Master Thesis

"Designing a product to enhance the experience of eating alone"

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University of Twente
Faculty of Engineering Technology

Industrial Design Engineering
Human Technology Relations

Designing a product to enhance the experience of eating alone

An approach to enhance the solitary eating experience through design.

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ABSTRACT

Commensality, also referred to as the act of eating in the company of others, has been addressed in several contexts by different authors, often indicating the benefits of eating together. In contrast, eating alone is frequently mentioned negatively. Some studies associate eating alone with adverse effects on a person, such as feelings of loneliness and depression. Other research indicates that eating alone has (at times) given the commensals a necessary break for isolation, peace, and quietness. Regardless, eating alone has become an accustomed practice of modern life.

Nowadays, most solo diners eat their meals in the company of ICT devices, seeking a certain level of entertainment and relaxation. However, this practice restricts them from focusing on their food, resulting in adverse effects such as poor nutrition.

Existing research focuses on enhancing the solo diner experience by implementing digital commensality rather than minimising the adverse effects of eating alone by strengthening the advantages of eating alone. Therefore, this project focuses on designing a product that enhances the solo eating experience by considering the needs and desires of solo diners.

Through a human-centred design approach, multiple methods aided in gaining a deep understanding of the context of use and user requirements for the design. After scoping the literature, a digital food diary was developed to be filled out by six participants. Their feedback indicated that people who eat alone identify several advantages of solo eating, such as feeling relaxed, enjoying a quiet environment, and having a me-time moment. This input was used as starting point to the iterative design process of this project. Early design concepts were evaluated and converged into a final design.

The final concept is an individual pod that delivers a new eating-alone experience by providing a self-nurturing environment at the dinner table through audio and visual cues. It helps the solo diner transitioning into a more relaxed state of mind. The final concept was delivered as a 3D render and a video clip aided as a virtual prototype to test the overall experience offered by the concept.

The user testing phase provided valuable insight into the effects of highlighting the positive features of eating alone to improve the dining experience. Results show that the final concept can influence the solo eating experience. Moreover, the outcome indicates that solo diners can benefit from product design to have a more mindful eating experience and enjoy the positive and nurturing qualities of paying full attention to their mealtime and food.

Abbreviations: Information and Communication Technology (ICT), Human-Centred Design (HCD).

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1. INTRODUCTION

Eating alone has become an accustomed practice of modern life. As a person's daily routine has grown increasingly active, hectic, and rushed, eating solo has become a more practical, convenient activity. From a more fundamental level, eating by oneself has given the commensal a necessary break for isolation, peace, and quietness.

Nevertheless, for some people, eating alone lacks some of the attractiveness of eating together. For that reason, most solo diners eat their meals in the company of ICT devices, seeking a certain level of entertainment, distraction, or social connection. However, this practice restricts people who eat alone from focusing on their food and prevents them from enjoying their mealtime, resulting in unhealthy eating behaviours such as consuming food rapidly, eating less regularly or having less nutritious food.

Existing research has focused on minimising the adverse effects of eating alone by incorporating digital technology to enhance the solo eating experience rather than strengthening the advantages of solo dining by designing products to facilitate the more pleasurable aspects of eating by oneself. Therefore, this master thesis investigates the attributes of eating alone to translate them into a design that enhances the eating experience of solo diners.

1.1. RESEARCH BACKGROUND

Commensality, 'the act of eating together' (Breen, Coveney, & Pflaum, 2018), has been widely discussed within the existing literature. With articles dating from 1895, numerous authors mention the religious, anthropological, cultural, and social attributes of commensality. In addition, several benefits of sharing food are broadly mentioned in different studies, highlighting that eating together promotes communal solidarity, sociability and solidarization, and reflects the social organization of societies (Danesi, 2012a). Overall, within the literature, there is an acceptance that eating in company leads to better psychosocial outcomes for individuals and groups (Breen et al., 2018).

Nevertheless, changes in society, such as demographic shifts and modifications to the family structure, and the growth of single-person households combined with hectic work schedules (Moon, Bonn, & Cho, 2020), have led to forming a new trend representing "solo" consumptive behaviour (Hall, 2017). According to Lahad and May (2017), "whole societies are increasingly doing away with communal meal times to eat alone". Furthermore, "the practice of eating with families and friends has become less common" (Yates & Warde, 2017) leading to an increase in the number of people eating alone.

In many cultures, eating alone has been stigmatised for years. Despite that, the topic has recently generated a vast number of studies "investigating the 'de-structuration' of meals" (Yates & Warde, 2017), the individualization of eating patterns, and the changes in commensality. For instance, Saeed, Fisher, Mitchell-Smith, and Brown (2020) mention that the changes in eating patterns show an increase in eating out, a decrease in food preparation times, and a decline in time spent eating with household members.

Undoubtedly, the subject has generated an increased interest from academia, resulting in a large body of research analysing the impact of solitary food consumption on the dining experience. According to Cho, Takeda, Oh, Aiba, and Lee (2015), compared to commensality, eating alone has a significant impact on the experience of eating. As referred to by Breen et al. (2018), dietary individualism might lack some of the allure of commensality. It is often perceived as less pleasurable to most people (Fischler, 2011);(Dannie Korsgaard, Bjøner, & Nilsson, 2019), and it is frequently associated with loneliness (Cho et al., 2015) and unhappiness (Brown, Buhalis, & Beer, 2020). Furthermore, people who eat alone often have more unhealthy eating behaviours, such as eating less regularly and having less nutritious food (Lee, Lee, & Kim, 2020) (Breen et al., 2018). Moreover, Rah, So, Park, Lee, and Jang (2019) mentioned in their study that "people who eat dinner alone or with non-family members are more susceptible to weight gain than those who usually have dinner with family, especially in younger generations".

However, eating alone seems to lose its stigma gradually. This is partly due to the increasing use of mobile devices that allow people who eat alone "to distract themselves and/or perhaps socialise with other people while being physically alone at the table" (Spence, Mancini, & Huisman, 2019).

Indeed, solo diners often rely on digital media to fill the growing gaps in dining companionship by using information and communication technology (ICT) devices (R. A. Khot & Mueller, 2019). However, more often than otherwise, the use of digital technology during solitary mealtimes is considered problematic. It is accused of encouraging unhealthier food practices or taking the attention away from enjoying the meal (H. S. Ferdous et al., 2016). According to Spence et al. (2019), extensive research has demonstrated the negative influence of mindless eating on food consumption, showing that people can eat a third more food while watching TV or any other screen-based device, such as a smartphone (Spence et al., 2019).

Regardless, recent research has demonstrated the potential of more positive outcomes from using ICT devices during mealtimes. For example, digital technology can be used to improve the eating experience through digital augmentation. It can also facilitate 'remote commensality' by connecting people who "want to share a meal while physically separated" (Spence et al., 2019). Admittedly, an extensive body of literature has explored improving the eating experience of solo eaters by incorporating technology that enables digital commensality.

Nevertheless, such solutions might be too technical or overly complicated to use on a day-to-day basis. For instance, Wei et al. (2011) designed the system "CoDine", a solution created to enhance the solo diner experience by creating a digital commensality. Through a dining table embedded with interactive subsystems that augment and transport the experience of communal family dining, CoDine creates a sense of coexistence among remote family members. Next to that, "KIZUNA" is a tele-dining system proposed to overcome the problem of eating alone. It enables people to virtually enjoy a meal together by transmitting recorded video messages. Tests show that using the system is likely to influence the diners communication and eating behaviours. (Inoue & Nawahdah, 2014).

A smaller body of research discussed the various benefits of eating by oneself. For instance, eating solo has become a more practical and convenient activity in the increasingly active, busy modern life. On occasion, it has given the commensals a necessary break for isolation, peace, and quietness. Additionally, other benefits related to eating alone are mentioned in the existing literature. For example, Fischler (2011), Takeda and Melby (2017), Kim (2020) and Hwang, Shin, and Mattila (2018) refer that eating alone provides to the solitary eater freedom of choice of what to eat. Next to freely choosing what to eat, solo diners are happy to eat whenever they feel hungry, according to Danesi (2012b). Another advantage of solitary meals is that eating alone saves time (Brown et al., 2020) (Kim, 2020) (Yates & Warde, 2017). The time saving does not refer only to the eating itself but also to preparing food, since less cooking is necessary (Yates & Warde, 2017). Takeda and Melby (2017) mention that eating alone provides freedom of pressure from others. For instance, solo diners have can be more comfortable when eating alone, because they can have a moment just for themselves (Danesi, 2012b) and "enjoy a relaxed meal" (Kim, 2020) with comfort.

Despite recognising several benefits of eating by oneself, the extant literature has hardly explored how to improve the solo dining practice by strengthening the advantages of solitary eating. Let alone academia has focused on understanding the context of use and user requirements of solo diners. Therefore, it remains unclear what aspects of the practice of eating alone could be heightened to provide the solo eaters a more pleasant dining time, resulting in few solutions that facilitate a pleasurable experience for solo diners.

1.2. PROJECT AIM AND OBJECTIVES

Existing research has explored enhancing the solo eating experience by minimising the adverse effects of eating alone by incorporating technology to create digital commensality. Nevertheless, those solutions are based on the perception that eating alone lacks commensal eating elements. Furthermore, little research has been conducted to understand the context of use and user requirements of solo diners concerning their eating practice. Hence, existing devices do not consider the specific needs of solo diners.

Moreover, improving the solo dining practice by focusing on the attributes of eating alone has not been widely investigated, resulting in few devices that facilitate a more pleasurable eating-alone experience by highlighting the advantages of eating by oneself. This project addresses this gap and, through a human-centred design approach, investigates the context of use and user requirements of people who eat alone to propose a design solution that considers the specific needs of solo diners.

Therefore, this master thesis focuses on understanding the needs of solo diners and investigates the attributes of eating alone to design a product that enhances the eating experience of people who eat alone.

The aim is to design a useful, practical, and convenient product that can support the eating experience of solo diners.

1.3. RESEARCH QUESTION

The following research question was established to outline the area of research of this project:

- *RQ1. How can a product design enhance the experience of eating alone?*

Four sub-questions were defined to help to answer the main design question:

- *RQ1.1. How are the concepts of commensality and eating alone defined, what are their benefits and drawbacks and how has research addressed improving the experience of eating alone?*
- *RQ1.2. How do solo diners perceive the practice of eating alone, and what are their needs during the solo eating experience?*
- *RQ1.3. How can a product design address the needs of solo diners to enhance the experience of eating alone?*
- *RQ1.4. How does the final design contribute to enhance the experience of eating alone?*

1.4. PROJECT SCOPE

This master thesis uses a human-centred design approach to investigate the context of use and user requirements of people who eat alone at home often to propose a design solution that is useful, practical, and convenient to use for solo diners. The field research phase involves people who often eat at home since the focus is to investigate the solo dining experience at home.

The human-centred approach of this project means that the target users are also involved in the design process. Therefore, their feedback and opinions are essential to design a product that improves their eating experience.

One limitation of the project is the COVID-19 crisis. Due to the pandemic, solo diners are approached and involved in the project remotely.

The design concept attempts to be a better alternative to the existing design solutions, which are often complex to use or involve complicated technologies.

1.5. THESIS OUTLINE

This thesis is divided into ten chapters. The most important ones are the Literature Review, Field Study, Ideation, Concept Development, Final Design and Concept Validation phases, that answer the main research question and sub-questions, which are this project's starting point.

The literature review presents an overview of existing literature on the topics of commensality and solo eating and elaborates on existing solutions to enhance the experience of eating alone. The findings of the literature review provided important information to conduct the field research. Next, in a diary study, six solo diners shared their eating alone experiences and provided insight into their needs. The literature study and field study results provided crucial input for the ideation phase of the project. By implementing a Human-Centred Design process and using different design techniques that included brainstorming, personas, and scenarios, nine ideas were proposed and evaluated with a multi-criteria analysis. The evaluation indicated which of those nine concepts was the best option to be further developed. The final design was implemented using different approaches such as sketching, 3D CAD modelling, rendering, and rapid prototyping. Lastly, the renders of the final design were used to create a movie to simulate the usage of the product and mimic the experience provided by it. Due to the COVID-19 pandemic, the concept was remotely tested and evaluated by solo diners with a virtual product testing method.

The last two sections are discussion and conclusion. These sections cover the reflections about the results and the contribution of this project and discuss and conclude the answer to the main research question and sub-questions.

2. METHODOLOGY

This chapter describes the methodology used within this project and the different activities implemented. Different methods have been used throughout this project. The methods of each phase are described in detail within every chapter.

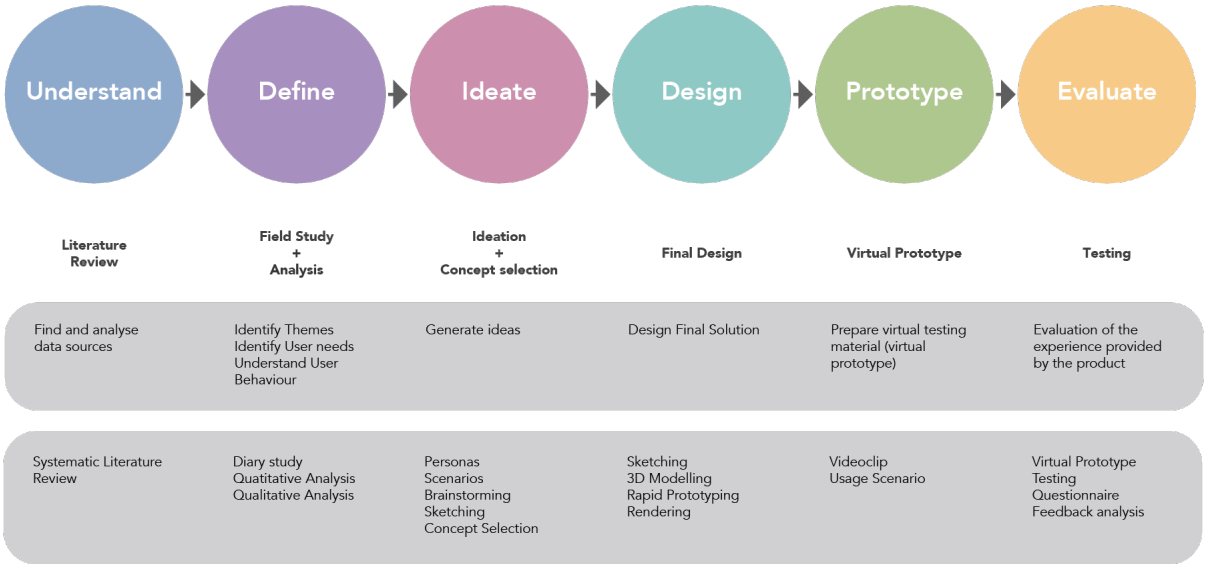


Figure 1. Human Centred Design adapted from Outwitly (2020).

2.1. PROCESS

The project has been carried out through a six-stage method (Figure 1) adapted from the Human-Centred Design (HCD) process (ISO, 2019). The Human-Centred Design is the process of uncovering user needs within a system to design better user experiences. It places "humans"—the people who use a product or service, or who take part in the experience being designed—at the centre of all activities (Outwitly, 2020). Therefore, the Human-Centred Design is the most appropriate approach to investigate the context of use and user requirements of people who eat alone.

The approach for this project is a six-stage methodology adapted from the HCD process. The adapted method divides the initial design phase into two stages, Ideation and Design, and divides the category Prototype and Test phase into two different steps. For this master thesis, the Implementation phase is omitted due to the project's scope, which does not cover implementing the final design.

The activities conducted for this project are further described in section 2.3. The method for each main stage is later described within every chapter.

2.2. PROJECT PLANNING

The first part of this master thesis consisted of developing a plan of approach, to understand the scope and purpose of the project. A preliminary plan was carried out by means of a Gantt-chart to describe how the project would be conducted (Figure 2). After the supervisors approved the project plan, implementation of the other activities of the project started.

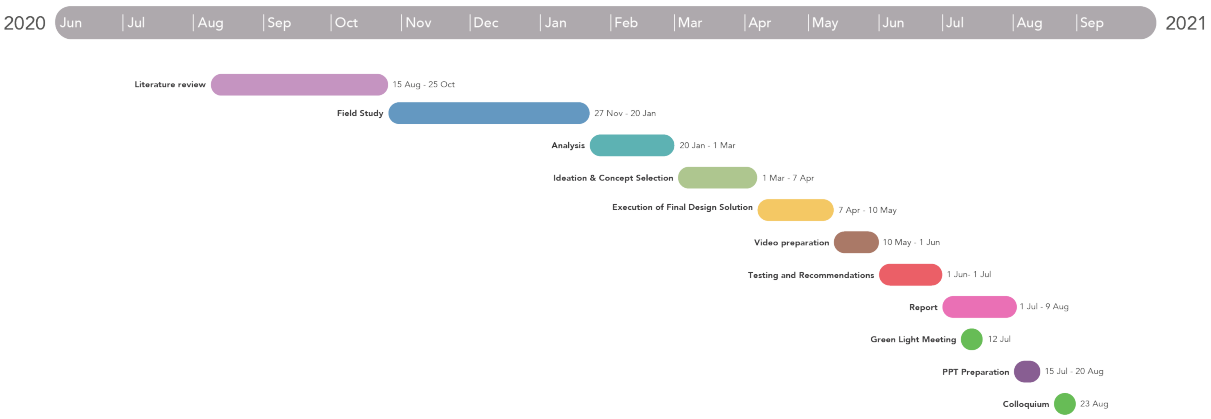


Figure 2. Project Planning.

2.3. CONTEXT OF THE PROJECT

To gain insight into the context of the project, a study of the next five papers took place:

- A literature scoping review of eating practices and food environments in 1 and 2-person households in the UK, Australia and USA (Breen et al., 2018)
- Eating together and eating alone: Meal arrangements in British households (Yates & Warde, 2017),
- Computational Commensality: from theories to computational models for social food preparation and consumption in HCI (Niewiadomski, Ceccaldi, Huisman, Volpe, & Mancini, 2019),
- Making sense of human-food interaction (Bertran, Jhaveri, Lutz, Isbister, & Wilde, 2019)
- Digital commensality: Eating and drinking in the company of technology (Spence et al., 2019).

After obtaining background knowledge on the project's problem, the next step was to scope the existing research through a systematic literature review.

2.4. PROJECT ACTIVITIES

The activities for the project were then defined:

- Literature review: Literature studies on the topics of eating practices, food environment for 1-2 persons, eating alone, commensality and human-food interaction to define what are the essential benefits from eating together and what solo diners are missing from. The objective is to collect relevant information that could be analysed to obtain input to develop several design concepts.
- Field study: to determine the behaviours of commensal unit, a diary study in the form of a questionnaire (online), is carried out to identify what the fundamental needs of solo diners are and what elements of the solo dining practice need to be improved and refined. The goal is to collect data to support /expand the literature review.
- Analysis phase: to define the area(s) of opportunity where a design solution can be implemented to improve the experience of solo diners.
    - Qualitative data analysis: getting familiar with the data, looking for basic observations or patterns:
        - content analysis: coding/indexing: identifying broad ideas, concepts, behaviours, or phrases and assigning codes to them.
        - identifying patterns and connections: themes, the most common responses to questions, data or patterns that can answer research questions, and finding areas that can be explored further.
    - Quantitative data analysis: through descriptive statistics.
- Ideation phase: After completion of the analysis phase, several design ideas are drafted by using distinct methods: brainstorming, mind mapping, sketching, scenarios. The objective is to further assess those ideas to collect, categorise, refine, and narrow down the best ideas

- Concept Selection: A concept is to be selected to further developed it into a design solution with selection methods such as multi-criteria analysis
- Execution of the Final Design Solution: After a final concept is chosen, a design solution is executed as 3D Model/Render and a virtual prototype that can support testing.
- Testing and Recommendations: The goal is to test the design's practicability, investigate how a sample of users think and feel about the product, and find out whether the implemented solution has been successful. The target users verify the prototype to collect valuable feedback to uncover whether the user needs have been solved. The testing phase is not a focal point of this project, but it is expected to generate recommendations for improving the design solution. Testing is carried out with virtual prototype testing.

2.5. RESULTS/DELIVERABLES

The goal is to deliver a product design that can be used by people who eat alone and aids to lower the psychosocial disadvantages of eating alone. With the design, the solo eater will be able to experience the allure of eating alone.

Due to the COVID-19 crisis, the prototype is virtual prototype that only allows remote testing. After a short testing period, overall recommendations about the design are formulated.

3. LITERATURE REVIEW

This chapter presents the systematic literature review carried out to identify the available data on the topics of commensality and eating alone. The literature review aims to highlight the positive attributes of eating alone that can benefit eating by oneself and identify technologies presently used to enhance the experience of eating alone.

3.1. INTRODUCTION

More often than otherwise, eating alone is perceived negatively. It is often frowned upon (Fischler, 2011), and there is some stigma within society about solo diners. For instance, a person who eats alone is often regarded as a lonely individual or to have failed building social relationships (Lahad & May, 2017). Moreover, eating by oneself carries nutritional disadvantages and social drawbacks. Nevertheless, eating alone has become more socially acceptable (Moon et al., 2020) and remarkably, has its gains.

This literature review aimed to understand the positive aspects of eating alone and to find out what techniques and designs have been developed to improve the solo dining experience. Therefore, a systematic literature review was conducted to scope the literature and address the research sub-question RQ1.1.: *"How are the concepts of commensality and eating alone defined, what are their benefits and drawbacks and how has research addressed improving the experience of eating alone?".*

To obtain a better understanding of topics related to the research question RQ1. ***How can a product design enhance the experience of eating alone?*** the following sub-questions were also established and answered by this literature review:

- *RQ1.1.1. How is the profile of the solo diner described within the literature?*
- *RQ1.1.2. How to enhance the experience of eating alone?*
- *RQ1.1.3. What technologies are being currently used to enhance the experience of eating alone?*

Section 3.2. describes the methodology implemented to carry out the systematic literature review. Section 3.3 elaborates on the results of the literature review, which respond to the questions stated above. Finally, the chapter concludes with sections 3.4 and 3.5, which discuss the literature review results and present the conclusion.

3.2. METHOD

For this systematic review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines protocol (PRISMA) was used to search all English published articles related to commensality and eating alone. The searches were performed during the period commencing on July 6, 2020, until July 31, 2020, on the databases Scopus and Web of Science Core Collection.

As recent publications deemed more relevant to the topic, only articles dating from 2010 onwards were selected. By exploring Scopus and Web of Science Core Collection, 1,119 articles were identified, with 557 unique papers of which, 116 titles were related to the topics discussed by the research question. A subsequent evaluation by abstract reading led to 61 papers. After a full-text assessment, 49 articles were included in this review, as they provide a relevant focus to the research question.

Protocol

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines protocol PRISMA (Moher et al., 2009) was used to carry out this systematic review and supported to conduct all the database searches. Guidance from Moher et al. (2009) on the PRISMA methodology was implemented during this review.

Eligibility criteria

Published articles on the topic of commensality and solo dining, were searched. The following criteria were included when performing this systematic review: a) Published article, and b) English language publication. Both quantitative and qualitative studies were included.

Information sources

The databases used for the search were Scopus and Web of Science Core Collection. Both databases are relevant for a systematic review on the topics of commensality and solo dining. The searches were carried out during the period commencing on July 6, 2020, until July 31, 2020.

Search strategy

A preparatory assessment of 5 papers (Bertran et al., 2019; Breen et al., 2018; Niewiadomski et al., 2019; Spence et al., 2019; Yates & Warde, 2017) aided to establish search terms and identify synonyms for those terms. A three-step search was carried out for this systematic review. The first step involved an initial search in the databases Scopus and Web of Science Core Collection. Search terms applied were 'commensality', 'solo dining', 'solo diner' (and the previously chosen synonyms), in combination with terms such as 'benefits', 'behaviour', 'experience', 'environment' (and synonyms). From a rapid evaluation of the first inquiry, exclusion sub-areas were determined and the search terms 'eating alone', 'companionless eating', 'human-food-interaction' and 'de-structuration of meals' were identified. A second exploration included said terms. A third search consisted of reviewing the reference list of the full text assessed articles. The searches were conducted on July 6, 2020, July 20, 2020, and July 31, 2020. All references were imported to EndNote X9. A full record of the search strategy on Scopus and Web of Science is shown in Appendix A.

