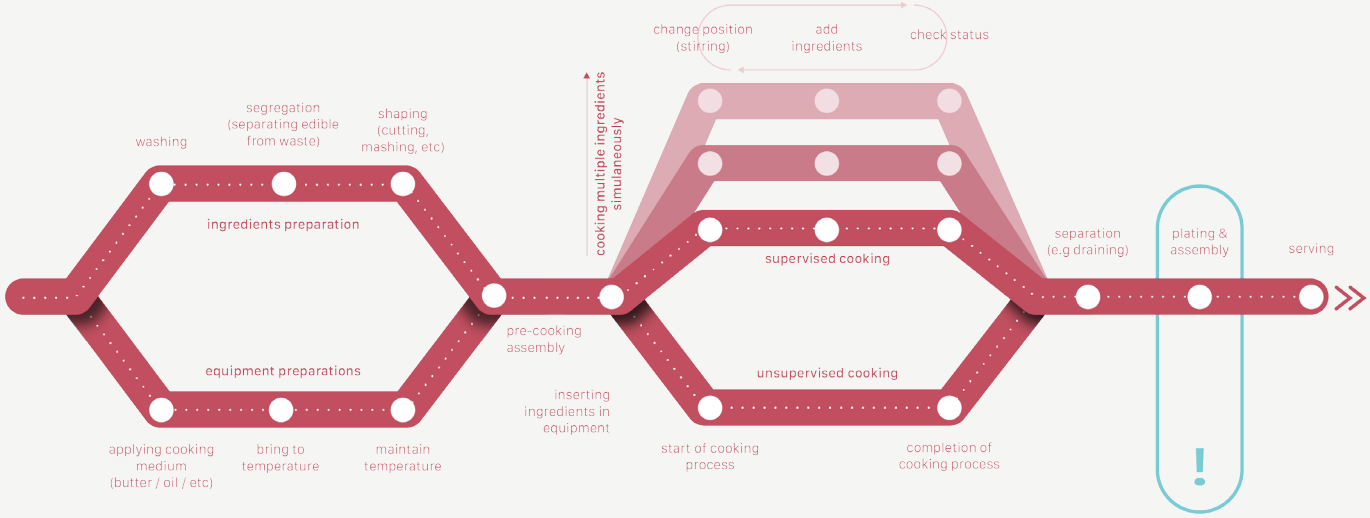


figure. 2.3.3 Preparing in-kitchen user flow

preparing out-of-kitchen and outsourcing

These steps (figure 2.3.2) involve the initiator of the whole process and deciding on the type of meal. As prices of ingredients rose, families with two breadwinners increasingly opted to buy prepared food rather than cook at home. "Higher food prices had a bigger impact than wage growth in 2016, so [consumers] became more budget-minded", says Junichi Makino of SMBC Nikko Securities (Nikkei Asian Review, 2017) When this happens the entire inside-kitchen process will be bypassed. Other factors could be the origin and distrust in ingredients as a result of the Fukushima radiation. Gaining insights on the drivers behind this behavior is important since it will give guidelines on the role and place of the 3D food printer. Furthermore, the printer can even have the role of evoking home-cooked meals. Further chapters will examine the behavior on decision making on meals, the reasons explaining it and to what extend the 3D food printer can have a part in this decision.

preparing in-kitchen

These steps involve the actual cooking steps, ranging from washing and cutting ingredients to cooking them in a pan / oven to plating the ingredients and serving them. The steps are then divided in supervised (actively being done by the cook e.g. baking in a pan) and unsupervised actions (initiated by the cook e.g. the rice cooker), which can be down simultaneously.

Over the past years, the art of plating has been trending in the form of the hastag #foodporn, with roughly 62.000 uploads a day. (Perasso, 2016) These photos range from restaurant to home-cooked dishes and social media platforms such as Instagram make sharing extremely accessible and desirable for consumers. The trend can also be explained using the meal-preparation diagram. Plating is the final step before serving, the process step closest to the consumer. It is about assembling finished components and does not involve any actual cooking skills. It is a form of instant gratification that requires no cooking skills and yet gives fast and satisfying

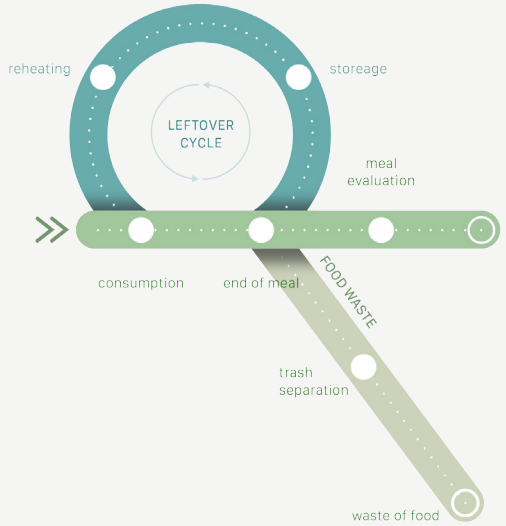


figure. 2.3.4 Consumption at dinner table

(if not stunning) results. With the abundance of amateur art plating being shared online, instagrammer Chef Jacques La Merde mocks the phenomenon by assembling fast food and supermarket products into haute cuisine compositions. (McCormick, 2015)

And with 3D food printing winning its fame for unique sculptures and shapes, this trend in plate aesthetics is in line with the key qualities of geometry freedom and manipulation. The question is whether 3D printing can offer the same amount of accessibility and instant gratification.

consumption at the dinner table

The last part of the process involves the actual consuming and evaluating whether the meal was pleasing and open for repetition. It also determines whether the meal is being stored for later consumption or being thrown away. The experience of the printed food is determined by various key qualities such as the novelty of the technology (made by machine, not man) which can be received as both good and bad, depending on the cultural context of the consumer. Especially in the case of consumers that perceive the printer as a blackbox, not knowing what goes in or happens with the food could result in negative associations of unhealthy processed foods.

The key qualities that determine the sensorial experience (aside from the visual aesthetics) are the capabilities in layer-composition complexity and texture defining. Although subconsciously, texture plays a very essential role in determining people's feelings about foods. Texture awareness is increased when expectations are violated, associations are made with non-food items, or unpleasant mouth sensations are experienced. (Szczesniak, 1971) With the printed food sculptures blurring the line between food and non-food, it is expected that the awareness will increase and could be at stake due to its uniformness. Szczesniak also states that textural qualities are often linked with whole-someness and excellence of food preparation. A lack in texture could then again accentuate the opposite.

Continuing on the need for texture, Malcolm Bourne, a food industry consultant, states in his book 'Food Texture and Viscosity' that the three most relished texture notes are crispy, creamy and chewy. "*We have a deeply ingrained need to chew*", writes Bourne in his book. "*...we'll throw cash and inconvenience at fixing our teeth so we may continue to chew, even though we could just as well get our nutrition from soft or pureed foods.*" (Bourne, 2002) And although pureed foods can offer solution for elderly coping with chewing and swallowing problems (Sun et al., 2015), the need for texture and chewing remains for the rest of the consumers.

Furthermore, texture is also essential in identifying food. When researchers pureed and strained foods, young adults of normal weight were only able to identify 40.7% of them. (Shiffman et al., 1978) Implying that texture functions as a medium for identity of food. On the other hand, this characteristic can also be used to innovate on food experience. Japanese 'foodhacker' Akihiko Iyoda experiments with a neutral-flavored agar jelly to give it an artificial taste using self-made food perfumes. His experiments successfully transferred the tastes such as cheese and curryonto the jelly, creating innovative methods of combining unrelated textures and flavors. (VICE media, 2016)

Other key qualities that are inherently related to this part of the process are the capabilities quantifying food and reducing waste. Quantifying food makes a portion comprehensible in numbers and allows alteration per individual when the portion was over- or undersized. Continuously offering a personalized portion size, this key quality could reduce food waste if the necessary feedback is processed appropriately. In addition, the printer also builds the food structure additively, using only the material it needs. This once again, saves material from food waste.

Role of 3D food printer (functionality and capability) and potential integration

> **"So it's really more of an assembly device; from the assembly of ravioli, a pizza dough base, or the bread and from there you'll have to finish off the food whether it's baking or frying."**

...says Lynette Kucsma, co-founder @ Natural Machines (Foodini 3D food printer) in an interview with weblog Inhabitat. (Lee, 2015)

Placing the functionality in the preparation process would cover the 'shaping' and 'pre-cooking assembly'. Since the ingredients need to be processed before being suitable for printing (e.g. pureeing for FDM printing), an extra step of

'shaping' needs to take place. These shaping steps do not require the supervision of a cook and has the same level of autonomy as a rice cooker during the cooking process. Adding the fact that a food printer is digital by nature and able to execute the operation planned ahead at any given time of the day, gives the technology a great potential in autonomy. However, this potential depends on the desired batch size. The prints currently need to be removed by human action, making it impossible to print more than what fits on the operating area autonomously (which would be acceptable for 1 or 2 users). A batch size that requires constant refreshing on the operating area will require an additional transportation system similar to a production line.

"You already have the food, it's not producing the food. It's just making it nice for you."

However, the interviewees of the "meaning of consumer 3D printers" interview (Appendix B) indicated that the shaping of the ingredients have no significant benefit other than enhancing the aesthetics.

"With 3D printing, you have plastic (for example) and you can build something that you can use for something else. For printing food, you just print something to eat it and then it's gone. "

And finally, one of the interviewees indicated that since food is eaten and deconstructed within the body, it does not require a certain shape. Although this argument can be countered with enhancing the experience of food, the costs and added effort put in the process will most likely outweigh the enhancement in food experience in the case of a consumer food printer at home.

"If you're talking about a cooking machine, perhaps that would be different. It's not even food processing I would say, it's more food drawing."

"It doesn't cook anything right? I think it should either cook or heat up. You can also drink lukewarm water with a teabag in it — but we don't do that for a reason."

All interviewees agreed that the integration of a cooking (or heating) functionality would prove to be a meaningful addition to the shaping functionality. As opposed to conventional 3D printers that provided a shortcut in the workflow for these interviewed makers, the food printers with their current functionality do not propose an equal level of benefit in the cooking process.

Although the printer can be involved in the entire process, from type-of-meal decision making, to meal preparation and assembling, to controlling consumption. The currently functionality only limits to the meal preparation where interviewees indicate its lack of cooking ability. The missing cooking functionality is also directly responsible for controlling textures of the ingredients.

2.3

Clustering key qualities

After deconstructing the technology and meaning, 26 key qualities in total have been identified that characterize 3D food printing (Appendix C.3)

Clustering the key qualities will give a domains that act as the building blocks of 3D food printing and can be related to the context in a broader sense. Each domain will then investigate how contextual states and developments will affect and define the implementation of 3D food printing in the urban Japanese context.

- Unsupervised Operation/Autonomy
- Made by Robot, not human
- Involvement in the entire process

What is the relationship between robot and human in the Japanese urban context?

Investigating the relationship between technology and people will give an understanding of how the printed food will perceived. Simultaneously researching whether technology (and food produced by technology) will see a shift in meaning. This component will give insight on the relationship between user and 3D printer; transactional vs emotional, distant vs intimate. In other words, the large part of the user interaction will depend on this domain.

- Quantified Food
- Form complexity vs Nutritional value

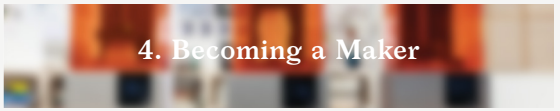
What is the state of the health and how is this developing?

With the ability to give transparency into food intake, it is crucial to identify which issues can be tackled with this. Another point of attention is to investigate which additional technology is required to make the food intake as transparent and controllable as possible. This information will give insights on the different target groups, the desired data needed to be measured and the requirements of a bigger system to make this data meaningful.

- Access to computation power
- Evokes experimentation
- 24/7 Working hour
- Geometry Freedom and Manipulation
- Complexity in Composition (layered)

How is creativity and Experience being exploited in the food industry using cutting edge technology?

As Japan is known for its unique experiences often using technology. This domain is about answering the question how leveraging the nature of digital food (freedom in geometry and computational power) can enhance the creativity and experience of cooking and eating.



- Accessibility to software
- (Steep) Learning Curve
- Shift in Skill Set

How low is the bar (and will be) set to be involved in 3D food printing?

The success of 3D food printers is dependent on factors such as the accessibility of resources, both physical (how easy can you get into contact with a printer) and digital (is there user-friendly and free software available?). Another factor is, assuming that the user will have time/money to invest, the effort/result-ratio whereas the application will fail if the effort put in the act will be higher than the given result. Research in this domain will give insight for the role of the user within the printing process, the use flow and how the application can be designed for different levels of users.

- 1:1 Replication
- Zero Cooking Skill

- Instant Sharing
- Connectivity / IoT
- Increasing complexity, steady labor
- Requires post-processing

How do people (wish to) acquire food?

Having drink automats at every corner of the street, convenience stores open 24/7 and an enormous offering of restaurants, the ease of acquiring food is extremely high. Introducing a novel application that produces food in such an environment will have a high level of competition. It is therefore important to investigate how people acquire food and how this is developing. This will give insights on which key qualities of 3D food printing to leverage to create value.

6. Quality and Value (Craftsmanship)

- One Uniform Texture
- Texture - improvement and innovation
- Made by Robot, not human

What is considered as "good food"?

The quality of food is in Japan heavily associated with the craftsmanship, meaning the way the ingredients are treated and their origin. 3D food printing makes use of pre-processed material (often associated with processed foods including additives) and involving little human craftsmanship. As the technology is still in its early stages, the set of functionalities is yet to be completed. This domain will investigate what is needed to add value to the printed food.

*As some domains overlap, the last two domains "The Physical Space" and " Food and Environment" will be merged spread over other domains.

7. The Physical Space

- Mobility (free from kitchen)
- Physical Required Volume
- Isolated operating area

How will the spatial factors of the environment affect 3d food printing?

As Japanese urban environments such as Tokyo are infamous for their population density and scarcity in space, the volume of the 3D printer is immensely important. Researching the spatial factors will give insights on the capacity as well as the placement of the product, whether at home (kitchen, living room, bedroom) or in a public space (share living space/ convenience store). Consequently, this will decide if ownership over the device would be desired or preferred.

8. Food and Environment

- Waste Reduction
- Alternative Ingredients

What is happening with conventional ingredients that would make alternative ingredients meaningful?

With the threat of resource depletion and the impact of livestock on the environment, it is evident that the current model of the food industry is taking its toll. It is important to investigate how global and local factors are affecting the Japanese society. As 3D printing is capable of processing alternative ingredients (such as insects) in an appealing way, this research will give insights on where to leverage this key quality to create value.

chapter 3 | Cultural Context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3.1

Cultural Dimensions

This chapter covers:
1) Hofstede's Cultural Dimensions
2) shifts in gender roles
3) Single households
4) Rise of elderly, decline in children

Hofstede's Cultural Dimensions

Culture has been defined in many ways; Geert Hofstede, a Dutch social psychologist, defines culture as:

> **"Culture is the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede, 2011)**

To characterize a specific culture the model of Hofstede proposes six cultural dimensions. Each cultural dimensions represent independent preferences for one state of affairs over another that distinguish countries (rather than individuals) from each other. This framework is used to explain the shifting values found in trends and developments as well as to support insights on future outcomes that will be crucial for the product design. The following six dimensions are explained in *Appendix E* along with Japan's score found by Hofstede's research conducted between 1967 and 1973. (Hofstede, 2011)

Stability over time

Although the dimension scores give a good indication on the cultural dynamics, the scores have been measured in the period of 1967 to 1973. Having over 44 years between now and the conducted researches, are the scores on Hofstede's dimensions stable over time?

As countries develop economically, modernization theory predicts shifting societal values, affecting country's scores on Hofstede's culture dimensions. Research have examined how Hofstede's dimensions have developed over time by replicating Hofstede's dimensions for two generational cohorts using data from the World Values Survey. Results show that, on average, societies score higher on Individualism and Indulgence, and lower on Power Distance. (Beugelsdijk, Maseland & Hoorn, 2015)

What happens is that dominant traditional beliefs of uncertainty avoidance are conflicting with new beliefs of higher individualism and lower power distance brought by economic growth and advancements in technology.

Shifts in gender roles

Research conducted by the National Institute of Population and Social Security Research showed that 30% of the 2,706 men sampled and 26% of the 2,570 females between 18 and 34 years said they were not currently looking for a relationship. (Aoki, 2016) Similarly, marriage rates are declining as men and women are marrying later, or sometimes not at all. (The Economist, 2016)

Women are better educated, pursue careers, can support themselves financially, these factors concur with the rise in individualism. The traditional view on relationships is to result in a marriage. And couples are expected to have children shortly after getting married. With these strong traditional beliefs (explained by a high uncertainty avoidance), women rather put off marriage, especially since it is hard for a Japanese woman to juggle a full-time career with children. Not only women, but also men are discouraged to marry as economics is a big part of the problem. Carrying the responsibility to support the wife and children, men will have to compensate on their own interests and hobby's.

Single households

Household count rose to a record 53.44 million, with one-person households making up 34.6% of the total. The biggest concentration of such households was in ages 25-29 for men, and ages 80-84 for women. One in six seniors 65 years and older live alone in Japan. (Nikkei Asia Review, 2016)

And whereas the kitchen remains gendered, this role will have to find its replacement in the form of either more simplified and time-saving cooking or another party/person. Either way, eating alone suggest a rising need in personalization and individualization of products as well as the limitations in space.

Less Children, More Elderly

Japan's rapidly aging population reached another high last year, as the amount of seniors aged 75+ surpassed that of children for the first time. Seniors aged 75 and up totaled 16.12 million, early one-eighth of the population. Children aged 14 or younger numbered 15.88 million. (Nikkei Asia Review, 2016b) The number of children a Japanese woman can expect to have in her lifetime is now 1.42, down from 2.13 in 1970. (The economist, 2016) The aging population coupled with low birthrates predicts Japan's population to drop to 127.11 million (2017) to 88.08 million in 2065. (Nikkei Asia Review, 2017) And with the high percentage of elderly living alone, there are serious questions about whether today's twenty- or thirty-somethings will be able to care for their elders. Rural economies in particular have cratered as young people cluster in big cities. (Oi, 2015) The elderly population will create a enormous need in both personalized or supplemented nutrition and physical help in meal preparation. Due to the shortage of caretakers, the solution will most likely lie in robotics and automation.

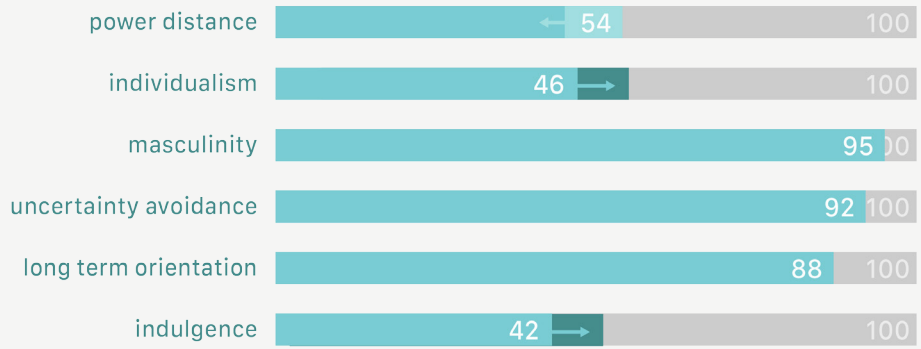
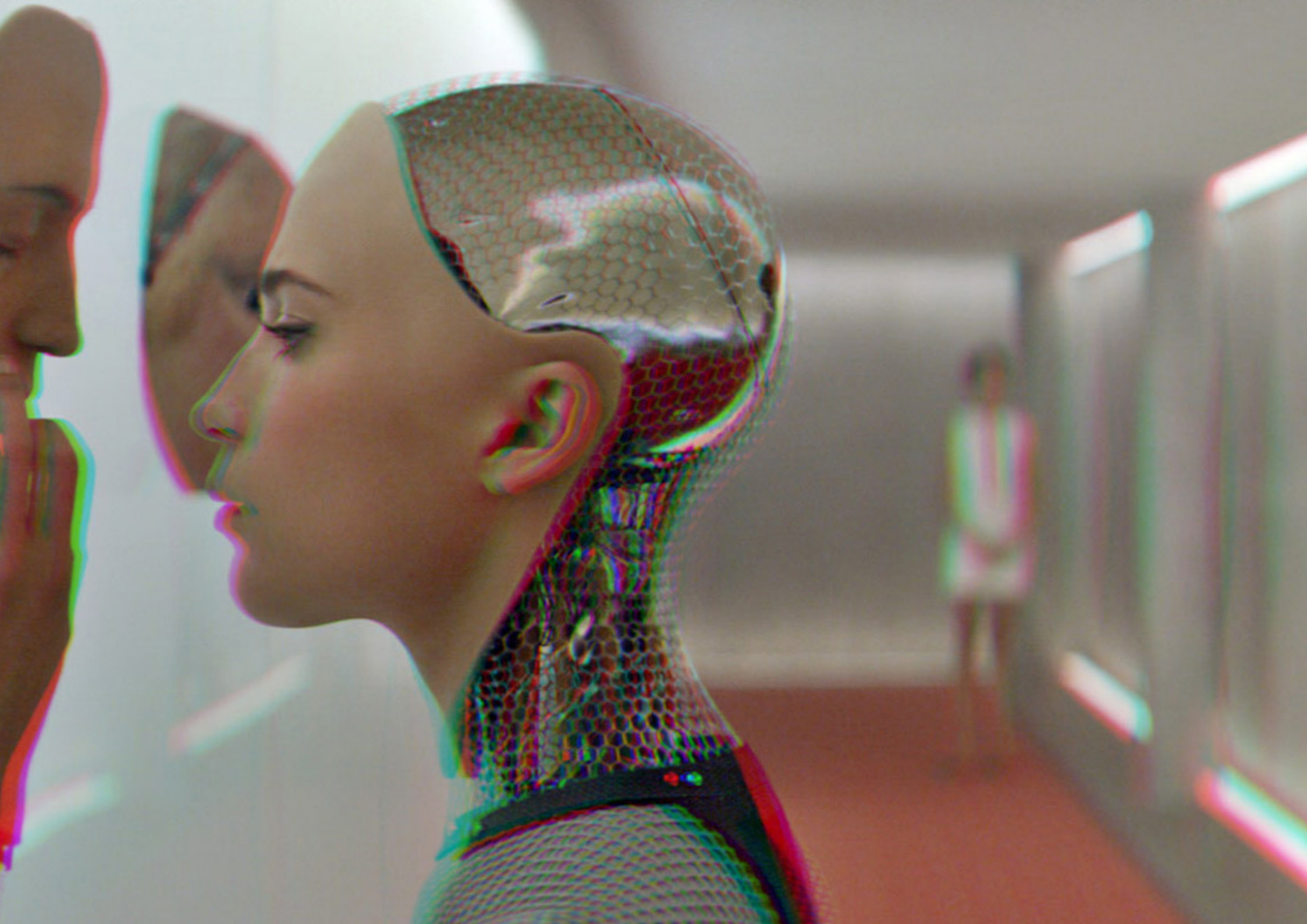


figure. 3.1.1 Hofstede's Cultural dimensions with Japan's score



3.2

Techno Intimacy

This chapter covers:
1) Intimacy Replacement
2) Virtual Idols and Girlfriends
3) Animism and Modern Circumstances

What is the relationship between robot and human in the Japanese urban context?

Answering this question will be able to determine the following key aspects of the vision and new design:

- *The value of inanimate objects and its products*

This could define the value of the product (and what it produces) as craftsmanship is linked to human abilities.

- *Ownership and Interaction*

This could define ownership and dependency on the application. Formal and transactional or emotional and experience

Intimacy Replacement

With falling marriage rates and rising preference for a single life, the intimacy gap between men and women is growing slowly but surely. Masahiro Yamada, a sociologist at Chuo University, reckons that if people aren't marrying and aren't dating, they must be doing something to satisfy their need for intimacy. And whereas a high score on uncertainty avoidance tends to create beliefs and institutions that try to avoid these uncertainties (Hofstede, 2001), both sexes have their own method. For the male part, the uncertainty in intimacy is being avoided using technology.