Study selection and data collection

Data of the retrieved records was compiled into an excel file for scrutiny. When certain information was inaccessible but required for further evaluation, it was additionally obtained (e.g., when abstract was unavailable). Duplicates were directly excluded from the review, and a consequent assessment of titles and abstracts led to the exclusion of articles not relevant to the study. This step was repeated three days later by the reviewer to avoid bias or excluding important studies. A full-text assessment was later conducted. Inclusion criteria considered several sub-questions that helped respond to the initial research question. Whenever a study included information responding to any sub-question, it was included in the review (see Appendix B). A revision of the list of references from the included articles was performed to ensure any relevant work was excluded. Five additional articles were identified through this step. Another full-text evaluation was performed a week later to avoid bias and exclusion of important records.

Synthesis of results

An analysis of all included articles was performed by clustering the studies in themes. Such themes were previously established by means of the research sub-questions (Appendix B). A narrative synthesis summary was subsequently executed.

Risk of bias across studies

Bias might have been introduced because both qualitative and quantitative studies have been used for this literature review. From interviews with approximately 15 persons, to quantitative studies under 500 persons. In addition, included findings are from multiple countries from Korea to Germany and Spain. Therefore, conclusions from all included studies might not be fully comparable.

Study identification and selection

Studies identified

Initial database searches retrieved 1,114 studies. After automated removal of duplicates, 552 studies remained, with 5 additional records identified through searching other sources. Preliminary screening led to the exclusion of 496 studies. Of the remaining 61 studies (for which the full text was obtained), 49 studies met the inclusion criteria and were included in the narrative synthesis (Figure 3).

Study selection

All 1,114 records were collected in one excel sheet. Duplicates were removed, and posterior screening of 552 unique articles was executed.

Screening of records for eligibility took place in three steps. Firstly, all titles of the 552 unique articles were reviewed. The reviewer repeated this step three days later, to corroborate no important articles were excluded. Title assessment led to the exclusion of 441 papers. Next, the abstracts of the 111 included records were evaluated. An additional revision of the abstracts was executed four days later to avoid exclusion of relevant studies. 55 studies were excluded after abstract appraisal. A third step consisted of a full-text assessment of 56 articles, which eliminated 12 more studies. 44 papers were included by full-text assessment and 5 extra articles were identified after exploring the full reference list of the 44 articles included in the review, resulting in 49 articles that were included in the narrative synthesis.

While performing the full-text evaluation, 3 articles were identified as non-English, 1 paper was unavailable, and 2 papers were identified as prior to 2010. 2 studies were related to technology and family but did not address fully on the topic of commensality, with other 2 papers that have an outcome on eating behaviours. 1 paper discussed the locations within the house where commensals eat (e.g., the table, the bed, the couch) and 1 extra paper was related to hospitality and loneliness. Those 12 papers were consequently removed. As this systematic review focused on the quantitative aspects of commensality, a meta-analysis was deemed inappropriate.

3.3. RESULTS

Most of the existing research focuses on the quantitative aspects of commensality. For instance, it is described how many people and how often they eat together. However, fewer articles refer to the benefits and disadvantages of commensality, which were, in a nutshell, the focus of this systematic literature review. Several articles reviewed how to enhance the solo dining experience, but from a commercially driven point of view, as they primarily focus on the solo dining experience in restaurants and hotels. Few articles discussed about enhancing the solo eating experience at home, but often described various technological ways to engage in an interactive dining experience. The search terms ‘virtual commensality’, ‘digital dining’, ‘tele-dining’, ‘celebratory dining’ and ‘eating in solitude’ were skipped from the initial search, which could have resulted in a greater number of articles.

3.3.1. Characteristics of included studies

The 49 articles included in this systematic review date from 2010 to 2020 and discuss the topics of commensality and eating alone and their advantages and disadvantages. Moreover, several articles explore how interaction design and technologies can contribute to create commensality.

In the following section, the topics of commensality and eating alone are presented, including a description of their benefits and drawbacks. Next, the lone diner profile is described. Later, it is elaborated on how to enhance the experience of the solitary eater and how technologies can contribute to commensality. Finally, design solutions that focus on strengthening the solo diner experience are reviewed.

The next PRISMA chart shows an overview of the results derived from the systematic review process carried out for this chapter.

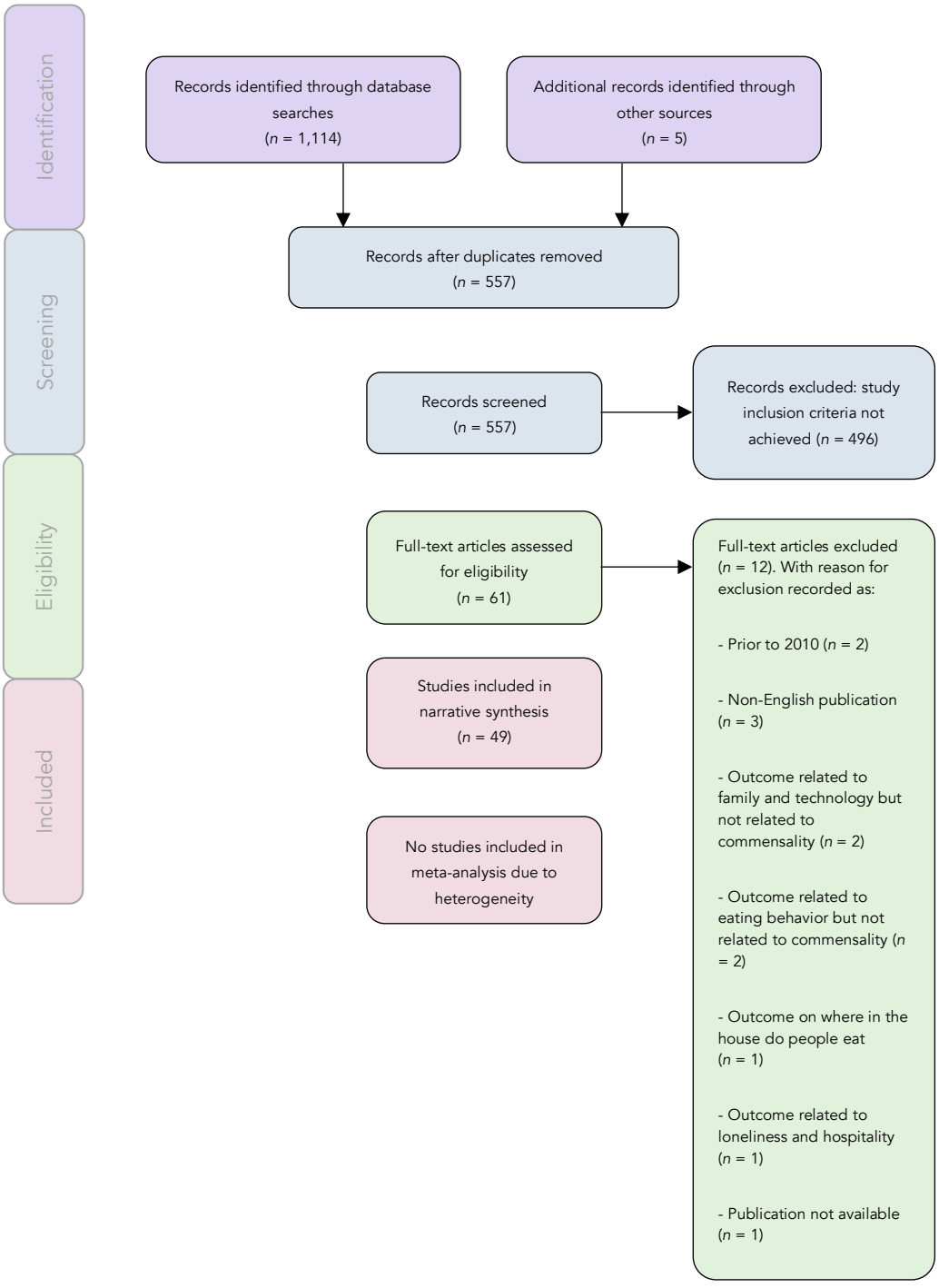


Figure 3. PRIMSA flow chart showing the systematic review process and refinement of results (Moher, Liberati, Tetzlaff, Altman, & The, 2009).

3.3.2. Commensality

The term commensality is often defined as eating at the same table (Kerner, 2015);(Fischler, 2011);(Takeda & Melby, 2017). Some authors define commensality as eating with others (Niewiadomski et al., 2019);(Kera & Sulaiman, 2014);(Cho et al., 2015);(Giacoman, 2016);(H. S. Ferdous et al., 2016). Others indicated that, people should share food with a social group such as the family, since eating together conveys a great social significance and nourishes the social body (H. S. Ferdous et al., 2016; Masson, Bubendorff, & Fraisse, 2018; Ochs & Shohet, 2006).

Commensality takes place at home, or at other locations and it is perceived differently for each location, or context. For example commensality is perceived differently at a party (Giacoman, 2016). Furthermore, it is stated that, generally, people prefer eating together compared to eating alone (Fischler, 2011).

3.3.3. Benefits of eating in company

Within the literature, commensality is often described as having many benefits. For instance, various authors have pointed out the benefits that a shared meal has to offer in comparison to eating alone. These benefits, and the associated negative elements of eating alone are outlined in the section below.

Nutritional Benefits and Food taste

Various authors conclude that eating together is healthier than eating alone (Danesi, 2012a). In addition, commensals have a lower prevalence of obesity than solo eaters (Fischler, 2011);(Kerner, 2015);(Danesi, 2012a). Mainly, because they eat less, which can be caused by the social norms that appear due to the presence of other people Fischler (2011).

Food intake of commensals has a better nutritional value, due to a better food intake and choice, and less health problems that relate to nutrition (Niewiadomski et al., 2019). Lee et al. (2020) conclude that commensals eat more regularly and slowly, eat more grains, protein foods vegetables and fruits. In addition, they also eat less processed foods, salty foods, and animal fats. Others, state that commensality results in less drug, alcohol or tobacco use (Danesi, 2012a);(Lee et al., 2020). Finally, eating together results in strict adherence to mealtimes, which is perceived a key to eating well (Fischler, 2011).

Other advantages of eating in company are related to how commensals taste food compared to solo eaters. Several authors state that people eating in company have a better taste or have a higher satisfaction of their food (Niewiadomski et al., 2019; Spence et al., 2019).

Social benefits, enjoyment, and social relationships

Many social benefits of commensality are described within literature. Overall, commensals are likely to feel better about themselves in terms of happiness and worthwhileness of life (Kim, 2020). A more concrete benefit of social dining is that it has been recognised as being more enjoyable than eating alone (Brown et al., 2020) (Vesnaver, Keller, Sutherland, Maitland, & Locher, 2016). Furthermore, commensality is described by many as enjoyable, as it creates a happy atmosphere. As such, social dining is comforting and of the same importance as the food consumed (Brown et al., 2020);(H. Ferdous, Ploderer, Davis, Vetere, & O'Hara, 2015);(Cho et al., 2015). Key qualities of commensality are the conversation and the opportunity to connect with other people (Vesnaver et al., 2016). Moreover, Spence et al. (2019) determine the positive mood as a benefit of commensality. Danesi (2012a) describes three related social benefits of commensality: it creates personal identity by solidarity, it contributes to socialisation, and it increases sociability (bonding) by forming new relationships and strengthening existing relationships.

Commensality increases solidarity since part of sharing food is often sharing the costs or tasks (Danesi, 2012a). Eating together in a group is associated with socialising, as it improves the experience of eating, and creates relaxation (Danesi, 2012a);(H. Ferdous et al., 2015);(Brown et al., 2020). Therefore, there are emotional benefits to be obtained from eating together that are not attributed just to the food participants eat (Brown et al., 2020).

According to Giacoman (2016) "you are what you eat", you are with whom you eat and eating together also creates bonds through the reciprocity established between people who gather together at the same table. Eating together increases sociability (bonding, belonging or conviviality) (Marovelli, 2019); (Danesi, 2012a) (Danesi, 2012b);(Fischler, 2011);(Brown et al., 2020);(Masson et al., 2018);(Kim, 2020);(Giacoman, 2016);(Fritzen, Andres, & Leite, 2018);(H. Ferdous et al., 2015). Danesi (2012b) describes ***conviviality*** as the word that occurs mostly when people speak of the advantages of commensality. The bonding that is created during commensality might create intimacy between people (Fischler, 2011). This feeling of belonging might also create feelings of security (Brown et al., 2020), common identity or belonging (Masson et al., 2018);(Kim, 2020). Marovelli (2019) researched food sharing initiatives in London and discovered that sitting at the table during eating contributes to more bonding, through establishing social relationships, which is described by Giacoman (2016) as the most important function of commensality. Furthermore, commensality reduces loneliness and increases interconnectedness between people (Marovelli, 2019).

Other benefits

Other benefits of commensality are that it creates community (Kera & Sulaiman, 2014), and has always been a source of cultural heritage (H. Ferdous et al., 2015). As such, food and commensality have important potential for organising tourism and cross cultural contacts, since it brings visitors together with local people and local culture (Kerner, 2015). In line with that, commensality is also an occasion to discover new dishes (Danesi, 2012b).

3.3.4. Drawbacks of eating in company

Despite the many benefits described within the literature, there are also several disadvantages associated with commensality. These included eating more, negative feelings, norms, and manners, among other drawbacks. These are summarised below.

Eating more:

Commensality has many benefits. Nevertheless, within literature several drawbacks were identified. Firstly, people eating in company tend to eat more due to longer mealtimes (Fischler, 2011). This is confirmed by Cho et al. (2015) who found that Korean people tend to eat more food when they are with others. Spence et al. (2019) concluded that several studies have demonstrated that the amount of food that people consume can be related to the number of people dining together: the more people dining together the more food is consumed.

Negative feelings

Next to an increase in food intake, commensality might also provoke negative feelings which are associated to the social interaction. By instance, the obligation to find topics of discussion and avoid silence (Danesi, 2012b), the perception of a negative atmosphere when there is no affinity among the people eating together, or when the diner feels as an outsider, which makes the experience not always convivial, causing tensions or conflicts between commensals (Giacoman, 2016).

Norms and manners

In some cultures and commensal units, the existing rigid norms and formal manners can be a source of stress or make the eating experience less pleasant or convivial. This can particularly occur while eating at one's workplace or while sharing a meal with the family. (Danesi, 2012b);(Giacoman, 2016). Danesi (2012b) indicates that young adults prefer a low degree of formality and high degree of intimacy.

Other drawbacks

Danesi (2012b) points out other drawbacks of commensality for young adults: they might feel judged by their companions, especially those who follow a special diet or do not eat a large variety of food. Moreover, stress can occur when inviting others over for a meal and the dish being served fails. When invited to eat by others, the stress might be caused because the dish offered is not liked.

3.3.5. Solo eating

Eating alone seems to be often treated as a less desirable alternative to social, commensal eating (Takeda & Melby, 2017). As Masson et al. (2018) indicated: "to eat alone is to be alone". It also seems that eating alone is often negatively perceived because "the solitary eater incurs suspicion for excluding him-/herself from communal eating" (Fischler, 2011). Solo eating appears to carry some stigma and, in the Asian dining culture, solo dining is regarded as being taboo (Moon et al., 2020).

However, various authors suggest that eating alone is increasing in the current societies (Breen et al., 2018). Moon et al. (2020) refer to it as "a new consumer behaviour derived from social changes", indicating that eating alone has become more socially acceptable nowadays. Moreover, solo dining is described as an emerging trend in restaurants (Moon et al., 2020);(Hwang et al., 2018). For instance, Lahad and May (2017) described the world's first restaurant for solo eaters, 'Eenmaal', indicating that it has the potential to transform dining alone into an entertaining experience. More positive aspects of eating by oneself are mentioned in the next section.

3.3.6. Advantages of eating alone

Many benefits of solo eating are described within literature. Five main types of advantages have been described: freedom of choice and timing; less time consuming; more relaxing; focus on the food and having time and space for oneself.

Freedom of what and when to eat

Vesnaver et al. (2016) describes several advantages of eating alone for widowed women in their study. Their participants perceive more freedom and feel they are less committed to eating times, since there is no partner expecting food to be ready at a certain time. In addition, the freedom of choice gives opportunity to eat different food since other commensals do not have to be considered. Freedom of choice is also regarded as general advantage of eating solo (Fischler, 2011);(Takeda & Melby, 2017);(Kim, 2020);(Hwang et al., 2018).Moon et al. (2020) describe that the advantage of having freedom of choice is that negotiation with others is not necessary. Danesi (2012b) relates to freedom of choice not only to time and food, but also to the location and budget as solo diners are not dependent on others for the choice of where to eat and how much to spend. Moreover, Danesi (2012b) describes that next to choosing what to eat, young adults that eat alone, are happy to eat whenever they feel hungry. This provides solo diners the opportunity to explore new food and restaurants (Moon et al., 2020). Finally the freedom, is also related to decide and control what to eat without being pressured by other people's views and not to have to pleasure anyone, except oneself (Takeda & Melby, 2017).

Less time consuming

Eating alone is perceived to save time (Brown et al., 2020);(Kim, 2020);(Yates & Warde, 2017). This time is not only saved during the eating itself but also during the preparation of food since less cooking is necessary (Yates & Warde, 2017). Solo dining in restaurants also saves time, due to the ease of being seated, and "timing related to convenience and efficiency" (Moon et al., 2020).

More relaxing

As described by Takeda and Melby (2017), eating alone provides freedom of pressure from others. Danesi (2012b) mention that, solo diners have the possibility to be more relaxed when eating alone, and can have a moment just for themselves, or "enjoy a relaxed meal" with comfort (Kim, 2020).

Focus on food and having time for oneself

Some solo diners perceive less distractions when eating alone and thus have the opportunity to pay more attention to the food (Danesi, 2012b) and to focus on what they eat (Moon et al., 2020). Other solo diners enjoy to have the time and space for themselves (Takeda & Melby, 2017).

3.3.7. Disadvantages of eating alone

Within literature, the disadvantages of solo dining are more extensively discussed than its benefits. Four main categories of disadvantages of solo dining are explored:

Nutritional disadvantages / obesity

Kwon, Yoon, Min, Lee, and Jeon (2018) argue in their study, that eating alone is significantly associated with an increase of abdominal obesity. Likewise, eating alone might be a potential risk factor for a metabolic syndrome, which could lead to diabetes type 2 and cardiovascular diseases. Their main findings are supported by the research of Rah et al. (2019) who studied the relation between having a dinner companion and body mass index (BMI) among participants in Korea. Dinner was chosen because it is most often consumed within a family unit and they concluded that "people who eat dinner alone or with non-family members are more susceptible to weight gain than those who usually have dinner with family, especially in younger generations" (people in their 20s and 30s). Rah et al. (2019) also found a stronger association between family dinner and BMI in males and discovered that a higher level of obesity might be related to the food intake of solo diners. Eating alone often results in a higher prevalence of unhealthy eating behaviour (Lee et al., 2020) and the effects are often stronger for men than women (Kwon et al., 2018). Fruit and vegetable consumption seemed to be lower among solo diners (Breen et al., 2018);(Takeda & Melby, 2017). Moreover, eating alone can lead to a decreased variation of food intake according to Takeda and Melby (2017). An explanation for the less nutritious food intake might be that cooking a variety of dishes is considered too much work for a person who is eating alone (Kera & Sulaiman, 2014).

Eating manners

In addition to the disadvantage of eating food with a low nutritional value, solo diners were also pointed out to eat less home-cooked food in general, are less likely to eat at a table, have poor table manners and eat quicker and less regularly (Danesi, 2012b);(Brown et al., 2020);(Fischler, 2011).

Social disadvantages

Eating alone is considered to be less pleasurable (Dannie Korsgaard et al., 2019);(Fischler, 2011), and for some, "is not regarded as a meal but a snack"(Cho et al., 2015)."The inability to share a meal with others is perceived to be symptomatic of solitude" (Masson et al., 2018). Therefore solo dining is often associated with loneliness (Cho et al., 2015);(Takeda & Melby, 2017);(Brown et al., 2020). It is seen as an uncomfortable experience and linked to negative physical and emotional impacts (Brown et al., 2020) and these negative impacts make people less motivated to prepare food (Takeda & Melby, 2017). Next to loneliness, eating alone is often related to perceptions of social isolation (Brown et al., 2020);(Takeda & Melby, 2017);(Moon et al., 2020). This might be because "intimate personal relationships are viewed as the chief source of human happiness they are a touchstone of health and happiness" (Brown et al., 2020). Finally, a negative emotion related to solo dining is boredom (Cho et al., 2015) and some studies showed that eating alone is associated with depressive symptoms (Takeda & Melby, 2017).

Disadvantages when eating alone in a restaurant / public space:

The disadvantages of eating by oneself seem to be stronger when solo diners eat in a public space or restaurant. Danesi (2012b) determined that a fear of judgement of other people when eating in a public space, lead solo diners to avoid going to a restaurant but rather choose fast food. When dining alone in a restaurant, solo diners often perceive a judgement from others in the restaurant, of both staff and customers. This perceived stigmatisation creates feelings of discomfort when eating alone. (Brown et al., 2020). This stigma is described by others as being seen as a "friendless loser" (Lahad & May, 2017). Because of this perceived stigmatisation, solo diners often feel uncomfortable when dining alone in restaurants (Lahad & May, 2017). Close proximity with other diner groups negatively influenced solo dining enjoyment (Moon et al., 2020). In addition, solo diners often experience shame and embarrassment when eating alone in a restaurant (Lahad & May, 2017). A common perception is that anyone eating on their own in a restaurant is lonely (Lahad & May, 2017). Solo diners often feel lonely in a restaurant which leads an avoidance of restaurants (Hwang et al., 2018). Stress was identified as one negative outcome caused by feelings of being isolated from others when dining in public space compared to those dining experiences shared with others (Moon et al., 2020). The negative feelings of solo diners in restaurants and the perceived stigmatisation results that solo diners tend to eat quickly

to avoid stigmatisation, and the dining experience is functional (solo diners just finish their meal, to get full) instead of a pleasurable experience (Brown et al., 2020). The perceived stigmatisation might be the reason that solo diners intentions to eat in a restaurant are higher in a restaurant with low crowding (Her & Seo, 2018).

3.3.8. The profile of the solo diner

Several articles give a description of the people who eat alone. For instance, it is described that people who eat alone, often live alone (Kwon et al., 2018). According to Yates and Warde (2017), the people that eat alone and live alone eat more quickly and spend more time making dinner compared to people that eat alone and live with other people.

Various authors describe that solo diners are often the *younger and urban generations* (Danesi, 2012a);(Lee et al., 2020);(Takeda & Melby, 2017);(Kera & Sulaiman, 2014). People in their 20s are often positive about eating alone and have a sense of freedom when eating alone (Lee et al., 2020). In addition, "young adults have more freedom to choose whether they eat alone or not, in response to social and cultural circumstances" (Takeda & Melby, 2017).

Another group of people that eat alone more frequently than others age groups are *older adults* (Dannie Korsgaard et al., 2019). Likewise, *widowhood* might result in a loss of commensality (Vesnaver et al., 2016).

3.3.9. Enhancing the experience of the solo diner

The most logical way to enhance the eating experience of the solitary eater is to eat together with others. Nevertheless, that is not always possible. Therefore, this section elaborates on the general points mentioned within the extant literature to improve the experience of the solo diner.