"As machines become embedded ever more deeply into life and even flesh, the line between human and nonhuman increasingly blurs. So does that between material reality and the image making we rely upon to see, know, and interact with our world(s)." (Allison, 2000)

Virtual Idols and Girlfriends

Most likely no other place acts as the technological utopia/dystopia as Japan, and perhaps no persona resonates as much to this environment as the "otaku." Japanese otaku are described as "children of media and technology" (Grassmuck, 1990), "socially inept but often brilliant technological shut-ins" (Greenfeld, 1993). In their world, "Technology is your companion. Technology is your friend. Ultimately, technology becomes your reality" (Greenfeld, 1994).

Virtual humans have taken the form of an idol and a romantic companion. In both cases, fictional animated characters are brought to life in the smartphones, gaming consoles or even during a live concerts and interact with the fans individually. One of Japan's biggest gaming phenomenons called Love Plus — available on the Nintendo portable consoles and the iPhone — lets users interact with their virtual partner through a pre-written script. The virtual personas — Rinko, Manaka or Nene

figure. 3.2.1 AR Performers, a virtual group, perform their first live show in Tokyo on Jan. 15.

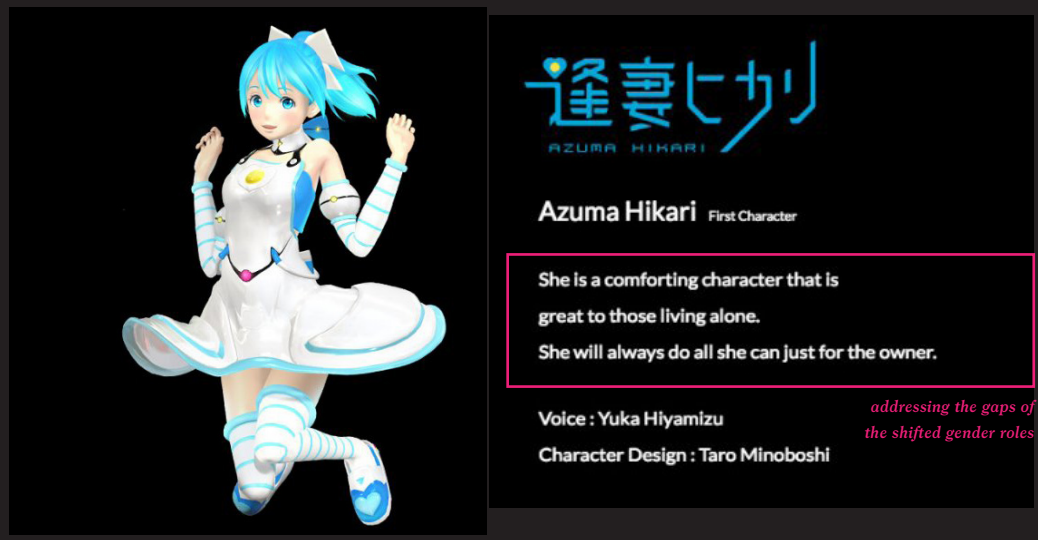


figure. 3.2.2 Azuma Hikari | the persona residing in Gatebox

— offer a kind of instant emotional connection at the tap of a stylus. (Lowry, 2015). Making the jump from 2D to 3D, Gatebox is currently developing a holographic home A.I. (artificial intelligence) that interacts through text via smartphone or speech. (Gatebox, 2016) Azuma Hikari, the persona inside the Gatebox, embodies the intimacy through interaction as well as productivity functionalities resembling the virtual assistants of Google and Apple.

Animism and Modern Circumstances

Robotics and automation has been heavily implemented into the urban Japanese lifestyle as the capacity of people could not be met if there was not a streamlined automated system (e.g. in transport) and sufficient resources (e.g. drink/snack vending machines on every corner of the street).

Another point is that inanimate objects are treated with respect as if they contain souls. This belief of animism dates back from the earliest traces in Shintoism in Japan. (McFaul, 2010) Furthermore, whereas the shifts in gender roles are giving women an equal social status, these virtual personas remain to be the obedient and serving companion that meets the male counterparts' needs. Virtual companions offer an intimate form of interaction without the uncertainties and responsibilities of marriage and children.

From Western perspective, this form of intimacy is being heavily criticized and gives articles titles such as "The Creepy Virtual Assistant That Embodies Japan's Biggest Problems" (Morris, 2016) and "Sadder Than HER, Creepier than Black Mirror: Gatebox's AI Assistant" (Atomicrowd, 2016) One of the reasons is the level of intimacy, as humans should only 'love' one another, whereas the historical background of Japan has laid sufficient foundation to love inanimates. Another reason behind the criticism is most likely due to the A.I.'s manifestation in the form of an 'anime' character, which is usually associated with children and cartoons. Although similar intimacy was presented in the movie "Her", a film about a man falling in love with his A.I. assistant, the manifestation was reduced to exclusively her voice; leaving the physical form suggestive and to the imagination of the user.

figure. 3.2.3 Reactions from American bloggers on the annoucement of Gatebox

The spectrum of our relationship with technology is growing; having human enhancement on one side and the replacement of human on the opposite. Up until now, it was only a dimension of productivity. Both in human enhancement (e.g. access to information/databases, virtual assistants, etc) as well as human replacement (e.g. automation replacing jobs). But with the cultural background of Japan and the developments in A.I. technology, a new dimension in intimacy is appearing where the replacement of humans is evident in the form of virtual companions.

How does this relate back to food and 3D printing?

Even in Japan, experts say there could be a psychological barrier to bringing robots into restaurants and hotels, where personal interaction and hospitality are valued. (Inagaki, 2017) With the before mentioned developments, food will most likely not loose its value due to the acceptance of robotics. On a higher level of intimacy where food is being prepared by a partner/parent as an act of love, this interaction can be replicated by having an A.I. controlling the 3D printer or letting the user help out as if 'cooking together'. A lowered level of intimacy could still take form as a friendly companion — targeting elderly living alone or children. With intimacy being high, it is more likely to target the product towards the home environment (rather than accessibility in restaurants/stores) and therefor satisfying the user's ownership over the device.

3.3

Diet & Health

This chapter covers:
1) the Japanese diet
2) Social Pressure
3) Quantified Food

How is the health of Japanese people changing?

Answering this question will be able to determine the following key aspects of the vision and new design:

- **The value of quantifying food**

Quantifying food gives transparency on nutrient and calorie intake. Analyzing the health needs will determine the emphasis on food data and which external products are needed to make this data useful.

The Japanese Diet

和食 (washoku). Literally, “wa” / “和” stands for peace or harmony and “shoku” / “食” means to eat or meal. In literal translation, it means a “harmonious meal”. It daily language washoku just means (traditional) Japanese food. Commonly served as a 定食 teishoku — a meal set — which consists of a main dish (e.g. grilled fish) accompanied with other dishes (rise, miso soup, pickled vegetables and side vegetables) in a variety of cooking methods and flavors. This way the humble portions make up a well-balanced and satisfying meal, contributing to the health. But the future of Japanese food is uncertain. Although not new, the daily diet shifted towards Western style,

figure. 3.3.1 Typical 'teishoku' meal consiting out of various dishes

"...it is "normal" to be thin in Japan, and failing to fit in to the stereotype can lead to a lack of acceptance from friends and wider society." (Marsh, 2016)

where breakfast is the most Westernized (bread-ified) meal of the day on average. (Hopson, 2017) (Appendix D.4). washoku is more difficult and time-consuming to prepare than western-style dishes, which spread via simplified cooking methods. Research on the Japanese family life over a timespan of 17 years shows clear signs that washoku is appearing less frequently on the dining table. (Nobuko, 2014)

As a consequence, the health would assumed to be at stake, however statistics show the opposite. As of 2014, only about 3.6 percent of the Japanese population was classified as obese, versus rates as high as 30 percent in the U.S. and the life expectancy being the age of 86.8 as of 2014. (OECD, 2014)

This statistics are a result of other factors as well: the active lifestyle during commutes, social pressure, school lunches, work regulations and even the law. With public transport as the primary method of commuting, people are relatively more active. As parking space is scarce and expensive (even for bikes). And with average commutes of 1-1.5 hours to work, forcing people to walk more on daily base. (Sugawara, 2017) (Appendix D.3)

"...it is "normal" to be thin in Japan, and failing to fit in to the stereotype can lead to a lack of acceptance from friends and wider society." (Marsh, 2016)

Social Pressure

The other fact of social pressure that keeps people from overeating is in the fashion industry. It is regular to find clothes with size 'free', making it unable to fit in certain brands if not complying with the sizes of the body archetype. School lunches offer healthy balanced lunches for children for a low price, which are prepared and cleaned up with the help of the children themselves. This teaches them responsibility and knowledge on food. Japanese companies let their employees undergo medical screenings with medical counseling in case of overweight. This is because if companies fail to meet weight standards, they have to pay higher insurance premiums. (Yunomi, 2016)

Finally, the Metabo Law requires men and women between 40 and 74 to have to waistline below a certain standard. If not, they are forced to seek medical attention. This behavior corresponds with the collectivistic mindset (low individualism score) and the low indulgence score.

Quantified Food

The digitalization (and thus quantification) of food promises personalized diets and thus a healthier way of food intake. With their current capabilities, 3D printers are able to produce a predetermined amount of nutrients (if the required information has been established beforehand), more accurately and efficiently than the human hand. And with sports trackers and diet tracking apps already on the market, 3D food printers seem to be a valuable addition in this quest to the personalized and healthy diet life.

However, quantifying data does not necessarily achieve the goal, but rather gives transparency in the process. It is only meaningful in a feedback loop wherein data is measured and input is adjusted according to the output. If the output cannot be measured, tracking input data is meaningless.

Weight loss is a clear goal with data of burned calories (using sports trackers) and consumed calories (using databases with standardized values) as the input. Evaluating the weight loss will give insight on the input (e.g. burning more calories and/or consuming less). The more ambiguous the goal is

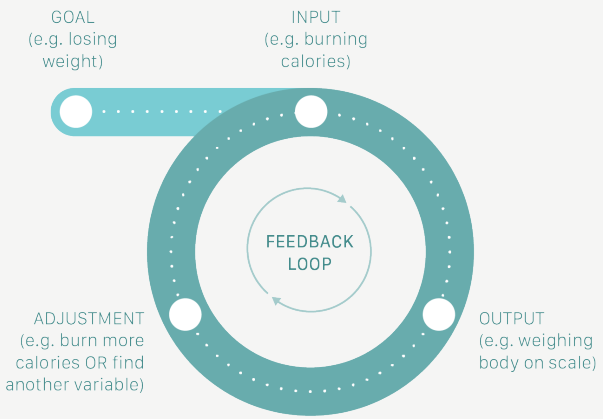


figure. 3.3.2 A feedback loop with a clear quantifiable goal and input/output streams

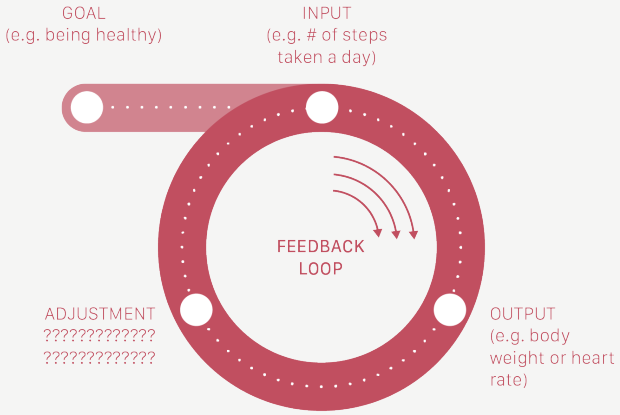


figure. 3.3.3 A feedback loop with a unclear unquantifiable goal and ambiguous input/output streams

(e.g. 'healthy' or 'fit'), the harder it is to translate this to understandable results. For professional athletes, the goal of improved performance is measured in speed, body fat, exerted force and such.

Activity trackers promise fitness and for some reason the pounds aren't falling off when we hit that 10,000-steps-a-day goal, largely because they're ignoring the much larger factor of our diet and they're just a cheap pedometer that links to our phones.
(Sullivan, 2017)

Other issues are that the goal is affected by multiple variables. For example, weight loss is not only dependent on activity but also diet. The other issue is interpreting the feedback. Without expertise, it is difficult to evaluate the output and take effective measures.

How does this relate back to food and 3D printing?
As quantified food is often associated with controlling weight, obesity is currently not posing a threat as this is being kept in check by social pressure, cultural traits and an active lifestyle. 3D food printers could relieve a part of the stress by giving the consumers more control and insight over their food intake. Going deeper into food data, the next property to measure is the amount of nutrients (proteins, vitamins, minerals). As mentioned earlier, tracking this data will only be meaningful if the goal is 1) measurable and 2) a shortage of nutrients being (one of) the key factor(s). Currently, none of the food printing initiatives possess sensors that can detect the amount of a certain nutrient. This is why the printers can only give the data indirectly (calculate predetermined data with the printed volume). The result is that the second half of the feedback loop is dependent on existing technology of third parties.

The rising elderly population poses a need for a healthy diet through a offering of sufficient nutrients. However, the goal of being 'healthy' or 'fit' is too ambiguous as this is dependent on too many variables; diet merely being one of them. If the issue of skin degeneration were to be tackled, the design can focus on the amount of vitamin D and measure the results in terms of skin flexibility or such. Again, measuring the results lies outside the 3D printer. This suggest that during this stage, 3D food printers are meaningful in environment where measuring the results are already present, such as hospitals, laboratories or training facilities.

In conclusion, If the goal is not clear and focused enough, the consumer will fail to grasp the value of quantified data.

3.4

Becoming a maker

This chapter covers:

1) "anybody can be a photographer"

2) Access to resources - the maker spaces

How low is the bar set to be involved in 3D food printing?

This chapter is about how accessible technology helps people turn into 'makers'. Answering this question will be able to determine the following key aspects of the vision and new design:

- **Supporting Software**

As the modeling software has a steep learning curve, it is needed to make this attractive to the consumer rather than letting them invest time and effort before seeing results.

"Anybody can be a photographer."

...says Jeremy Cowart, a photographer, on his website. With the advancements in technology, photography has become extremely accessible: prices of equipment go down, digital makes the mistakes forgiving, software helps in enhancing the quality and social media platforms make it effortless to share and (most importantly) receive the reward of acknowledgement. When all these requirements are satisfied, turning an exclusive hobby into an accessible and popular activity.

figure. 3.4.1 ingredients for success

[low material / economical investment]
+
[a forgiving environment]
+
[quick high results]
+
[ease of sharing]
+
[reward]
=
[success recipe for popular hobby that was only available for a very small group]

Access to resources — The Maker-spaces

The first requirement for getting involved with the activity is the ownership or accessibility to the equipment. Maker culture sites, fab labs and hackerspaces have been springing up all over Tokyo in recent years, offering designers (both established pro's and aspiring amateurs) the chance to share ideas and skills, either through organized workshops or by working in the same physical space. (Japan Trends, 2016) Located in the heart of the shopping district Shibuya, FabCafe Tokyo combines the concept of a makerspace, supported by experts, with a casual and hip cafe and organize events related to the maker community. Whereas traditional makerspaces are visited for the sole purpose of thinkering, Fabcafe is accessible to people who do not originally have intentions for making things, thus reaching a bigger audience.

Furthermore, the level of forgiveness will determine how motivated the user will have to be. As discussed in chapter (Deconstruction in meaning), printing a part requires several iterations before being functional and can be discouraging for a beginner. The support offered by experts at the fablabs is crucial for guiding beginners into the process.

Another obstacle and key quality is the steep learning process, mostly directed at learning the 3D modeling software. Takeo Igarashi, professor computer graphics at the University of Tokyo, designed a 3D modeling application, named Teddy (figure 3.4.2), that produces basic shapes using only quick 2D doodles.

"So in the case of using simplified 3D modeling software, the shapes are extremely basic. So in the case of cooking, I would just use hands which is faster."

(Igarashi, 2017)

(Appendix D.1)

In the case of 3D food printing, there seems to be a dilemma: simplified 3D modeling is accessible for non-designers, however, the simplicity of the shapes will most likely be too basic to be rewarding and even make the capabilities of the printer obsolete (in the case of cooking). It makes sense with plastic or metal, as this is not easily done by hand.

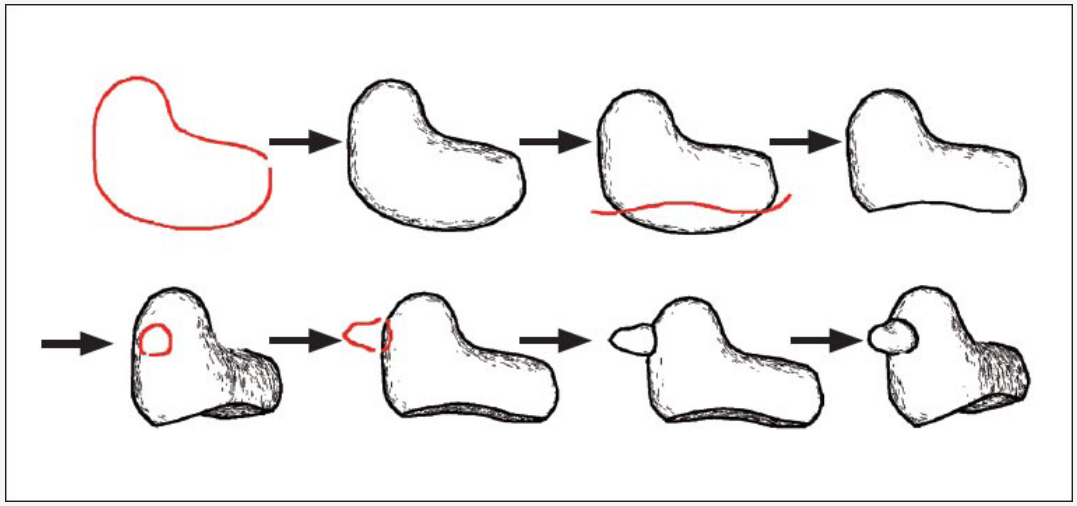
If the modeling software is too generic, the general purpose becomes difficult. (Igarashi, 2017) Instead, the software should produce very specific and complex shapes but achieve this through simple and playful user flow. This way, the effort is low whereas the results are high.

So if you specialize for a certain kind of shape, the specialized software we develop can make it easier and maybe make it worth doing because it cannot be done by hand."

(Igarashi, 2017)

(Appendix D.1)

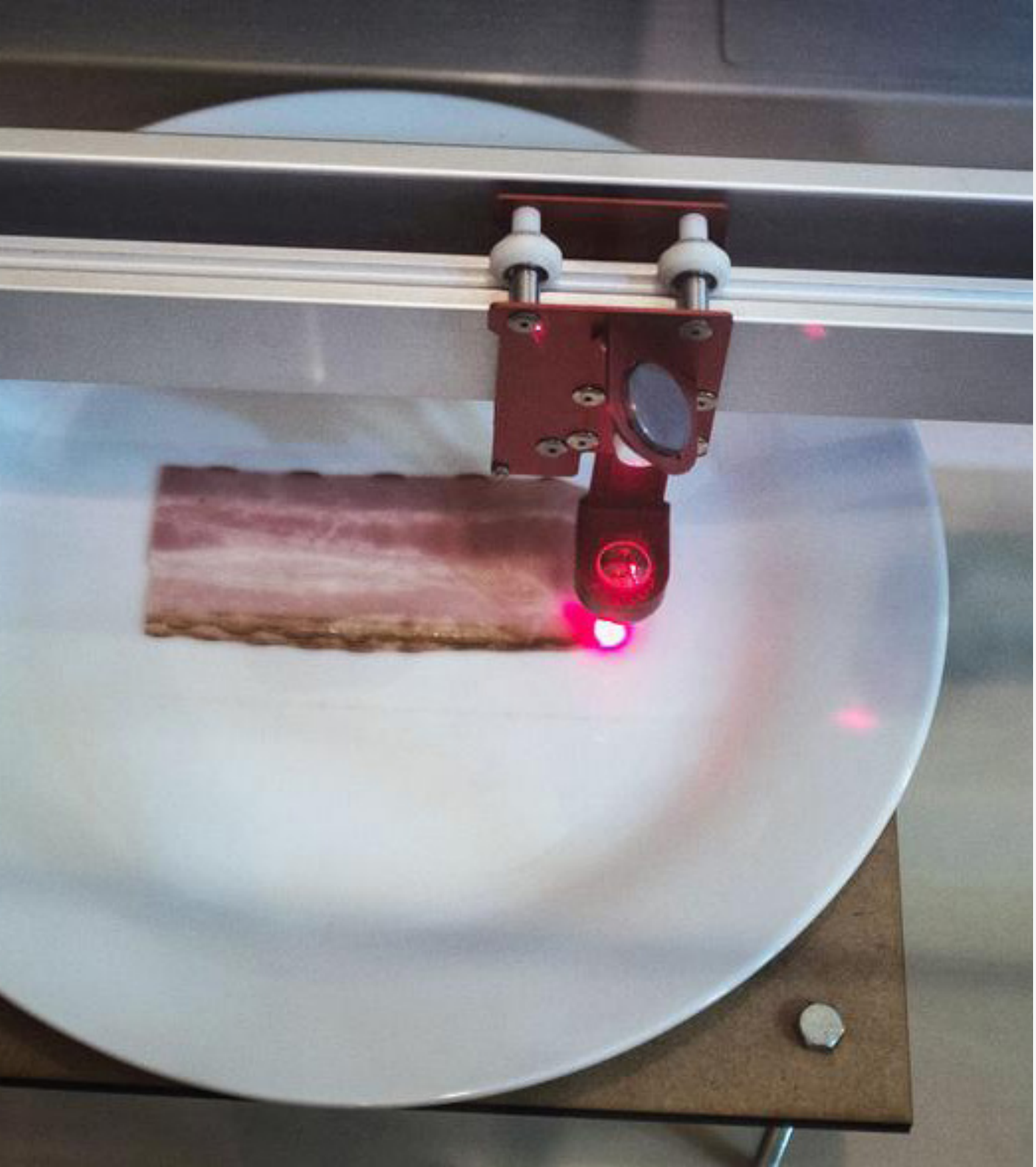
figure. 3.4.2 Userflow of the Teddy application by Igarashi (2006)



How does this relate back to food and 3D printing?

Becoming a maker is easier than ever as resources are highly accessible to consumers in the form of shared maker spaces and low-level software. Whereas too basic and easy application may require low effort, the results might not be as rewarding and vice versa. Especially since consumers are more driven through instant-gratification, the application should focus on a effective effort-reward ratio.

Another insight is that a 3D food printer should enable a geometry that would not have been possible using bare hands. And here lies the difference in printing methods, whereas powder binding offers complex geometries, extrusion of purees are very limited in that sense and could be done by hand and analog tools. The added value of a 3D printer would only be the automation of that handling. Linking back to the roles of the cooking process, puree extrusion would seem meaningful in the case of wanting to create the food but not being able to. This could result in scenarios where there is a lack of sufficient hand-eye coordination (e.g. elderly or children) or simply not having time (e.g. over working).



3.5

Creativity through technology

This chapter covers:
1) "anybody can be a photographer"
2) Access to resources - the maker spaces

How is cutting edge technology being exploited in the food industry for enhancing creativity and experience?

This domain is about answering the question how leveraging the nature of digital food (freedom in geometry and computational power) can enhance the creativity and experience of cooking and eating. Answering this question will be able to determine the following key aspects of the vision and new design:

- **Place in the cooking process**

A food printer can add value to different stages of the cooking process. It is needed to investigate to what extent each stage can be enhanced using this technology.

- **Type of experience**

Technology in the food industry is currently being used for entertainment purposes. But since technology can enhance our capabilities that we would not ordinarily have, what is the true potential?

- **Additional functionalities**

Currently, the key quality of the technology lies in the precision of the extruder or binder jet. This enhances the aesthetics of the dish. By adding more functionalities, the application will be able to enhance more than only the appearance.

Food Experience

Japan is known for its quirky or original (sometimes weird) experiences. Thus being able to offer new food experiences will most likely generation attention and revenue. The quality in food is constantly being improved by craftsmen as they are attempting to define perfection. In these cases, the archetype of sushi or tempura remain the same, wherein the quality lies in the way the food is made. Similarly in the entertainment industry, the recipe remains the same but the experience lies in the aesthetics of the food. Themed-cafe's, often derived from a pop-culture anime/manga/game, are using standard dishes (e.g. omelette-rice) and present these in playful designs containing elements of the theme. (figure 3.5.1) Other examples of boosting up the experience is conveyor belt or train delivery sushi; originally used as a way of automating the waiters. But consumers (often tourists) have been visiting these restaurants in search for the quirky experience. Finally, in the Henn-na Hotel — a hotel in Japan that is mostly staffed by robots — offers a kitchen wherein robots prepare the food. Rather than designing a robot that integrates very specific tasks, such as making ice cream or pancakes, they chose to use generic robotics (with arms and hands) to imitate the human movement. This means that the kitchen appliances and tools remain the same; but the cook is now replaced by a robot.

figure. 3.5.1 Various themed cafe food of pop-culture brands (Pompompurin, Kirby, Rilakkuman and Pokemon)

This makes the act automated but still laborious.

Foodhackers in Japan (a documentary by VICE)

Whereas themed-cafes use technology for entertainment, a community of food hackers is using technology to enhance the experience of eating. Food Hackers, a documentary produced by VICE media in 2016, follow a number of individuals (University professors/PhD students/designers) who are 'hacking' into aspects of eating rather than the food. The projects emphasize on the use of their own expertise field in the process.

> **"The question is how you leverage the computational power of a computer." (Igarashi, 2017) (Appendix D.1)**

One of the projects called Chef's Hippocampus, done by Yui Kita (Appendix D.2) is using machine learning to built relationships between ingredients using existing recipes. The application produces countless ingredient combinations that can be either logical or uncommon.

Moreover, IBM's Chef Watson is a cognitive computing application that can help people discover new ideas, from

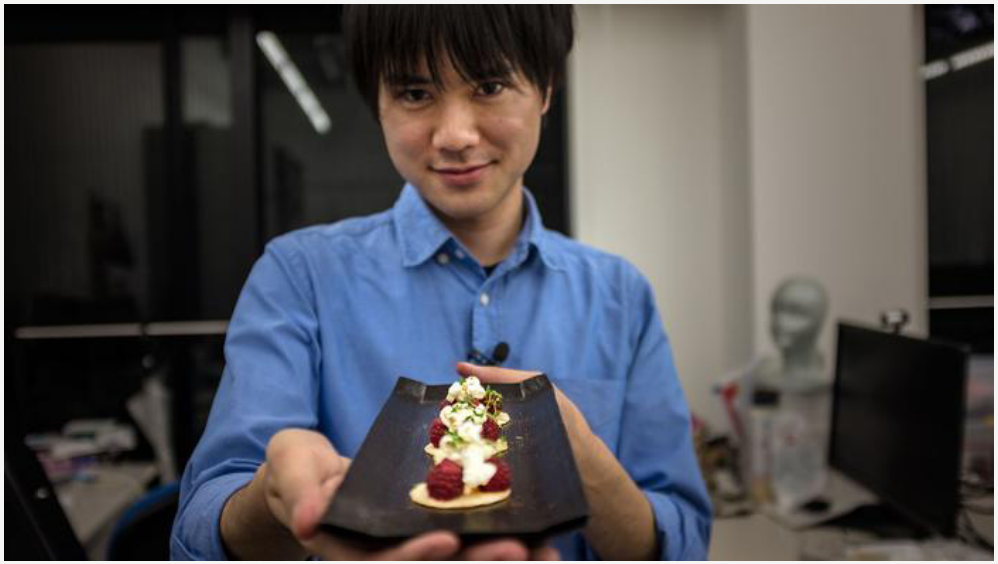


figure. 3.5.2 Yui Kita testing out one of the recipes generated by his "Chef Hippocampus" project

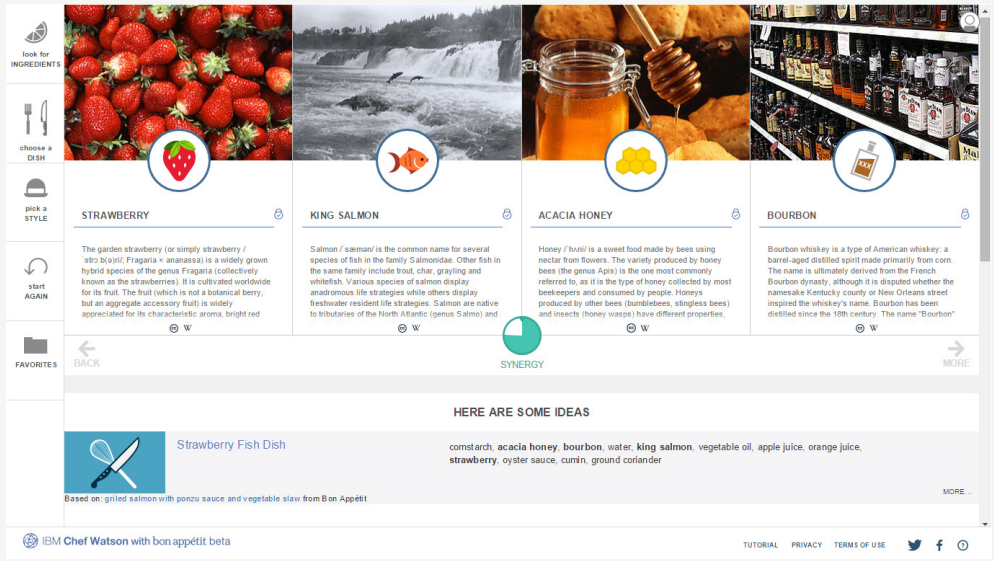


figure. 3.5.3 Interface of IBM's Chef Watson

creating surprising new recipes. By combining that data of recipes websites and detecting certain patterns, Chef Watson has learned to suggest up to four different ingredients that blend together seamlessly. Watson will run through the most typical ingredients used in a specific cuisine, plus the ingredients they're likely to go well with, to come up a realistic and tasty recipe.

I need myself to do the work and do the cooking.
(Kita, 2017) (Appendix D.2)

How does this relate back to food and 3D printing?

With the need for more complex and customized food decoration, 3D food printers can (and most likely will) play an important role in this part of the food sector. The question is rather how to speed and scale up the process so that it is profitable in a cafe or restaurant. In this case, the food printer will have to be part of an automated production line. However, it appears that although the automation is used for efficiency, it is also part of entertainment and therefore needs to be visible to the consumer.

Digitizing food is an aspect that needs to exploited. The chapter of "Food and Health" mentioned quantification as a digital aspect. Furthermore, by harnessing the computational power of the computer can enhance the thinking process, in a way the human brain is not capable of. Whereas the current meaning of 3D food printers is seen as tool to make geometries that are too tedious (or impossible) by hand, a new meaning could propose enhancing not the production of food but thinking about food. As food pairing is being done using machine learning applications, sophisticating the recipes — composition, ratio, aesthetics — still need to be done by the human. And using the 3D printers as simulation/prototyping device, this could dramatically enhance the sophistication of innovative or recipes using alternative ingredients.

3.6

Food Acquirement

This chapter covers:
1) designed to be living away from house
2) Cooking behavior
3) Are Japanese meal disappearing?
4) Food & Environment

How do people (wish to) acquire food?

Answering this question will be able to determine the following key aspects of the vision and new design:

- **Food Offering**

Introducing a novel application that produces food in such an environment will have a high level of competition. It is therefore important to investigate how people acquire food and how this is developing.

Designed to be away from house - the physical space

With a population density of 6,158 persons per square kilometer, Tokyo is the most densely populated prefecture in Japan. (Tokyo Metropolitan Goverment, 2016) The Japanese urban lifestyle is designed to live outside of the home. With averagely commuting for 1-1.5 hours and a scarcity in living space, people are used to utilizing public resources. In Japan, public baths, laundromats, and 24-hour convenience stores with public toilets can be found even in remote parts of the country. (McGee, 2017) The public space is a safe environment. Using McDonalds or Starbucks are a regular working/studying space, there are no worries for leaving your belongings (laptops, smartphones, wallets) behind as you go to the toilet or order

another cup of coffee. Even on street, people are comfortable with walking into a store leaving their bike unlocked outside, showing the collectivistic side of the Japanese society.

“ It is possible to live your life without ever having to cook. Food is available Anywhere, everywhere, whenever. ”

In dense Japanese cities, food is available all hours of the day and around each corner. This is due to the high population density and the on-going lifestyle. Drinks, snacks or instant food are offered by automats at every corner of the street or a コンビニ convenience store (Lawson, 7/11, FamilyMart). Japan has around 55,000 convenience stores nationwide — roughly one for every 2,300 people. (Nussey, 2017) In addition, branch restaurants such as Matsuya (Japanese food) or McDonalds (American) offer affordable meals at every hour of the day. Other restaurants that serve higher quality food have either normal operating hours or serve all hours if it is located in a busy area such as Shinjuku or Shibuya.

“Some people say it is better to cook at home because it’s healthier or cheaper. But actually it’s very expensive to cook at home.”
(Kita, 2017)
(appendix D.2)

Cooking Behavior

At the same time, as prices of food rose, families with two breadwinners increasingly opted to buy prepared food rather than cook at home. (Nikkei Asia Review, 2017) Not only is the offering more convenient and time saving, it is also cheaper as opposed to home cooking. Furthermore, delivery services made possible by mobile technologies (such as UberEats, FineDine or DeMae-Can) eliminate geographical limitations for the consumer as food from higher quality restaurants are now also being delivered to their homes.

“I have a box for delivery and they can put the food package in my box. So functionally, this box is turned into a very high quality 3D food printer”
(Kita, 2017)
(appendix D.2)

Finally, the aspect of time is eliminated. This delivery box method is used during key-handoff in AirBnB, where the key is located in a locked mailbox that is only accessible through a number-combination communicated through private messages. Neither of the parties need to be present to hand over the package safely.

Are Japanese meals disappearing?

Derived from own observations, Japanese traditional meals are not disappearing at all. At most, they are migrating out of the home and being outsourced. The health benefits of Japanese meals are still present and not declining. which explains the positive-looking statistics on obesity and life expectancy. Consumers can now bypass the time-consuming cooking of Japanese traditional meals with the help of innovative delivery services. Consequently, encouraging to eat more balanced teishoku meals.

Food & Environment

The rise in prices can be clarified by the current state of the agriculture, livestock and fishing industry. The documentary “Sushi: the global catch” several industry experts state that the supply of fish is falling dramatically and the demand in countries such as Russia, China and Brazil are growing rapidly. The result is a threat of extinction, with the blue fin tuna being the first on the list. The decline in biodiversity demands a decrease in consumption but whereas meat may have tofu (or printed meat) as a replacement, the sustainable substitute for fish has yet to be found.

More over, the Japanese agriculture is at a dire state. “Japanese farming has no youth, no water, no land and no future.” says Hitoshi Suzuki, an 57 farmer in Minamisanriku. “All the young people have gone to the big cities like Sendai or Tokyo.” Furthermore, Japan is already importing 70% of their food. (Harper, 2015) This means less diversity, lower quality and higher dependency on other countries.

How does this relate back to food and 3D printing?

Food acquirement in the urban Japanese environment is available on so many levels. Whereas the key qualities of on-demand personalized food at home promises a utopian lifestyle, the current and upcoming services are already making this possible. Furthermore, most of these services will offer higher quality food to which a food printer will not be able to compete with (yet). In such an environment, the current key qualities are not sufficient. Although a printer may save time, the preparation such as filling the machine with the materials or even cleaning the device still needs to be done by the user which only shifts the time that is put in the act.

Prediction of loss in biodiversity and the effect of the greenhouse gasses call for the use of alternative ingredients, such as insects which also contain a high level of nutrients. However, due to the lack appealing substitutes, sushi experts can only advice to simply eat less.

Taking the conclusion of the “Diet and Health” into account, perhaps a more evident issue is the behavior of traditional cooking at home — or lack thereof. Although the traditional cuisine is not necessarily disappearing, it is the general know-how of cooking at home that is at stake. This development will create an even bigger gap between the consumer and the food — the ingredients, its origin and process. This phenomenon will only be reinforced when applications such as 3D food printing will be used in the process. On one hand, outsourcing and automation will put the familiarization and knowledge at stake, but on the other hand, the user will not be troubled by the higher costs and required effort and time. Home-cooking will done by those enthusiasts who consider it as a hobby.

3.7

Quality and Value

This chapter covers:
1) what is good food?
2) Shokunin
3) Artists vs Craftsmen

What is considered as “good food”?

For the success of the food printing technology, it is necessary to not only offer a new way of acquiring food but also food of high quality in general. But what is quality? And as the technology is still in its early stages, the set of functionalities is yet to be completed. With the limitations in texture, is it possible to produce good food? Answering the question of ‘good food’ will be able to determine the following key aspects of the vision and new design:

- **Place in the cooking process**

A food printer can add value to different stages of the cooking process. It is needed to investigate to what extent each stage can be enhanced using this technology.

What is good food?

Good food is often associated with ‘tasty’ or ‘delicious’ food. Interpreting various definitions of experts (Food Made Good, 2016), quality appears to have different domains: (1) Functional — physical attributes such as the nutritional value or simply satisfying the hunger, (2) Emotional — indulgence

and sensorial experience of food, often the 'delicious' part or the quirky experience of using robots (mentioned in previous chapters), and (3) Intellectual — impact on environment/ society and whether this corresponds with the ethics of the consumer. These domains suggest a hierarchy of some sorts, similar to Maslow's hierarchy of needs. When the budget is limited, one would only choose for a meal that is delicious and indulging if it satisfies the need of hunger. In the case where the budget is not limited or priority (e.g. fine dining) the priority is lies with the experience as satisfying the hunger will not be an issue and covered by another meal. There are also other cases where the hierarchy does not work out: being a vegetarian can limit the options for food as recipes can still be unsophisticated (e.g. being limited to with the vegetarian alternatives on a barbecue). This can result in a lowered enjoyment for the sake of one's ethics. The suggestion of hierarchical relations will be omitted as it will not be further researched for now.

"Higher food prices had a bigger impact than wage growth in 2016, so [consumers] became more budget-minded."
(Nikkei Asia Review, 2017)

figure. 3.7.1 Mamoru Sugiyama handeling the fish with precision

Furthermore, whether one chooses to purchase a meal is not only dependent on the quality, but also the costs and convenience. Chefs in various Japanese restaurants in Tokyo say that the main factor of dining is economic. (Kita, 2017) (Appendix D.2) With the high food prices and the convenience offered in the dense city areas, it is clear that these factors dominate over the quality domains.

Shokunin

Japan is well-known for its craftsmanship in the cuisine, especially the sushi chefs. The term for chefs is 職人 *shokunin* (translated as 'craftsman') whereas the act of craftsmansip is called 物作り *monozukuri*. Although the western definition may imply the emphasis on the 'man' and the crafting skills, monozukuri emphasizes specifically on the "mono", the thing that is being made, and "zukuri", the act of making. The person doing the making is de-emphasized, and skills are only implied. This reflects the Japanese sense of responsibility for making things, as the Japanese Shinto religion celebrates an appreciation and reverence for things animate and inanimate. (Pringle, 2010) This is also explained through cultural dimensions where the individualism and indulgence is low, refraining the craftsmen from enjoying the fame of high skill. Reaching the top by giving the highest effort as possible is a typical cultural trait of masculinity where success is equal to the effort put in.

"I'll continue to climb, trying to reach the top but no one knows where the top is."
Jiro Ono, 2012

In *monozukuri* the shokunin trains years to achieve perfect by eliminating the three Mu's: 1) 無理 *Muri* is activity that is not reasonable or overly burdensome in relation to the task. (e.g. learning to apply just the right amount of force with a wrench), 2) 無駄 *Muda* is an activity that is wasteful and useless. (e.g. having an an economy of motion that preserves stamina so that he can be more productive) and 3) 斑 *Mura* is inconsistency of process leading to uneven results. (Pringle, 2010)

Rather than artistry, I think of it as showing the beauty of my work which I acquired through years of experience.
Mamoru Sugiyama, 2012

Evaluating the characteristics of *monozukuri*, the focus is on making the dish rather than inventing new recipes. Referring back to the three roles in the cooking process (Chapter 2.3 Cooking Process), the model should be evaluated whether the three cooking roles are consistently applicable, irrespective of culture. As the recipes of sushi or tempura remain consistent, these shokunin fit more in this models' classification of a cook. To prevent any confusion in definitions, the classification of 'craftsman' suits the model better than 'cook'.

Artists vs Craftsmen / Sushi vs Ramen

As for a 'chef', the classification of an 'artist' is suited in this model as the difference lies in how craftsmen make it opposed to what artists make. In artistry, the emphasize lies more on the artist as the novelty of the dish is a brainchild of the artist. And where chapter 3.1 explained a rise in individualism and indulgence, Japanese individuals might focus more on artistry rather than craftsmanship alone.

A dish wherein both artistry and craftsmanship merge is a bowl of noodle soup eaten on a daily base: Ramen. Affordable at an average price of 800yen/6.50euro and offered by ten thousands of ramen shops, it is perceived as a fast yet high quality food. Although not associated with fine dining, already two ramen shops, Nakiryu and Tsuta, in Tokyo have gained a Michelin star for their level of quality. (Ramen Adventures, 2016) Following the way of the shokunin, these shops are still selling their bowls for around 850yen/6.90euro. Again, the emphasize lies on the product and the skills, not on the individual or the revenue.

"There is no authentic ramen recipe. The majority of ramen shop owners in Japan pride themselves on their "secret" ingredients".
Ivan Orkin, 2017

And where there is little space for innovation when it comes to sushi, ramen offers plenty of opportunity for that. The concept of ramen is essentially broth and noodles accompanied with various toppings. It provides a platform where the originality of the ramen artist can be celebrated as well.

What is happening in craftsmanship?

Makoto Fukue, chief executive officer of Tokyo Sushi Academy, says: "There were just not enough people wanting to become sushi chefs." As for the sort of authentic shop where the chef serves the sushi over the counter, for an apprentice, it takes 10 years to be allowed to serve customers. Currently counting 18,764 sushi restaurants, these went down 19% compared with five years earlier. (Tani, 2016) Furthermore, sushi schools that offer a 3-month intensive training program are becoming widely popular. The target is to work abroad, whereas this amount of training is not acknowledged in Japan. This phenomenon is explained by the refusal of long-term commitment, a conflict between established beliefs and the rise in individualism/indulgence.

Furthermore, women are still not acknowledge to become expert sushi craftsmen. With arguments like " the menstrual cycle affecting their ability to taste" to "women having high body temperature that affects the quality of the sushi" (Wisdom, 2016), conservatives believe that women are physically incapable of making high quality sushi. Another sign of the strong uncertainty avoidance that traditional male craftsmanship is the way to go, leaving no room for new meaning.

How does this relate back to food and 3D printing?

The quality of food is dependent on deeper layers of self satisfaction — physical, emotional and intellectual. The decision-making shows that quality is only one of the drivers, along with convenience and affordability taking the upper hand as food prices in Japan continue to rise. For 3D printed food to become successful, these drivers must offer at least an equal level compared to the established offerings. And although the uniformity in texture may pose a problem, dishes such as tofu have the same uniformity and are part of a collection of dishes. In such a teishoku meal set, the variety in texture is spread across the different dishes instead of being concentrated into one dish.

In a way, the philosophy of craftsmen are similar, if not identical to the functionality of robots. The act revolves around efficiency, consistency and no mistakes. In other words, craftsmen are training themselves for decades to become robots in the flesh. Using a 3D food printer for precision in the meal preparation would defeat the purpose of their years of training. And with a declining interest of life-time craftsmanship commitment, craftsmen will start to thin out which makes the act even more valuable. The application is interesting for culinary artists as they are focused on innovation as well as craftsmanship. The role of the food printer would lie in the experimentation phase to test out the new recipes. The established dishes would still be made by the craftsman himself/herself.

chapter 4 | Interpreting

Goal

Collecting and choosing the most promising contextual factors that will ultimately give direction to the context vision.

Method

Key interpreters of the fields of home living and digital creativity were identified and used as additional input for the vision. The conclusions of all the previous chapters were processed and identified as contextual factors that could give direction to the vision. To graps the significance of the abundance of factors, they are clustered to see them in the bigger picture. The clusters then pose either a sequential or contradicting relationship, both of these giving birth to potential future scenario's upon the vision is built. In order to choose a (set of) cluster(s), the value is determined based on the methods of Vision in Product (Hekkert et al, 2011) and uses intuition to determine whether the direction has the potential to 'shed new light' on the subject of food printing and personalized food. The final direction of the vision has been formed that gives an overview of the crucial elements to be adopted in the vision.

4.1

Contextual Factors

The insights derived from the previous chapter will act as the building blocks for the vision. The full list of insights can be found in appendix F. To process these insights, methods of Vision in Product (Hekkert et al, 2011) are used. The theory states that the insights, so-called 'contextual factors', are value-free descriptions that may have to do with culture, economy, technology, biology, theology or any field of science and can be either dynamic (trends and developments) or static (principles and states of cultures). Their influence on the vision will be based on personal values of the student designer as well as their potential for uniqueness (to result in a radical innovation in meaning). For example, observing that there is a strong desire for visual robots in food preparation is relevant in this case but will not necessarily shed new light on the act of food preparation through 3D printing. But a shift in relationships with robots might spark new interpretations of what a food printer can be. As the abundance of relevant factors can be overwhelming, clusters are created by grouping factors that 'point into the same direction'. Appendix G lists the 19 clusters that are formed out of the roughly 70 factors derived from the contextual research of chapter 3. These clusters among each other will either form a narrative together or form a contradiction, both resulting in potential future scenario's.

Back and Forth

As this chapter marks the transition from analysis to design, the act of iterating on the vision is needed to find the right direction. Before resulting the actual design direction (which will be discussed in the upcoming chapters), the clusters that were addressed were the care of the elderly and the social role of robots. As the rise in elderly population is explosively rising in Japan, the shortage of caretakers is failing to cope with the needs of the elderly. The contextual clusters proposed a rather new future scenario: elderly being independent of caretakers by making use of technology that both enhances and controls their personal nutrition. This way, they would be able to not only replace the caretakers' tasks but also sustain their physical condition which postpones the need for help to a later age. A vision was created with several solutions for different aspects of the encompassing solution, such as interaction with the robot assistant and how to establish an organic relationship as well as more practical aspects such as accessibility to public food printers and the variety in printable materials.

After a timespan of several weeks, in discussion with one of the supervisors, it has been decided to not longer pursue this direction for several reasons. Although addressing a major problem in Japan, the project was not heading towards the initial goal of the project: a radical innovation in meaning. Rather, it was a direction that was already taking place and was simply a next step in the current proposed solutions. The theory of innovation, Design Driven Innovation (Verganti, 2013), as well as Vision in Product (Hekkert et al, 2011), propose that innovation is about exploring possible future scenarios instead of solving present-day problems. To further stimulate the vision crafting, the next chapter will discuss the interpreters that will play an important role in the direction of the vision.

4.2

Interpreting the interpreters

As food and technology is deeply seated in the lives of the Japanese, the subject of food printing for consumers questions not only how people could/should live in their homes as well as the role of technology and robotics. By tapping into the visions of key interpreters a suitable vision can be crafted (together with the insights of the context). Rather than combining an abundance of interpreters, it has been decided to focus on rather a small amount of Japanese interpreter collectives from the fields of home living, robotics and creativity.

figure. 4.2.2 Muji Hut - Inside View

MUJI — interpreter in home life

As food printing proposes to drastically change the layout of the kitchen, it is vital to look at how the home life in the urban Japanese environment is envisioned. Muji, formally known as Mujirushi Ryohin (translates as "no-branded quality goods") is famous for their minimalist philosophy in product design. In 2015, the company revealed plans of producing huts: small, humble houses that would allow users to enjoy the simple pleasures of life, irrespective of the location.

figure. 4.2.1 Muji Hut - Outside front view

> "Who hasn't dreamt of living somewhere they really want to be?"