According to the article 'Dining Solo: Eating Well When You're Eating Alone' (2014), there are multiple tips to help a solo diner to improve their eating alone practice:

- Planning food preparation ahead. Since foods are usually packed for families (big portions), planning meals ahead helps the solo diners take advantage of what they buy (e.g., buying food to prepare a meal that can be eaten twice or more).
- Making meals more pleasurable (eat mindfully):
    - Setting the table for oneself.
    - Putting on music.
    - Serving the meal on a plate. Thus, no eating straight out of the pan.
    - No eating in front of the TV or use the computer, smartphone, or tablet.
- Exploring cooking-for-one books and communities. The solo diners are more likely to enjoy the meals when the cooking experience is more pleasant. So, improving their cooking skills can be beneficial.

Next to the above-mentioned, Vesnaver et al. (2016) suggests that focusing on the pleasure of certain foods balances the reduced enjoyment of mealtime when eating alone. Finally, Lee et al. (2020) recommends several measures to enhance the healthy food intake in people who eat alone:

- Government should provide information on healthy menus for eating alone.
- Efforts should be made to develop cooking programs for solo diners where they learn healthy cooking.
- Develop kitchen sharing systems for solo diners to enable people to cook and share food to eat healthier.
- Restaurants should provide healthy meals for people who eat alone. Moreover, food delivery apps should be developed more user-friendly for people who eat by themselves.

In restaurants

Solo restaurant-goers use different techniques to enhance their eating alone time. According to Brown et al. (2020), solo diners use some distractions. For example, by observing other restaurant visitors or reading a book. Furthermore, they use their smartphone as a virtual dining companion or to connect with others in online

communities. In addition, solo diners take photographs of the food and send them to others with whom they usually eat, to share the delights of their meal both remotely and in real time (Masson et al., 2018).

To attract the increasing solo dining market, restaurants have developed several strategies. For instance, providing one-person seating arrangements and train staff to welcome solo diners appropriately. Restaurants are also developing concepts that explicitly focus on improving the solo dining experience. For example, the 'Go Solo' concept "facilitates an inclusive environment for diners who prefer to eat alone"(Brown et al., 2020). A restaurant that focuses on delivering a pleasant eating experience for people who eat by themselves is the Dutch restaurant "Eenmaal", which is exclusive for people who eat alone and honours and indulges solo dining (Dossey, 2015). The setting at Eenmaal is organised so that every diner has to be seated alone which offers an opportunity to dine alone and not to feel isolated (Lahad & May, 2017).

Another restaurant initiative to provide a pleasant solo dining experience is the 'Go Plural' concept, which brings solo diners together in a shared table and encourages interaction (Brown et al., 2020). Solo diners prefer tables surrounding an open kitchen because they feel like they are sitting next to other solo diners and are also separated from group diners (Moon et al., 2020). That creates a feeling of belonging; hence restaurants are perceived as more friendly by solo diners if they offer such a solution. It also generates a better atmosphere to enjoy their meals fully. In addition, sitting at a shared table allows for conversation among solo diners so that they can form a sense of community (Hwang et al., 2018).

When a restaurant increases perceived similarity among diners (e.g. solo diners sense that other guests in the same space shared similar demographic and psychographic characteristics), solo diners feel more identified with that restaurant (Moon et al., 2020).

Furthermore, the Moomin cafés, offers solo diners the company of a stuffed animal to enhance their solo dining experience (Dossey, 2015).

3.3.10. Technological contributions to solo dining

Technologies can contribute to the experience of eating alone. Often, technology is used during alone-consumed meals as a form of distraction and to reduce loneliness or boredom (Lemke & Schifferstein, 2021). ICT or mobile devices let people connect with others. Moreover, technology can enhance the food experience and the social aspects of eating of solo diners by facilitating the pleasurable aspects of dining or 'digital commensality' (Spence et al., 2019). Technologies can create opportunities to support connectedness and mealtime interaction, and, in addition, technologies may even positively influence mealtime routines (Grevet Delcourt, Tang, & Mynatt, 2012).

The proliferation of blogs and discussion forums on the internet also offers opportunities to link up with a 'digital community' and possibilities for remote dining experiences are enabled through the use of videoconferencing technologies (Masson et al., 2018). As mentioned by H. Ferdous et al. (2015), even minimal social connectedness could improve the dining experience of solitary eaters.

3.3.11. Negative effect of technology in the eating alone experience

Technologies can also have a negative effect on the experience of eating alone. For instance, solo diners who are distracted by digital technology might "eat/drink more (they might overconsume) as a result of their failure to attend to the food-related sensations that are thought to cue the termination of eating" (Spence et al., 2019). Besides, it is unclear how technologies influence the experiences of solo restaurant goers and to which extent mobile devices can help to challenge the stigma of eating alone (McKeown & Miller, 2019).

3.3.12. Technological solutions to tackle the disadvantages of eating alone.

Several technologies have been developed to enhance the experience of the solo diner. These can be divided into digital technologies that enable solo diners to connect with other people and technologies focused on making eating alone more pleasurable in itself.

Technologies to connect solo diners with other people

The system "Food Media" is an intuitive interaction platform designed to engage remote people into entertainment and social communication. The system consists of a video connection enhanced with multi-sensory interactions such as touch, smell, and taste. As such, it transports the experience of family dining to people who are eating alone remotely from each other (Wei et al., 2011).

Wei et al. (2011) designed the system "CoDine" as a dining table embedded with interactive subsystems that augment and transport the experience of communal family dining to create a sense of co-existence among remote family members. CoDine is a solution created for solo eaters to enhance the solo diner experience by creating a digital commensality experience.

D. Korsgaard, Bjørner, Bruun-Pedersen, Sørensen, and Perez-Cueto (2020) completed "a pilot study on the effects of mixed-reality conversations and virtual environments on older eater's solitary meal experience and food intake". They tested the effects on older adults, and found that the mixed reality, with an illusion of eating in a living room resulted in a better food experience, and the food was considered of a higher quality compared to foods eaten alone. "Eating while engaging in avatar-based social interactions with three remotely located friends resulted in lower sensations of being alone and positive mood changes" (D. Korsgaard et al., 2020).

The FridgeMatch application is a form of online social network about food leftovers, connecting strangers to cook and eat together. By signing into their Facebook account, the users begin the matching process by entering ingredients, availability to have a dinner, and a location where they can offer the dinner. Targeted FridgeMatchers were college young adults and working adults with a similar lifestyle of eating outside or takeaways due to their busy schedules (Kera & Sulaiman, 2014).

The system "KIZUNA" is a tele dining system, which enables to virtually enjoy a meal together, by the transmitting recorded video messages. Tests show that using the system is likely to influence the diners communication and eating behaviours (Inoue & Nawahdah, 2014).

Finally, Spence et al. (2019) point out several directions for further technologies, such as using food delivery platforms (e.g. Uber eats, Deliveroo, just eat) to connect solo diners. In addition, they stress that research needs to be conducted to conclude whether commensality is enhanced if two remotely eating persons together eat the same food. "There are a number of routes by which digital technologies may increasingly help to connect the solo diner with physically co-located, remote, or even virtual dining partners" (Spence et al., 2019).

Technologies focused on making eating alone more pleasurable in itself

Grevet Delcourt et al. (2012) "developed and deployed a technology probe which provide social awareness around mealtimes to explore how social systems might help to alleviate the loneliness of solitary dining". The system shares basic information on a screen (eating at home, eating out, and activity, cooking, eating) about the commensal activities of a group of friends. Their findings state that "it may convey a sense of connectedness around a meal". Three advantages of the system have been identified: it creates peripheral awareness: users gather social awareness information unintentionally; it creates sociability and connectedness (it gave the users a pleasant feeling knowing what someone else is doing) and it is a catalyst for rich interaction as users created the need to communicate more than only sharing their status.

Nam, Disalvo, Do, and Mendenhall (2010) designed "Dinner Party" a tabletop application with which a solo diner can have a "dinner party" with virtual creatures. When a solo diner moves anything on the table, the interfaces in the table respond with animated words describing imaginary creatures that appear on the tabletop. Their research focuses on creating a sociable interface, between humans and technology. By placing these interfaces in everyday objects, participants interact naturally with the interface. They concluded that in our solitary modern society, people might feel less lonely having the table as imaginary friend.

R. Khot, Arza, Kurra, and Wang (2019) presented FoBo, "a robotic dining companion that acts and behaves like a human co-diner. Since it is a co-diner, it participates in the eating activity by consuming batteries and tries to converse with the diners through beeps and purrs." They argue that existing solutions to tackle solo dining often impose conditions that are hard to fulfil, such as setting up a video connection and requiring a remote

presence. They also indicate that various restaurants have experimented with non-human dining companions such as pets (cats and dogs) or giant stuffed animals. The popularity of these restaurants suggests that non-humans can be dining companions. They indicated the FoBo was designed since robots were not yet used as dining companions.

Takahashi, Tanaka, Yamana, and Nakajima (2017) developed a virtual co-eating system that places a fictional character into the real space (using artificial reality) as a partner to eat together. The goal of the virtual co-eating system is to offer an enjoyable conversation with the virtual eating companion since the system is responsive. They concluded that, by facilitating having a conversation with an empathetic virtual partner, the system provides a better eating alone experience.

3.4. DISCUSSION

Chapter 3 answered to the research question*: RQ1.1 How are the concepts of commensality and eating alone defined, what are their benefits and drawbacks and how has research addressed improving the experience of eating alone?*

Commensality, the activity of eating in company, is fundamentally a social activity associated with family or groups of people. Yet, changes in society have led to an increase in the number of people eating alone. Whilst commensality is often perceived as having several benefits, such as social interaction and socialisation, it also has drawbacks. For instance, eating in a group can trigger an increase in food consumption. Likewise, negative feelings can be associated with eating in company. For example, people might feel an obligation to avoid silence, or they do not have affinity with other commensals. Next to that, rigid norms and formal manners in commensal units might cause stress or make the eating experience less pleasant or convivial.

Interestingly, what some authors describe as advantages of commensality, others define as drawbacks. For instance, while some studies state that people engaged in commensal eating are less obese than those who eat alone, others research indicate that commensal eating can increase food consumption. Thus, commensality can lead to enjoyment but also to negative feelings. However, Spence et al. (2019) suggest that the benefits of commensality outweigh the drawbacks.

Eating alone is often placed in contrast to commensality, and it is frequently perceived negatively as there is some stigma within society about the solo diner. A person who eats alone is often regarded as lonely or to have failed to build social relationships. Eating by oneself also carries nutritional disadvantages since it is significantly associated with health implications such as metabolic syndrome and diabetes. Social drawbacks are also significant since eating alone can be perceived as less pleasurable and lead to depressive and negative feelings. Remarkably, solo dining has its advantages. For instance, solo eaters can have a sense of freedom because they can easily decide what, when and where to eat. Furthermore, people who eat alone generally spend less time cooking and eating, and they can have a more relaxed mealtime since they can enjoy a moment "just for themselves" or without pressure from others. In addition, some solo eaters perceive less distractions while eating, which helps them pay more attention to the food itself.

As with eating together, the so-called advantages of eating alone can at the same time be considered disadvantages of solo dining. For instance, having a moment to be with oneself while a person eat alone can be an advantage, but being alone while eating can be considered a drawback. However, as opposed to commensality, the drawbacks are mentioned more frequently than the advantages. Thus, overall, it can be stated that commensality is more positively described within the literature than eating alone.

Chapter 3 also addressed the sub-question *how is the profile of the solo diner described within the literature?* Studies indicate that people who eat alone are often people who also live alone. Solo diners eat quicker and spend more time preparing dinner than people who eat together. Furthermore, solo diners are often the younger and 'urban' generations and older adults. Likewise, widowhood might result in a loss of commensality.

Few authors elaborated on *how to enhance the experience of eating alone.* According to literature, solo eating can be improved by eating mindfully. For instance, by setting the table for oneself, putting on some music, no

eating straight out of the pan or in front of screen-based devices and by making the cooking-for-one experience more pleasurable by learning new cooking skills.

Regarding the sub-question ***what technologies are being currently used to enhance the experience of eating alone?*** studies indicate that technologies can in fact, contribute to the experience of eating alone, as a form of companionship or to reduce loneliness. ICT devices can create opportunities to support connectedness and mealtime interaction. According to the literature, some technologies are focused on improving the experience of eating alone by connecting solo diners to other people. Next to that, other solutions are focused on making eating alone more pleasurable in itself.

The technologies that connect solo diners with other people include tele-dining and mixed reality dining systems, which focus on creating digital commensality by using technology to connect people to share a meal while physically separated. The digital technologies that focus on improving the dining experience of a solitary eater often include connecting with a virtual companion. It can be concluded that researchers believe commensality can simply be recreated in a digital space. However, these technological solutions would never replace 'traditional' commensality since "it remains to be investigated whether or not computational commensality systems provide the same benefits of actual commensality" Niewiadomski et al. (2019).

Many of the identified technologies to enhance the experience of eating alone require installing complicated hardware, which might prevent a broader use of such technologies by solo diners. Furthermore, the identified technologies have hardly explored improving eating alone by strengthening the advantages of solo dining since it has not been investigated the context of use and user requirements of solo diners. Therefore, it remains unclear what aspects of the practice of eating alone could be heightened to provide the solo eaters a more pleasant dining time. Thus, for this project, it is important to identify the needs and requirements of solo eaters to be able to develop a technological solution that provides solo eaters a more pleasant dining time.

3.5. CONCLUSION

The systematic literature review indicated that commensality is seen as the ideal form of eating a meal, while solo dining can be prone to negative associations. Moreover, while many different technologies have been implemented to improve the experience of eating alone, these solutions are often not being developed using a human-centred design approach. Likewise, it is unclear which specific needs solo diners have regarding their eating solo practice.

Furthermore, the systematic literature study identified focus areas that can be used as input for developing a product to enhance the eating experience of solitary eaters. For instance, the product should avoid the use of screen-based digital technologies since they can negatively affect the experience of eating alone, such as increasing food consumption and restricting diners from focusing on their meal. As opposed to the existing ICT devices to enhance the solo dining practice, the product to be developed during this project should be simple to use on a day-to-day basis and should not require complicated hardware. The technology should emphasise on improving the solo dining practice by focusing on the attributes of eating alone since this has not been widely investigated.

The following section describes the field study performed to gain an understanding of the lived experience and requirements of people who eat alone.

4. FIELD STUDY

This chapter describes the field research that was carried out to understand the solo diners' eating experience and identify their needs. A final step of the field study was to analyse the data to evaluate the targeted behaviours and recognise the primary needs of solo eaters. Ultimately, the information obtained from this field study was used as the input of chapter 5 to ideate design concepts to enhance the experience of eating alone.

4.1. INTRODUCTION

Several advantages and disadvantages of commensality and eating alone are discussed within the existing literature. However, the available studies do not focus on understanding the needs of solo eaters and most of the technologies discussed within literature were designed while assuming that establishing virtual social connectedness or digital commensality benefits the solo dining experience. Still, none of those concepts is centred on strengthening the advantages of eating alone. Thus, this field study focuses on answering the research question RQ1.2. *How do solo diners perceive the practice of eating alone, and what are their needs during the solo eating experience?*

4.2. METHOD

4.2.1. Study Procedure

The research method for the field study is a ***diary study***. The diary study was conducted online and asked participants to record the diner habits by describing their experience and taking some photos.

Respondents were asked to complete a diary entry for four different solo dining experiences in a period of 2 weeks. Next to the Diary Entry Online Form, the respondents received a small introductory online questionnaire and a final questionnaire. Both questionnaires were to be completed within the same 2-week period.

The solo dining experience investigated was *dinner* because it is the meal that is most often consumed within a family unit (Rah et al., 2019). While around half of breakfasts are eaten alone, less than one-fifth of dinners are and evening meals are shared twice as often as breakfasts or lunches on weekdays (Yates & Warde, 2017).
The content was gathered in four steps. Firstly, participants were asked to respond an initial 10-questions survey about name, age, gender, nationality, and the value they give to the experience of eating by oneself, etc. (Appendix C).

Secondly, participants were asked to fill out a diary entry form on four different days. The online diary (Appendix D) aimed to gather a deeper understanding of the solo diner behaviour and how solo eaters complete the activity of dining alone. Respondents were asked to fill out the diary entry form only after completion of their meal. Respondents were asked to capture moments with their cell phone camera during the dining experience. Guidance on how to fill the diary entry was provided by giving examples of questions that a respondent could answer (e.g., what type of food I ate, what was my mood, what was my dining setting (formal/casual), etc.).

The third step in the field study was to ask participants to respond to a final survey to assess the needs of the solo diners. The questionnaire focused on the advantages of solo dining but also on the specific needs of the solo eater during the evening meal (Appendix E).

4.2.2. Participants and recruitment

Most frequently, the people that eat alone also live alone (Kwon et al., 2018). Therefore, the respondents for this diary study were people who lived alone for at least one year and eat alone frequently. Inclusion criteria of this study included that: (1) participants had to live alone; (2) live in the Netherlands; and (3) eat occasionally or frequently a dinner alone. The respondents received a €20 gift voucher as compensation for their participation.

Impact of the field study on the respondents

The field study aims to research the experience of solo eaters. However, to this day, there is a stigma associated with solo dining. For instance, the associated stigma of being seen as a lonely person, because, "to eat alone is to be alone" (Masson et al., 2018). Therefore, the diary study was presented the most positively for the respondents and considering not reminding them of their solitude. For example, the terms 'solo diner', 'dining alone', 'eating alone' etc., were replaced by the terms: 'eating by oneself/yourself'. The diary study focussed on the positive features of eating alone, specifically on those that help to enhance the dining experience. During the diary study, the respondents were asked to describe their day-to-day practice with regards to having dinner. Hence, there did not exist any negative association with the study and the practice of dining alone (for this field study, approval from the Ethics Committee of the University of Twente was obtained and all participants signed an Informed Consent Form).

Although some insights on the negative aspect of solo dining were investigated, the association with negative feelings was minimal. For example, the 'negative' features of dining alone were researched by asking questions such as: *what would you do to improve the experience of dining by yourself? what do you love about eating with others that is not included when dining by yourself?*

4.2.3. Data Analysis Procedure

The field study produced qualitative and quantitative data. Qualitative data including text and images was analysed using content analysis. Quantitative data was analysed using descriptive statistics.

Qualitative data analysis

The information collected from the participants resulted in qualitative data. The Content Analysis Process (Lazar, Feng, & Hochheiser, 2017) allows to systematically analyse the data provided by participants, which contained both text-based (answers to the open questions of the survey) and multimedia-based information (pictures that the respondents took).

A priori and *emergent* codes were used to categorize the answers of participants. A priori codes were determined from the literature review results (Table 1), and the emergent codes were based on recurring topics within the diaries.

Advantages of eating alone	**Aspects that could help to improve the experience of eating alone**
• Freedom of what to eat • Time freedom (deciding at what time to eat and how long to take to eat) • Relaxation (no peer or social pressure) • Not having to worry about etiquette or manners • Focus on food / quality of food • Having time for yourself	• Effort on the cooking • Pastime/side-line activities (sound experience, visual experience, technological distractions, non-technological distractions) • (Social) connectedness • Enjoyable/fun/celebratory experience

Table 1. A priori categories.

All answers from the four Diary Entries were assessed using an iterative process. First, the data set was retrieved from Qualtrics and exported into an excel document. In a consequent step all relevant sentences from the diaries were highlighted and copied into an excel table. After completing the initial analysis of the four diary entries, all sentences were clustered in code categories. A priori codes involved coding categories established from the literature review part of this project. Emergent codes were created by capturing interesting remarks on the participant's answers. Each code (whether a priori or emergent) was assigned a colour to facilitate the analysis process (see Table 2 for an example). Each code's recurrence was counted, providing a 'code summary' that showed which codes were most frequently chosen.

			A PRIORI CODES			EMERGENT CODES	
			TFM	FRX	FOF	MDE	SLN
Diary Entry	Participant ID	Text Fragment	Time Freedom	Feeling relaxed	Focus on food	Mindful eating	Self nurturing
D1	P1	I was focusing on my food and chewing thoroughly. I like to focus on my food to be mindful about eating.					
D2	P1	I eat slowly at the table. Cosy with the light switched on and dimmed					

Table 2. Example of the coding process with a rainbow sheet.

All multimedia information (pictures retrieved from the diary entries) was analysed together with the text to understand the eating setting and to get an impression of the food prepared by solo diners. The photos were not assessed by code as they were only used as support during the coding process.

Quantitative data analysis

The initial and final questionnaire were analysed quantitatively using bar charts and other graphs to illustrate the respondents' diversity and to look for relevant insight. Firstly, the data set was retrieved from Qualtrics and exported into an excel document. Descriptive statistics were used to show the initial questionnaire results concerning the age distribution of participants, gender, years living alone, diet, frequency of eating alone, and satisfaction regarding eating/cooking alone. Descriptive statistics and graphs were used as support to show the results of the final questionnaire concerning the (possible) advantages of solo dining. All results were discussed and compared with the hypothesis derived from the literature study.

4.3. RESULTS

4.3.1. Participants

In total, six persons participated in the field study. The diaries were completed from November 2020 to January 2021.

This section describes the general information of the participants. Four out of six participants are female, and two are male (Figure 5). All respondents are Dutch living in various places within the country (Figure 4) with varying occupations (IT, Secretary, Financial, Construction, Communication, Online Marketing). The age of the participants is between 26 and 59 years old (Figure 6). All participants have lived alone for more than one year (Figure 7), and most of them eat alone more than four days a week (Figure 8). Three out of six participants have dietary restrictions, for instance, follow a diet high on protein (Figure 9), and most of the participants (4 out of 6) found both eating and cooking alone somewhat or very satisfying (Figure 10).

Figure 4. Geographical distribution.

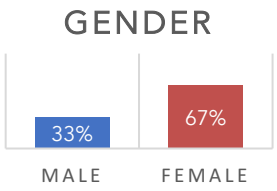


Figure 5. Gender distribution.

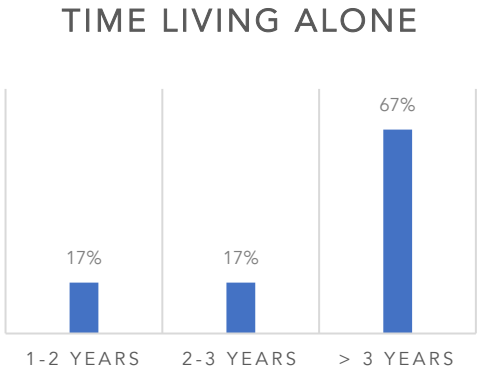


Figure 7. Years living alone.

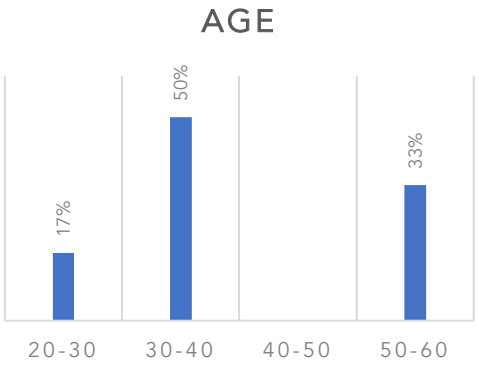


Figure 6. Age distribution.

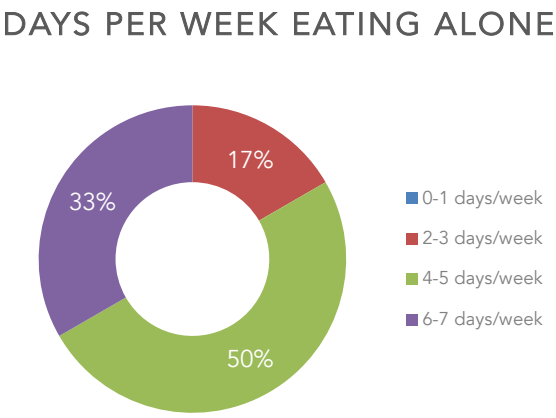


Figure 8. Times per week a participant eats alone.

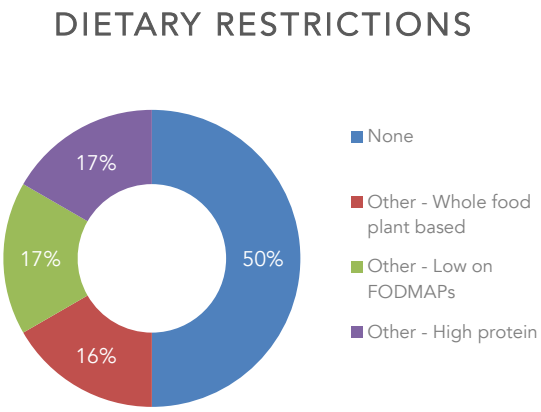


Figure 9. Diet.

Figure 10. Level of satisfaction regarding both cooking and eating alone.

4.3.2. Diary Entries

The diary entries' results consisted of textual answers and pictures taken by the respondents regarding the practice of eating alone. Five participants completed all four diary entries, and one participant completed only two diary entries.

Figure 12 shows the outcome of the coding and displays both ***a priori*** and ***emergent*** codes, with the number of times those codes were identified positively (respondent mentioned the code in a positive context) or negatively (respondent mentioned the code in a negative context) within the diary entries.

Participants referred once to each of the following advantages: *freedom of choice of what to eat, time freedom and time for oneself. Focusing on the food* and *not worrying about etiquette or manners* have both been mentioned nine times. The most cited advantage of eating alone for participants was *feeling relaxed*, with seventeen mentions.

Concerning the **aspects that could improve the solo dining experience,** the most relevant high-level code was PSA (pastime/side-line activities), mentioned 35 times. The four lower levels codes from this category refer to sound experiences (SE), visual experiences (VE), technological distraction (TD) and non-technological distractions (NTD). The most significant being VE with 27 quotes. From the VE category, watching TV (which includes streaming series or Netflix) was the most recurrent category. Some responses indicated not to enjoy having any distractions while eating as it was preferred to focus exclusively on the food.

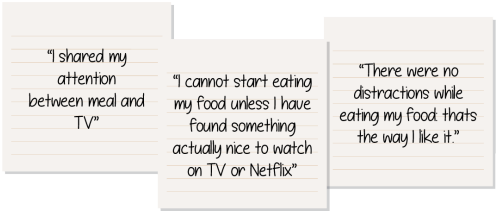


Figure 11. VE Code Quotes from the Diary Study.

Regarding the emergent codes, the most mentioned ones were related to *practicality* and *cooking with the available ingredients*, which sum up 39 codes.

		Code	Process	Definition	Count Positive Aspect	Count Negative Aspect	Total
A Priory	Advantages of solo dining	FEW	Freedom of what to eat	Freedom to decide what food to eat	1	0	1
		TFM	Time freedom	Deciding at what time to eat (not need to stick to a schedule) and how long to take to eat or how long to cook	1	0	1
		FRX	Feeling relaxed	Feeling relaxed	16	1	**17**
		NEM	Not etiquette or manners	Not having to worry about etiquette or manners	9	0	9
		FOF	Focus on food	Being able to exclusively pay attention to the food: its flavors, taste, appearance	9	0	9
		TFY	Time for yourself	Enjoying having a "just for myself" moment	1	0	1
	Aspects that can improve the solo dining experience	EOC	Effort on the cooking	Amount of effort put into cooking	7	0	7
		SE	Sound Experience	Listening to something while you cook / eat	6	0	6
		VE	Visual Experience	Watching something (tv, movie, series) while you cook / eat	27	0	**27**
		TD	Technological distractions	Use of mobile technologies (smartphone or tablet)	3	0	3
		NTD	Non-Technological Distractions	Use of printed media (magazine, books, brochures)	4	0	4
		SCN	Social connectedness	Experience of feeling close and connected to others	0	1	1
		EEC	Enjoyment of eating / cooking	Eating as an enjoyable / pleasurable / fun / celebratory experience	5	1	6
Emergent		CWH	Cooking with what I have	Cooking with what I have	12	0	**12**
		MDE	Mindful eating	Paying full attention to experiences, cravings, and physical cues when eating, without distractions	3	0	3
		PEC	Practicality in eating and cooking	Cooking and eating easy and quickly. Not taking too much time/effort to prepare food or eat	27	0	**27**
		NVF	Nutritional value of food	Focus on the nutrients or the nutritional value/ quality	10	0	10
		FDR	Following dietary restrictions	Paying attention to the type of food consumed because of a diet.	3	0	3
		ETE	Enjoyment of the environment/ atmosphere	Environmental stimuli that have an in impact on the experience of the participant.	12	3	**15**
		SLN	Self-nurturing	Treating / pampering yourself	10	1	**11**
		FOC	Focus on the Cooking	Paying attention to the cooking process	2	0	2
		ROP	Routine or old practices	Sticking to (old) habits about how to cook, where to eat or what to eat	7	0	7
		FAS	Food as memory/ Seasonality	Memories brought back by food, or enjoying the season	11	0	**11**
		IOM	Impact on the mood	Experience having an impact on the participant's mood	0	3	3

Figure 12. Coding.

4.3.3. Final Questionnaire

Table 3 indicates to what extent respondents agree with the advantages of eating alone derived from the theoretical analysis. Generally, respondents agreed with the advantages of *freedom to choose when and what to eat* and *having time just for myself*. Two of the **advantages of eating alone** identified from the theoretical framework deemed relevant in the final questionnaire, as all of participants "*strongly agree*" with the *freedom to choose when and what to eat*, and 5 out of 6 participants enjoy *having time just for themselves*. The latter was mentioned only once in the diary entries. 4 out of 6 participants disagree with the advantage of *not having to worry about manners or etiquette*. Only 1 participant evaluated this aspect as significant. Yet, some of the respondents' photographs (Figure 13) display an informal eating setting. Some respondents seem to like eating on the coffee table in front of the TV. Others eat on the couch while covering their legs with a blanket. 4 out of 6 participants disagreed with the statement *'I enjoy eating alone because it is more relaxing than eating with others'*.

Figure 13. Different participants having dinner in an informal setting.

Table 4 displays the answers to questions about the *features that could improve the experience of eating alone.* Responses indicated that only two out of the three features that could improve the experience of eating alone mentioned in the literature are relevant. Those being *the quality of the food* and *to be entertained while having dinner*. The last-mentioned was confirmed as very relevant by the coding analysis. The third aspect, *social connectedness* rated as not significant in both the final questionnaire and the code analysis.

Table 5 depicts the perception of participants to statements related to the drawbacks of eating alone. Overall participants disagree with the disadvantages of eating alone. Three out of six participant strongly disagree with the statement, "when eating by myself, I miss having company".

Table 6 indicates how the respondents perceive the activities of cooking and eating alone. While 4 out of 6 respondents found cooking and eating alone from *very satisfying*, to *somewhat satisfying*, two of the participants recognized cooking alone as '*somewhat unsatisfying*' and one respondent rated eating alone as '*very unsatisfying*'.

The tables below indicate the results of the final questionnaire. For each question, the percentages of respondents' answers are shown.

Using a scale of 1=Strongly Disagree to 5=Strongly Agree, please rate the following aspects of eating by oneself:	Strongly Disagree				Strongly Agree
I enjoy the freedom to choose when and what to eat	0%	0%	0%	0%	100%
I enjoy eating alone because it takes less time	17%	17%	50%	17%	0%
I enjoy eating by myself because it is more relaxing than eating with others (no peer, social or time pressure)	33%	33%	33%	0%	0%
I enjoy having "time just for myself"	0%	0%	17%	33%	50%
I enjoy eating alone because I can eat healthier	33%	33%	0%	17%	17%
I enjoy not having to worry about manners / etiquette	67%	0%	0%	17%	17%
I enjoy eating by myself because I can focus just on the food itself (its quality, flavours)	17%	33%	33%	0%	17%

Table 3. Evaluation of the advantages of eating alone derived from literature.

How important are the following aspects of eating by yourself?	Not at all Important	Very Unimportant	Neither Important nor Unimportant	Very Important	Extremely Important
The quality of the food (I try to make an effort in cooking a delicious meal)	0%	0%	33%	33%	33%
Being entertained while I have dinner (I watch TV, Netflix, I listen to music, I video-call family or friends, I read a book or magazine)	17%	17%	0%	50%	17%
Social connectedness while I eat (I use my social media to interact with others, I post pictures of my food on social media, etc.)	67%	17%	17%	0%	0%

Table 4. Evaluation of the features that are important to solo eaters during dinner time according to literature.

Using a scale of 1=Strongly Disagree to 5=Strongly Agree, please tell us what you think about the following statements	Strongly Disagree				Strongly Agree
When eating by myself, I miss socializing (sharing everyday experiences, conversations, sharing memories and stories)	17%	33%	33%	0%	17%
When eating by myself, I miss having company	50%	0%	33%	0%	17%
I would like to be (more) entertained while I eat alone	33%	33%	17%	17%	0%
I would like the experience of dining alone to be more playful (play a game, complete a challenge, etc.)	67%	33%	0%	0%	0%
I would like the experience of dining alone to be more fun/celebratory	67%	0%	17%	17%	0%
I would like to have more social interaction (social connectedness) when I eat alone	33%	33%	33%	0%	0%
I would like to eat healthier when I eat alone	50%	0%	17%	17%	17%
I would like to interact, share experiences, etc. with other people who eat alone	67%	17%	0%	0%	17%

Table 5. Evaluation of the disadvantages of eating alone.

Overall	Very Satisfying	Somewhat Satisfying	Neutral	Somewhat Unsatisfying	Very Unsatisfying
How would you value the experience of eating by yourself? (*) - Cooking for myself	50%	17%	0%	33%	0%
How would you value the experience of eating by yourself? (*) - Eating alone	50%	17%	17%	0%	17%

Table 6. Evaluation of the experiences of both cooking and eating alone.

The transcriptions of the participant's answers to the open questions in the final questionnaire are included in Appendix F. Open responses to the question ***'what do you like about eating with others that is not included in eating by oneself?'*** suggest that participants desire the following aspects: conviviality, companionship, cooking with others, conversations during and after the mealtime, 'making a moment' of the dinner time, talking about daily experiences, sharing the food, sharing the day, interacting with others, and having a chat.

4.4. DISCUSSION

To address the research question RQ1.2. *How do solo diners perceive the practice of eating alone, and what are their needs during the solo eating experience?* a digital diary study was used to gain an understanding of the experience of solo diners.

Although some of the literature findings regarding solo dining were confirmed by this analysis, not all of them deemed relevant. Likewise, the discrepancies between the participants' answers to the diary study and the questionnaires' answers provided valuable input on the solo diners' needs, and helped to identify essential cues that could positively affect the eating alone experience.

According to the results of this diary study, most of the participants find ***the experience of eating alone*** *very* or *somewhat satisfying*, while only one participant said to find it *very unsatisfying*. That may be related to the fact that most participants in this diary study enjoy the activity of cooking. Hence, respondents might find themselves in a good state of mind or even feel relaxed during and after cooking, which can positively affect the eating-alone experience. Compared to the literature study results, this is a positive outcome because academia often portrays eating alone negatively.

The diary entries and the participants' responses to this field research's intro and final questionnaires provided valuable information about how much the solo diners rely on the positive aspects of eating alone to make their own experience better. This diary study determined that five out of ***six advantages of eating alone*** are often implemented by the participants to make their solo dining moment more enjoyable:

- ✓ Participants enjoy both the ***freedom of what to eat*** and ***time freedom*** as they all strongly agreed on both aspects of the final questionnaire. Furthermore, the diary transcripts confirmed both advantages since participants frequently mentioned they like to cook with what they have at hand and like to be quick while cooking. Therefore, an option to include in the final design could focus on supporting solo eaters to cook easy recipes with the ingredients they have at hand.
- ✓ ***Relaxation***: four out of six participants disagree with the statement 'I enjoy eating alone because it is more relaxing than eating with others'. Interestingly, in the diaries, statements related to relaxation are *frequently mentioned*. The explanation for this could be that participants might feel relaxed during their solo dining experience but still perceive eating with others as more relaxing than eating alone. The proposed design could thus, focus on providing a relaxation experience to the solo diner.
- ✓ ***Not having to worry about etiquette or manners:*** surprisingly, four out of six participants disagree with that 'advantage' of solo dining. However, contrary to these statements, the respondents' 'photographs' rom the diary study show an informal eating setting. For example, some respondents like to eat on the coffee table, in front of the TV. Others eat on the couch while covering their legs with a blanket. The design could therefore incorporate aspects that relate to not having to worry about etiquette or manners.
- ✓ Only one participant indicated to enjoy ***focusing on the food*** (the quality of the ingredients, the flavours of the food). That advantage was also not frequently mentioned within the diary entries. This advantage of solo dining could therefore not be confirmed by the field study.
- ✓ Five out of six participants enjoy ***having time just for themselves***. Despite that, the aspect was mentioned *only once in the diary entries*. It could mean that respondents do enjoy having time for themselves when eating alone. However, when describing the experience itself, they do not mention it as a positive aspect of solo dining. Nevertheless, this advantage of eating alone is confirmed and should be considered when designing a product to enhance the experience of eating alone.

Respondents care about ***two of the four aspects that can help improve the experience of eating alone.***

- ✓ ***Effort on the cooking***: most participants find cooking for themselves very satisfying as stated in the diary entries.
- ✓ ***Pastime activities:*** this was the aspect most frequently mentioned by participants in the diary entries. That means that participants improve their eating alone experience with a 'distracting' or 'entertaining' activity. The most popular was watching TV/Netflix. Surprisingly one respondent stated that he/she does not enjoy having any distractions while eating and prefers to focus exclusively on their food. The use of ICT devices while eating alone is positively and negatively referred to within literature. However,

the outcomes show that solo diners "need" a sort of distracting experience. Thus, an innovative visual experience that helps focus on the meal could be considered for the project's design phase as a mindful eating time can benefit the practice of eating solo.

- ✘ ***Social connectedness:*** was rated as not relevant by most participants, which indicates that participants do not consider social connectedness or digital commensality an aspect that can help to enhance their lone eating experience. This is an important consideration because social connectedness is what research commonly has included as a crucial element when trying to provide a more pleasurable eating moment by trying to implement digital commensality through different technologies.
- ✘ ***Enjoyable/celebratory experience:*** eating alone as an enjoyable/fun/celebratory experience could not be confirmed as an important aspect during the field study, as respondents did not frequently mention it in the diary entries, nor the questionnaire.

Five needs of solo diners that were not mentioned within literature were discovered during the field study.

- ✓ ***Cooking with what I have*** and ***practicality in eating and cooking:*** participants frequently mentioned cues related to cooking with what I have and practicality in cooking with the available ingredients. Interestingly, this is vastly related to the cooking process but less associated with the solo dining experience. Cooking appeared to be a relaxing or enjoyable activity for most of the participants and was, at times, the perfect prelude to an enjoyable solo dining experience. However, there should be some consideration when considering the cooking experience to improve the solo dining moment. For this project, most of the participants are positive about cooking. This part should be further investigated with other lonely eaters who do not enjoy cooking to verify whether this is a crucial need to consider as part of the solitary eating experience.
- ✓ ***Enjoyment of the environment / atmosphere:*** the 'enjoyment of the environment' was frequently mentioned within the diaries entries with phrases related to enjoying a 'quiet' and 'relaxed' environment. An aspect of attention for a design solution may include focusing on providing a relaxing aspect for the solo eater.
- ✓ ***Self-nurturing:*** a need for self-nurturing needs was identified in the diary entrances. For instance, in sentences such as: "putting some extra additives next to the food, it is like you are treating yourself to something special." A look-after-oneself/way-to-please-oneself without caring for the exterior world could be implemented in the design phase to provide a more pleasant eating time.
- ✓ ***Food as memory:*** it was found that participants often reminisce about lived experiences through their food. For instance, some respondents prepared their favourite grandmother's dish to evoke positive memories while consuming the meal. To evoke sensorial memories through the product could be implemented. Bringing back memories of past experiences, such as being relaxed during the holidays or other positive moments, can make the experience more emotional and joyous.

4.5. LIMITATIONS

The field study results for this project provided insight into solo diners' perception and needs regarding the eating alone experience. However, due to the small number of participants in the Diary Study, the results' extent was limited. Another factor was that the sample of participants was not representative of all alone eaters. Most of the respondents for this research appeared to be 'foodies,' or people who enjoy cooking, and some have dietary restrictions. Hence, bias was introduced to the study and could have affected identifying positive aspects of eating alone.

Three out of six participants follow a specific diet, which might have influenced the diary study results. According to research, people who follow a specific diet find the experience of eating alone positive as they do not have to worry about what others think of their eating requirements, or they can better stick to their food regime. This could have influenced the results, meaning that the research could have benefited from including participants who do not follow a specific diet.

Overall, respondents disagreed with the statements related to the *aspects that could improve the experience of eating alone*. This discrepancy might have occurred because participants filled in the questionnaire immediately after dinner. Thus, they might have failed to recognise their solitude due to completing this activity.

Alternatively, they might not have associated those statements with aspects that could improve the dining-alone experience.

Furthermore, as most participants appear to have some affinity towards cooking and eating alone, major cues on improving the experience might have been undetected. Further research could investigate the perception of dissatisfied solo diners and people who do not enjoy cooking to reveal further insights.

4.6. CONCLUSIONS

The food diary study indicated that solo diners enjoy the *'freedom to choose when and what to eat'*. Furthermore, they enjoy *'feeling relaxed'* while eating alone. Next to that, they appreciate a *'quiet, relaxing environment'* since they perceive the moment of dining alone as a *'time for just themselves'*.

Therefore, aspects that can improve the eating experience are offering a *relaxation moment* for the solitary commensal, providing a *self-nurturing environment* and deliver a pleasurable *'me-time'* moment to better enjoy the self-company. Another crucial feature in the eating practice of the solitary eater is to obtain visual entertainment. However, the last mentioned should not take away the focus on the meal, as an eating mindfully can benefit the experience of eating alone.

These insights will be used as design requirements in the next phase of the research, which focuses on the development of a design concept. The ideation and concept development phases are further described in the next two chapters.

5. IDEATION

Chapter 5, together with chapters 6 and 7 comprise the iterative design process to develop a product to improve the experience of eating alone that ultimately responds to the research sub-question RQ1.3. How can a product design address the needs of solo diners to enhance the experience of eating alone? The aim of the ideation stage was to create a broad variety of ideas that could be evaluated and refined to later converge into a final concept (Chapter 6).

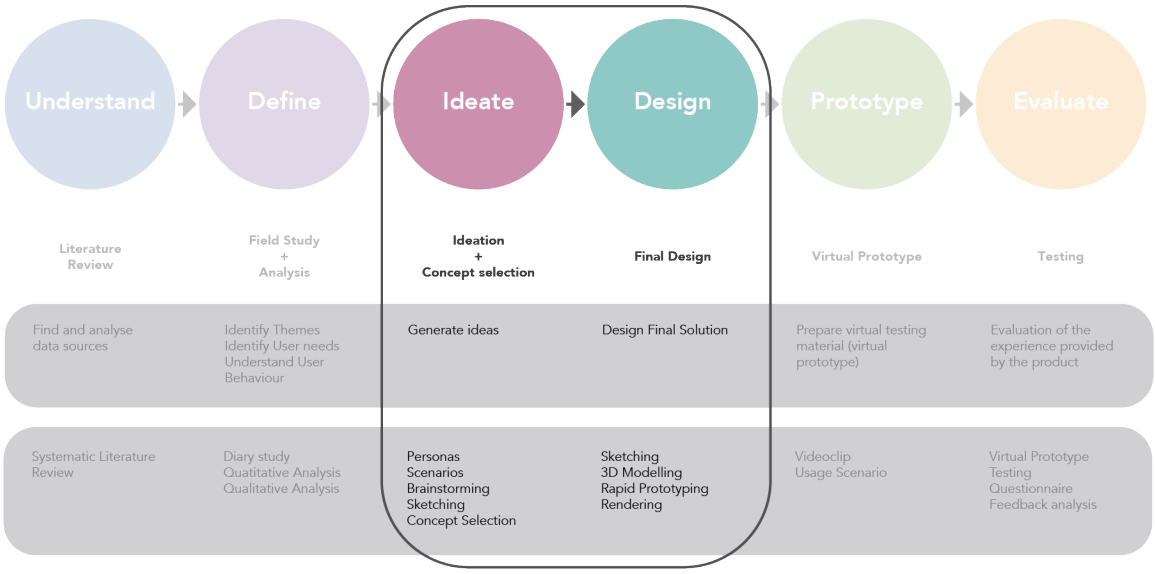


Figure 14. Outline of Chapters 5 & 6 comprising the design phase.

5.1. INTRODUCTION

The input from the literature review (Chapter 3) indicated that the **features that are relevant to people who eat alone during mealtime** are *freedom of when and what to eat, enjoyment of a visual experience, being entertained, not to worry about etiquette or manners.*

Further, people who eat alone identify **relevant aspects of the cooking practice**, such as *cooking with what they have at hand*, *practicality while cooking*, and *focus on the quality of the ingredients.*

Alone diners described that the **missing aspects of eating with others** are *conviviality*, *companionship*, *cooking with others*, *food sharing*, and *conversations with others.*

The field study showed that the cooking experience has a significant influence on the enjoyment of eating alone. Furthermore, results indicated that people who enjoy cooking find some amusement in the activity of preparing food for themselves. Thus, most participants who have an affinity towards cooking also enjoy eating alone. However, the most important cues to consider when ideating a product that enhances the experience of the alone eater are divide into three categories and described next:

Figure 15. Categorisation of the identified features to improve the experience of eating alone derived from the Literature Review.

The above elements derived from a converging, iterative process, and as result from the literature study, the field research, and the valuable input from the supervisors of the project. These three categories served serve as ideation directions. The first direction focuses on designing a product that offers a relaxation moment for the solitary commensal. The second route centres on providing a self-nurturing environment and the third direction focuses on deliver a pleasurable 'me-time' moment to enjoy the self-company better. Other aspects to consider during the conceptualization phase are providing a virtual companion and the use of food as an element to bring back good memories. The design proposal can be designed for both women and men and can consider the cooking process as part of the interaction.

5.2. METHOD

The aim of the ideation phase was to create a variety of ideas that could be refined and converge into the final concept. The process for the ideation phase was iterative, including explorative and creative tools. The explorative tools used for this phase included an exploration of existing products, creation of personas, scenarios, and existing products mapping. The creative methods, brainstorming and sketching, were used to generate as much ideas as possible.

Exploration of existing products

The searching of existing products was based on the categorisation of the identified categories to improve the experience of eating alone from the literature review (Figure 15) and provided insight for possible ideas.

Personas

As input for the creation of the personas five main elements were chosen to focus on.

- Self-nurturing: a sense of self-indulgence
- Relaxing moment: need of quiet time
- Food as memory: using food as an element to bring back memories
- Me Time: enjoying the company of oneself
- Companionship: having a (virtual) companion

Concept evaluation

A concept was selected using a multi-criteria analysis. Nine criteria, based on the outcomes of the literature and field study was used to evaluate the ideas were used:

- Non-Human Companionship
- Interaction with others
- Entertainment
- Self-pampering
- Relaxation
- Memories
- Me-time
- Multisensory experience
- Displaying of environments.

5.3. EXISTING PRODUCTS MAPPING

The goal of the existing product mapping was to gather inspiration on possible directions for the initial ideas.

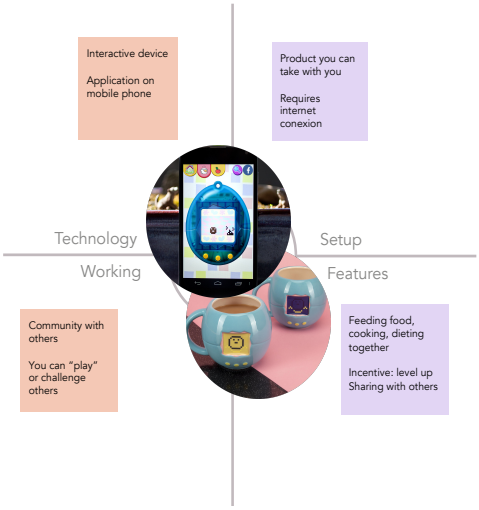


Figure 16. Ideas derived from the Tamagotchi.