The Muji Hut (2017) — intended as a holiday retreat or an everyday villa — has 9 square meters and does not come with any plumbing or water connection, meaning no kitchen, toilet or bathroom. It is designed to fit in an environment where these facilities are all externally accessible. In Japan, public baths, laundromats, and 24-hour convenience stores with public toilets can be found even in remote parts of the country, so living full-time in a small hut like this without a kitchen or bathroom is something that isn't out of reach. (McGee, 2017) The vision states *"Who hasn't dreamt of living somewhere they really want to be?"* (MUJI, 2017) which in itself is contradicting to the design as the basic needs of sanitary and cooking equipment is not offered. The concept works if facility centers — offering shared bathrooms, kitchens and toilets — are built as a hub for these huts and forming the heart of a micro community. This is the reason why the first units revolve around a facility center located in Chiba prefecture (south of Tokyo). Similarly, the concept

can be applied to urban environments in the form of shared apartment complexes.

Insights: Ownership and Escapism

On a physical level, MUJI reinforces their vision of minimalisim and ownership over products and resources and limits this to that which is truly important for the self. As resources are (or becoming) low-priced (or free) and within comfortable distance, the need for ownership is deemed obsolete. Envisioning the kitchen as an obsolete space within the home, food printers won't have to be limited to the space an individual has in their own apartment. On the other hand, MUJI envisions a break-free from the geographical location — suggesting that city-dwellers should be able live outside in the nature temporarily. This key quality resonates with food printers as they are not bounded by the kitchen and only need electricity to function. More importantly, looking at the rationale behind the Hut, Muji clearly indicates a need for escapism from the dense city environment and true immersion into the nature. This same goal of escapism could also applied on the functionality of not the food printer itself, but the food it produces.

Shun Matsuzaka of McCann Japan — Robotics and Creativity

In 2015, ad agency McCann Japan's creative planner Shun Matsuzaka set himself a task he called the "creative genome project": he wanted to create the world's first AI creative director, capable of directing a TV commercial. Matsuzaka and his team in a newly-created division called McCann Millennials first began their project by breaking down a TV commercial into two parts: (1) the creative brief — the type of brand, the campaign goal, the target audience, and the claim the ad should make — and (2) the elements of the TV ad — Including things such as tone, manner, celebrity, music, context, and the key takeout. After assembling a database of award-winning examples of the last 10 years determining which elements made them successful, the AI (named AI-CD) learned from this data set and was put to the test. To test its capabilities, McCann organized a ad-design competition between AI and human. After an online public vote, the AI came out as winner. (O'Reilly, 2017)

Matsuzaka has two big predictions: "The future [ad] agency evolution will be based on its algorithms, which are created by humans," and "innovation only happens when the traditional barriers of partnership are broken down."

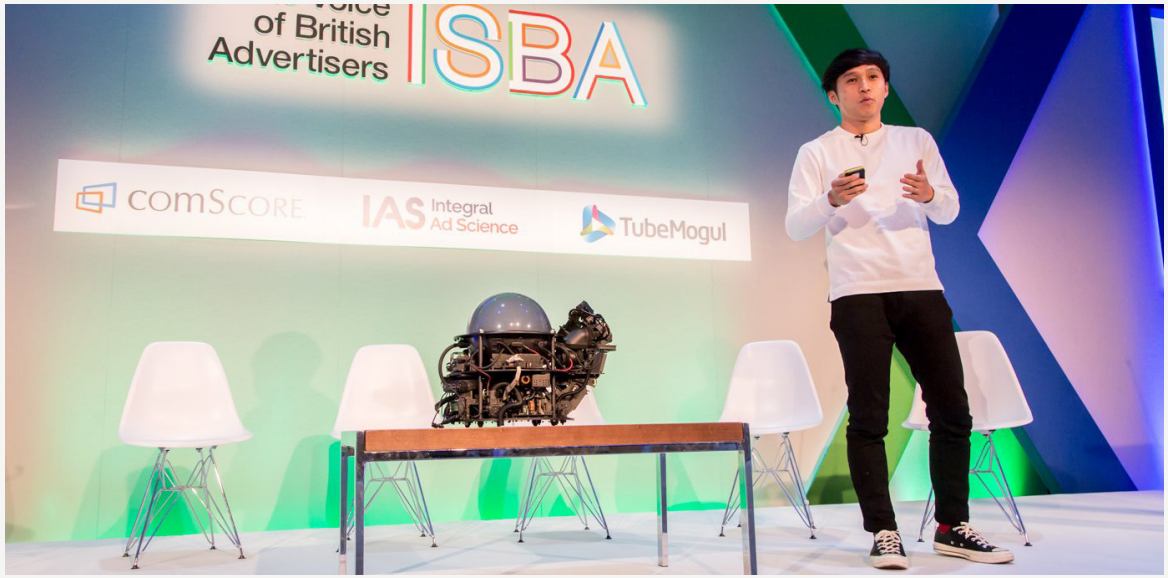


figure. 4.2.3 Shun Matsuzaka of McCann Japan presenting AI-CD at ISBA's annual advertisers conference in London

Insights: Creativity and relationship with technology

Matsuzaka proposes a more algorithmic way of creativity, which was mostly considered something intuitive and person-specific. This new algorithmic creativity makes it accessible for anybody to be creative. And whereas a 3D printer was mostly a tool for those who want to realize their own creativity, it would mean that artificial creativity would make 3D printers accessible to the general public. This also implies that the quality of something created is focuses on the end results and its effect rather than the hardships the creator had to go through during the process. By breaking down the traditional barriers of partnership, virtually everyone is able to create something unique and meaningful using the proposed technology

> **"The future [ad] agency evolution will be based on its algorithms, which are created by humans"**
>
> **"Innovation only happens when the traditional barriers of partnership are broken down."**

4.3

Choosing the Contextual Clusters

The cluster of "building artificial intimacy" has been chosen to further investigate and craft a vision upon. The criteria for this decision were primarily based on the potential in meaning innovation. As this project pursues the quest in uncovering yet unknown meanings of personalized printed food, it should focus on a meaning that food is not normally supposed to do. This could involve mental aspects such as feeling connected, creativity, concentration or intimacy with others. In other words, it raises the question whether food can tap into the personal emotions instead of personal (nutritional) numbers.

The insights on intimacy in the modern context states that a contradiction between artificial and traditional genuine intimacy is formed. Genuine intimacy poses an interaction between two individuals wherein experiences is shared and communication goes two ways. On the other side, artificial intimacy is an interaction wherein one serves the other. In this case, it is not necessarily an interaction between human and robot (as discussed in chapter 3.2), as these similar types of exclusively-digital relationship do exist as genuine intimacy. An example is a long-distance relationship where the interaction happens only through the screen and/or audio. Artificial intimacy is characterized as a one-way direction interaction, satisfying the need of only one half. It is therefore very much a transactional act, as both man and women pay for this service (purchasing dating apps/games, visiting so-called 'host/hostess' bars that provide a person to go on a date with). Although negatively perceived in Western eyes, it is a logical response to the high-pressured work-life and heavy responsibilities that come with a 'normal' relationship in the Japanese culture. To shed off the negative connotations, the contradiction in intimacy is rather a spectrum where on one side 'interplay' between two people is nurtured, and on the other side 'the self' is nurtured.

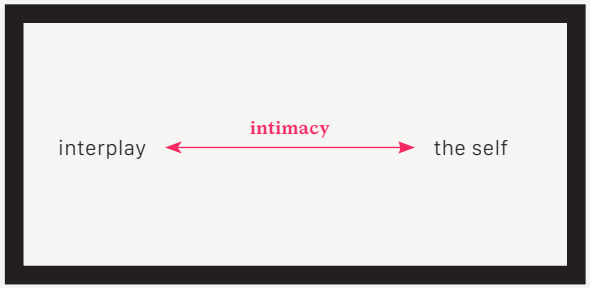
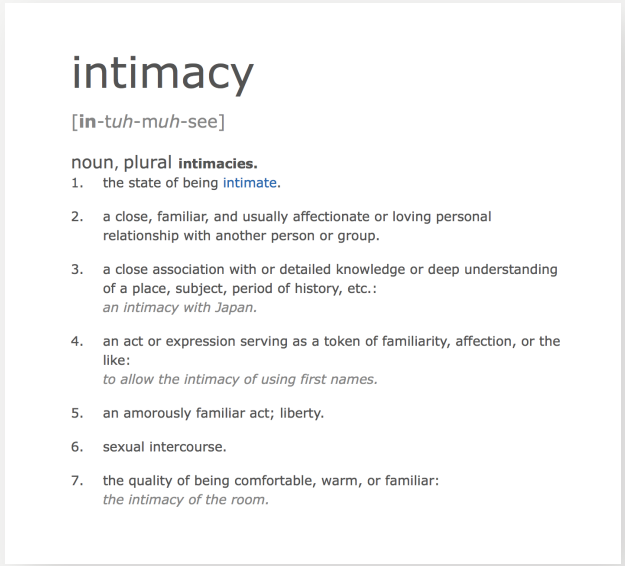


figure. 4.3.1 Forming Dimensions out of clusters - Vision In Product Methods

Communicating with Food

As neither sides of the spectrum is right nor wrong, the challenge of this project is not necessarily about solving a problem, but exploring the possibilities and enhancing intimacy, whether focused on interplay or the self.

In the dictionary, intimacy is defined as " a loving personal relationship with another person or group" or " an expression serving as a token of affection". These definitions revolve around communication — and to be more specific, the



intimacy

[**in**-*tuh*-*muh*-see]

noun, plural **intimacies.**

1. the state of being intimate.
2. a close, familiar, and usually affectionate or loving personal relationship with another person or group.
3. a close association with or detailed knowledge or deep understanding of a place, subject, period of history, etc.:
   an intimacy with Japan.
4. an act or expression serving as a token of familiarity, affection, or the like:
   to allow the intimacy of using first names.
5. an amorously familiar act; liberty.
6. sexual intercourse.
7. the quality of being comfortable, warm, or familiar:
   the intimacy of the room.

figure 4.3.2 Definition of "Intimacy" on Dictionary.com

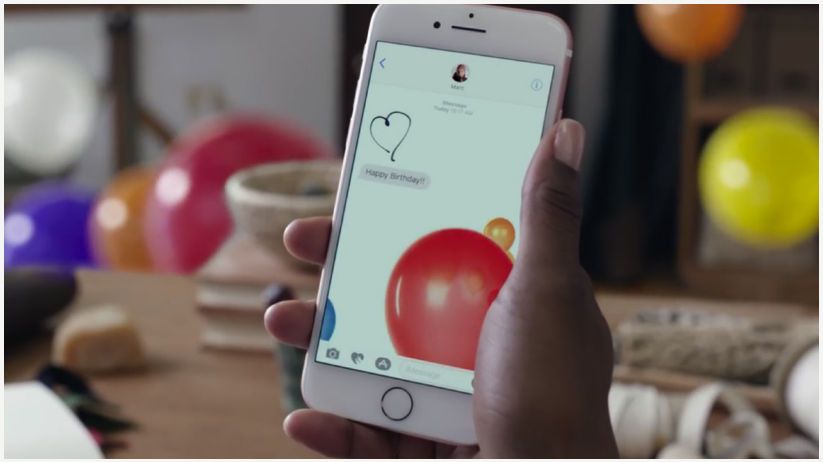
communication of personal emotions and thoughts. This raises the question how a new meaning of food can be created that communicates personal emotions in order to enhance intimacy. For this reason, communication has become a vital element in the vision crafting and needs to be further investigated.

The future of communication — Integration and Immersion

Personal communication is continuously evolving to convey the message more vividly. Texting evolved with emoji's, embedded photos and videos to messaging effects (e.g. balloons popping up the screen) used in Apple's iOS10. Furthermore, the way we perceive media content is evolving to a higher form of unobtrusiveness through wrist- and head wearables (such as Apple Watch or Google Glass) and immersion through virtual reality (such as Oculus Rift). The overlapping trend seems to be focusing on integrating the content output into our lives more seamlessly. In the case of virtual reality, it is the other way around. It integrates our mind into the virtual world, yet again creating a more seamless experience. As food is an essential part of the everyday life, is it possible to make it a carrier of content? And whereas all the above mentioned media forms stimulate the senses of sight, hearing and tactility (haptic feedback), food can offer an experience that stimulates all five human senses, introducing the use of smell and taste. And although the 'resolution' of this form of output has yet to be determined, it opens up new possibilities; for example, certain memory recall or communicating the atmosphere of an environment through scent.

Pop-culture Immersion

Japan is famous for (obsession for) pop-culture in the form of anime, manga and videogames. These elements are brought to the real world through merchandise, themed cafes, consumables' promotions, cosplaying (crafting/wearing character costume), events and so on. It all contributes to the immersion of the pop-culture and integrating it into the everyday life to make it feel more 'real'. Continuing on using printed food as content output, these fictional worlds could achieve a deeper level of immersion through food as environment and sceneries could be further described using smell, flavors and texture to trigger similar associations with the consumer.



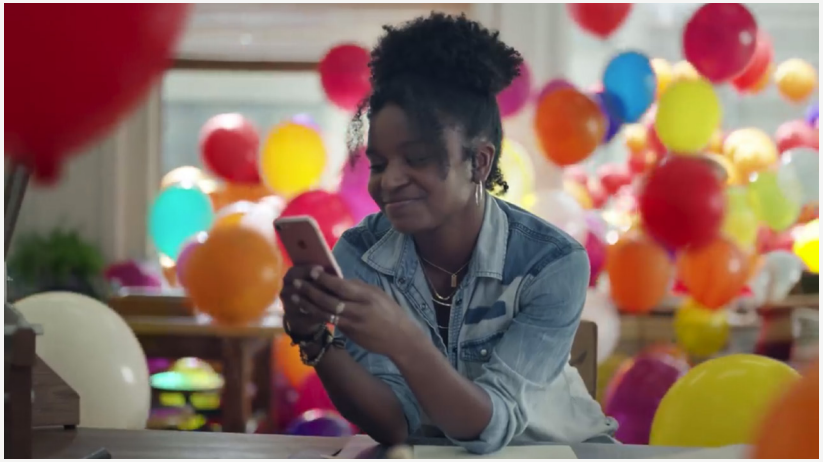


figure 4.3.3 Apple's iOS 10 "Pure Magic" TV ad

Chapter Conclusion:

This chapter collected all the key elements that gave the direction for the vision.

Building Genuine Intimacy

The meaning of intimacy is shifting towards more transactional forms. Although this gives an experience of companionship, it is only temporary, hollow and simulated. And as food has always been an activity that brings people together, personalized food is only focused on the individual. The opportunity lies in fulfilling the need in genuine intimacy.

Immersion to Escape

Muji, the key interpreter for Japanese home living, poses a need for escape from the daily routine and embodied their vision of escaping in their newly released Hut. And whereas the rise of immersive technologies (virtual/augmented reality) give consumers the ability to transport themselves to another world, the same concept of escapism applies. Looking at the meaning of food (preparing, consuming or both), food has its own escaping functionality. However, due to lack of time, lifestyle and costs, most people are not able to participate in this escaping behavior. The opportunity is that food stimulates multiple senses (similar to the immersive technology) and can give a level of immersion that acts a micro escape during the daily routine.

“For the mind, not the body”

As the national health of Japan is in a condition with all-time low numbers of obesity and cardiac disseases, the issues are significant on a mental level, such as loneliness, pressure of the society and stress at work and school. This posed the opportunity of improving the quality of life on a more emotional level. At the same time, personalized food from food printers pose a personal nutrition plan. However, in this perspective, the personalization would mean fitting the personality rather than the body.

“Respect your elders” | Tradition and innovation

The traditional values and the modern mindset are always clashing; intimacy and the meaning of relationships being a noticeable example thereof. As these values cannot be cut off, it gives the opportunity to modernize a part of the tradition and making it fit the needs of the modern mindset more seamlessly.

These building blocks are the foundation on which the vision is built.

chapter 5 | Vision

Goal

Tying together the building blocks and crafting the vision for food printing in Japan. As the vision speaks on a more abstract way, the goal is to result in a concrete design goal that can be translated in a physical product.

Method

The key elements of the previous chapter were combined in an abstract narrative that conveys the emotions and importance of food poetry within the context. Moreover, a metaphor is used to clearly communicate the desired effect of food poetry. It was then assessed on its fit within the traditional culture of Japan and as well as its feasibility. As the vision is a process that involves a creator and a receiver, different desired outcomes and interactions were proposed. The vision was then translated into an outline for a product service system. This then proposed a set of products to achieve the desired user experience. Due to the dependency on the technological developments, the capabilities are estimated. This defined the timeframe for the vision. Lastly, the key challenges per process phase have been identified and were crucial in synthesizing the concept.

5.1

Context Vision

> *"I want people to be able to create messages, using food as narrative, in order to share their feelings to the intended person"*

The vision is the product that combines all the relevant contextual insights, interpreters' visions and own ethics. It is expressed in a statement which defines what the product will over people within the established context. In addition, it opens up the design opportunity as well as the end goal. In the end, the vision is the rationale where the designed product is the physical manifestation of it. The vision will embody the following components: **[role personalized food] + [immersion into another world] + [intimacy between people] + [3D food printing capabilities]**

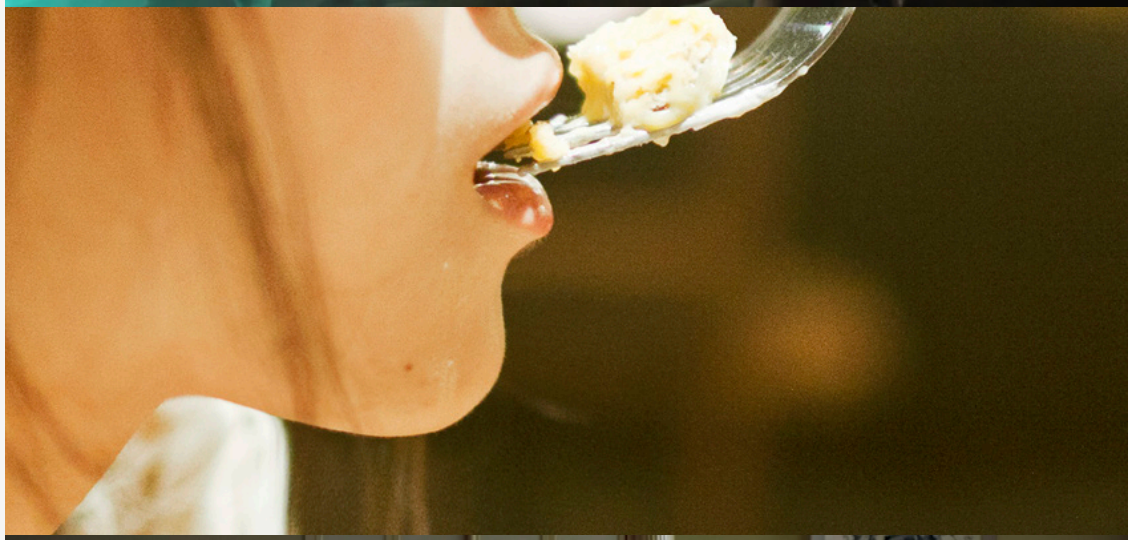
The vision explores a new way of communication due to the evolving desire for immersion. It uses the qualities of food that stimulates the senses (taste, texture, temperature, scent, color, shape, sound) to trigger associations that are personal to the intended person. Yet again, emphasizing personalized food on the emotional domain. In a way, it is a very codified way of communicating between two people, making it very intimate and exclusive. It aims at turning something edible into poetry, an artwork following a narrative; hence the name: Food Poem.

The role of the food printer in this vision would be the infrastructure for sending these messages (basically a teleportation device for the food poem; being able to send it to a food printer all over the world and not being bound by expiration dates. As this relies on the adaption and advancements in the technology of food printing, the vision is set for 2022.


What if we can **use food to tell our stories?**

reliving our **precious memories**

immersing by **engaging the senses**



sharing the experience **as a gift with our beloved ones**

to **appreciate our relationships**

to help us **escape the daily routine**

to ultimately feel **more deeply connected** with each other

5.2

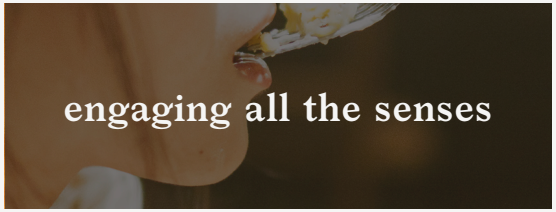
elaborating the vision

This chapter covers:
1) a day-dream escape
2) food and memories
3) gifting culture in Japan

As the concept of using food as a carrier of feelings/thoughts is somewhat new and unusual, it is best to explain the value of this interaction using metaphors. This chapter describes what type of interaction is envisioned as well its place in the cultural context.

figure 5.2.1 Moss Geta by Shuhei Hasado (2004)

The desired end-state: Day-dream escape
The Moss Geta by Shuhei Hasado (2004)
This particular 'Geta' — a traditional Japanese wooden sandal — is covered in moss to let the user experience nature through tactile feedback. If the user would close one's eyes, it would be as if he or she would be walking through a forest by means of imagination. This piece contains the elements of the desired end state: (1) something used everyday (2) imbued with a memory, when the user closes the eyes and experiences the food, he or she would be transported to that place (3) through the associations. Identifying that place and moment could happen instantly if the right associations are made. That moment could even lasts only a split second. This micro moment during the day will offer a tiny escape from all the stress.



Storytelling in haute cuisine
"Story food", where certain dishes are said to remind the chef of his own childhood memories, or perhaps of events relating to his or her region, is catching on with renowned chefs all over the globe. With the same goal of offering a non-verbal narrative through taste sensations, the chef is challenged to create a dish that both conveys the message and is pleasurable to consume. A dishes that resembles the desired interaction for a food poem is called "The Autumn Scene — A Walk in the Woods" served in Next by Grant Achatz and Dave Beran. A salad paints a picture with roasted mushrooms and fried carrots (logs), fried chard (leaves), leeks (hay), mushroompowder (dirt) and garnished with various herbs. This landscape is then served on glass over a half log with aromas of roasted chestnut, hay and apple. The Autumn Scene attempts to help the consumer with reconstructing the intended narrative and associating with personal memories.

figure 5.2.2 The Autumn Scene - A Walk in the Woods by Grant Achatz and Dave Beran, served at NEXT

Food poetry is an attempt to replicate these dishes' effects on the consumers and make it accessible to the general public. However, as the resources and freedom in these restaurants are virtually endless, food poetry produced by 3D printers is limited: capabilities of printers, available materials, costs and the creativity of the creator. In other words, the challenge of this project is to approach the desired experience as much as possible making use of the limited resources.

sharing the experience as a gift

The act of gifting in Japan

As it seems in Japan, reciprocity through gift-giving is much more prevalent than other cultures and people give gifts for many occasions. Indeed, gift-giving is a minor institution in Japan, with complex rules defining who should give to whom, on what occasions he should give, what sort of gift is appropriate on a given occasion, and how the gift should be presented. (Befu, 1968) When one gets a gift, one is usually expected to give a gift of equal or greater value back. These occasions range from fixed times of the year to situational times where it is expected. The more traditional and 'seasonal' occasions are the Oseibo 御歳暮 (end of the year) and the Ochuugen 御中元 (mid year). These gifts, usually in the form of seasonal fruits to Japanese style sweets, called Wagashi 和菓子, are a way of letting people know how much they care about them. Occasionally, the extravagance of the gift is equal to the love/respect for the recipient. This immediately links back to the characterizing hierarchical system and suggests that people should always gift something extravagant to their superiors. As for the situational gifts, the most important ones are a Temiyage 手土産 and an Omiyage お土産. A Temiyage is brought when visiting someone's house and is considered rude when arriving empty-handed. It could be considered as a gift for hospitality and always comes in the form of food (usually Wagashi) which is consumed at some point of the visit. An Omiyage is similar to a souvenir or a personally delivered postcard that represents a part of the trip that person just came back from, therefore locally made food or Wagashi. These trips can range from big overseas holidays to one-day business trips or visits to country-side relatives. It is a social obligation and mostly seen as a way of saying "good job keeping up the fort while I was gone" and will be shared with the entire office/group as well as given to family or a close friend. (Tofugu, 2013)

As these types of gifts are meant for specific occasions, the rationale behind food poetry is that it can be send irrespective of any occasion, as long as there is a desire for contact. This could range from cheering someone up after a bad week to telling that person you miss him/her to the conventional occasions. In conclusions, food poetry will expand the opportunities in gift giving.