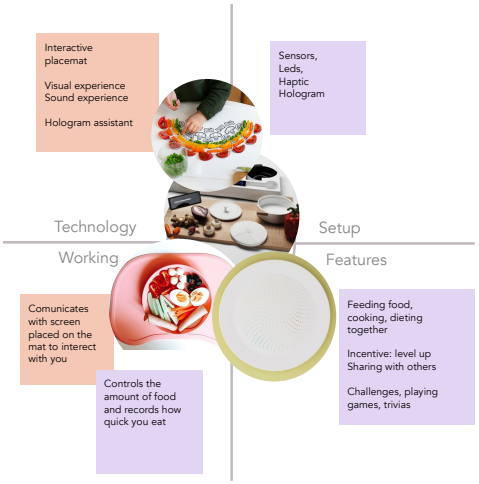


Figure 17. Ideas derived from Interactive Placemats.

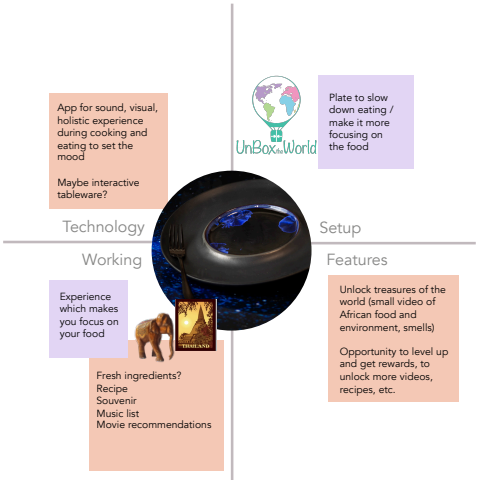


Figure 18. Ideas from interactive delivery cooking box.

5.4. PERSONAS AND SCENARIOS

The personas and scenarios were used during the brainstorming session to facilitate the ideation process.

Persona

A persona is a way to summarize and communicate about people who have been researched. A persona represents persons in the real world and enables the designer to focus on manageable characters. Personas aid designers to create designs for different kinds of people rather than for a generic somebody. Personas help designers to see the world form the perspective of the future user (Goltz, 2014). As part of the design process, three qualitative personas that are based on the field research (Laubheimer, 2020) were created to represent the different solo diner profiles. Specifically, the first persona represents the solo eater that is positive towards the experience of eating alone. The second persona exemplifies the diner that is neutral about eating solo. Finally, the last persona characterises the solo diner that has a negative approach concerning solo dining. The goals of creating personas was to understand the solo diners' needs in the context of eating alone and to aid in creating a good product for the target group (Dam, 2021), which are Dutch people who live alone and have Dutch eating habits.

Scenario

A scenario is way to understand the future user and built upon the basis of a persona. Scenarios describe specific situations or tasks of a future user, they can help to create empathy for the user in order to be able to create the best solutions for them (Costa, 2020).

For each of the three personas a scenario was created. Each scenario describes a typical day for the persona.

PERSONA 1 + SCENARIO

Joost

JOOST

Non-dietary restrictions

Joost is 35 years old. He lives in Bunnik in a "rijtjes" house he bought around three years ago, where he lives alone. He works as an internal auditor. Joost has a demanding job, working many hours per week. He is single.

Joost used to travel a lot for work before the COVID pandemic. Nevertheless, he also likes to travel abroad for holidays as he likes to get to know other cultures. After work, he cooks and eats rapidly, so he has time to do other activities like renovating his house or sport. Although he is used to eating alone, he does not enjoy it. He used to have dinner with friends once a week and often eat with his parents on the weekends. However, due to the current situation, he finds himself having dinner alone. Usually, he prepares something easy and practical. He often cooks extra food that he can later re-heat on those days when he does not feel like cooking.

He does not like to eat 'in silence', so he looks for something entertaining to watch while he has his dinner on his couch, in front of the TV.

Joost never finds the motivation to cook fresher dishes or spend more time enjoying his dinner as he thinks eating is just another 'chore', and he prefers to spend time doing other things. Also, he likes it more when he has dinner accompanied as he often feels lonely and bored. That is why Joost likes to be quickly done with cooking and eating. However, he is trying to improve his eating-quick habit, which is not good for his health.

Attitudes:
'I want to eat slower and enjoy my food more'
'I want to be entertained while I have dinner".

Challenges:
He doesn't like cooking as he is usually too tired after work, so he prepares quick and eats quick so he can do other chores.

Cooking behaviour:
He cooks with pre-cooked ingredients from the closest supermarket. He prepares a lot of food so he can eat on different days.

Eating behaviour:
He always eats around 18:15h and often orders takeaway food. Sometimes, during the weekends, he eats with family or friends.

Figure 19. Persona 1 Joost.

"Quickly done with my lonely dinner"

Joost stops working around 17:30. He goes to the supermarket, which is very close to his place. He is starving, and he fancies something tasteful like bami or nasi. So, he buys some already cut vegetables and a 'maaltijdmix'. Joost goes back home and prepares his food.

Joost prepares a significant portion to have some food left to freeze to eat on other days when he does not have time or motivation to cook. While he cooks, he plays some music, which relaxes him after a busy working day. He does not want to spend any extra minute serving his food or making it look more appetizing as he is hungry and wants to have dinner as soon as possible, usually around 18:15h.

Joost eats on the coffee table in front of the TV because he does not like to eat in silence. He needs some distraction, so he watches some series on Netflix while he eats. It takes him around 15 minutes to eat. He eats very fast as he likes to have time to do other house chores. Typically, he is busy renovating his house, so he spends most of the evening patching up and repairing some old walls.

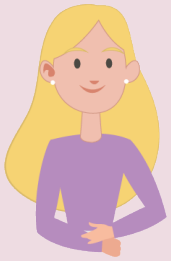
At 20:00h, he watches the evening news while drinking something. After that, he workouts because he is prone to gain some weight when he does not sport after dinner. Joost misses the companionship, having a chat and, at times, interacting with others. He would like to have a more satisfying experience of dining alone. He is sometimes feeling lonely or bored when he is just eating by himself.

Figure 20. Scenario 1: Quickly done with my lonely dinner.

PERSONA 2 + SCENARIO

Fleur

FLEUR



Healthy diet

Fleur is 25 years old and lives in The Hague, very close to her office. Since she graduated from university, she lives alone in a small apartment she has been renting for a little over a year. She works full time as a marketeer for a multinational marketing company. Living and eating alone was a whole new experience for her after graduating.

In the beginning, Fleur did not enjoy cooking for herself, so she got a subscription to a meal kit delivery service. She finds it very practical because she does not have to worry about going to the supermarket or buying more food than needed to prepare food for herself. She also prefers fresher and healthier ingredients as she was interested in losing the weight she won during her studies.

She is not entirely used to live alone, but she is neutral about eating alone. Sometimes it makes her feel lonely and sad, although other times, she finds it quite relaxing and enjoys having time to enjoy her food. Sometimes she finds the time to make her dish look more tasteful and set a beautiful candle-lighted table because she wants to have a 'restaurant' kind of experience at home. Nevertheless, she is often too tired or hungry, so she moves her dinner to the couch, eats covered with a blanket in front of the TV. She often gets distracted by looking at her smartphone but tries to put it away when she notices that she is distracted.

As she sometimes misses family or friends at mealtime, she prepares dishes that help her remember special occasions, like that special apple cake her grandma used to bake when she was little.

Attitudes:
'I want to eat healthily.'
'I want to have a nice environment while dining, so I can enjoy my food more.'
'I want to pamper myself.'

Challenges:
She does always enjoy eating alone.
She wants to be able to relive pleasant moments through food.

Cooking behaviour:
She prefers fresher and healthier ingredients from a meal kit and tries to pamper herself by making the most enjoyable eating experience.

Eating behaviour:
Sometimes, she does not like eating alone, but often, she thinks dining solo is the perfect 'me-time' for her.

Figure 21. Persona 2: Fleur.

"Remembering grandma's dish"

Fleur stops working around 18:00h and walks to her apartment. Their neighbours receive her 'Hello Fresh' box every afternoon. She tries to order healthy options as she likes to be in shape. Sometimes she goes for a run before preparing her dinner. She usually turns the TV on while she cooks.

She does not always have dinner at the same hour, as she wants to have a moment to relax before dinner and take her time while cooking. Often, she takes her meal on the couch in front of the TV. Sometimes she finds herself distracted by her smartphone while eating, so she tries hard to put it away to enjoy her food more.

Every now and then, Fleur enjoys devoting herself to the eating moment. She prepares everything meticulously and she sets her table as if she was eating in a restaurant. This is a special way to pamper herself during the dinning moment.

When Fleur feels a little sad or lonely, she prepares food that reminds them of their loved ones or of the nice moments she had on her childhood. She loves to bake an apple cake on the weekends and pampers herself a little. Even if she is breaking her diet for a moment.

Figure 22. Scenario 2: Remembering grandma's dish.

PERSONA 3 + SCENARIO

Femke

FEMKE

Low-FODMAP diet

Femke is 52 years old. She works as a pharmacist in a small town. She has been living alone for quite some years, so he is very used to eat by herself.

She enjoys cooking a lot and getting to try new recipes, so she always has many fresh ingredients at home. She strictly sticks to her Low-FODMAP diet. Because of her dietary restriction, she does not enjoy eating with others as much as she enjoys eating by herself. She loves pampering herself, primarily through food. Therefore, she eats without distractions since she likes to focus on the flavours and the quality of her meals. When eating alone, she prefers quietness and a time for just herself. She nicely decorates and sets her table as she loves to eat in a cosy environment.

Although she sometimes misses eating with family or friends, she feels eating with others can be complicated because of her special diet. She especially misses the conversations during and after mealtime and talking about daily experiences. So instead of eating with others, she prefers to go out for a drink.

Attitudes:
'I want to eat according to my special diet.'
'I want to enjoy my delicious meals.'

Challenges:
Femke has a Low-FODMAP diet, so she prefers to eat alone.
She wants to enjoy her meals without other distractions.

Cooking behaviour:
She spends much time cooking with fresh ingredients. She usually spends a lot of time in the kitchen.

Eating behaviour:
She usually eats late because she takes her time to prepare her meals. However, she eats mindfully, chewing slowly and enjoying every flavour.

Figure 23. Persona 3: Femke.

"Enjoying the colours and flavours of my special food"

Femke enjoys having free time to go to the open market to select bio/organic produce to cook her special Low Fodmaps meals.
She enjoys cooking delicious, healthy, and fresh meals. She also likes to discover new flavours, so she always tries new recipes that adhere to her special diet.

She is very aware of the ingredients and colours of her food. She somehow likes to play with that and create masterpieces when cooking her Low Fodmaps dishes.

As Femke spends a lot of time cooking, she eats late sometimes. But she does not mind as she enjoys dinner time a lot because she can have some alone time, and she can entirely focus on her food: she can truly enjoy the flavours and colours of her meals. Moreover, she enjoys eating in a quiet, relaxing environment. Femke likes to imagine she is eating in a forest or sometimes she plays relaxing music while dining.

Femke sometimes misses the company of friends or family. For example, she really likes to cook with others that share the same diet. Moreover, she loves to have some chit-chat about her daily experiences. But she often prefers just to have a drink with friends, since eating with others who do not share her diet can be stressful and uncomfortable.

Figure 24. Scenario 3: Enjoying the colours and flavours of my special food.

5.5. BRAINSTORMING

Brainstorming was used to "create a vast array of ideas and draw links between them to find potential solutions" (Foundation, 2021).

A first individual brainstorming session was conducted to generate initial ideas/directions for possible ideas Those ideas were discussed with the master project's supervisors and their input led to a more detailed brainstorm session. The second brainstorming session was carried out together with three other designers with different backgrounds (industrial design, graphic design, and fashion design) that are familiar with the practice of eating alone as they eat by themselves often. The duration of the brainstorming session was 1.5 hours. The brainstorm session took place online using the online collaboration tool Mural. The brainstorming session focused on four steps (1) introducing participants to the topic; (2) developing ideas based on the personas and scenarios; (3) grouping the developed ideas; and (4) evaluate their feasibility based on a feasibility and importance matrix.

1. Introduction to the topic

The participants received a short introduction to the topics of commensality and eating alone and the advantages and drawbacks of those. To define the goal of the brainstorm session, the output from both the Field Study and Literature Review was briefly described.

2. Ideation per scenario

The three scenarios were presented to the participants of the brainstorming session. After each scenario was briefly explained, the participants were asked to write down all possible ideas on sticky notes on the online collaboration tool, and if possible, to add images to describe the idea. All ideas were accepted, focusing on quantity rather than quality. Each ideation session took approximately 10 minutes.

3. Grouping the ideas:

After the ideation, all ideas were grouped in clusters containing similar ideas. Each of the 10 group were given a name describing what the ideas have in common.

4. Feasibility of ideas:

The last step of the brainstorming exercise was to prioritize all ideas. The most feasible ideas were identified and mapped into a "feasibility and importance" matrix. This matrix has two axis, the vertical axis "importance" shows the value this idea adds to the solution of the problem and the horizontal axis shows how feasible the idea is perceived by the designers (Gibbons, 2018).

Appendix G shows the overall Brainstorming session on the Mural tool.

The session led to early product ideas for each persona/scenario:

The ideas gathered for the *Quickly Done With My Lonely Dinner* scenario were:

- A virtual dining companion with which the solo diner can interact.
- A "slow eating plate" that closes when the solo diner eats to quick
- A virtual video call or hologram
- A sketching book or audio book

Diverse ideas collected for the *Remembering Grandma's Dish scenario* included:

- Various solutions that can be an aid during cooking
- A solution that includes spreading relaxing scents or aromas
- An interactive food tray

The ideas gathered for the *Remembering Grandma's Dish scenario* were:

- A cocoon that provided a personal environment for the solo diner
- Non-conventional cutlery which enables diners to be more connected to their food
- A social app for people to share dining interests.

5.6. INITIAL IDEAS

The brainstorming session and ideas gathered from each persona/scenario, led to the definition of three conceptualization directions:

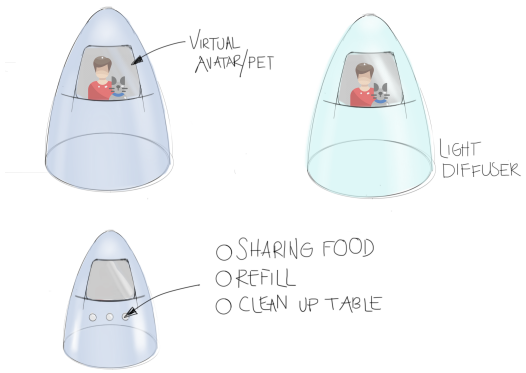
- *Companionship/Entertainment*
- *Playful dining*
- *Relaxation/Me-time*

An initial explorative sketching session resulted in three different concepts for each of the above-mentioned directions. The nine ideas were not extensively detailed but aimed to provide a direction for further development on the concepting phase. The initial ideas were presented by means of digital sketches and are presented in the next section.

CONCEPT 1. COMPANIONSHIP / ENTERTAINMENT

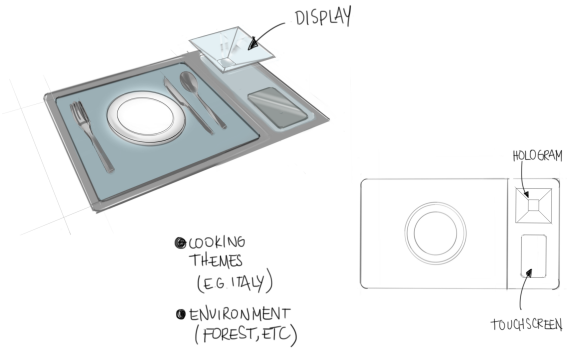
The first category encompasses the companionship and entertainment features. The aim of each of the three ideas is to enhance to solo dining experience by creating a (virtual) dining companion and to provide a good level of entertainment.

Idea 1: Portable dining companion



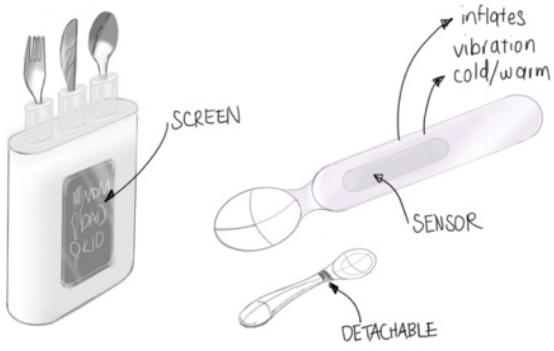
The portable dining companion should be placed on the eating table during dining. The solo diner can interact with the digital avatar through the buttons on the device. Depending on the mood of the solo diner, the avatar can provide (customised) cues such as displaying colour changes and playing music to help provide a better eating experience.

Idea 2: Hologram placemat



This concept integrates a hologram on an interactive eating placemat. A touch screen is also included. The hologram and touch screen provide entertainment to the solo diner by delivering information about cooking themes (cuisines of the world) or relaxing environments such as beach sounds and images.

Idea 3: Entertaining cutlery

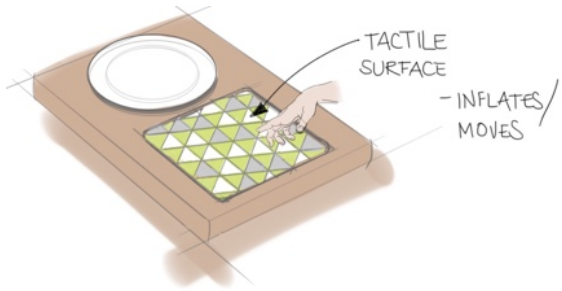


This interactive cutlery set is a device that acts as a digital companion and provides entertainment by interacting with the solitary eater in several ways. For example, the handles register the usage pattern and send sound cues to call the attention of the user. When in use, the interactive cutlery set is dynamic: the handle inflates, heats, and vibrates based on the diner's behaviour to call his/her attention.

CONCEPT 2. PLAYFUL DINING

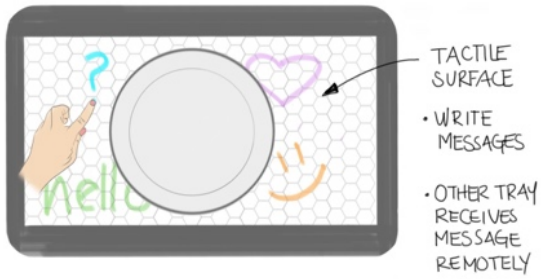
The second concept category aims to provide a playful dining experience to enhance the solo eating practice.

Idea 4: Playful placemat



The playful placemat has an integrated interactive and a fabric-based tactile surface. The touchable surface interacts with the user by responding unpredictably when touched: it can move, inflate, or change colour.

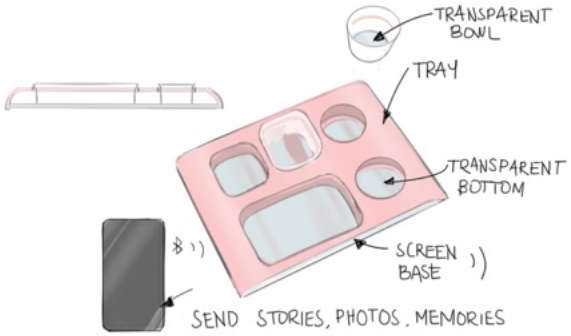
Idea 5: Remote connecting placemat



This interactive placemat creates the opportunity to connect with other solo diners using a tactile surface. The user can write a message to other commensals remotely. The message is then portrayed on a remote's diner pairing placemat

when the diner is eating.

Idea 6: Display tray

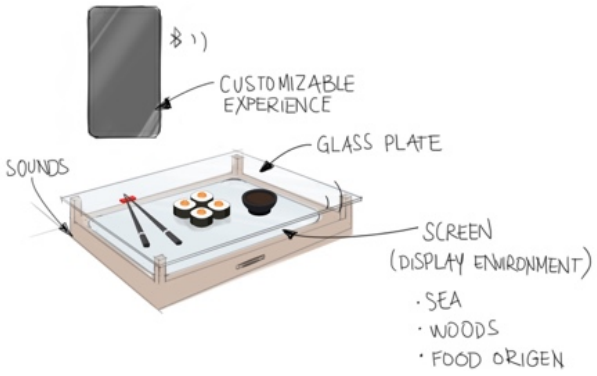


The display tray is a portable display that is attached to a tray with transparent food containers are strategically placed above the display surface. When the food is finished, the displayed media is be visible to the diner. The medis that is portrayed can be pictures or movies with fictive stories or photos/clips of memorable moments.

CONCEPT 3. RELAXATION

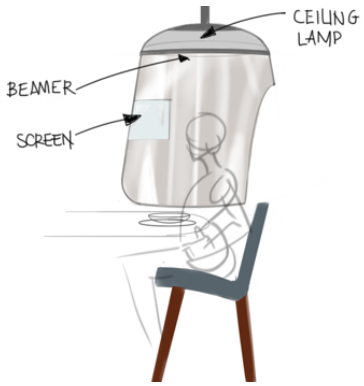
The third concept intends to enhance the eating alone practice by adding relaxing / entertaining elements to the dining experience.

Idea 7: Relaxing dinner plate



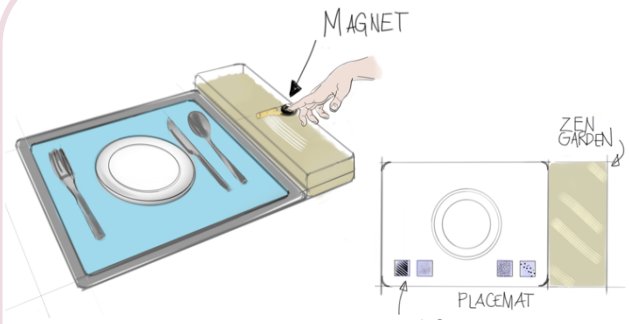
The relaxing eating plate is a transparent glass plate placed on top of a display. While dining, relaxing sounds combined with relaxation images are portrayed on the screen below the plate. For example, images of sea waves matched with sea sounds, or forest sounds, and nature images. Also, food themes can be included to enhance the food being eaten. This eating plate can be customised on the smartphone through a Bluetooth connection.

Idea 8: Solo dining cocoon



This concept creates an enclosed space for the solo diner, so he/she can focus more on its food and enjoy more the dining experience. Inside the cocoon, a relaxing atmosphere is created by displaying changing coloured lighting and relaxing music. A screen inside the cocoon provides the opportunity to display visual cues during dining.

Idea 9: Zen Garden / Placemat



The zen garden placemat combines a zen garden with a placemat. During dining, the integrated zen garden can be used by the solo diner to draw figures on the sand. To ensure no sand is spilled, the sand is enclosed in a transparent box, and the sand can be moved with the help of magnets attached to the transparent box.

5.7. CONCEPT EVALUATION

The nine initial ideas were evaluated by the participants of the brainstorming session (three designers who eat alone often) by means of a multi-criteria analysis. A multi-criteria analysis evaluates multiple criteria as part of a decision-making process. The goal of a multi-criteria analysis is to make more justifiable decisions (Janse, 2018).

The evaluators were asked to assess each of the nine ideas by valuing several criteria for each concept. The nine criteria for evaluation are based on the most important aspects to enhance the eating experience of solo diners, according to the outcomes of the literature review and field study of this project. The three evaluators assessed the nine ideas by giving a score of 1 to 5, with 1 being "not at all contributing" and 5 being "very much contributing" to indicate how much the idea contributed to that criterion.

Table 7 shows the sum of the scores given by the respondents. The idea with the highest score is idea 8, the solo dining cocoon. Therefore, is the preferred concept and is to be further developed towards a final design.

		Evaluation criteria									
#	Idea name	Non-Human Companion-ship	Interaction with others	Entertainment	Self-Pampering	Relaxation	Memories	Me-time	Multisensory experience	Displaying of environments	Total
1	Portable dining companion	14	3	13	3	7	5	12	7	3	67
2	Hologram placemat	8	3	11	7	13	11	14	12	14	**93**
3	Entertaining cutlery	6	3	5	5	5	6	6	11	4	51
4	Playful placemat	7	12	10	6	9	5	7	10	8	74
5	Remote connecting placemat	11	15	11	8	8	11	11	9	9	**93**
6	Display Tray	9	8	10	7	7	15	9	10	14	89
7	Relaxing dinner plate	9	5	13	6	9	11	11	10	15	89
8	Solo dining cocoon	10	4	15	10	10	10	13	12	14	**98**
9	Zen Garden/ Placemat	7	3	11	7	14	5	9	11	4	71

Table 7. Evaluation of the initial ideas by a multi-criteria analysis.

5.8. DISCUSSION

Chapter 5, 6 and 7 comprise the iterative design process to develop a product to improve the experience of eating alone that ultimately responds to the research sub-question *RQ1.3. How can a product design address the needs of solo diners to enhance the experience of eating alone?* by proposing a concept that creates an enclosed space for the solo diner, so he/she can focus more on its food and enjoy the eating-alone time more.

For this chapter, nine ideas were developed as digital sketches and evaluated by the three participants of the brainstorming session. Three of the nine ideas covered the concept ***companionship/entertainment***: a portable dining companion, a hologram placemat, and the entertaining cutlery. The hologram placemat was evaluated as the best option of the set and ranked as the second-best option in general. Interestingly, there was a significant difference between the dining companion and the placemat scores since both concepts share some similarities, especially since both offer entertainment and dining companionship. One of the diary study participants evaluated the hologram placemat as the most interesting idea but did not provide input through a multicriteria analysis and did not provide further information. The *hologram placemat*, however, was the second-best evaluated concept. Interestingly, it was the second choice. The concept seeks to provide companionship virtually but through its placemat, which is a 'subtle' way to create virtual companionship considering that existing solutions propose the use of complicated systems to create the virtual commensality. This seems to confirm that solo diners do not appreciate the use of complex technology while eating alone. The *portable dining companion* inspired on the 'Tamagotchi' was the penultimate-ranked idea. This is interesting since some of the existing technological solutions have tried to enhance the eating solo experience by offering a playful dining companion, for example, through a robot. However, solo diners did not seem to think this solution will improve the solo eating experience or will make it more pleasurable. This was also evident from the entertaining cutlery, which was ranked as the worst idea. The *entertaining cutlery* was also ranked as the worst idea out of the nine proposals, meaning that probably solo diners do not appreciate the idea of a companion. Thus, from evaluating these ideas, it can be inferred that most solo diners would not appreciate a physical dining companion.

Regarding the second concept, ***playful dining***, three placemat ideas were developed, all with different playful dining elements. Out of the three options, the *remote connecting placemat* was evaluated as the best one. This is surprising because this option provides a form of interaction with other solo diners remotely, and solo eaters indicated in the field study they do not to have the need to "virtually" connect with other diners. This discrepancy might be related to the fact that participants who considered this option as interesting, were not part of the diary study conducted. Their input differs then from that of the diary study participants. More research, with more participants could clarify whether solo diners need (or not) to be virtually connected to other diners. The *playful placemat* was rated as the worst option within the set, and overall, ranked in the sixth position. This could be related to the fact that the solo diner must engage in and physical activity or 'game' next to focusing on the food when using the playful placemat. This could mean that people who eat alone prefer to focus on the food that distracting with games or other activities. The *display tray,* ranked globally in the fourth place and was the second-best rated option of this set. This option was highly evaluated in the memories category, meaning that solo diners seem to appreciate being reminded of special moments during their eating moment. The fact that the tray does not take away the focus of the solo eater could have been an important feature to highly rate this option. However, this idea centres on providing entertainment mostly after finishing the food, as the person must finish the food to be able to see images or pictures. Refinement of this idea and further evaluation could provide better insight into how other solitary eaters think of this idea.

The third concept relates to ***relaxation***. The *'solo dining cocoon'* idea was evaluated as the most appealing option of the three ideas from this set. It is interesting considering that the solo dining cocoon is one of the ideas that does not require interacting with others. The highest score of the cocoon is in line with the field study where solo diners indicated not to require interaction/ connectedness with others. Furthermore, the outcome of the literature review highlighted that most of the design solutions that include interacting with others require complicated technology or are too difficult to use on a day-to-day basis. The solo dining cocoon is a straightforward design that does not require interacting with others or require complicated technology. Therefore, it seems like a good idea as it matches the aim of this project which is to design a useful, practical, and convenient product that can support the eating experience of solo diners. Although the *zen garden /placemat* also does not require interaction with others, it was evaluated as the worst idea out of the set. The

difference with this concept might be that the user needs to engage in a physical activity next to eating to interact with the zen garden placemat. This would confirm that people who eat alone like to focus on their food rather than engaging in other activities next to eating, such as "playing", in this case, with the zen garden. However, that does not apply when the distraction is visual. Therefore, it seems that solo diners do not mind "putting their eyes and ears" in something other than their food when eating. Interestingly, the concept of the *relaxing dinner plate* was looking to provide a visual/sound experience. Although it rated high in the criteria of displaying environments, entertainment, and multisensory experience, it only rated as the fifth-best option out of the nine proposed ideas. Maybe the fact that the dinner plate was at the same time the 'screen' displaying environments or images was not so appealing to solo diners, but more research or explorations of this concept could confirm that.

5.9. LIMITATIONS

The design methodology implemented for the ideation phase requires the involvement of the final user throughout the whole project. Unfortunately, the solo diners who participated in the diary study of the field research phase for this project were reluctant to evaluate the initial nine ideas. Only one out of six early participants assessed the nine proposed concepts, stating that none of the ideas seemed attractive. Ultimately, the respondent indicated a preference for the placemat with a hologram. The brainstorming session carried might have resulted in a more relevant outcome if the solo diners that participated in the field research had been involved in the ideation session.

5.10. CONCLUSION

During the ideation phase, the "solo dining cocoon" idea was selected as the concept to develop further. The chosen concept focuses on celebrating the solo eating practice rather than focusing on interacting with others. According to the conclusion of this project's literature review, the use of digital technology during the practice of eating alone can have a negative effect on the solo eater, for instance, the increase in food consumption. Therefore, the solo dining cocoon product should focus on creating an enclosed space for the solo diner, so he/she can focus more on its food and enjoy more the dining experience. Few devices facilitate a more pleasurable eating-alone experience by highlighting the advantages of eating by oneself. Thus, the chosen concept should centre on assisting the solo diner by strengthening the advantages of eating solo. The chosen concept is further developed in the next chapter.

6. CONCEPT DEVELOPMENT

This chapter comprises the iterative process to develop the 'solo dining cocoon' chosen in Chapter 5. The concept development chapter focuses on refining the idea to ultimately generate a final design to improve the experience of eating alone. This chapter ultimately aims to respond to the research sub-question RQ1.3. How can a product design address the needs of solo diners to enhance the experience of eating alone? The goal of the concept development phase is to mature the solo dining cocoon idea into a Final Design (Chapter7).

6.1. INTRODUCTION

This section comprises developing the 'solo dining cocoon' idea to evolve into a final design.

The goal of the design phase of the project was to create a design concept that would help to improve the eating experience of the solitary diner. According to the outcomes of both the literature and field studies, the product should focus on enhancing the following features:

- Me-time
- Self-nurturing
- Relaxation

6.2. METHOD

The development of the chosen concept was achieved through different techniques. First, an exploration of existing products was carried out. Later, a sketching session of rough ideas took place. In a subsequent step, CAD modelling helped to detail the concept's features while quick prototyping assisted in checking the idea's feasibility. The quick prototypes aided in provide a better understanding of the anthropometry, size, materials, and look of the final design. The experience provided by the concept was also revised with quick prototypes. As this process was iterative, the initial CAD model was constantly revised and modified to improve the design, and the 3D model aided in exploring different colours and materials.

Exploration of existing products

A search of existing products aided in gaining inspiration and understanding on how a product can provide certain features, for example, privacy, a moment of relaxation, isolation and noise cancelling. Exploring such products provided valuable input to develop essential features of the final design further.

Early sketching

Sketching of different ideas served as a starting point for the ideation. The early sketching session led to the visualization of initial ideas before considering too many restrictions and before the definitions for the final design were set.

Initial CAD Modelling

After exploring diverse ideas through an initial sketching session, solid modelling computer-aided design assisted in exploring the shape of the cocoon.

6.3. EXPLORATION OF EXISTING PRODUCTS

The product Nascodino Booth by Pierre-Emmanuel Vandeputte is a collection of three alcoves from natural felt, that seek to provide a moment of intimacy. According to its designer, Nascodino creates a new space in which the user can lose himself/herself in reverie (Vandeputte, 2016).

The Offline Chair is a chair designed by Agata Nowak. It is equipped with long side panels and soft noise-insulating fabric, created to provide the perfect privacy spot to the user. The Offline Chair provides an intimate

little spot, allowing the user to have some solace from the world, whenever it is necessary and can be used at home or at the workspace (Mitra, 2020).

By exploring these and others existing products, the initial ideas for developing the solo dining cocoon were conceptualised.

6.4. EARLY SKETCHING

An early exploration of a solo dining cocoon was done through a sketching session (see Figure 25).

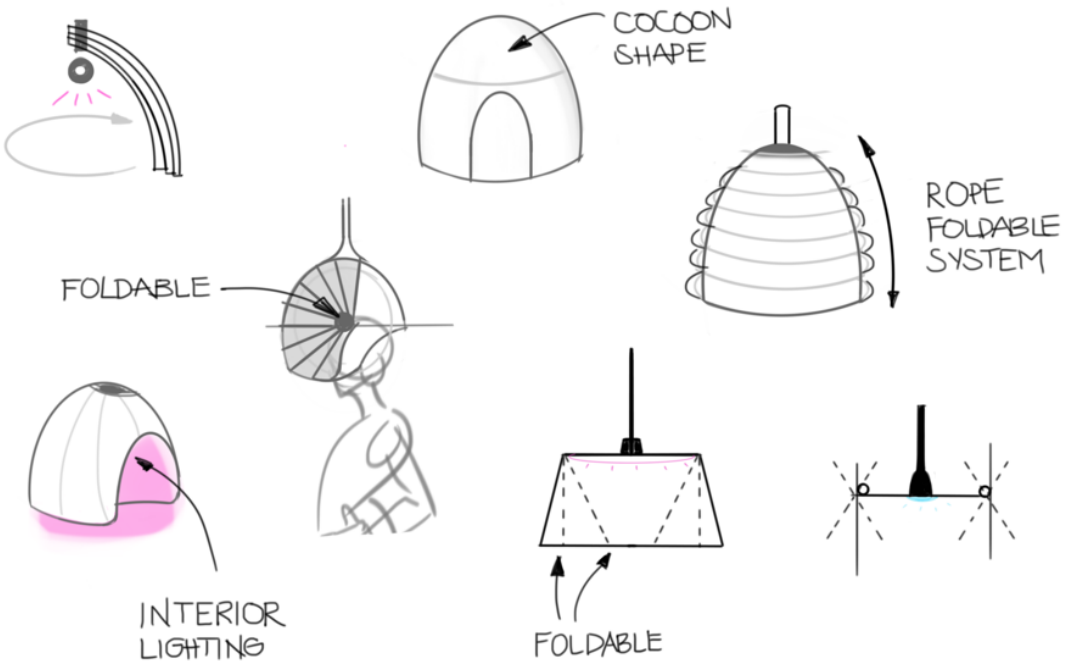


Figure 25. Early sketching session

6.5. INITIAL CAD MODELLING

After the sketching session, a first CAD model was drafted in SolidWorks to explore different shapes and renderings produced on the KeyShot programme supported exploring several materials and colours.

Figure 26. Initial CAD modelling to explore a transparent dining cocoon.

The first exploration was presented to supervisors and to obtain feedback into the shape, size, colours, and materials.

6.6. EXPLORATION ON DIFFERENT MATERIALS

Exploration of different materials was also done. The first CAD concept developed was from a transparent plastic material. However, a non-transparent material was chosen to provide features such as noise-cancelling and to create isolation for the user. Quick prototyping and renderings aid in exploring different colours for the noise cancelling material.

Figure 27. Explorations on a noise cancelling material.

A second CAD exploration led to a noise-cancelling pod in grey thick felt fabric. This concept was evaluated by supervisors. The main remarks to improve the concept were concerning the big size and whether the concept was easy to handle by the user.

Figure 28. CAD modelling and renders exploring a felt cocoon.

6.7. RAPID PROTOTYPING TO EXPLORE DIFFERENT SHAPES

Other shapes, and foldable options were further explored. After studying different shapes, a movable two partition cocoon was selected as the final concept. Rapid prototype and explorations on the noise cancelling material helped to refine the initial CAD concept.

Figure 29. Exploration of a two partition movable pod

6.8. CAD MODEL WITH MOVABLE PARTITION

After exploring the rapid prototype of a movable pod with two partitions, a CAD exploration was prepared.

Figure 30. Movable pod with partition CAD Exploration.

6.9. FINAL CAD CONCEPT

The final shape has a smaller cocoon with a triangular shape. Exploration on the elements of the cocoon such as noise cancelling material and led lighting were also explored.

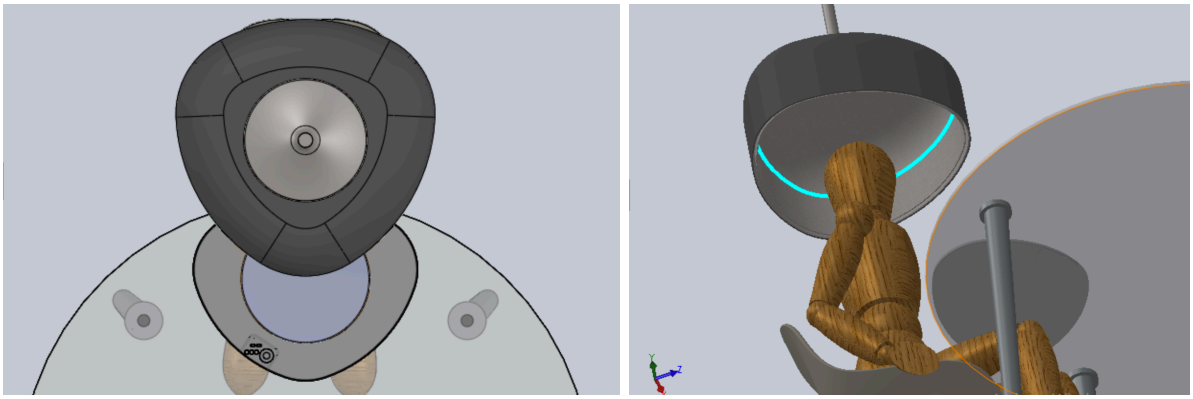


Figure 31. Final CAD concept with movable partition and triangular shape.

6.10. DISCUSSION

This chapter covered the concept development of a solo dining cocoon idea to generate a detailed final design to improve the experience of eating alone. This chapter responds to the research sub-question *RQ1.3. How can a product design address the needs of solo diners to enhance the experience of eating alone?* by exploring the several aspects that this concept should include to create a product that aids solo diners to enjoy their solo dining time.

The concept development phase diverged different options, that considered several shapes, materials, and features for the 'solo dining cocoon' to finally converge in a final design.

The focus was to create a product with a simple shape, functional, practical to use on a day-to-day basis. Supervisors evaluated the initial shape of the cocoon as too big to fit in a regular dining room. Therefore, further explorations were made into foldable and extendable pods. Finally, an extendable cocoon was selected as the best option for the final design. The selection considered that a movable partition could facilitate the interaction and simplify the use of the pod. Different materials were explored as well. To reach the goal of creating a product that aids solo diners in focusing on the food and provide relaxation, the pod included a noise-cancelling feature and is non-transparent.

The involvement of solo diners could have benefited the development of the concept. However, due to the limited time for this phase, the pod's main design elements (shape, materials, and features) were discussed only with the project supervisors, and most of the design decisions were supported by research.

6.11. CONCLUSION

After working on the concept development from the initial idea to a 3D model, the final design's features should also be developed further.

The supervisors' input helped develop some of the pod features further and consider them for the final design.

1. The size of the pod.
2. The interaction: an important thing to consider for the final design was understanding the user's interaction with the product (i.e., how to control and use the pod).
3. The experience provided by the pod: defining the experience that could help to improve the solo dining practice.

The next chapter describes the final design in-depth and explains all the features that aid to make the dining alone experience more pleasurable.

7. FINAL DESIGN

Chapter 7 describes the final design of a product to enhance the eating experience of solo diners. This section responds to the research question *RQ1.3. How can a design address the needs of solo diners to enhance the experience of eating alone?*

This chapter elaborates on the main design choices for the final design, including the main shape of the product, the materials, and the different features that aim to provide a pleasant experience to solo diners.

All the features of the final design were detailed in depth on the 3D modelling programme SolidWorks and visualisations of the final design were created as renders on the programme KeyShot. Parallelly, 3D animations were created to be used in Chapter 8 as part of the Concept Validation phase.

The overall idea of the final design was to create a product that would provide sound and lighting experience on the solo diner 'own' personal space, to create a nurturing, relaxing environment.

As stated by Grimes and Harper (2008), "technologies that celebrate the way that people interact with foods", are described as celebratory technologies. Accordingly, MattPod is designed to provide a way to celebrate eating alone.


MattPod
MyselfAtTheTable

Figure 32. Conceptual prototype render.

7.1. MATTPOD

MattPod (**M**yself **A**t **T**he **T**able **Pod**) is a product designed to improve the practice of eating alone. MattPod is an individual pod that provides a more pleasant dining experience the solitary eater by delivering an enveloping, comforting environment to help people who eat alone to enjoy their food more (Figure 32).

MattPod aims to enhance the eating-alone experience by providing a self-nurturing environment at the dinner table through audio and visual cues. The goal is to promote a more enjoyable dining time by helping the lone commensal's mood transitioning into a more relaxed state of mind.

MattPod provides a whole new eating experience by playing a mix of relaxing sounds matching colour lighting changes inside a cocoon-shaped pod. MattPod has a sound proofing head shell that displays colour lighting and plays different sounds. The hood provides a soundscape combined with a lighting relaxing experience so that, while eating, solo eaters can feel ‘safe’ on their own protected space (their own pod)(see Figure 34).

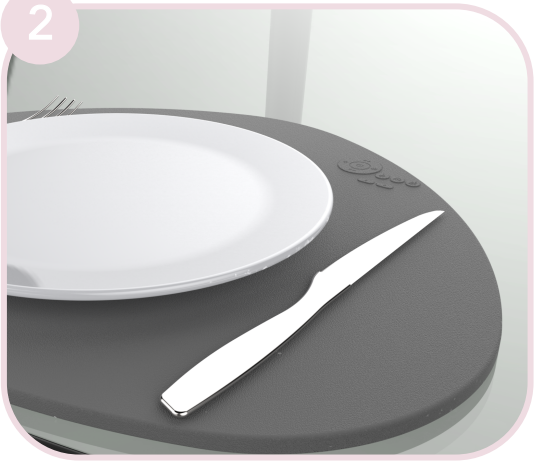
Ideally made for people who live alone and eat alone often, this dining pod has an enveloping shape to provide the idea of being immersed in a protective, own private space. The interior thick felt material offers proper noise isolation to assist the user in focusing on its food while enjoying a global sensory experience. The speakers placed on the pod's dome provide immersive calmness by playing relaxing, meditating sounds as well as preferred music or food related music.

7.2. SEQUENCE OF USE

1

To experience MattPod, the solitary eater should position the pod above his/her head.

2



The buttons located in the placemat serve to activate and control the pod.

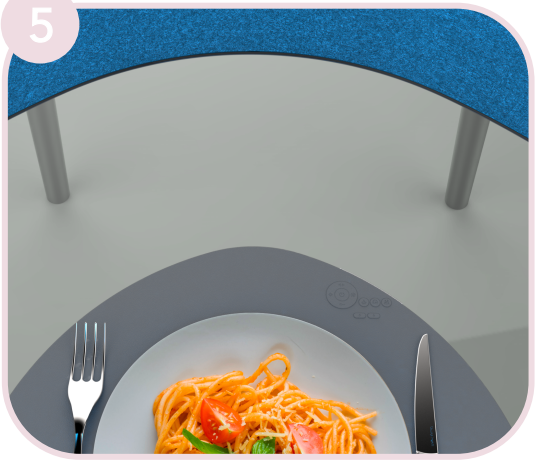
3

When the user presses the 'on/off' button, inferior partition of the shell comes down automatically. The user can then select one from the three MattPod experiences.

4

MattPod then starts playing a mix of relaxing sounds matching colour lighting changes inside the head pod.

5



The solo diner can enjoy an immersive eating experience while focusing on indulging in the food.

6

When the user is done with eating can simply press the 'off' button and MattPod will shut down.

Figure 33. Sequence of use of MattPod.

Figure 34. MattPod delivers sound and lighting cues on the solo diner 'own' personal space, to create a nurturing, relaxing environment.

7.3. SHAPE

Looking like a modern standing lamp, MattPod fits seamlessly in the interior of any home due to its simple, modern look.

Since single-households in the Netherlands do not have much space in general, the MattPod fits easily in the dining room area, while the shape should create an enveloping personal space.

Different shapes were explored in the concept development phase. However, an evaluation of all shapes led to the decision for a soft edges-triangular shape. Sievers, Lee, Haslett, and Wheatley (2019) researched the impact on the emotion of persons of images and sounds. According to them, the smoother shapes are linked to more quiet emotions such as peacefulness. The soft edges aim to provoke quiet emotions. MattPod is light and easy to move.

7.4. MECHANISMS

Extendable shell partition

An extendable partition allows for a smaller pod size and takes less space in the interior of the home (Figure 35). It also allows integration in the home's interior design better and provides easy interaction and use.

The extendable mechanism allows for horizontal and vertical movement of the pod (up and down but also forward and backward). This is essential to allow for a better placement above the head of the solo diner.

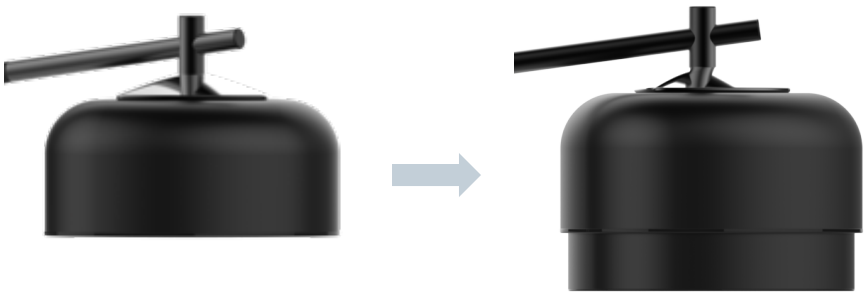


Figure 35.MattPod has an extendable partition that opens when the product is in use.

Standing and movable arm

The standing moveable arm allows the user to position the pod easily. It also provides a better integration within the home interior since it requires less space than a ceiling-attached pod. It is easily moveable, meaning the user can transport the pod to another dining location, for example, to the living room and use MattPod while eating on the couch.

Figure 36. Movable arm detail.

7.5. COLOURS, MATERIALS AND FINISHES

As shown in Figure 37, MattPod is composed of several materials. It has a hard black plastic shell on the outside and a soft sound absorbing thick felt fabric on the inside of the hood. Various fabrics are good sound absorbers, providing controlled echo and reverberation, to improve listening enjoyment (Sokol, 2021). Generally, fabric that absorbs sound frequency waves are thick and porous such as thick felt.

Although a transparent pod was initially considered, the final choice was to have a thick felt interior material with an exterior hard-shell plastic to create an enveloping effect that provides a better 'me-time'. By exploring different material and colours (Figure 27) a light grey colour was chosen for the thick felt fabric as it seemed to reflect an appropriate level of light.

To provide a modern look, the outside of the pod is made of strong lightweight plastic (e.g., thermoformed plastic). Various colours can be available based on the user's preference.