In conclusion, the immersive experience that is described with the Moss Geta offers the escape from the daily routine. The practice of story telling through food is being done by chefs around the globe. The challenge is to approach the desired experience as much as possible by leveraging 3D food printing capabilities. Finally, making the food piece into a gift falls perfectly in line with the Japanese culture. Due to freedom in occasions, food poetry even broadens the opportunities in gifting.

directing with assistance

curating, not finding

5.3

Desired Interaction

This chapter covers:
1) Interaction vision for Creation
2) Interaction vision for Interpreting
3) Products and Challenges

The interaction vision speaks in a metaphorical way how the users would be interacting with the product/service. As the act of gifting involves two users, the interaction vision is divided into two: creating and interpreting. The metaphor of an art exhibition has been chosen to make the interaction easier to digest.

Creating food poetry should like curating an art exhibition; searching for the right pieces until the story is told perfectly.

Inspired by the key interpreter Shun Matsuzaka (chapter 4.2), creating artworksin the future is something that is expected to be done in collaboration with artificial agents. Hence, the focus on curating instead of actively making. The key elements during the creation of food poetry are:

Directing with assistance
People are required to have a high skill level various fields in order to create food poetry. To make it accessible for everyone, the interaction focuses on what every user is able to do: indicating what is true to their feeling and having an assistant point out what is needed.

Not finding, but curating
Finding the right pieces that make up the narrative and not worrying about being able to make the art piece or even going through the effort of identifying all the options. It is about taking away the struggle of not knowing where to look.

Perfecting
There are no mistakes. Revising the end result until the story is told flawlessly.

Building the anticipation

Fully immersing

A sense of understanding

Interpreting food poetry should like visiting an art exhibition; Building up the immersive experience and understanding every single detail

The key elements during the creation of food poetry are:

Anticipating

Steadily approaching the artwork from a distance and seeing more details as you get closer. From afar, the colors and silhouettes are only visible, but on touching distance, the every single detail is present and the story begins to live.

Immersing

Being immersed in the moment and building your own story of what the painting is portraying.

Understanding

Finally, after experiencing the art piece, the description gives the full story behind the painting.

The products

Translating the interaction into a perfect situation would result in:

Creating:

- Hiring a top chef to compose a recipe that conveys my narrative
- Using the exact ingredients from that specific location
- Applying cooking methods that work best for each ingredient
- Sending the recipe as detailed as possible

Fabricating

- Gathering all the ingredients from all over the world
- Reproduce the recipe of the food poem identically

Interpreting

- Picking up the food poem anytime I want or letting it get delivered
- Experiencing a Michelin star serving
- Immersing in the experience
- Completely understanding the narrative
- Paying a reasonable price for all of this (e.g. the price of a well-made muffin, not Michelin-star prices)

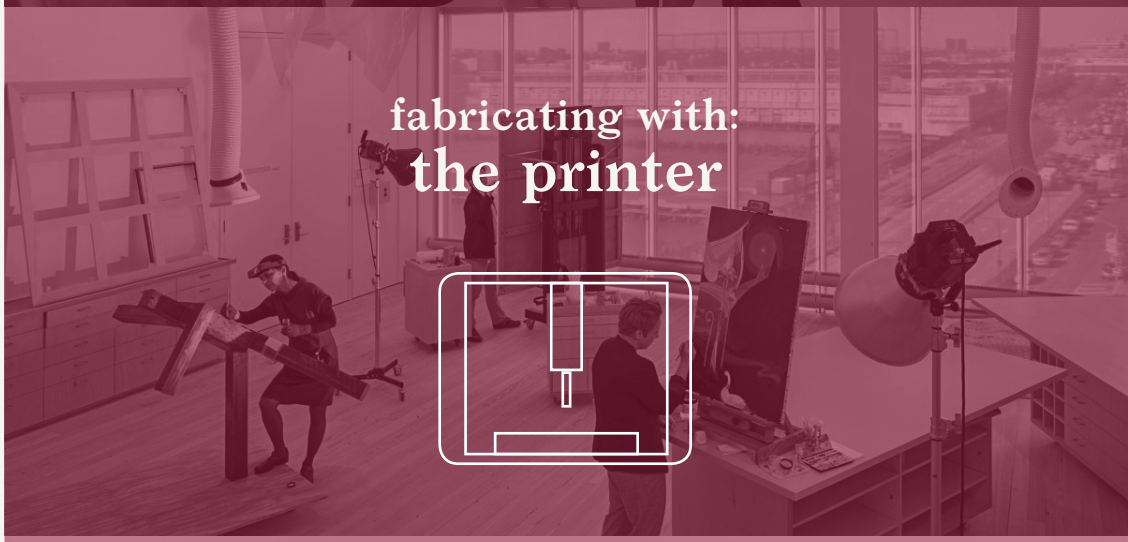
Obviously, this would be extremely costly and not accessible for the mass public. However, these roles can be substituted with technology. It is needed to identify the key challenges of the different phases.

1. Creating poetry

This phase ranges from the moment the sender initiates the act of sending a poem up to sending off the instruction files needed to produce the poem. The challenges that need to be addressed are:

- 1.1 How can a person, possessing none of the required skills, still create a high quality food poem? Where can that person find assistance?
- 1.2 How can the creation process offer a framework that ensures high quality (comprehensible and feasible) food poetry?

As the biggest challenge in the creation phase is knowledge, this will be replaced by an application for mobile and desktop devices. Directing translates to a functionality of inputting all necessary content to build the complete narrative. Choosing translates to a functionality of the app suggesting options, rather than having the user actively look for ingredients themselves. Lastly, perfecting requires a functionality to constantly revise the process and review the end result.



2. Fabricating Poetry

This phase includes all the actions that are needed to form the physical poem and deliver this to the recipient as desired. In this phase the responsible persons are the host of the food printer and the ingredient supplier. The challenges that need to be addressed are:

- 2.1 What a set of techniques and capabilities must a printer possess to create a high quality food poem?
- 2.2 How can the printer deliver a seamless experience as possible to the recipient, in terms of accessibility and waiting time?
- 2.3 What kind of materials are needed to achieve a high-quality result?
- 2.4 How can the supply of ingredients offer a wide variety yet not demanding too high costs?

The biggest challenge with interpreting is communicating the story as clearly as possible yet giving room for the own imagination to do its work.

> **“It needs to be clear but not too obvious.”**

Anticipating translates to slowly building up and constantly providing more details to the story. In terms of product functionality, it would conceil the product and constantly reveal details, similar to unwrapping a gift. Immersing translates to emphasizing on the five senses and making full use of these. Understanding translates to the functionality of providing explicit information of the artwork.

3. Interpreting the poem

This phase is ranges from the moment the recipient comes into contact with the physical printed poem up to the moment it the recipient decides to reply. The challenges that need to be addressed are:

- 3.1 How can a food poem deliver the narrative clearly yet intuitively? How will the architecture of food poetry look like?
- 3.2 How can the food communicate the narrative on its own as much as possible and how can it make use of additional media to strengthen the narrative?
- 3.3 How can it ensure that it distinguishes itself from regular food?

Other challenges that do not involve the communication of the narrative, but still involve the consumption:

- 3.4 How can it ensure to be appetizing in ingredient combinations and mouthfeel?
- 3.5 How can it dispose of the negative connotation of processed food?
- 3.6 How can it ensure food safety?

As the food printer will fabricate the food, the important user interactions are creating and interpreting, involving respectively the person sending the food and the recipient.

Chapter Conclusion: the product service system of food poetry

The video of the vision combined the elements of building genuine intimacy, a need for an escape and the possibilities of immersion to tackle the contextual status quo and impending dystopia. The vision can be concluded in the statement:

“I want people to be able to create messages, using food as narrative, in order to send their feelings to the intended person”

This gave birth to the concept of food poetry: food compositions that embody the sensorial stimuli of a memory and trigger these associations with the intended receiver. The desired and ideal effect is a short day-dream experience that triggers a distinct memory. Although any story can be used as narrative, the focus lies with memories as this is the most intimate kind of story between two individuals. The concept then proposes this to be used in the act of gift-giving, a long-standing Japanese tradition and presents that it can be used in mostly personal relationships which allows the user to not be bound by just the seasonal gifting occasions but be more flexible and spontaneous in the act. The tradition of gifting halved the user journey in two parts: creating and receiving.

The creation experience is intended to let the creator of the poetry focus on what the perfect piece of poetry should be rather than how to make it, both digitally and physically. This resulted in the need for an application that could generate pieces of poetry based on the input and choices of the user, this targets people without any experience in knowledge in ingredient combinations, 3D modeling or literal poetry.

With the primary purpose of triggering the memory, the desired interaction for interpreting proposed to start the experience with intuitively stimulating the senses and end with explicit written poetry. This gives the user the chance of an immersive experience as well as ensuring of comprehending the intended memory.

The key challenges has been identified for the three phases: creating, poetry fabrication and receiving. These key challenges will be addressed in the next chapter in order to synthesize the concept. As the end product at interpreting is the focus of the vision and project, the embodiment of the other phases are dependent on the aforementioned.

chapter 6 | Food Haiku's

Goal

Building the concept of a food haiku by defining the characteristics of the food: their arrangement, size, complexity and so on.

Method

The vision was embodied in a physical form of three snacks. This decision was made after an ideation phase and assessing on communicative ability, nature of food printers, eating behavior and fit with the traditional culture. The type of food was defined by determining the portion size, its place in the daily routine and the limitations in complexity.

The possibilities of the snacks were then explored by looking at the relationship between its properties and those of memories. Different methods for conveying scents have been assessed to decide on the most suited and effective method. The chosen method of cold smoking as been tested to validate its effectivity. After unsatisfying results, the choice has been revised. To further create a frame work for the snacks, different types of story elements have been identified by translating various memories into food haikus.

6.1

Composition

This chapter covers:
the framework for a food haiku

Key Functionalities
The physical form of food poetry needs to fulfill its core functionalities:

- clearly communicating elements of a memory
- providing an intuitive interpretation

The physical form of the food will be determined in this chapter. Essentially answering the question of what is to be eaten and how this helps to convey the narrative. This started with defining its physical composition.

A framework for composition
Deciding on a fixed composition was done using the following criteria:

- **Communicative ability:** designing the composition as such so that elements can be clearly interpreted.
- **Fabrication process:** the nature of food printers give a set of limitations.
- **Cultural heritage:** the opportunity to incorporate traditions that makes it specific for the cultural context.

A Food Haiku
After a process of ideation, the chosen composition is derived from the unrhymed verse form of Japanese origin: the Haiku; a composition of 3 sentences, respectively containing 5-7-5 syllables and usually describing a specific scenery referring to one of the seasons. Each sentence holds only one important element per scenery. Although only three, it provides enough space for the imagination and retains its simplicity. The elements are clear yet the story behind is interpretable. Translated to food makes a composition of three key elements of the memory. Although these three might be clear, only the person that shares the memory knows the true narrative behind it - making it an extraordinary intimate way of communicating. Here is how the composition of a food haiku makes sense to the aforementioned criteria:

- **Communicative ability**

Deconstructing into elements gives space to experience the pieces separately. Imagine tasting three ingredients separately, this way it will be clearer to identify these than when these are integrated into one dish.

- **Fabrication Process**

The qualities of 3D food printers lie in the shaping, not so much the assembling of parts. meaning that it would cost more labor to print them all seperately and then assembling by hand. Three separate pieces placed next to each other would perfectly suit the method of FDM printing.

- **Cultural heritage**

Incorporating a traditional form of Japanese poetry using new technology will mark this concept as a Japanese product. At the same time, as the concept of haiku's are commonly understood, the name will help people understand it is about describing a certain scenery.

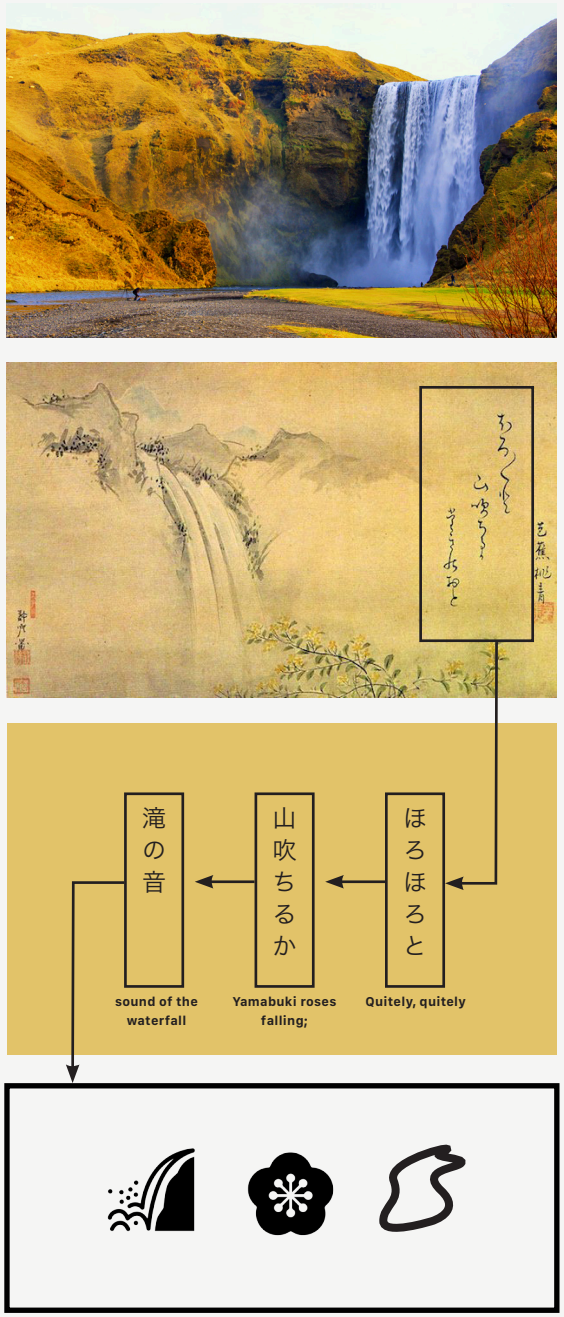


figure 6.1.1 the process of translating a haiku into food elements.

figure 6.2.1 A collection of Japanese traditional confectionery and dish of a tasting menu to give an impression of the envisioned type of food.

6.2

Type of Food

This chapter covers:
Reference mood board
Portion
Sweet and savory
Limitations in complexity

Following the composition choice of a haiku, the characteristics of the haiku pieces need to be defined. The reference board gives an impression of the envisioned haiku piceces in terms of:

- portion
- ingredients, savory or sweet
- complexity in dimensions, color, shape and texture.

The portion

The portion was chosen to be a collection of 3 small snacks, similar to the wagashi sweets that are traditionally consumed during a tea ceremony. The reason for this smaller size is not only due to simplicity, but primarily so that is can be consumed throughout the day, not interferring or replacing a daily meal. The vision proposed a moment to escape from the daily routine. A short break can be consumed somewhere in the afternoon during the coffee/tea break at work or late at night after overworking. Being a small portion keeps this flexibility to be consumed over the entire day.
A haiku piece would be about 2-3 bites, making 6-9 bites in total. This is comparable to a piece of cake or a muffin.

Sweet and Savory

During discussions with Japanese natives, it was often understood that the concept involved exclusively wagashi since it were 1) little snacks 2) enjoyed with tea 3) that described some scenery or story and 4) is shared as a gift. Wagashi is fixed to ingredients as rice flour, red bean paste and matcha, resulting in a subtle and sweet flavor. But a specfic flavor of the food haiku carries information, it is completely dependent on the story. Meaning that it could also be tomato, bacon or curry. In hindsight, whereas wagashi is always a sweet treat, food haiku's can be either sweets or savory snacks.

Boundaries

Following the rule for 2-3 bites per piece, the maximum dimensions are set at 30x30x30mm. This basically means the maximum work area for the printer per piece.

The boundary for the ingredients has been set at 2 ingredients per snack, having the possibility of 6 ingredients in total. Two ingredients per piece because it can suggest some kind of dynamics, such as a contrast in flavor or a gradient in sweetness. Whereas one flavor might be too monotoneous, three would make the identification of flavors more difficult.

Moreover, more ingredients means more ingredient slots in the food printer, which makes the machine more complex as well as bigger in size.

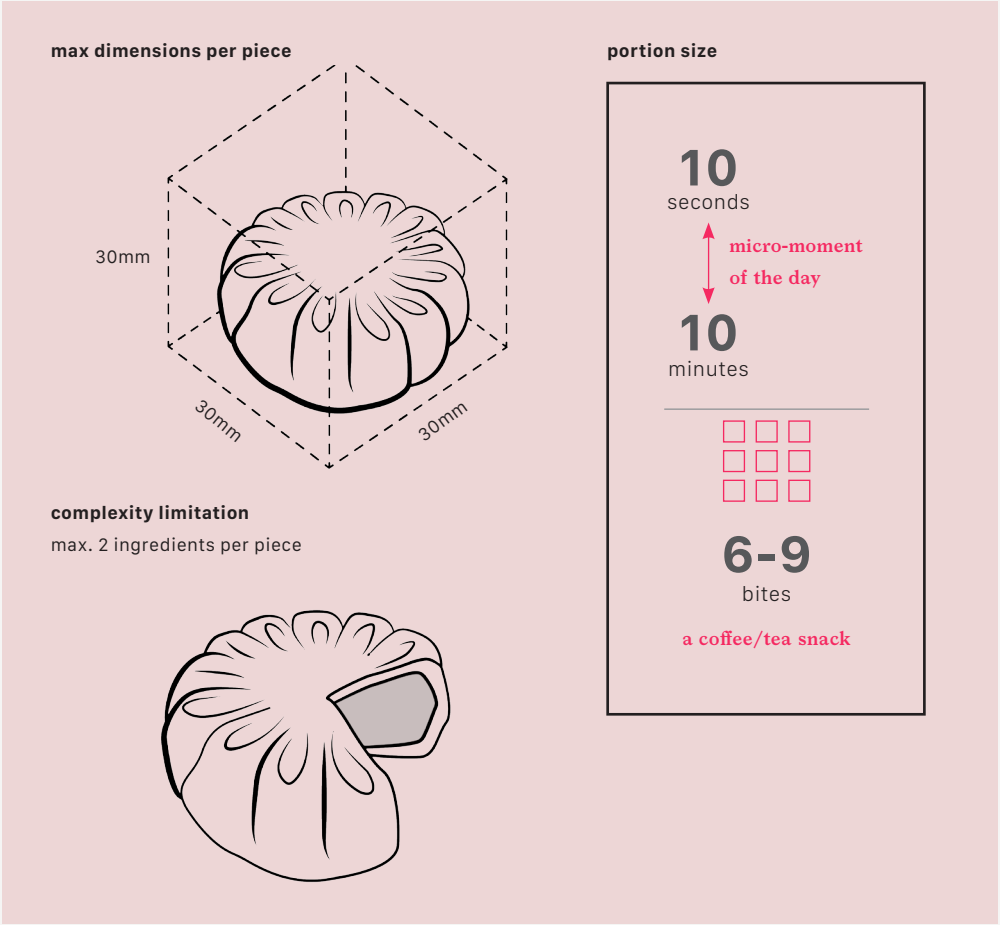


figure 6.1.2 a properties overview of the food haiku pieces

6.3

Narrative Building Blocks

This chapter covers:

1) Narratives and food properties

2) Importance of scent and memory

3) Methods and evaluation

This chapter defines the methods and boundaries of the food and answering the question: "How can a memory turn into food?"

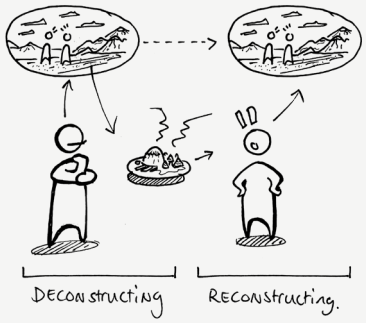


figure 6.1.1 Genuine building blocks contain descriptive information

Narratives and Food Properties

So how does a memory turn into food? Essentially, it takes all the sensorial stimuli from that moment or event and expresses that into food properties (figure 6.1.2). Focusing specifically on memories between two individuals carries benefits. Firstly, in contrary to a newly told story, the memory already exists

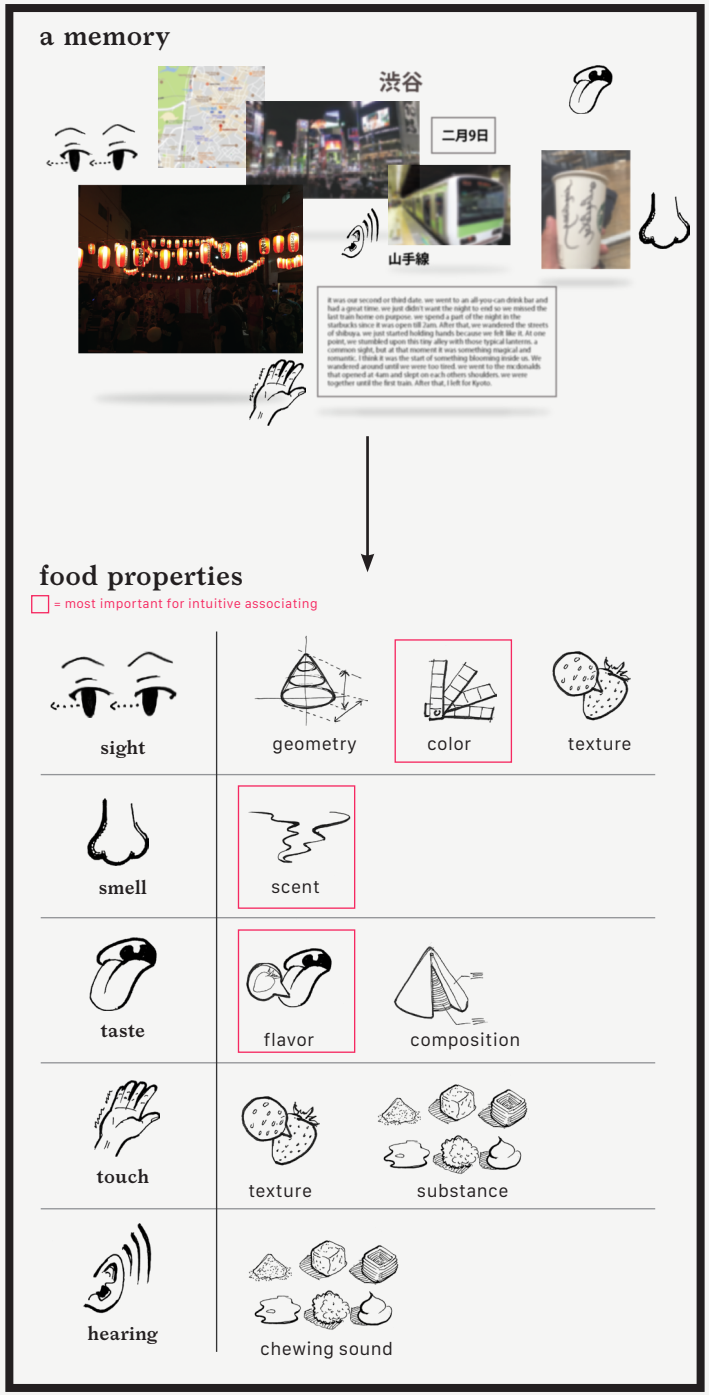


figure 6.1.2 Overview of food properties that carry information

in the mind. This way, the food only needs to make clear to which memory it speaks of rather than communicating the details of what had occured; resulting in hinting at a set of specific elements exlcusive to that memory. Moreover, this allows the elements to be interpreted intuitively by only offering the scent rather than explicit words and shapes. This pursues the associative interpreting of the food and lets the imagination do the immersive work. The risk is that everyone remembers differently; the most striking smell of a trip might not be associated by the other person at or might not even be identified at all. In this case, the value still remains as it is still a gift from the other and is then a conversation starter.

Genuine and Simplified Building Blocks

These food properties are so-called building blocks for the narrative that can be divided in two types: genuine and simplified.

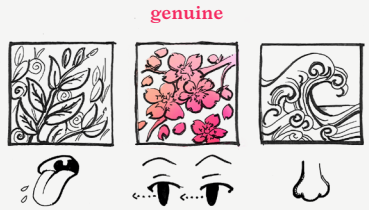


figure 6.1.3 Genuine building blocks contain descriptive information

Genuine types can deliver the true elements of the narrative (e.g. the real smell or color). For example: seeing a beautiful sunset with vibrant colors with the scent of the sea or perhaps even that one amazing date at the barbecue restaurant with all the colored neon lights. Achatz's Autumn scene (figure 5.2.2) is a perfect example of using genuine building blocks to describe the story. The simplified types can only deliver an abstract version (e.g. the shape of the mountain or a texture that should give the feeling of walking in mud).

simplified

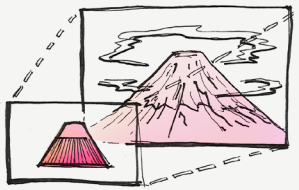


figure 6.1.3 Simplified building blocks represent a certain object

The genuine types are the most important ones as these have a direct link to the memory and will give the most sense of immersion. However, these are only limited to color and scent, in the case where food is included in the narrative: flavor, texture (mouthfeel) and substance.

The most vital simplified-type is the geometry, which is actually more a plating/preparation aspect than an actual food property. As this is essentially used to draw the shapes of objects, it is the most comprehensible and informative building block (but not immersive). In addition, it is worth mentioning that no ingredient will be able to look like its natural form and texture after deposition. Lastly, elements of sound will never be communicated through food as food is unable to reproduce sounds of, for example, the wind or a barking dog. And although some properties might seem irrelevant, the food has another important aspect next to its communicative ability: edibility. “Is it appetizing and delicious?” In this regard, texture, flavor, mouthfeel, scent and temperature are the most vital properties. Obviously the edibility should be above a certain standard as offering repulsive food will most likely be offending in the Japanese or any culture.

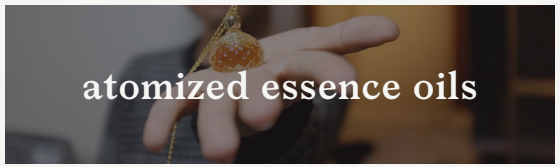
It is vital to assess the possibilities in controlling all of these food properties to determine a set of printer functionalities. As the flavor, color and textures are determined by the food printers, there is not much emphasis on the smell.

The importance of smell

Behavioral evidence indicates that odor evoked autobiographical memories (OEAMs) are older, more emotional, less thought of and induce stronger time traveling characteristics than autobiographical memories (AMs) evoked by other modalities such as visual or word. (Arshamian et al., 2012) In addition, scent carries elements of environments that food usually not has (e.g. scent of moss or wood). This needs to be integrated as a separate functionality. The methods for adding a fragrance to the eating experience are:

The criteria for this choice were:

- Producing authentic scent



- Safety
- Costs / Need for additional equipment
- Intensity
- Visual effects

Weighing the criteria, the cold smoking method was chosen as the best option. It produces authentic fragrances as it directly incinerates the natural elements (flowers, herbs, plants, etc). At the same time, it would cause a magical visual effect during the unveiling. The intensity would be a subtle hint of flavor on the exterior of the food, leaving the inside of the food true to its ingredients. The value of this weight up against the need for implementing extra electronics. As for the other methods, liquid nitrogen was assessed to be too dangerous and would bring too high costs for safety and preparation equipment. Essence oils would suffice with low tech sprays or pipettes, but would not deliver the visual effects. An experiment was carried out to assess and verify the effectivity of a cold smoking device. The test was carried out by using multiple types of burnables with the base wood. The results were that the

scents were all similar with different hints, however not strong enough to identify a difference. One of the test participants mentioned it reminded her only of Christmas and other participants could not associate to any of a memory. Although the method seemed promising and delivered an interesting visual effect but did not have enough range in scent.
Because of the results, the choice has been revised and changed to using essence oils as a way to manipulate the scent (and flavor). The core benefit was the deposition potential: being dropped with a pipette inbetween the layering, being sprayed on the outer surface of the food or even only in the surrounding area not touching the food at all.

After experimentation and further research, the available essence oils were mostly suited for vapor aromatizers and not suited for food and consumption. In addition, the smells were more associated with bathing or relaxation activities than representing the genuine smell. Strong smells of food such as Japanese curry was successfully applied. The experiment posed two requirements: 1) genuine fragrances need to be developed and made available, suggesting collaborations with perfume artists that acquire over the knowledge and resources. And 2) the fragrance needs to be brought to the nose as the food will not have the convection working of steam coming from the food.

In conclusion, the food properties that communicate narrative elements were identified as: shape, color, texture, scent, flavor, composition and substance. The key functionality is providing the intuitive association with the memory. This is done using the genuine building blocks of scent, color, flavor and texture. As scent is not necessarily being emphasized by printers, additional methods are investigated. The use of essence oils is chosen due to their potential in deposition, low technology costs and range of scent. The other building block type is the simplified one, which is a representation of a concept that needs to be understood and is communicated through the shape.

In hindsight, making use of the correct ingredients and textures is key to making food poetry successful. Then, shaping it to interpretable shapes will fortify the communicative ability.

6.4

Element types

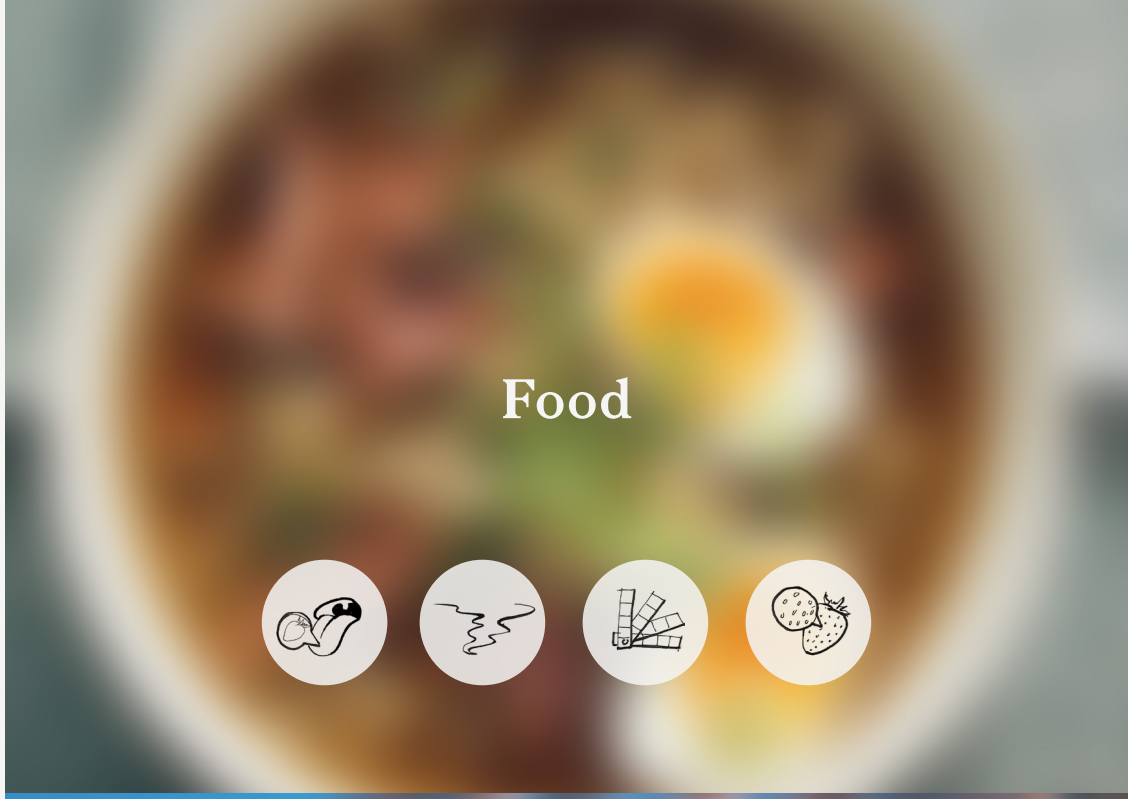
This final chapter combines all the insights from 6.1 to 6.3. In essence the food haiku is a composition of three pieces that embody one element per piece through the food properties of shape, color, texture, scent, flavor, composition and substance. Genuine building blocks were the most important properties and included the smell, flavor and color of an element. However, as memories could contain all sorts of elements, not all elements can be translated into those genuine blocks. For this reason, four element types has been identified, each explaining in which food properties they can be expressed.

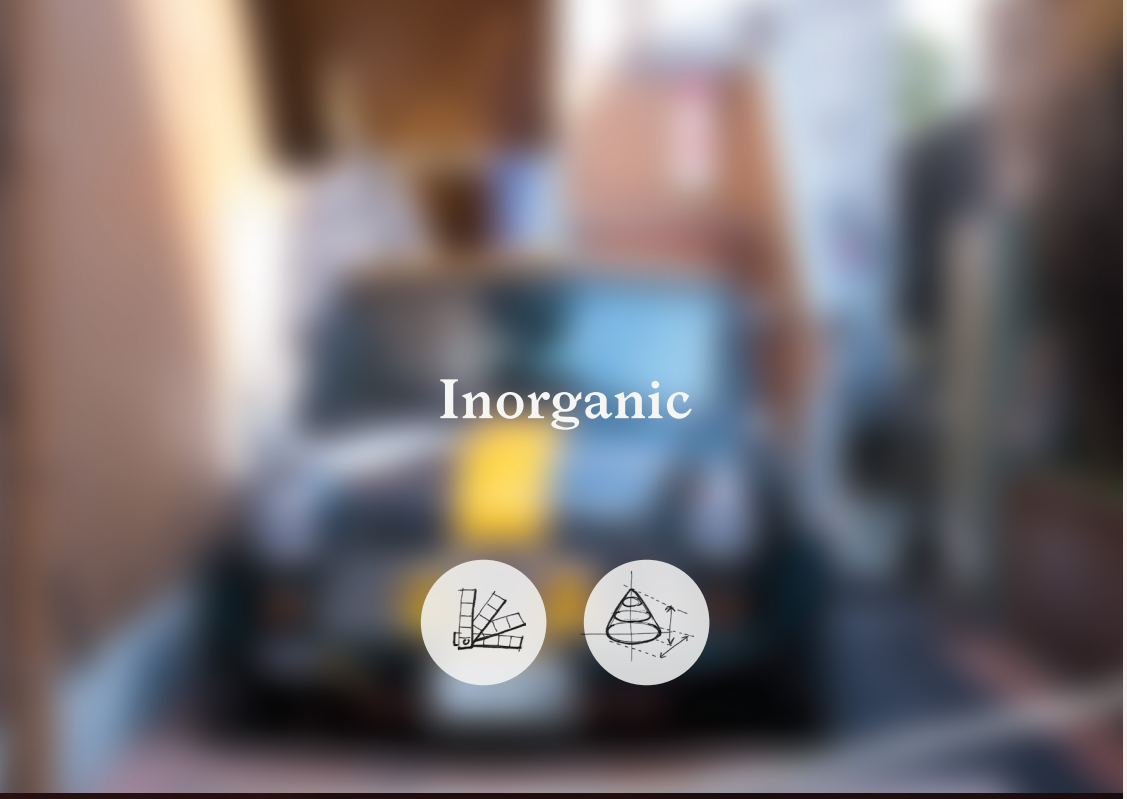
1) Food Type
The most easy one as the same ingredients can literally be copied and can be expressed in its flavor, scent, colors and substances. To emphasize on the flavor/smell, the appearance can be turned into something abstract.

2) Organic Type
The organic type is the type of element that can be expressed in a scent as well as colors. (e.g. flowers or moss). Although having a distinct scent, this does not mean that it has a pleasant taste. For this reason, the scent will be placed separately from the element.

3) Inorganic Type
These elements represent all the tangible objects that do not have any particular flavor or smell (that are pleasant to consume). These will mostly be expressed in their color and their shape. (e.g. a Japanese lantern or a train)

4) Abstract Type
These are the story elements that are an abstract concept or have no tangible shape (e.g. Love or the night) and can to rely on the creator's interpretation for its buildingblocks. For example, using sweet flavors and red colors to express love. Moreover, these concepts are usually expressed through symbolism, giving them a tangible form (e.g. a heart or a moon).





Chapter Conclusion:

This chapter concluded the embodiment of the food haiku and defined its physical form.

The composition of food haiku's

The vision of food poetry is embodied in a food composition of three components, named after the traditional Japanese poetry form of a Haiku. The food haiku both carries a communicative functionality as well as being a form of art, which urged to find its spot in abstraction level. The choice of deconstructing the dish into three seperate components was based on the criteria: ensuring communication, enchantment of the art form, relationship with traditional culture and the nature of 3D printers.

Type of Food

As the traditional gifts consisted mostly out of sweets with typical red bean paste fillings, the food haiku relies on the smells and taste of different ingredients that are related to the memory. This means that the choice of ingredients ought to be faithful to the memory, not the culture and results in in either sweets, savory or a combination thereof.

Having a flexible nature, the portion of the three pieces combined is chosen to be comparable to a slice of cake or muffin. This will not interfere with the daily meals. The complexity limit of the snack is set on two ingredients, six per haiku. One ingredient being too monotone whilst two can strike a constrast or gradient of some sort. Further than two ingredients per snack will lose sight on the emphasis of the ingredient and not fully comprehending the flavors.

Building Blocks

Each snack is built up by an amount of food properties that is dependent on its ability to correspond with the memory element. The properties of food that can embody elements of a story are: form, color, texture, scent, flavor, ingredient composition, substance and temperature. The distinction has been made that between true properties that can offer a intuitive interpretation experience and a simplification of property that conveys the memory more explicitly. With an importance on the scent, different methods have been assessed for its best fit. After testing cold smoking, the method lacked in ranging in wide scents and the use of edible essence oils have been chosen as the method.

Story Element Types

The four story element types are: Food type, Nature type, Inorganic type and Abstract type. Whereas the food can rely on smell and taste, nature type can only relate to smell, both having the ability for an intuitive interpretation. Inorganic elements can not be expressed in (appetizing) smells/flavors and only rely on form and color, thus delivering a more explicit interpretation. Lastly, abstract types are not related to food at all and have to rely on the interpretation of the creator itself.

chapter 7 | Product Service System

Goal

Detailing the complete user experience of both creating and interpreting and stitching all the seperate phases together.

Method

The ingredient building blocks and elements types were used to elaborate the interpretation process into a frame work and was given a physical form to demonstrate various steps and user experience. Subsequently, the creation process bridges the memories with the physical food haiku. The interaction between the creation app and the user was tested in a setup where another human played the role of an AI supporting the process. The feedback was used as input for the framework.

The frame work was formed that included the actions and limitations of the user. Lastly, the complete user journey was defined that stitched all the phases together and gave all the stakeholders their respective parts.

7.1

Interpretation

This chapter covers
1) the desired user experience
2) Haiku Case blue print

The interpretation is the most important part as here the food haiku truly fulfills its purpose of triggering the memory with the reader.

The desired user experience
The desired interaction was characterized as anticipating, immersing and understanding (chapter 5.1). Translating this to a physical food haiku gave an designed reading order that builds up the interpretation of the memory, similar to the metaphors in the interaction vision. The artwork, now in the form of a food haiku, gives away its rough silhouettes, colors and a hint of the fragrance. As the reader approaches, details become clearer by every step (or bite) and a story starts to live in mind of the reader. Lastly, the reader inspects the description and matches it with his/hers — either confirming and gaining new insights on the artwork.

This build-up of anticipation and understanding demanded a specific plating format. Within the gifting culture of Japan, the wrapping and packaging itself carries a great importance for protecting the gift, signaling the reason for giving and as serves as anticipation (a beautiful box must carry an item of equal or higher value) (Noritake, 2014).

A case was created specifically for food haikus that enhances the user experience, focusing on the specific elements of:

- **a reading order that builds up the anticipation**
- **an emphasis on the environmental scent**
- **a clear positioning of the haiku composition**
- **a descriptive explanation after immersion**

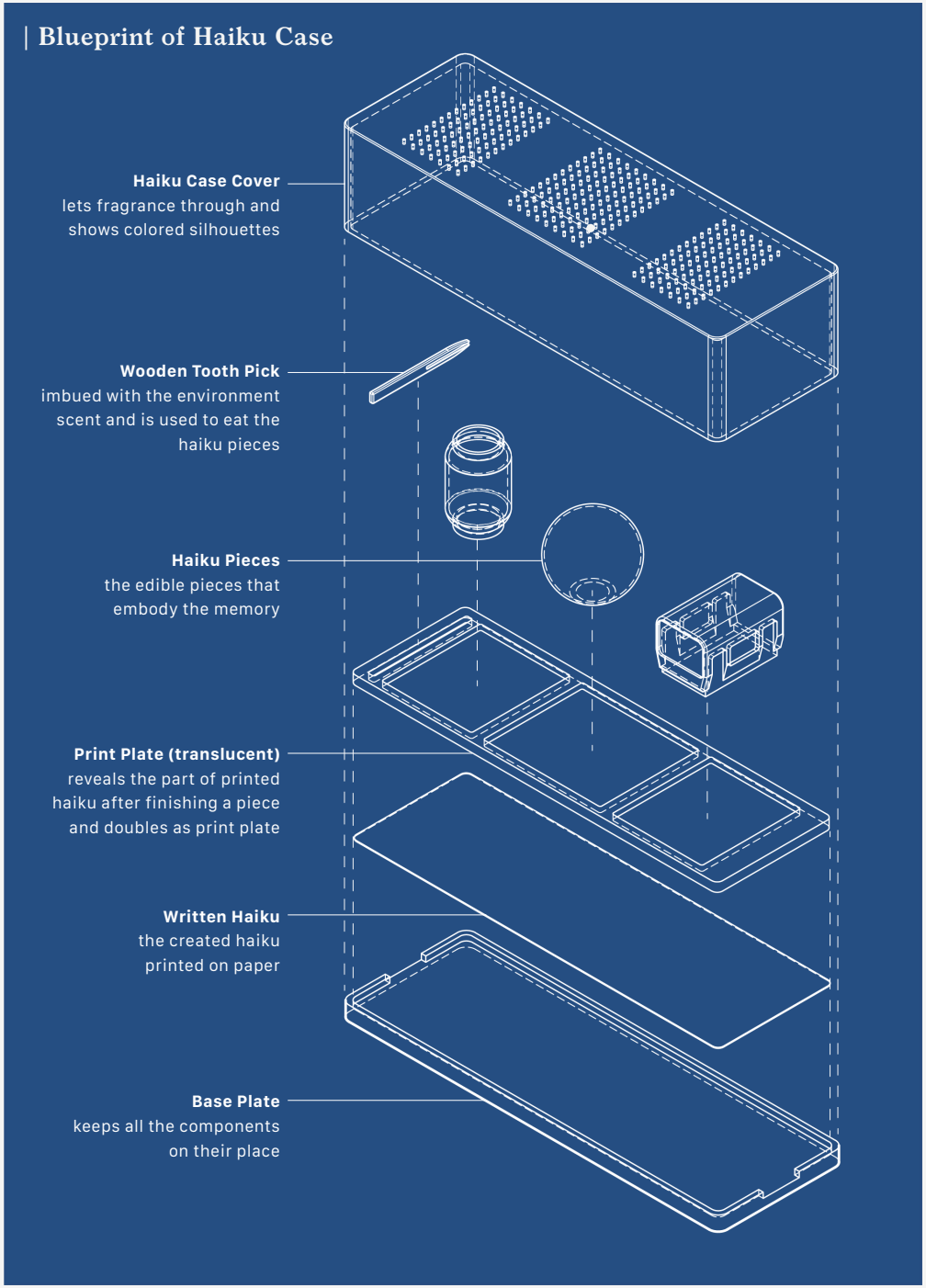


figure 7.2.1 The blue print of the haiku case covering all the elements needed for the user experience.

| User Experience

Although the true goal of conveying the memory can be done by solely the food itself, the case design will enhance the user experience in interpreting the food haiku.

1. First Thoughts

Actions: After receiving the gift from the pick-up point, the reader takes the case to the desired location for consumption, possibly being at the pick-up spot itself or at home. This phase emphasizes working up until the moment the cover is lifted.

Senses: The sight and smell are addressed. The silhouettes and colors already give a certain hint in combination with the fragrance that is subtly coming through the venting holes of the case cover.

Desired Interaction: Anticipation

2. Unveiling

Actions: The reader finally lifts the cover and unveils the three haiku pieces that embody the memory.

Senses: The eyes can now inspect the haiku pieces; their shapes and details already tell a story.

Desired Interaction: Anticipation

3. Setting the scene

Actions: The wooden tooth pick is imbued with the environment fragrance.
As this scent was already subtly present before the unveiling, it is now smelled every time the reader takes a bite.

Senses: Smelling the pick alone will only affect the nose. However, as flavor is largely determined by the smelled aroma, the flavor will be highly influenced smelling the pick's fragrance.

Desired Interaction: Immersion

4. Tasting

Actions: After addressing the sight and smell, the tasting will finally uncover the flavors of the ingredients.

Senses: In the case of food-type elements, the shapes and colors will be more ambiguous and the true information will reside in the flavor. Meaning that the element can only be identified after tasting it. Ultimately providing a intuitive interpretation.

Desired Interaction: Immersion

5. Reading

Actions: After finishing one of the pieces, the print plate reveals the written haiku and provides a descriptive yet poetical explanation. The written piece will have the highest probability of element identification (if not already in the preceding steps).

Senses: Sight

Desired Interaction: Understanding

6. Connecting the dots

Actions: After finishing all three pieces, the complete haiku is revealed. The memory should be clear by now if not already.

Senses: Sight

Desired Interaction: Understanding

7. Wrapping and rolling up

Actions: The written haiku is then taken out and rolled up. After assisting the reader in clarifying the memory (if it was needed), it now acts as a more permanent memento of the gift in the form of a fortune cookie print.

Senses: -

Desired Interaction: Appreciating

8. Sealing the haiku

Actions: Now doubling as a paperclip, the scented pick and the now written are reunited into a single small object, as a take-away of the experience. (*after the pick has been wiped clean with a napkin)

Senses: Only the scent will remain after the experience and will lose its intensity over the following days. With the written haiku being more permanent, the food haiku has a multiple time frames in which the elements can be experienced (food in minutes, scent in weeks and paper in years).

Desired Interaction: Understanding + Appreciating

9. The conversation starter

Actions: As the experience has ended, this moment signifies how the reader will decide to reply and, if using food haiku, which memory to address.

Senses: The memories

Desired Interaction: deeper connection with the other | the desired end-state defined in the context vision

7.2

Creation

This chapter covers
1) The human-robot interaction
2) Product elements

The human-robot interaction

The desired interaction for the creation process proposed a directing role for the user, outsourcing the creativity skills to the digital agent. This human-robot collaboration would give much of the control out of hands. For this reason, the interaction between human and robot has been explored in a user test (Appendix H) to get insights on the limitations, freedom and support of the agent that the user could desire. In the test setup, the human had to communicate with a digital agent and direct the creation process of the food haiku. The role of the moderately intelligent digital agent was done by a human where the contact could only be done through written text, replicating textual input on a screen. The output of each process step was then constantly redrawn on paper. The following insights were the most important in designing the creation process for food haiku's:

- **Struggle to recall memory**

Participants had a hard time recalling the memory and with making associations to smells, flavors and textures. Due to the conversation-based communication, textual input was not enough and additional formats such as photos were requested to be used. Effectively, analyzing the photos could help in recalling forgotten aspects (that might be important to the reader).

- **Sense of creative ownership**

When creating a haiku for an important occasion or relationship, the participants needed to have full authority on choosing the ingredients and details; shifting the role of the AI to only suggesting instead of actively creating.