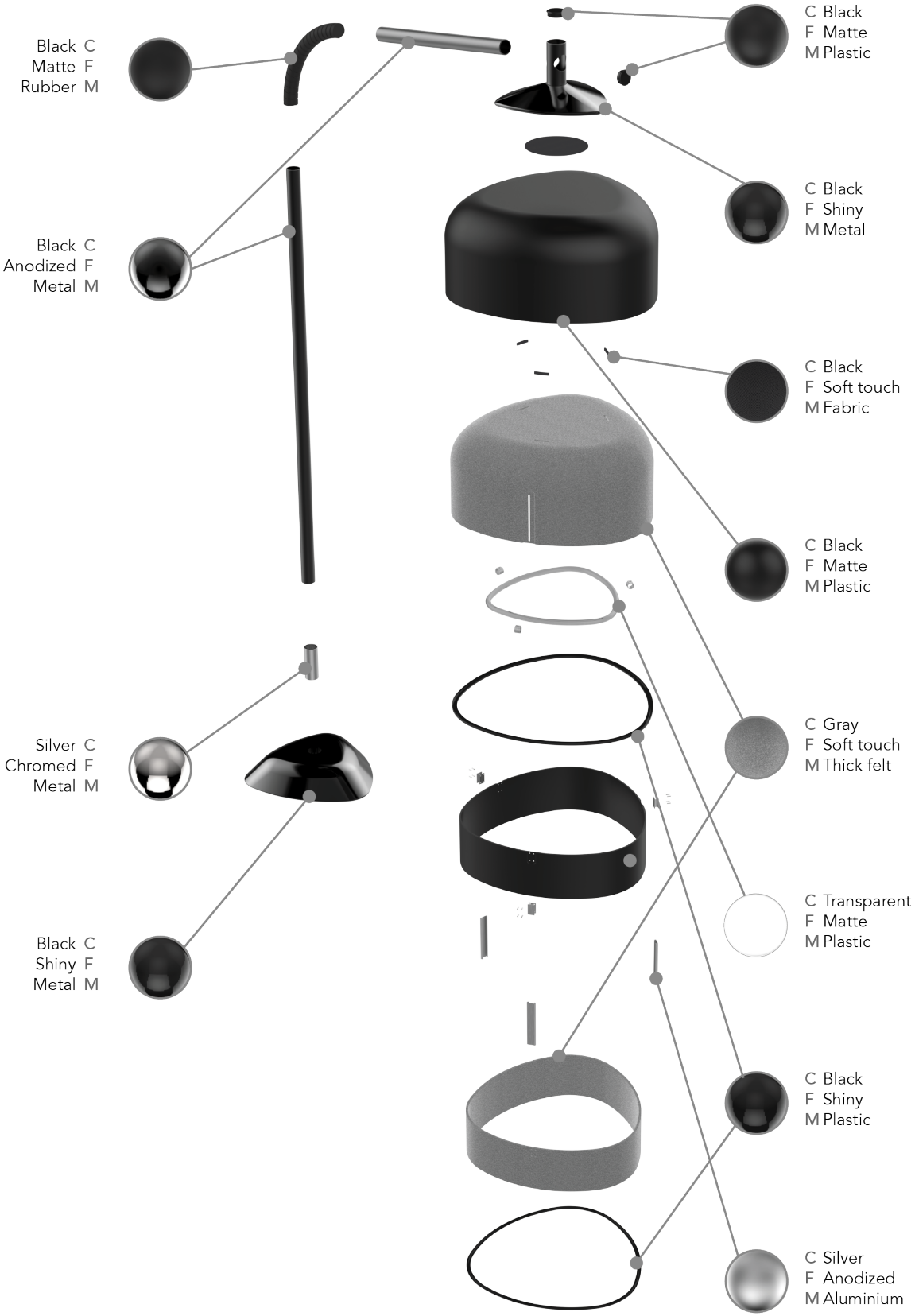


Figure 37. Exploded view with Colours, Finishes and Materials.

7.6. FEATURES

Noise cancelling

As stated by Spence (2016) loud background noise can suppress the ability of a person to taste food and presumable alter flavour perception. Therefore, the pod has sound absorbing material (thick felt) in its interior, so when the solo diner is immersed inside the hood, the environment becomes calmer and more pleasant. The goal of the noise cancelling feature is to encourage the solo eater to focus on the meal, so he or she can enjoy the flavours more and pay extra attention to the food.

Sensory stimuli

Sound stimuli

"Ambient sounds and music can influence the experience of a meal". Some restaurants use sounds to enhance the eating experience. For example, the restaurant The Fat Duck provides the diners with a MP3 player with earbuds so the commensal can listen to sounds of the sea while eating (Wang, Li, Jarvis, Khot, & Mueller, 2018).

Reinoso Carvalho et al. (2015) mentioned in their paper about the influence of music on the multisensory tasting experience that "it is possible to significantly influence taste using sonic cues that are unrelated to the food itself". Thus, choosing the right music does not only have an impact on the solo diners' mood but also on the taste of food. Grimes and Harper (2008) mention that music can add to a relaxation experience while eating. Sievers, Lee, Haslett, and Wheatley (2019) researched the impact of images and sounds on the emotions of persons, concluding that sounds with many abrupt variations (spiky) call for higher emotional arousal (e.g., angry) than mildly fluctuating sounds (sine wave) that call for low-arousal emotions (e.g., peaceful). Sonic seasoning refers to pairing sound and flavour stimuli. For example, certain sounds can improve the taste of the food, provoking positive emotions on the diner, which results in having a better eating experience (Spence, 2021). Therefore, to positively enhanced the dining experience, soft, calming sounds, are reproduced by MattPod.

Ragneskog, Bråne, Karlsson, and Kihlgren (1996) researched on the influence of music on the mood of dementia patients during dinner. They concluded that when calming music is played, the patients were less irritable, anxious, and depressed.

Macht, Meininger, and Roth (2005) note a whole range of other reasons why individuals find food pleasurable. They examined how individuals subjectively characterize hedonic eating experiences as well as what conditions were needed for eating to be pleasurable. They describe how the features of the physical environment, the nature of the social interaction that surrounds the eating process, and feelings of relaxation can all contribute to individuals feeling that their eating experiences are pleasurable.

The speakers located on the dome's pod play background music and sounds (see Figure 38). Three soundscapes are provided by MattPod:

- Relaxing melodies or sounds such as forest/ sea sounds are played to help the commensal to transition to a more relaxed state of mind
- Preferred music: according to the hedonistic transfer theory, the more a person likes music the more likely it is the person will like the food (Morrison, 2019) . Therefore, a selection of the preferred music of the commensal can be played.
- Food related music: as stated by Sensory Experiences Ltd (2019), "based on the science of how we form emotional, sensory memories" the experience and the flavour of food can be enhanced. Therefore, the experience of eating a certain type of food (e.g., Italian food) can bring back positive memories, making the eating experience more emotional, hence, making the food tasting better. The goal of this 'sound experience' is to enhance the eating experience by pairing the dish with the music. So, if the solo diner is having a delicious homemade pizza, Italian music can be displaying while eating.

The above-mentioned soundscapes aim to encourage the solo eaters to focus more on the meal, so they can enjoy the flavours more by paying attention to the food.

Figure 38. Details in the interior of the pod: speakers and LED light at the top of the pod.

Light stimuli:

According to Bourldand (2019), changing an environment's colour can have a significant impact on how a person feel, function and act, and "several studies have proven the incredible impact of lighting colour on hear rate, circadian rhythms and overall mood" (Bourldand, 2019).

As LED lighting can offer multiple colour options, a wider range of possibilities in terms of colour therapy, and the pod should provide a smart led light colour changing.

Coloured light changing is displayed in the interior of the pod to allow for a calming colour therapy (see Figure 39), since the use of relaxing calming tones can contribute to provide a relaxing experience. For example, 'displaying of the colour blue promotes feelings of relaxation, safety, and stability, and makes an excellent choice for meditation' (Bourldand, 2019). Purple is a powerful colour that "reduces emotional and mental stress" (Bourldand, 2019). According to Bourldand (2019), adjusting a LED light to a shade of purple after a stressful day can help a person relax. Colour yellow "promotes relaxation and comfort and has also been used to improve digestion" (Bourldand, 2019). Pink can aid in dealing with angst or when a person "needs to cool down from intense feelings" as described by Bourldand (2019). Another MattPod feature is that the intensity of the light can be adjusted (dimmed) to tailor the lighting experience to the preferences of the solo diner.

Figure 39. Colour lighting is displayed in the interior of the pod to allow for a calming/relaxing effect.

7.7. INTERACTION

Instead of using a smartphone or tablet to interact with MattPod, a remote control integrated into an eating placemat was designed, to avoid any potential distractions that other devices could evoke (Figure 40). Therefore, the interaction with the pod is straightforward, to prevent the solo diner from getting distracted by the product and losing focus on the food. As described by Spence et al. (2019), technology can potentially distract commensals from their meal, and mindless eating can increase food consumption. Thus, the pod is controlled in a subtle way, so that the eating moment is not disturbed.

Figure 40. Remote control embedded in an eating placemat designed to match MattPod.

The buttons located in the placemat serve to activate and control the pod. For example, one can choose from three different experiences to display on the MattPod: the meditating experience, the recreation experience, and the cuisines of the world mode.

The remote control has the following functions (Figure 41):

- On / Off
- Light level (more / less bright)
- Sound volume (increase and decrease the loudness)
- Moving the pod partition up and down
- 3 dining experiences
    - Relaxing mode
    - Amusement mode:
    - Cuisine mode

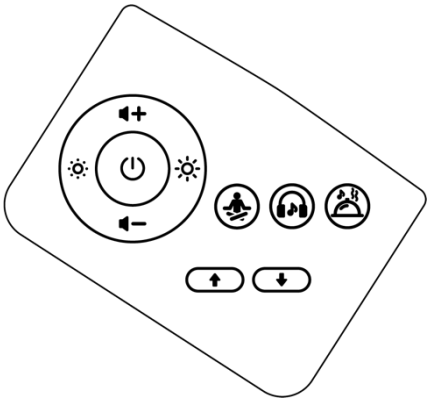


Figure 41. Control buttons/functions.

As shown in Figure 42, the remote control can be easily detached from the silicon placemat to recharge.

Figure 42. Detail of the remote control been detached from the silicon placemat.

7.8. PROVIDED EXPERIENCES

MattPod provides three experiences to enhance the eating practice of solo eaters that can be easily initialized by pressing the buttons located on the eating placemat (see Figure 43).

Relaxing mode

The relaxing experience provided by MattPod assist the solo diner in transitioning to a calmer state of mind. When the relaxing mode button is pressed, a combination of calming lighting shades and soundscapes provide a relaxing ambience. The light changes colour inside the pod while relaxing melodies or sounds (i.e., sea sounds, bird chirps, wind blowing, rain sounds) are played, creating an enveloping own space of tranquillity.

Amusement mode

The amusement modality provides a more cheerful environment, by displaying quicker colour lighting changes, while playing the user's favourite selection of music.

Cuisine mode

The cuisine mode is a customised experience related to the dish to be eaten. "Based on the science of how to form emotional, sensory memories, to enhance the experience and the flavour of food" (Ltd, 2019), the cuisine experience can bring back memories related to the food that the solitary eater is about to eat by displaying soundscapes related to the food. For instance, if the diner wants to reminisce about his/her holidays in Spain the music and lighting colours are paired to the tapas he/she is about to consume.

Figure 43. Detail of the control buttons embedded on the eating placemat, to initialize the MattPod experience.

Figure 44. Final Concept Design MattPod.

Figure 45. MattPod and eating placemat.

7.9. DISCUSSION

This chapter comprises the final design of a product to enhance the eating experience of solo diners that responds to the research question *RQ1.3. How can a design address the needs of solo diners to enhance the solo dining experience?*

MattPod provides a whole new solo eating experience by playing a mix of relaxing sounds matching colour lighting changes inside a cocoon-shaped pod. MattPod has a soundproofing head shell that displays colour lighting and plays different sounds. In addition, the hood provides a soundscape combined with a lighting relaxing experience so that, while eating, the solo eater can feel 'safe' in its own protected space.

It provides an enveloping environment by cancelling outside disturbance, which helps enjoy a 'me-time' while dining. The three experiences provided by the pod aid in improving the experience. In the specific case of the relaxing mode, aid in transitioning to a more relaxed state of mind, helping to focus more on the meal.

Due to a limited time for the design phase, further development of a physical prototype for testing was not possible. Some of the features of the MattPod could have also been further explored and refined. For instance, including a more tailored/customised experience for the user (exploring how to create a more personalised experience).

Future development on the final design could include creating an app connected to the MattPod and allows for personalisation of both the sound and lighting cues, according to the user preferences. The app could be used to pre-set the preferred experience and understand the user's music preferences by tracking the user's behaviour on other apps (such as Spotify). In the same way, because of the short time to prepare for the validation phase (Chapter 8), only the relaxing experience could be tested by the target group.

The final concept could have benefited from a co-design session with solo eaters to incorporate user's feedback directly.

7.10. CONCLUSION

Based on the considerations and conclusions derived from the concept development phase, a pod for the solo diner was developed and detailed within this chapter using an iterative process that included different techniques such as sketching, 3D modelling, rendering. The project's supervisors provided valuable input while additional research aided during the iterative design process.

Several features were detailed during the design of the final concept: the shape and size of the pod, the moving mechanisms such as the extendable partition, and the movable standing arm. In addition, the colours, materials and finishes (the looks of the pod) were also defined.

The innovations to improve the eating experience of the solo diner were explored and refined, such as noise-cancelling and the sound and light stimuli. Literature research supported the choices of the sensory stimuli for this product,

Finally, a remote control was designed and integrated into an eating placemat. It was deliberately chosen not to create an app or use the smartphone to interact with MattPod to prevent the distraction of the solo diner by digital technologies.

Additional literature research supported the development of the different modalities that MattPod will provide to the solo diner: the Relaxing, the Amusement, and the Cuisine mode.

The next chapter (Chapter 8) identifies design opportunities to the final design through the concept validation phase that focuses specifically on testing the relaxing experience.

8. CONCEPT VALIDATION

The visualisations developed for the final design of MattPod, facilitated the creation of two clips to validate the overall design and the experience provided by MattPod. This chapter answers RQ1.4. ***How does the final design contribute to enhance the experience of eating alone?*** by explaining the process and results of the concept validation. It first describes the setup of the validation questionnaire. Secondly, the results of the questionnaire are presented. The concept validation gave insight into how solo diners perceive the final design and the global experience provided by MattPod. The insights generated by the concept validation provided relevant input for further recommendations regarding the final concept.

8.1. INTRODUCTION

The Covid-19 pandemic complicated the possibility of carrying out physical testing of a product prototype. Instead, a 'virtual prototype' was created as a video used to test the experience provided by the product remotely. Thus, the concept validation was implemented through virtual prototype testing.

Dahan and Srinivasan (2000), investigated that virtual product testing creates the same results as physical (and more costly) product testing. Through remote validation, a virtual prototype was tested by users to gather valuable customer feedback and find (possible) issues in the design.

8.2. METHOD

The evaluation of the final design was carried out through an online questionnaire on the Qualtrics online survey platform. The link to the online survey was distributed electronically to the participants. The next section describes the details of the remote evaluation:

8.2.1. Testing goals

The goals of the virtual prototype testing were:

- Determine to what extend MattPod contributes to a positive dining experience for the solitary commensal.
- Validate if MattPod provides its users with the important features derived from the field study:
    - Me-time
    - Self-nurturing
    - Relaxing
- Identify design opportunities for the MattPod:
    - Feedback on the shape
    - Feedback on the user experience

8.2.2. Target group

The target group for the testing phase was in line with the target group of the field study. Therefore, participants for the testing phase were ***people that eat alone frequently*** and have lived alone for a long time.

8.2.3. Testing procedure

The following steps were carried out to implement the concept evaluation.

1. **Introduction:** participants were introduced to the topics of solo dining and to the goal of this research project.
2. **Initial evaluation of the eating alone experience:** respondents were asked to prepare a small snack and eat half of it alone, to re-enact the activity of eating alone at any regular day. Afterwards, respondents were asked to complete a short questionnaire about the eating alone experience.

3. **Introduction to the MattPod concept:** respondents were shown with a short video about the MattPod Concept (see https://vimeo.com/565617398) to explain the final design: how it works, the shape, its main features etc.
4. **Evaluation of the concept:** after watching the clip, respondents were asked about their perception of the concept with the following questionnaire:
    - *What is your initial reaction this concept?*
    - *How much do you like or dislike this concept?*
    - *How believable is this concept?*
    - *How relevant is this concept to you personally?*
    - *From the list below, which best describes your need for this concept?*
5. **Evaluation of the experience:** the evaluation of the experience provided by MattPod is divided into providing the usage scenario, experiencing MattPod and evaluating the eating experience with MattPod. Those are explained in detail in the next sections.

Figure 46. Screenshot of the video displayed to participants to explain the MattPod concept.

8.2.4. Usage scenario

The following usage scenario was provided to the participants to provide an idea of the context of use of the virtual prototype.

The experience provided by MattPod

"After a hard, stressful day at work, you come home hungry and a little tense. Tonight, you just want to relax off while enjoying your food. So, you decide to prepare a quick but delicious meal. You often relax by listening to some music while your cook, but today you are late because there was a lot of traffic, and you just want to eat as quickly as possible. When you finally sit to enjoy your delicious homemade dinner, you realize you are still not in the best mindset to eat. On top of that, there is a lot of noise from kids playing and shouting at the playground next to your home.

You need a relaxing moment, a time to be just with yourself, to enjoy your solitude, and to forget about the outside world! You want to enjoy your meal and focus entirely on your food. Luckily, at the dining room, you can always find MattPod, which is the perfect gadget to use whenever you need to enjoy a peaceful, relaxing eating

time. You place the pod close to you, and just before starting to eat your first bite, you 'start' MattPod by clicking the button on your eating placemat. The partition comes down to envelop your head and provide an instant private, noise-cancelling environment. You select the relaxing mode on the placemat. Immediately, MattPod starts to play calm, meditating music, accompanied by slow, colour-changing lighting. After you finish your meal, you feel refreshed and are ready to enjoy the rest of your evening".

8.2.5. Experiencing MattPod

In a subsequent step, respondents were asked to mimic the use of MattPod while eating the other half of their snack. For that, participants are asked to watch a 3-minute video (see https://vimeo.com/565575592) as exemplified in Figure 46, that simulates the experience provided by MattPod. The respondents were asked to have a snack/food at hand, put headphones on, and watch the movie in full-screen mode. After watching the clip, they had to exit the full-screen mode to return to the survey.

The video shown during the evaluation aims to simulate the multisensory experience delivered by MattPod to the solitary eater. According to the scenario mentioned above, the solitary diner is having dinner after a busy day. *Background noise* (sound effect "ambience of a lively children's playground in Bulgaria" from Zapsplat.com) that comes from the playground close to the home is disturbing the eating moment. Therefore, the user initiates the *Relaxation Experience*, which provides subtle changes of relaxing colours. According to Pangin (2017), science says that looking at colours can relax a person. They have a tremendous psychological, emotional, and even physical impact. Colour can be used as a stress management tool when someone is feeling overly stressed. For instance, "blue has a tremendous power to manage stress" (Pangin, 2017). Other colours that deliver a tranquilising feeling are pink (it promotes tranquillity and peace), violet (which can bring balance and make a person feel inner peace and create a peaceful environment) and grey, which can create a relaxing atmosphere (Pangin, 2017). Hence, MattPod uses colour effects to facilitate a relaxing experience.

MattPod provides a calming soundscape by playing *relaxing meditation music* entitled "Royalty Free Music" from Bensound. After having dinner, the respondent stops the MattPod by turning it off on the buttons located in the eating placemat. The hood's partition comes up, and the diner proceeds to enjoy the rest of the evening.

8.2.6. Evaluation of the eating experience with MattPod

After watching the simulation of the *Relaxing Experience* on the MattPod, respondents were asked to respond to some questions about the experience provided by the concept and to evaluate their dining experience (see Appendix H).

8.3. RESULTS FROM THE CONCEPT EVALUATION

8.3.1. Participants

In total 23 persons responded to the virtual testing questionnaire. One of the respondents previously participated in the Field Study (Chapter 4) of this project and provided input on the early concept ideas developed during the Ideation phase (Chapter 5).

Six records were excluded from analysis. Four records were excluded. The reason for exclusion was that respondents took less than eight minutes to complete the online questionnaire. Since the two videos shown during the evaluation survey (Matt Concept Video and MattPod Experience Video) together last around 5 minutes, three minutes to read thoroughly the instructions of the survey and answering the questionnaire was considered too short to provide valid input. Two additional records were excluded because the input was not accepted, since the same answers were given for each set of questions.

Most participants are young adults (Figure 47), with 12 male and 5 female respondents (Figure 48). 14 out of 17 participants eat alone from 4 to 7 days per week (Figure 49). Most respondents are European, with exception of the 2 participants from Mexico, and 4 from South Africa (see Figure 50).

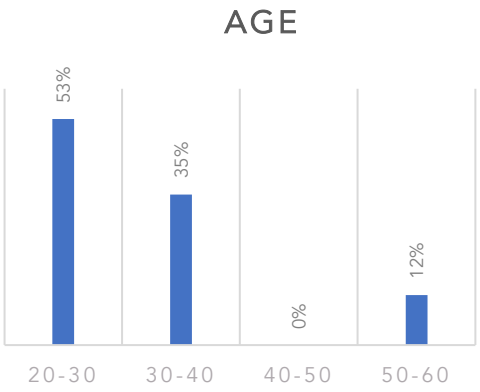


Figure 47. Age distribution (concept evaluation).

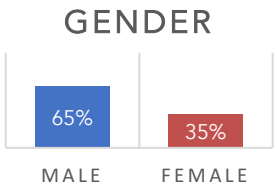


Figure 48. Gender distribution (concept evaluation).

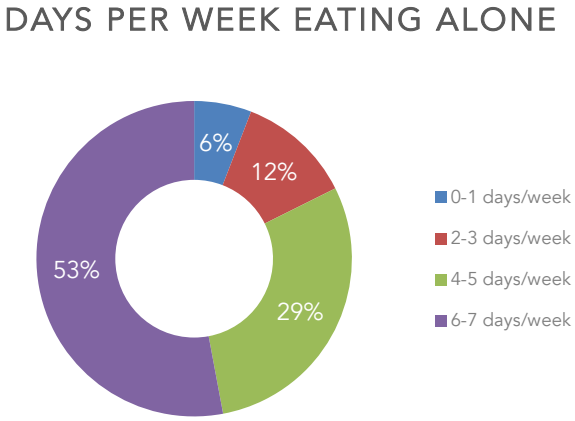


Figure 49. Days per week that participants of the concept evaluation phase eat alone.

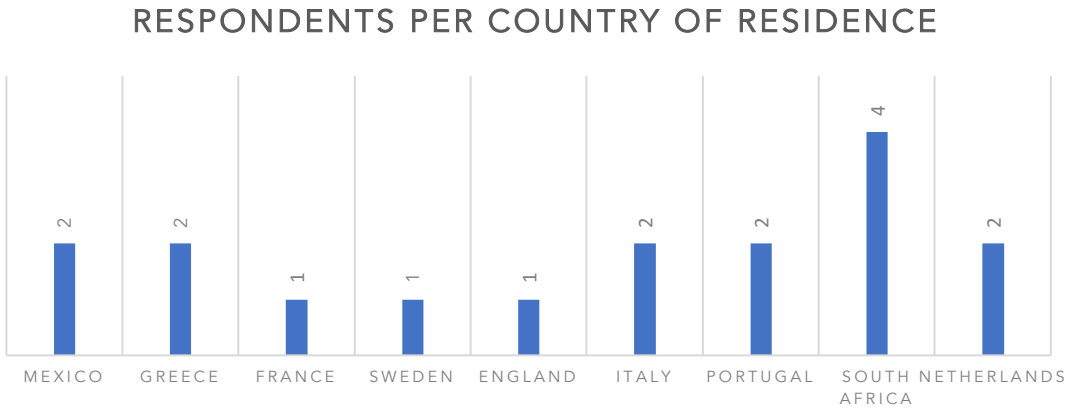


Figure 50. N° of participants per country of residence.