Combining the vision, desired interaction and insights of the user test, a creation process app was created to achieve the desired user experience for creating food haikus. The focus was laid on the specific elements of:

- **Support in recalling the memory**
- **Nominating the most suited elements**
- **Decision making with suggestions by app**
- **Ability to revise the haiku outcome**

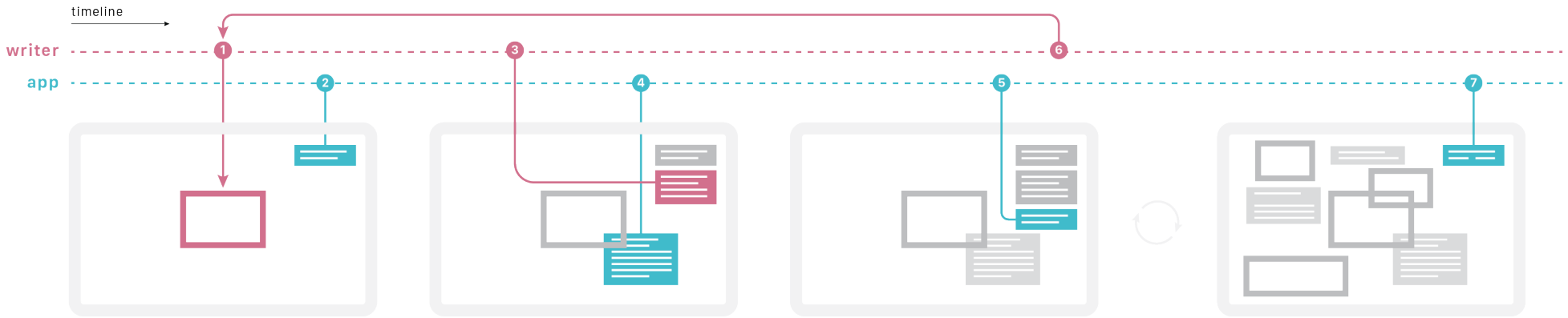
1. Building the narrative

Rationale: As the user test indicated, people will have trouble recalling the memory. This phase helps the user in creating an overview of the narrative and trigger forgotten elements.

Writer actions: collecting all relevant material for the food haiku simular making a mindmap of the memory. And can use mainly words and photos as input.

App actions: needs to acquire two things: 1) the key elements to the narrative and 2) the physical details of those. Using text (strings) and photos (keywords related to visual recognition), the app identifies the elements and can search for links such as color, taste, smell, textures to ultimately translate to food. The questions will also extract food and organic-type elements (e.g What did you eat that moment or day? Any smells that evidently appealed to you?)

Desired Interaction: Directing with assistance - The writer may know the story, but does not necessarily know what is needed to make a successful food haiku. The app guides the writer in finding these details.

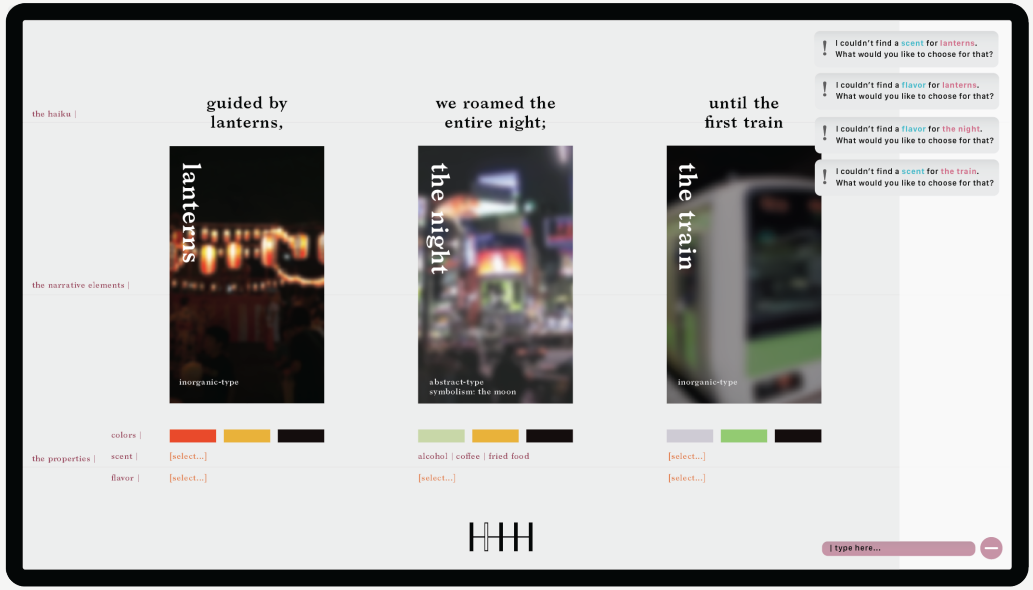


1) writer uploads content (photo/text) to build build up the memory narrative.
2) app asks details to find relevant elements and associations to food properties.

3) writer inputs details
4) app identifies keywords and implements the content to the collection.

5) app asks for details on newly identified elements to expand the narrative mindmap.
6) writer inputs details in the form of photos and text.

7) After finding 3 solid elements for a food haiku, the app asks to procede to the next step or if the writer has anything to add.



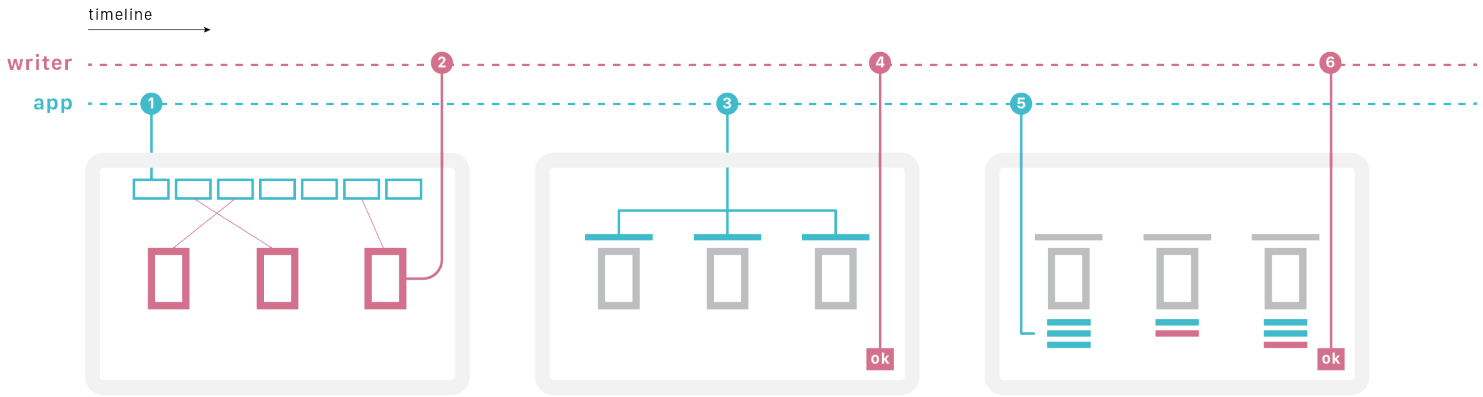
2. Writing the Haiku

Rationale: Filtering out the less important elements and preparing the transition from words to food.

Writer actions: choosing the most essential elements of the narrative and listing out his/her preferences for the textual haiku and the food properties.

App actions: identifying all the narrative elements and categorizing them into the different types (food/organic/inorganic/abstract). Ultimately, it uses the details of the narrative as well as the ones found on online databases to create this profile that tells the colors, smells, flavors of the elements.

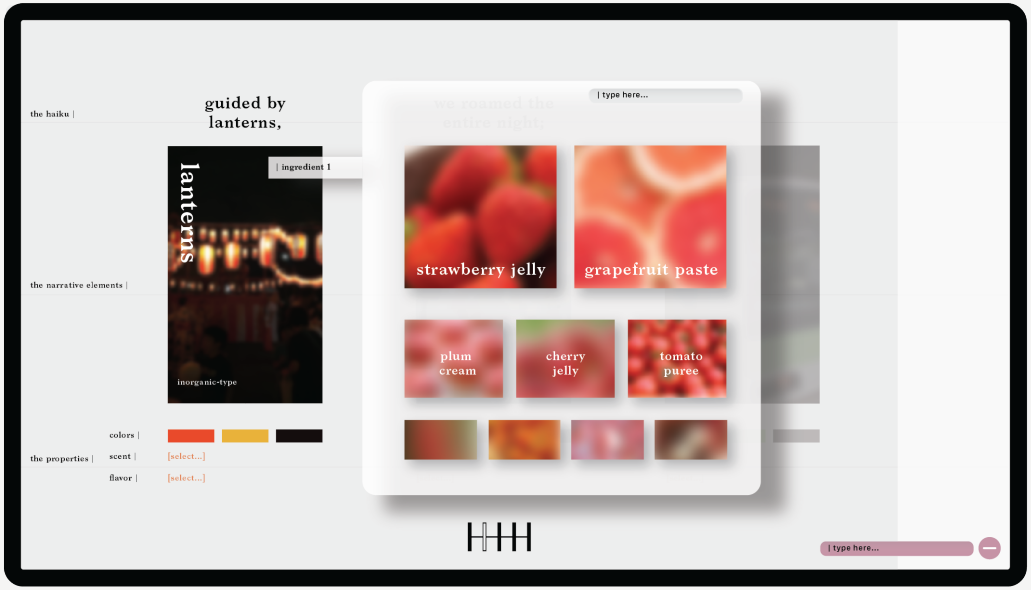
Desired Interaction: Not finding but curating - as the app fetches the elements and their properties, the user simply only has to choose. In the case of no found property, the user must provide its own interpretation.



1) app lists all the identified key elements and emphasizes on the food/organic-types.
2) writer picks the three most important elements to be used.

3) app generates a textual haiku using the three elements.
4) writer is able to revise the haiku. If satisfied, it can proceed.

5) app categorized the elements into food/organic / inorganic / abstract-type and searches for properties associations. If unsuccessful, the writer is asked to provide a selection.
6) writer inputs own interpretation or expected food preferences of the reader.



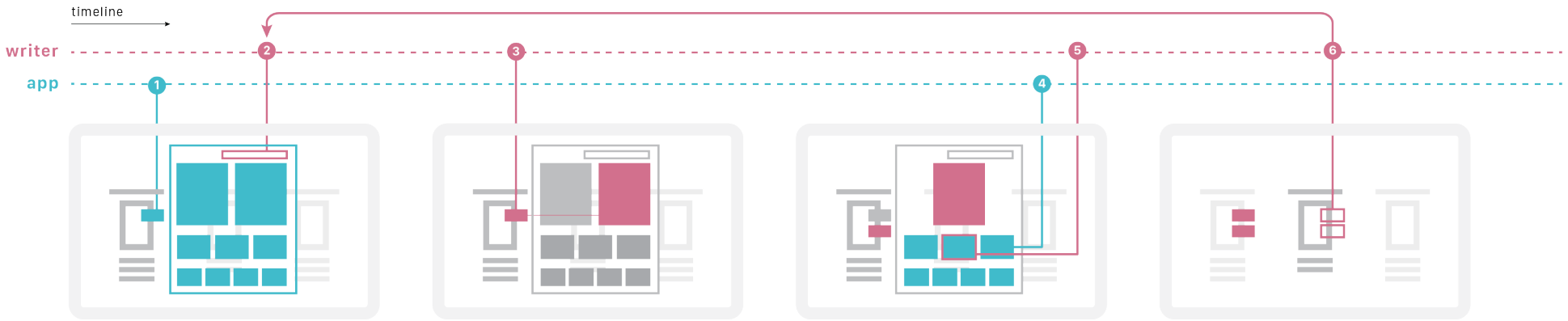
3. Choosing the ingredients

Rationale: This phase bridges the properties of the element with the actual ingredients that will be used.

Writer actions: choosing the right ingredients that will make the food haiku. The biggest pain point is that the writer is not able to smell nor taste any ingredient through the screen. If tasting is desired, the writer will have to visit a designated printing location.

App actions: Using the properties of the previous step as input to filter the most suited ingredients that are available for printing. After the first ingredient has been chosen, the apps uses food pairing algorithms to determine a fitting ingredient, similar to IBM's Chef Watson (figure 3.5.3).

Desired Interaction: Curating, not finding - the app already lays out the options that are available for printing and matches the criteria. Simplifying the process for the writer to only the choosing, not the acquisition of ingredients.



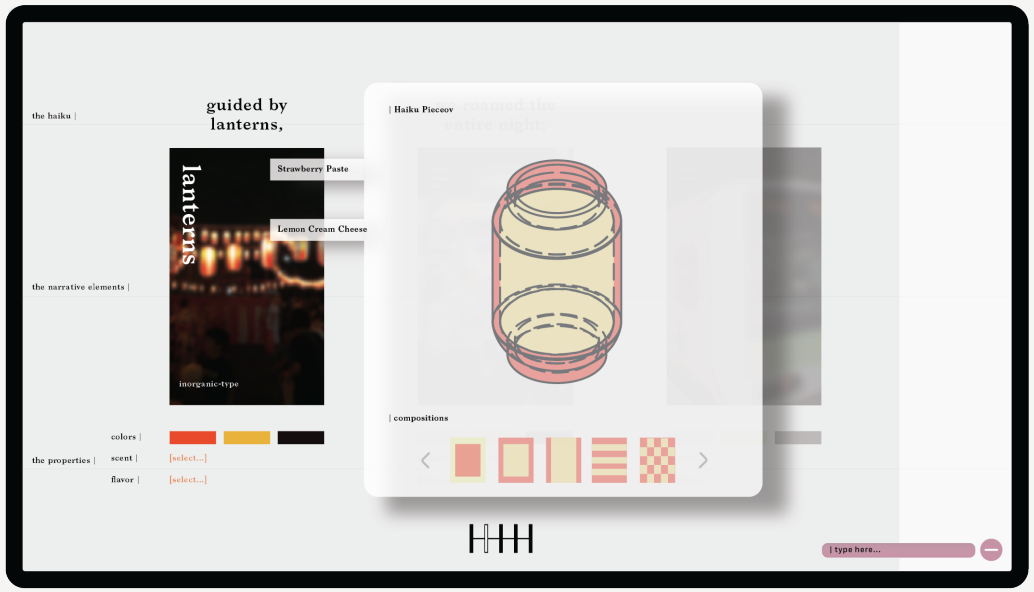
1) app suggests the ingredients that match the previously defined element properties
2) writer can either pick from the selection or search him/herself if there is someting in mind.

3) writer selects the ingredient and its substance (depending on what is being offered)

4) app suggests options for the second ingredient that goes well with the first using ingredient pairing software.

5) writer selects the second ingredient and substance.

5) writer repeats same procedure with the remaining elements.



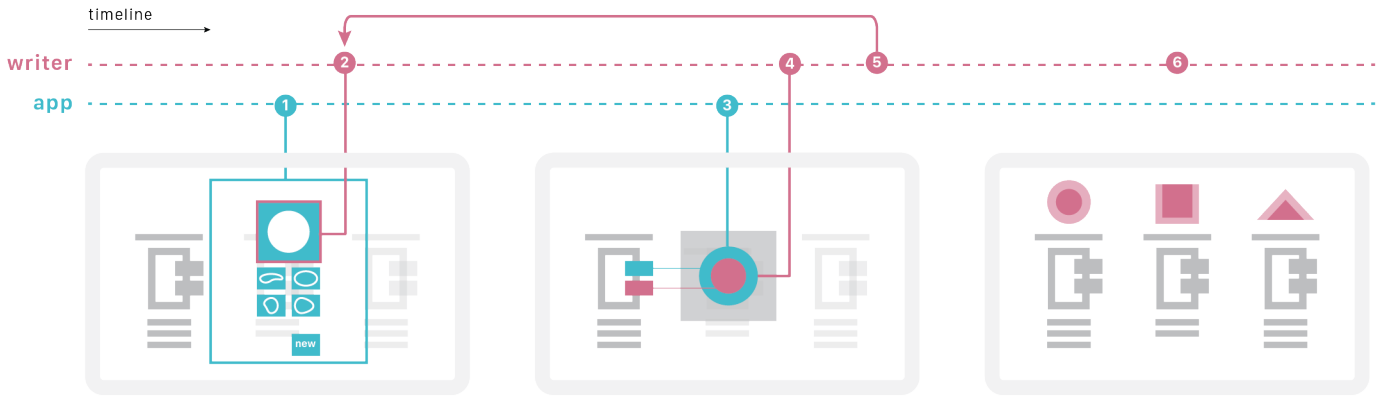
4. Shaping the geometries

Rationale: the final step that defines the physical using the ingredients that have been determined in the previous step. As the ingredients carry the most intuitive information themselves, the shapes can be very abstract. In the case of inorganic or abstract-type elements (Chapter 6.4), the shape will carry the important information.

Writer actions: Choosing from the suggested shapes. If desired, the writer can create a 3D model from scratch (as the conventional 3D modeling software). Afterwards, the ratio of the two ingredient is decided using predetermined compositions. Lastly, the writer reviews the end result and to edit or to send off to the reader.

App actions: Fetches relevant geometries in 3D model databases based on the keywords of the elements. Suggests an ingredient composition based on their substance properties.

Desired Interaction: Curating, not finding - the app already lays out the options that are available for printing and matches the criteria. Simplifying the process for the writer to only the choosing, not the acquisition of ingredients. Ultimately, the writer can go through the process unlimited until satisfied with the food haiku.



1) app suggests the shape possibilities for the selected ingredient textures. If really neeeded, the user can start the 3D model from scratch.

2) writer selects the desired shape and can edit if needed: size and shapes.

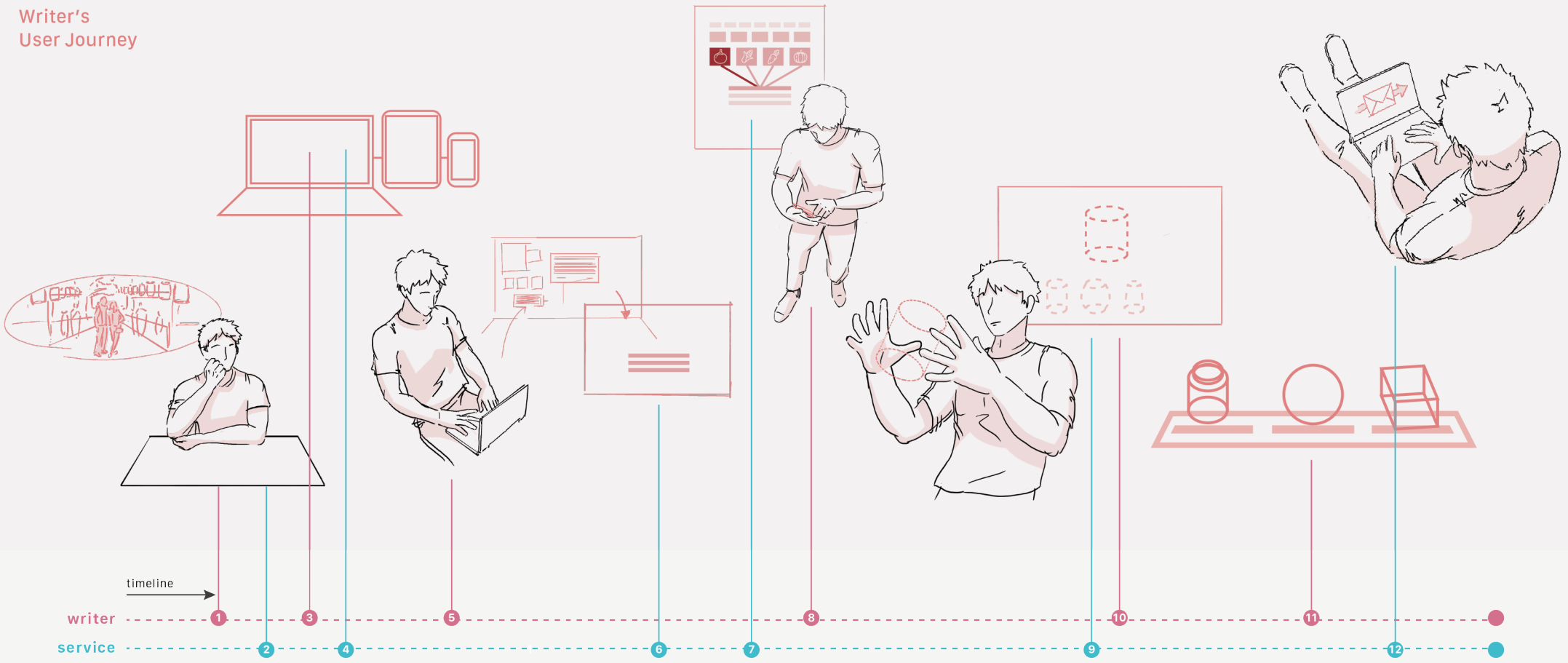
3) app makes a standard composition of the ingredients.

4) writer is able to edit the composition if desired.

5) writer repeats same steps for the remaining elements.

6) writer reviews the complete food haiku: the geometry, ingredient combinations and written haiku. From this point the writer can edit or send of the digital file to the reader.

Writer's User Journey



1) Remembering: thinking of that person and remembering a precious memory with him/her to send as a food haiku.

2) Product Exposure: comes into contact with consumer.

3) Signing up: uses the food haiku application that for the computer, tablet or phone and can switch during the process.

4) Tutorial and Examples

5) Narrating: writes out the memory and collects photos/ videos in the app to remember the complete memory.

6) Haiku: proposes a set of three elements that are essential for the story.

7) Printable Ingredients: suggests ingredients that relate to the memory, or assists in choosing the writer's own interpretation. These are chosen from the complete offering of ingredient suppliers.

8) Choosing ingredients: chooses the ingredients that will be responsible for recalling the memory through scent and taste.

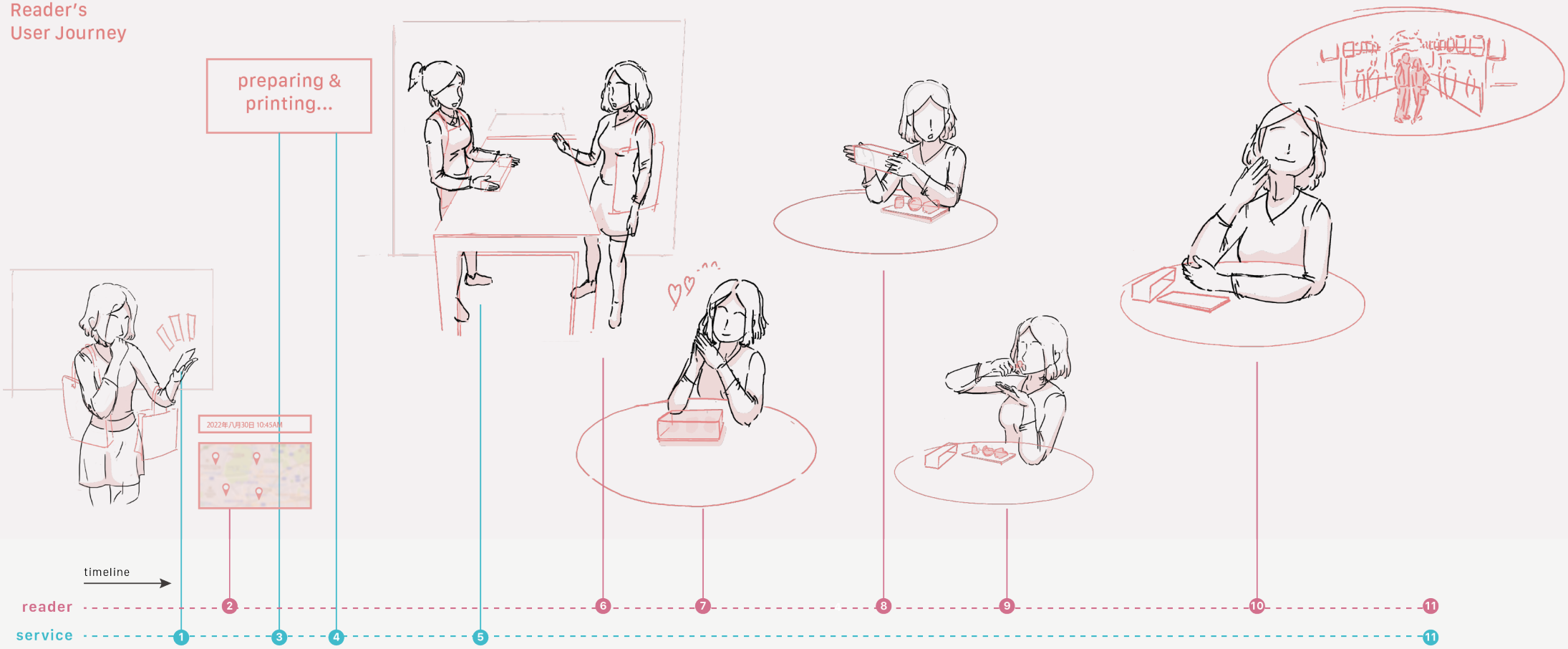
9) 3D model Database: suggests shapes related to the memory elements by linking the key words of the elements with those in the 3D models database.

10) Creating the composition: decides on the 3D shape of the snacks. can choose from suggested shapes or make own 3d shapes.

11) Reviewing: reviews the complete digital haiku before sending

12) Final Check + Send off: checks if the digital recipe files contains no errors that will result in an unsuccessful print. sends the digital file of the haiku as a message. confirms payment, and only pays when the haiku is printed.

Reader's User Journey



1) Receiving: a notification of receiving the printed file.

2) Requesting pick up: chooses a convenience store or coffee house as pick up point and time that suits her schedule

3) Planning and Collecting: plans the printing job at the desired location and time. The needed ingredients are collected from the storage or made on the spot and prepared for print.

4) Printing: the print is initiated in time to ensure a seamless pick up.

5) Packing up: the printed haiku is ready and placed inside the packaging with all its components.

6) Picking up: identifies herself at the desk and receives the printed haiku and it has already been paid in advance.

7) First thoughts: sits down and notices the smell, colors and silhouttes coming through the box.

8) Unveiling: opens up the box and sees the collection of bites. already she is starting to form the memory in her mind

9) Tasting: notices that the pick is scented and smells the scent with every bite. the taste and smell of the snacks are starting to tell a story.

10) Recalling: finishes one of three pieces and reveals a part of the written haiku on the bottom. finished the entire food haiku and recalls the entire memory.

11) Conversation starter: the second part of the conversation begins here. The reader will initiate the process as a food haiku writer.

7.3

User Journey

This chapter covers
1) The Creation app
2) The Printing Hosts
3) The Ingredient Suppliers

The complete user experience showed the roles of the stakeholder in the user journey swiftly, this chapter will elaborate on them.

The Printing Hosts

The food printers will not be owned individually but by external parties that hosts the printing process and oversees the ingredients. Receiving a food haiku is dependent on having access to a food printer and not owning one. Whereas ownership carries benefits as direct access, it also brings burdens in maintenance, higher startup costs, access/ storage of printable materials or simply sacrificing valuable living space. A personal home printer will most likely not be producing multiple food haiku's a day, but rather once every other week. Maintaining and storing of printable materials will always remain an issue as the user needs access to a wide variety of materials.

In addition, the printing hosts are a pick-up service, not delivery. This is chosen because of several reason:

1) flexibility: Food haiku's are not a daily meal but something that you want to eat when you are in the mood. In the case of conserved confectionery, this bares no problem, but in the case of food with textures that will disintegrate over time, it is best eaten right after print. Imagine a food haiku being delivered and left at the doorstep or mailbox for hours.

2) Physical distance: the same counts for long-distance exchanges as this cannot ensure the quality after delivery.

3) Cultural traits: gifts are never opened in the presence of the gifter. Unless it is an omiyage/temiyage, it is eaten and shared on the occasion. But since this gift is very intimate. it is best enjoyed in solitude and a comfortable place.

The Ingredient Suppliers

Ideally, all the ingredients should be available on all the printing spots. This is not realistic in terms of business sustainability. So instead, when creating a haiku, an ingredient palette of a certain brand is used. So for example, starbucks has this palette of ingredients, that will be used for creating haiku's under their hosting. If they don't have the ingredients you need, you can look for other suppliers/hosts that do. This will make prevent the printing hosts of needing to possess the ingredients of all the suppliers available. This would result in coffee houses, department stores, convenience stores, health centres (gyms and spa's) carrying their own ingredient palettes and printers.

Chapter Conclusion:

Interpretation process

The desired interaction demanded an intuitive interpretation that would give space for the imagination as well as ensuring a message comprehension. The haiku case has been designed to satisfy this. The case builds up the story by exposing the sensorial buildings blocks in a sequence: starting from scent, to visual, to taste (and smell) to lastly explicitly reading the haiku.

Creation Process

The user test simulated the interaction with another person as creating assistant. The users indicated the need for more control over decision making when it is an important occasion. This defines the role of the application, a suggestive functionality where the writer still has to choose themselves.

Complete User journey

The complete overview of the user journey has been defined using the creation and interpretation process as its base.

Printing and Ingredients

Printing at home is not efficient due to low frquency, vast amount of needed ingredients, as well as maintaince and investment costs and a lack of living space. Therefore the printer is located out of house and placed at convenience stores and coffee houses that act as the infrastructure. The ingredients will be available at the printing locations. In the case of purees, they will be stored in frozen form and prepared by the staff upon printing. The receiver can check the availability of ingredients using the application.

Appreciation

chapter 8 | Evaluation

Goal

Evaluating the project by assessing its current state with the proposed initial goals of meaning innovation, fitting the cultural context and implementing 3D food printers. Finally evaluating the project how it has progressed, reflecting the actions and attitude of the student.

Method

The evaluation was focused on the three pillars of the project. Assessing the innovation in meaning has been done with incremental steps over the entire process. For the evaluating the value of the vision and the concept within the cultural context, 8 Japanese designers and researchers that live in Tokyo have been interviewed over video call or an email conversation. For evaluating the role of the printer, a plan has been laid out how this product service system could potentially develop starting today, assessing its dependency on printers.

Eventually, this led to evaluating the feasibility and its potential to grow in the future along.

All these have been digested and translated into concrete future recommendations to continue the concept development.

Finally, the progress of the students actions and attitude during the project have been assessed by answering three questions: which incidents have occurred? How is it interpreted and explained? How will this gain insights for future career?

8.1

Evaluating the vision and concept

This chapter covers
1) Innovation in Meaning
2) The role of 3D printing
3) Cultural context evaluation

This chapters retrospects the entire process and if the initial goals were achieved.

Innovation in Meaning
The project started with the goal to change and (re)define the meaning of 3D food printers. As the project progressed, the focus shifted from the printer to the printed food; in this case, personaized food. And as the meaning of personalized food was focused on hyper specialized nutrition, the vision focused not on the physical but mental wellbeing. As food haiku's are designed so that only the intended person can 'consume'/ interpret these, it posed a new form of personalized food. In conclusion, the innovation in meaning is successful by redefining food not as a functional commodity of nutrition but as a new medium for intimate relationships.
In addition, the introduction posed two general questions: "Where does it fit in our lives" and "Will it be able to make good food?". The first question essentially sought the answer for the meaning innovation. In this case, the answer would be: "It fits in our lives as means to share memories and appreciate our relationships". As for the latter question, this project had not focused much on the physical quality of the food; appetizing, texture control, sustainable ingredients, etc. Rather, it focused on expanding the quality to nurture the mental wellbeing of the individual. In hindsight, it is good food for the heart and the mind.

Where does it fit in our lives?
-
How will it be able to make good food?

Role of 3D printing
The effect of food haikus can still be acquired without a 3D food printer, yet the result will not be similar if the human does not possess over the precision of a robotic arm. In the case of food haiku's, since every haiku already consists out of three different elements, doing this by human hand would be too time consuming and therefore economically ineffective at the envisioned scale. In addition, food printers make the act more accessible to long-distance exchanges and flexible in choosing the moment of consumption. In conclusion, although the food printer is not necessary for reaching the end state of memory reliving, it is essential in provding an optimal user experience.

Cultural Context Evaluation
The goal of evaluating the concept with Japanese users is to determine the value of food poetry within the cultural context. Instead of offering validation, the evaluation should offer insights through in-depth interviews for recommendations.
The 8 participants were all native Japanese citizens between 20-35 years old living in the city center. The participants are familiar with 3D modeling and design and will therefore discuss more the value of the concept instead of how it could be made. Due to the location difference, the interviews were done using skype calls and web blog presentations.
The interviews and conversations included topics on:

- The value for the individual
- Occasions and relationships
- Types of Food
- Integration in daily life
- An open-end discussion

Results

- **Understanding the concept**

immediately understood the concept as haiku's are also used to portray a certain scenery and own memory from the nature in a specific season. The relationship with wagashi was then quickly made. Lastly, the concept was highly appreciated as this was seen as a modernized version of the traditional tea ceremony, in which wagashi that represent the nature and seasonal scenery are consumed.

Occasions and Relationships
Since the connotation with the traditional gifting culture was so strong, it meant that they could only see the food haiku's being used on these specific occasions. The idea is that the concept needs to be applied outside of the conventional occasions. Although it is beneficial that people will understand the concept of a haiku easily, the association with the existing causes them to not see the differences and therefore its true value.

“Sharing is important, but should be done without strong expression.”

One of the participants emphasized that within a culture, one is expected to stay humble and collected. Meaning that you cannot strongly express your feelings. He then indicated that the subtle and implicit way a food haiku communicates strong feelings is a perfect fit for the culture.

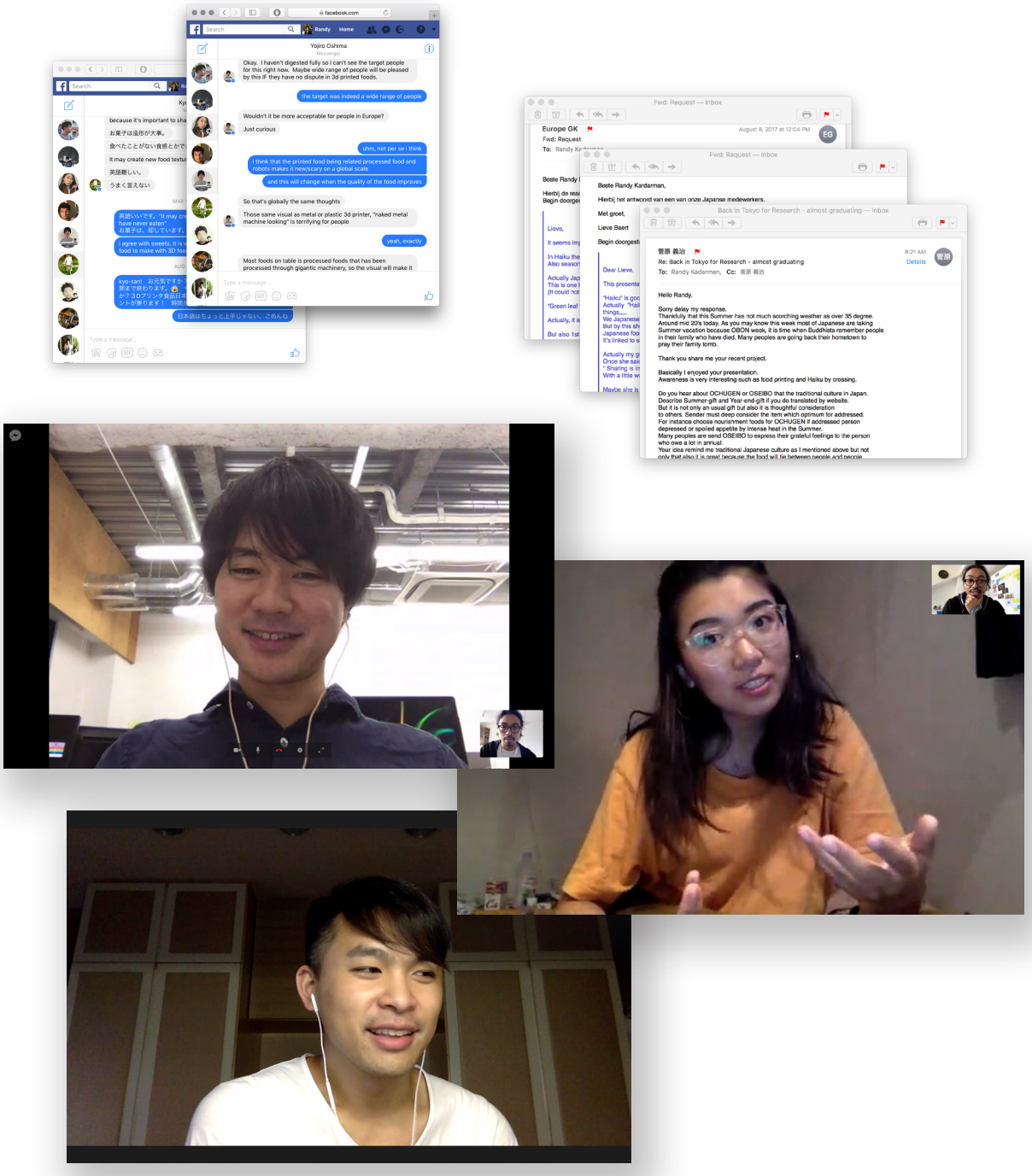
But what about Amazon.Jp?

The most important topic was whether the value of food haiku’s was high enough over gifting alternatives. Participants indicated that Amazon.jp was basically the way to go when sending someone a gift. And as the offering is so wide, the question was whether the hyper customization of food haiku was really necessary. This question was all the more important as the concept required a tremendous amount of investment costs.

Lastly, one of the participants ended with:

“I think you should definitely do it.”

Saying that the first steps can definitely be possible with confectionery artisans and that the concept can definitely be an added value to the lives of the Japanese consumer.
In conclusion, as the implementation still requires elaboration, the value is a success.

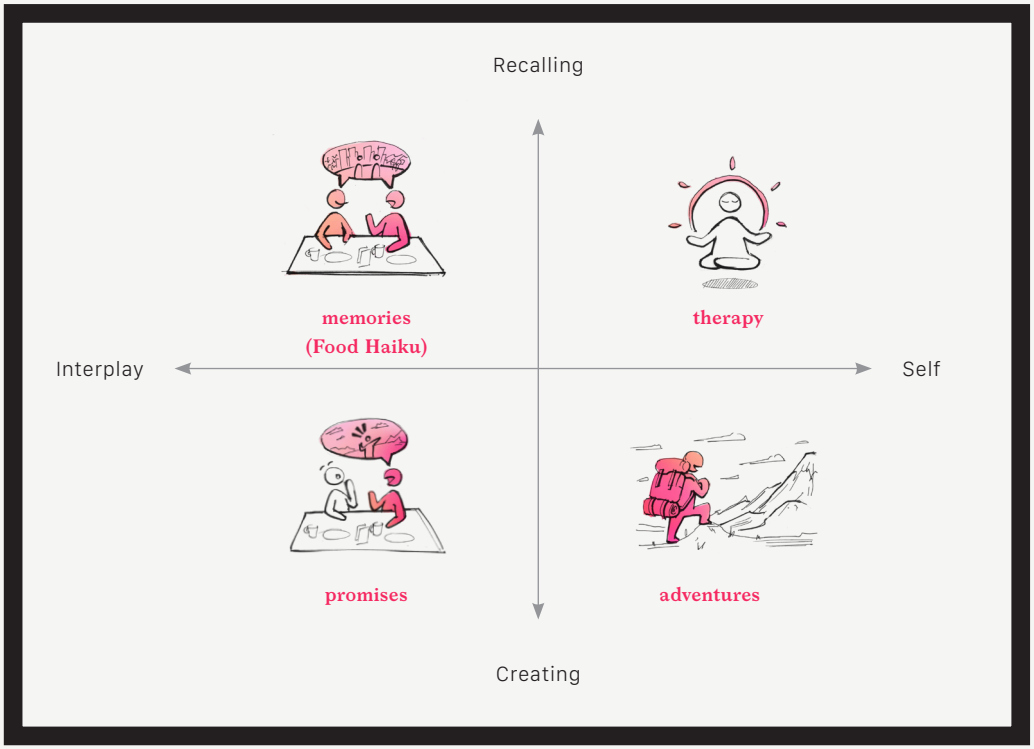


8.2

Potential

Future Potential

As the frequency of sending a food haiku is expected to be low, placing food printers at various locations over the city would seem to be a negative cost-return ratio. However, the vision of food poetry proposes telling stories through food. The graphic proposes different types of relationships with respective formats. ‘Memories’ are existing stories between two individual, this is the focus of a food haiku. ‘Therapy’ is an existing memory that is shared with only yourself. This could be used for leisure (as if you would play an old favorite song) or nurturing the mental health (anxiety, depression, dementia). ‘Promises’ are basically future haiku’s where the memory or idea only exists in the mind of the writer. As food haiku’s are specifically designed for personal relationships, different forms of poetry can be designed for commercial relationships between brands and consumers. This is the playfield of ‘adventures’. This proposes the brands of popculture (fashion, video games, anime, movies, manga, etc) to be extended into the realm of food and being able to offer a more holistic customer experience. Scaling up the use of food poetry by expanding the types of relationships would effectively justify the costs of implementing the 3D food printers across the city (and globe).



Types of formats in Food Poetry

8.3

Future Recommendations

Recommendations

The recommendations for further development cover three areas: 1) creation process simulations, 2) food printer design and 3) logistics of ingredients.

In terms of concrete steps, firstly, a large number of food haiku's need to be fabricated using a functional creation app, to ultimately let the receiver consume the true representational food haiku.

Secondly, a 3D printer that streamlines the haiku fabrication needs to be designed. This would primarily aim on combining the different end state of the ingredients: puree, foam, liquids, atomized perfumes and even texture control. In otherwords, a feasibility check if the different methods can be housed in the same printer or whether the process needs to be split up.

Thirdly, the logistics behind the availability of the complete range of ingredients at every printing location. There is a need for backwards engineering, the food is decided on its story telling ability and needs to be further assessed into the logistics and even its origin in terms of sustainability.

8.4

Process Evaluation

This chapter covers:
1) Deliverables
2) Student Reflection

Deliverables

The initial deliverables were stated as 1) a demonstrator of a food printer and 2) an offline/online presence of the project. As it turned out, the first has not been achieved due to a turn in events. The nature of the project changed from the design of a printer to the design of the printing application and its service. This laid focus on the food instead of the printer. The primary goal was to craft a vision for food printing in the cultural context. Due to inexperience and underestimation, the assumption was made that the printer could be designed after crafting the vision and designing the food application (all this in less than 6 months.

The second part of the deliverables were the online and offline presence. The online presence was done through a blog that posted the contents of the project so that it could be shared with the coaches, interviewees and interested parties (in the Netherlands as well as Japan). Furthermore, the vision video (and later the concept video) are publicly shared on Youtube, as the end goal of the Verganti theory urged the design student to partake in the design discourse himself and share his vision to influence others. This has been done over email, social media as well as in real life in Tokyo. The goal is to interact with design and food blogs to share the vision behind food poetry. Furthermore, the concept has been entered at the Future Foods Design Awards for the Dutch Design Week 2017. The goal was to gain offline and online exposure if the project would be nominated.

In conclusion, the initial deliverable of the printer demonstrator has not been achieved due to the change in focus. Instead, a conceptual service system and a mock-up model of the product has been delivered, which will be elaborated during the final presentation. The presence consisted of an online blog, video content on social media, discussion within the cultural context and a competition entry for online/offline exposure.

Student Reflection

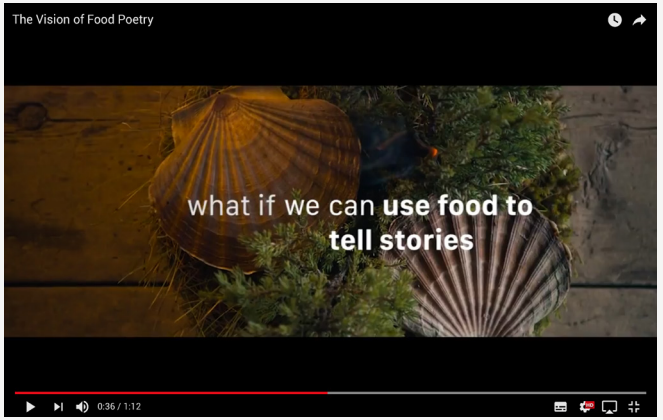
Lastly, it is needed to reflect on the actions during and attitude towards the project to come up with meaningful insights for the future career. After all, failure is a feedback system.

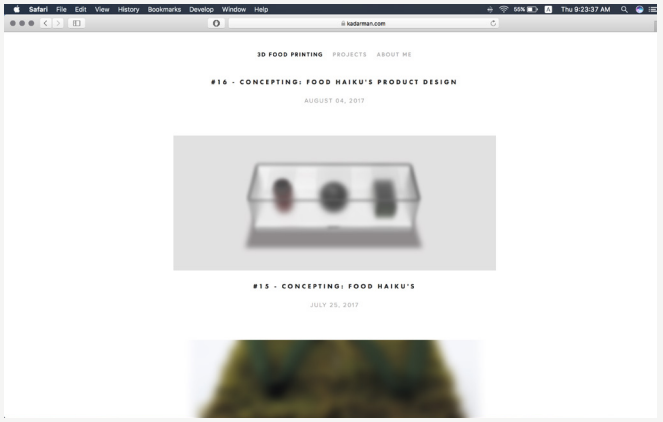
- **Decision making**

The most evident hurdle was by far making the decisions on the project direction. As the project was explorative, the possibilites are boundless (a recipe for destruction). This had two consequences: 1) procrastination in deciding and 2) playing it safe. This ended up in unnecessarily overcomplicating the project. This happened when: choosing the type of user, the contextual factors, the type of relationships for sending food poetry, choosing the type of food and even the physical form of the haiku. The notion of "we need to keep all the options open" was a direct product of the lack of confidence in the direction. A lot of valuable time was lost during the hesitation which ended in less results that planned. The gains are the exercises in decision making as this was done far more effectively during the final phases.

Focusing on the wrong thing

The initial goal was a design of a food printer. However, the vision required the design of the food concept, not the printer,





to be the top priority. This resulted in an attempt to design the recipe by designing the pan, where it should have been the other way around. This was caused by the fixation on designing a high-tech product as well as the need the satisfy learning goals for the curriculum. As the food concept was not defined, the printer had no foundation for design. Although costing precious time, the take away is to stay true to the project, not external motives of the school or the self.

Last remarks on personal growth and work ethics

In summary, the gains were mostly found in the hard skills of productivity and not so much in product design. In terms of personal development, it a grand success. In terms of project quality, I feel it still has a long way to go. So how was this project essential for my future career? It did not necessarily teach me any new hard skills, besides applying new design methods, or result in tangible groundbreaking input for a startup or company. What it did teach me was to perform under high mental stress on my own with an own agenda and no responsibilities to anyone but myself. I have started to learned to cope with work/stress and to create healthy work ethics to maintain productivity and avoid stress.

All to avoid the rookie mistake of thinking that taking the project seriously means dedicating every moment of your life to it. The most important take-away that made the project a grand success is that I stayed true to myself. As there were enough times where I wanted to take the easier and familiar road; in the end, I feel content as this is *my* project.

As thus, we end the chapter of both this project and my curriculum at TU Delft. Thank you.

Chapter Conclusion:

Innovation in Meaning

The project shifted its focus from the printer to the food, evaluating the meaning of personalized food. The innovation in meaning showed an enormous leap, as personalized food is normally seen to function as a nutrition plan and poetical food being limited to high dining. Food poetry is used for the mind and could also be considered as a form of media that needs physical consumption. As for the high dining, food poetry is designed to be for the majority of the consumer whilst sacrificing some of its food quality. Evaluating the outcome of food poetry, it can be considered a successful proposition of meaning innovation.

Cultural Context Fit

As cooking and haiku's are already linked to summer (haiku's actually have to be linked to a specific season) and the cooking form of kaiseki always uses only ingredients that give the feeling of the season.
The memories are mostly seasonal and rather a general one than a more specific one.

Role of 3D printing

The product can still be acquired without a 3D food printer, yet the result will not be similar if the human does not possess over the precision of a robotic arm. In the case of food haiku's, since every haiku already consists out of three different elements, doing this by human hand would be too time consuming and therefore economically ineffective at the envisioned scale.

Future Potential

As the frequency of sending a food haiku is expected to be low, placing food printers at various locations over the city would seem to be a negative cost-return ratio. However, the vision of food poetry proposes telling stories through food. As food haiku's are specifically designed for personal relationships, different forms of poetry can be designed for commercial relationships between brands and consumers. This proposes the brands of popculture (fashion, video games, anime, movies, manga, etc) to be extended into the realm of food and being able to offer a more holistic customer experience. Scaling up the use of food poetry by expanding the types of relationships would effectively justify the costs of implementing the 3D food printers across the city (and globe).