8.3.2. Initial reaction to the concept

The initial reaction to the concept is slightly more positive than negative as more participants evaluated MattPod more positively than negatively. More participants dislike the concept than like the concept. The majority of participants evaluated the concept as feasible. The majority of participants does not consider the concept as relevant (Table 8).

Using a scale of 1=Extremely Positive to 5=Extremely negative, please evaluate the concept on the following aspects:	Extremely Positive		Neutral		Extremely Negative
Initial reaction to the concept	12%	29%	24%	29%	6%
Likeability	18%	24%	12%	41%	6%
Feasibility	6%	53%	29%	12%	0%
Relevance	12%	18%	12%	29%	29%

Table 8. Initial response to the Final Design.

More participants consider that they would enjoy their food more while using MattPod, but more respondents would not use it if they would have it at hand (Table 9).

Please answer to the following statements:	Strongly Disagree				Strongly Agree
Using the MattPod while eating by myself, I enjoy my food more	12%	12%	35%	24%	18%
If I had the MattPod available when eating by myself, I would use it	35%	12%	18%	18%	18%

Table 9. Overall evaluation of MattPod.

Regarding the need for the concept, most participants do not see a reason to use the MattPod or consider what they are currently using as a better option (Table 10).

	I need it because nothing else solves this problem	This would be slightly better than what I am currently using	This is essentially the same as what I am currently using	What I am currently using is better than this	I don't see any reason to use this
Which best describes your need for this concept	0%	24%	12%	18%	47%

Table 10. Evaluation of the need for MattPod.

8.3.3. Evaluation of the eating alone experience before and after introducing the concept

Four questions regarding the perception of the experience of eating alone were asked before and after introducing the final design to the respondents (Figure 51-54).

All participants evaluate eating alone as neutral or satisfying without using MattPod. Most participants rate eating alone while using MattPod as very and somewhat satisfying. When using MattPod, more participants evaluate the satisfaction of eating alone as unsatisfying compared to how they evaluate the experience when they are not using MattPod.

The evaluation of the features to enhance the experience of eating alone (*relaxation, self-nurturing, and time for oneself*) before and after using MattPod do not show a significant difference. Participants are slightly more relaxed when using the MattPod than without it. Nevertheless, they perceive eating alone as less self-nurturing when using MattPod. There is also a significant decrease in the perception of the enjoyment of the 'time for oneself' feature when using the pod.

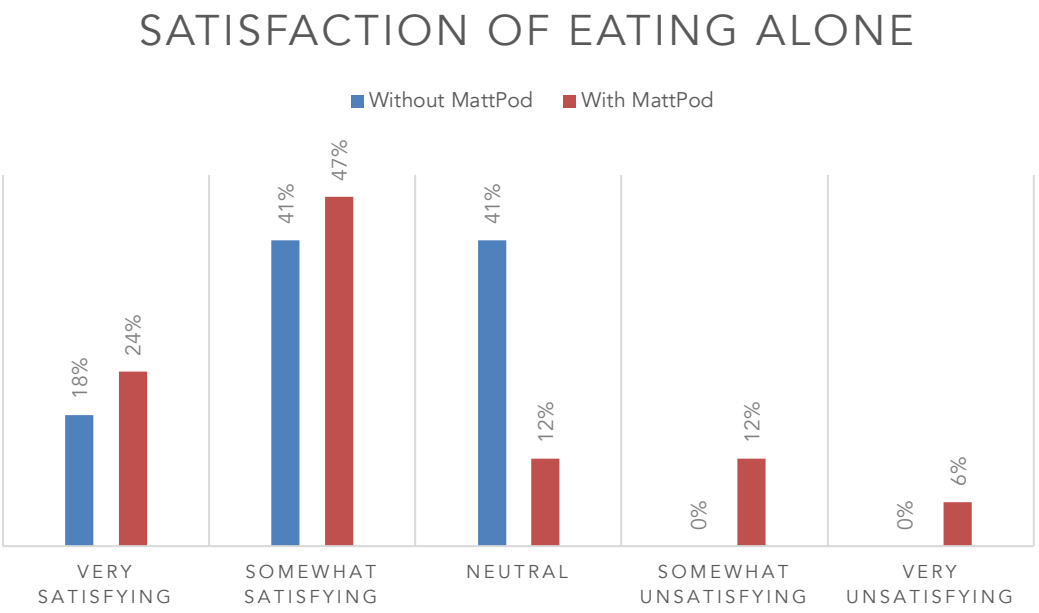


Figure 51. Satisfaction of eating alone with and without MattPod.

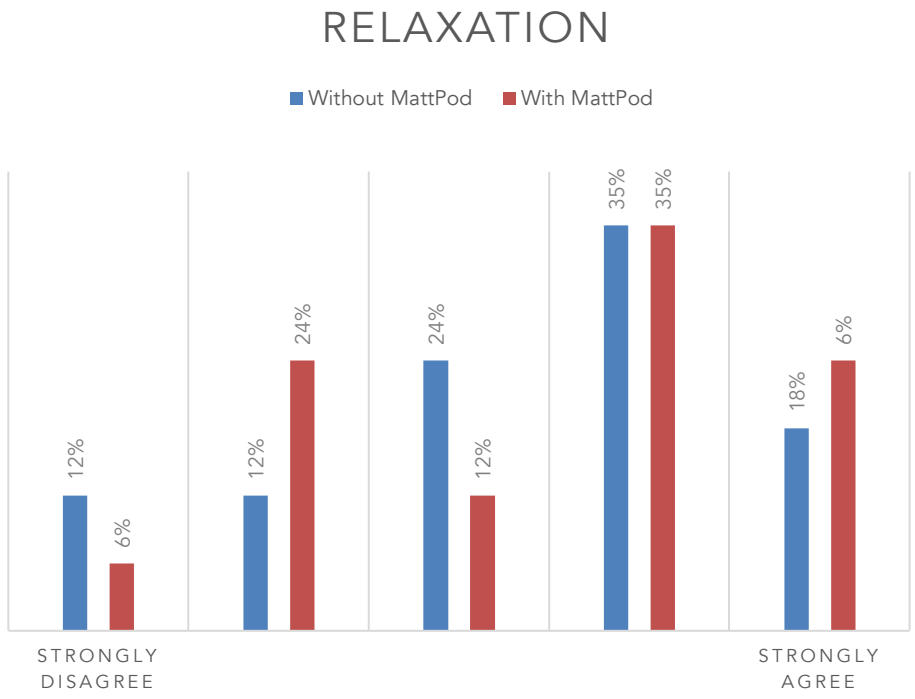


Figure 52. Level of relaxation with and without using MattPod.

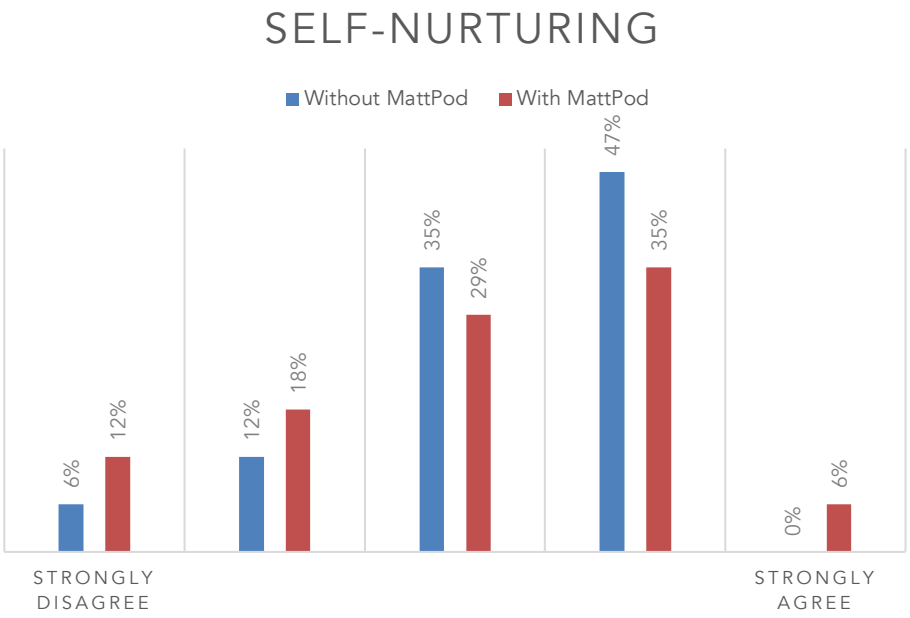


Figure 53. Self-nurturing feeling with and without MattPod.

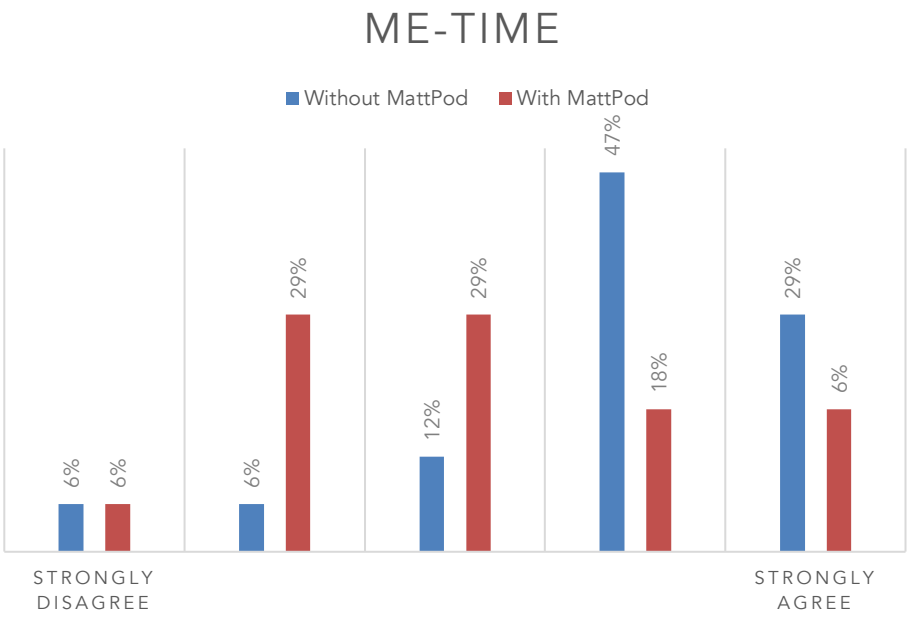


Figure 54. Enjoyment of the time for oneself with and without MattPod.

8.3.4. Answers to the open questions

Three open questions were included in the questionnaire. Participants were asked to explain why they would use or not use MattPod and what they like the most and dislike the most about the concept.

As reasons to use MattPod, respondents frequently mentioned that MattPod, aids in eating slower, helps to focus on the food, assists in providing 'me-time' and helps in relaxing.

As reasons not to use MattPod, respondents frequently mentioned the size (the product looks too big), the comfort (respondents believe that having a pod around the head is uncomfortable), and the fact that 'watching TV is not possible while using MattPod'.

Respondents frequently liked the music, feeling relaxed while using it, the noise cancelling, and the fact that MattPod is shaped like a lamp, so it is easy to integrate into the decoration of the house.

Respondents disliked the enclosing pod (some participants expect the MattPod can cause them claustrophobia) and the large size, and some people evaluate the music as "a bit creepy".

8.4. DISCUSSION

Most participants evaluated eating alone while using MattPod as ***satisfying***. In addition, more participants find eating alone ***more relaxing*** when using MattPod compared to without using MattPod. This confirms that the experience provided by MattPod is relaxing.

All participants rated eating alone as *neutral or satisfying* without using MattPod. Interestingly, when asked about eating alone while using MattPod, most respondents are satisfied with the experience. However, there is an increase in the number of participants that are dissatisfied with the experience. It seems that participants either 'love or hate' the concept. However, the majority of participants state that they will enjoy their food the same or more using MattPod, which points out a potential advantage of MattPod.

Since the concept validation was carried out during the Covid-19 crisis, physical prototype testing was not possible. However, the fact that the concept was validated virtually might have impacted the outcome. Some respondents mentioned they would have liked to experience the product to "get the real feeling". This is somewhat positive feedback since those participants were intrigued by the concept and were willing to try it.

When participants responded to questions about what they like about the product, they often mentioned that MattPod supports them in eating slower, helps them focus on the food, provides time for just themselves, and helps them relax. Furthermore, the respondents liked the music, the noise-cancelling feature, and they liked that MattPod looks like a lamp. Those comments are assertive, confirming that MattPod succeeded in providing such features.

Most of the negative feedback related to MattPod has a lot to do with the product being tested virtually, meaning that if the product had been tested with a physical prototype, the participants would have understood the final design's features better. For example, some participants wondered whether the size of the product was adequate since they pictured the product as too big to fit into their homes easily. In addition, some participants did not accept the enclosing feature of the pod as they believe it could cause claustrophobia. Such feedback would need to be revised or re-evaluated with a physical prototype. Therefore, concept evaluation with a physical prototype could have resulted in better input for future development.

Further research related to the final design of MattPod, needs to include creating a physical prototype and perform testing in a home setting to gather more accurate information about the effects of the product on the experience of eating alone. In addition, testing with more solo diners with different nationalities, ages, eating preferences could provide a better overview of the impact of the product on the eating alone experience. However, to verify whether the final design reaches its goals, it is necessary to collect more data during the testing phase.

20 out of 23 participants received monetary gratification to complete the survey, which might have impacted the outcome of the concept validation. It might be the case that their motivation was the financial incentive leading to focus on completing the survey quickly rather than focusing on the concept evaluation (and understanding the survey thoroughly).

8.5. CONCLUSION

The evaluation of the final design provided important input regarding the final design.

The results showed that MattPod reached the goal of providing a relaxing environment for solitary eaters, according to participants' qualitative and quantitative input. Some participants found in MattPod an exciting concept to focus more on the food and centre their attention to the eating moment instead of distracting themselves with their phone. Other participants, however, preferred to keep using ICT devices to distract themselves while eating.

The concept evaluation provided input for the improvement of the concept. For example, the size of the pod was perceived as too big by some participants.

However, solo diners should be involved in future processes regarding improving the final design, especially when creating a physical prototype, which would be worth testing since various participants respond positive or neutral to MattPod.

The following chapters elaborate on an in-depth exploration of the project's results by going into detail about the findings, later discussing the contribution of the project towards solo diners and finally presenting some recommendations and suggestions regarding future research directions for the project.

9. DISCUSSION AND LIMITATIONS

This chapter elaborates on an in-depth exploration of the overall project's results by going into detail about the findings.

This study aimed to answer the research question ***how can a product design enhance the experience of eating alone?*** by implementing a human-centred design process. After systematically reviewing the literature, commensality was defined as having several benefits, such as social interaction and socialisation. Interestingly, what some authors describe as advantages of commensality, others defined as drawbacks. For instance, eating together with others can cause negative feelings related to rigid norms and formal manners that causes stress and triggers an increase in food consumption when eating in a group.

Eating alone compared to commensality is frequently perceived negatively, as society has some stigma about solo diners. Although there are many social and nutritional disadvantages related to eating alone, solo dining has its benefits. The most important advantages mentioned by literature are that solo eaters can have a sense of freedom because they can easily decide what, when and where to eat. Furthermore, they can have a more relaxed mealtime since they can enjoy a moment "just for themselves" or without pressure from others. In addition, some solo eaters perceive fewer distractions while eating, which helps them pay more attention to the food itself.

Furthermore, ***solo diners are described within the literature*** as being from younger and 'urban' generations. Older adults often eat alone too, and studies indicated that widowhood might result in a loss of commensality.

The results of the literature review indicated that ***the experience of eating alone could be enhanced*** by eating mindfully and by making the cooking-for-one experience more pleasurable by learning new cooking skills.

According to the literature, some ***technologies are being currently used to enhance the experience of eating alone*** and focus (1) on improving the experience of eating alone by connecting solo diners to other people and (2) on making eating alone more pleasurable in itself. The first ones focus on creating digital commensality by using technology to share a meal with other diners virtually, and the second ones often include interacting with a virtual companion. It seems that researchers believe commensality can be recreated in a digital space. However, these technological solutions would never replace 'traditional' commensality since it has not been studied whether digital commensality provides the same benefits of eating in the company of others. Furthermore, since the advantages of eating alone have not been broadly investigated, the context of use and user requirements of solo diners were not considered when developing such technologies. It also remained unclear what aspects of the practice of eating alone could be heightened to provide solo eaters a more pleasant dining time. Thus, for this project, it was important to identify the needs and requirements of solo diners to develop a technological solution that would enhance their eating experience.

Therefore, it was essential to understand how ***solo diners perceive the practice of eating alone and what are their needs during the solo eating experience.*** The field study chapter aided in uncovering the above, determining that ***alone diners evaluate the overall experience of eating by themselves*** as ***very or somewhat satisfying.*** Furthermore, solo diners did not indicate needing virtual companionship while eating, contrary to what literature has explored. The field study revealed that ***a product design*** should ***address the following needs of solo diners to enhance the experience of eating alone:*** a product should focus on providing relaxation, a self-nurturing feeling and allowing solitary eaters to have some time for themselves. Those aspects established a direction for developing MattPod, a product to provide a more pleasant eating experience for solitary eaters and are interesting breaking ground for developing new products or services that aim to improve the practice of eating alone.

The final design, MattPod, contributes to enhancing the experience of eating alone by providing a relaxing environment, as uncovered during the concept validation chapter. Participants found eating alone more relaxing when using MattPod, and most respondents indicated that they enjoyed their food the same or more using MattPod. At the same time, some of them mentioned that MattPod aids in eating slower, helps to focus on the

food, provides time to themselves and helps them to relax. Furthermore, some respondents liked the music, the noise-cancelling features.

In this sense, MattPod *is a product that can enhance the experience of eating alone.* However, since the concept was validated virtually, some respondents mentioned they would have liked to test the product with a physical prototype.

Furthermore, the validation phase revealed that solo diners are unaware of the harmful effects of using digital technology as a distraction while eating alone. The research confirmed that solo diners often rely on screen-based devices to improve their eating alone experience since some participants stated that MattPod was an unnecessary product since they could get the needed entertainment by watching TV or using their mobile phones. While lonely diners seek to make their eating experience more entertained or enjoyable, they do not realise the adverse effects of such practice. Solo diners should be made more aware of the benefits of focusing on their food and eating mindfully, which can positively affect their health and general well-being and help them enjoy their eating alone time more. Thus, an area for further development could centre on enhancing the experience of eating alone by creating awareness on solitary eaters about eating mindfully and enjoying their eating alone time more.

The main limitation of this thesis is related to the involvement of solo diners during the whole process. Although solo diners were involved in each step of the process, there was limited response in the concept evaluation. It would have been tremendously beneficial for the project to have the same group of solo diners involved throughout the project, especially in the design phase, to validate the developed concepts, ideas, and final design. Having input from the final users could have benefited the outcome of the final product. Unfortunately, participants from the diary study (field research) were reluctant to continue participating throughout the whole project. Only one solo diner provided feedback on the initial nine ideas for the ideation phase, commenting: "I do not think I would use any of the ideas, but if I must choose, I will pick idea 2 (the interactive hologram placemat)". As the project had limited timing, the decision by then was to continue the design phase with the input of the supervisors and the researcher only.

Another limitation of this research was the pandemic. Since it was carried out during the Covid-19 crisis, face-to-face or in-depth interviews were impossible, and physical prototype testing was not feasible. However, the fact that prototype testing was performed virtually might have had a tremendous impact on the results. Some respondents mentioned they would have liked to experience a physical prototype to get "the real feeling" of the product. For example, some respondents wondered whether the size of MattPod was adequate since they pictured the product as being too big to fit easily into their dining rooms. Others commented that they might feel claustrophobic. Testing with a physical prototype could have provided a better impression of the characteristics and features of the final design to the participants. Thus, the concept evaluation could have resulted in better input for future development.

Further research related to the final design of MattPod, needs to include creating a physical prototype and perform testing in a home setting to gather more accurate information about:

1. the effects of the product on the experience of eating alone,
2. how it affects food intake,
3. the level of relaxation that it provides and
4. how well MattPod supports solo diners in focusing on their food.

10. CONCLUSION

This chapter discusses the contribution of the project towards the final users, solo diners.

More often than otherwise, eating alone is perceived negatively. It is often frowned upon, and there is some stigma about people who eat alone about being lonely individuals or to have failed to build social relationships. More importantly, eating alone can carry nutritional disadvantages and social drawbacks. Nevertheless, changes in society have led to an increase in the number of people eating alone. Eating solo has become more socially acceptable, as remarkably, solo dining has its advantages.

The objective of this master thesis was to gain an understanding of the needs of solo diners and investigating the attributes of eating alone to design a product that enhances the eating experience of people who eat alone. In addition, the aim was to design a useful, practical, and convenient product that can support the eating experience of solo diners. The final product was designed considering the needs and preferences of people who eat alone.

This project was carried out through a six-stage method adapted from the Human-Centred Design process. A crucial step of the process was to understand the positive attributes of eating alone that can benefit the practice of solo dining and to identify the user requirements and fundamental needs of solo diners regarding their eating experience.

A crucial part of the project was considering the needs of solo diners. Therefore, the ideation and development of the final concept considered the input gathered from both the literature review and the field study. The aim was to create a product easy to use that would not require complicated technology, which could enhance the eating alone experience by focusing on enhancing the advantages of eating alone.

The main elements considered to create the final design were providing a ***relaxing atmosphere***, offer a ***self-nurturing environment*** and aid solo diners in ***having an enjoyable time for themselves***.

The final design evolved from a 'solo dining cocoon' idea to an individual pod that provides a more pleasant dining experience for the solitary eater by delivering an enveloping, comforting environment that aids the solo diner to enjoy the meal more. MattPod provides the solo diner with a relaxing, self-nurturing eating experience. The noise-cancelling enveloping pod isolates the solo diner from all distractions of a hectic life. The relaxing experience is strengthened by colour changing lights and by integrated speakers that provide relaxing music.

MattPod differs from existing solutions identified within the literature since it does not require complicated technology nor establishing a connection with other (solo) diners. The product is modern, easy to use and fits seamlessly in any one-person household. Due to its simple, modern look, the focus on the meal will not shift to the product, as the interaction with MattPod is straightforward, through a remote control designed to avoid any potential distraction that the devices could evoke, and which is integrated into the eating placemat.

11. RECOMMENDATIONS

This chapter presents some recommendations and suggestions regarding future research directions for this project.

This project focused on the experience of eating alone at home. All the research was directed to the experience of solitary eaters in a private context. However, MattPod could cover other eating situations. For example, in public spaces. An exciting research direction could be to investigate if MattPod can offer a positive eating experience in a public space such as a restaurant or workplace. Based on the data collected so far and the knowledge gathered during this project, it can be inferred that MattPod could be a great option to provide a pleasant eating alone experience in public spaces. Probably even more than in a private home. The reason to consider that is based on theories of perceived territoriality and sense of belonging by (Moon et al., 2020). According to Moon et al. (2020), solo diners enjoy solo dining less when they are close to other diner groups. That means that, in a restaurant, MattPod could provide an 'own private space' to the solo diner, so he/she does not have to worry about being too close to other commensals. Next to that, a restaurant that makes MattPod available to use for solo diners can "engendering their sense of belonging and further, forming a better atmosphere for solo diners to fully enjoy the meals" (Moon et al., 2020), providing the idea of being a restaurant familiar to solo diners. The same principle could apply to other public spaces, such as the workplace. However, further research is necessary to confirm all the above.

Furthermore, MattPod is intended to be used while eating but can be used in other situations, where an immersive, enveloping, soothing moment is needed. For example, when there is a lot of noise, but the person wants to have a peaceful, reading-a-book moment after dinner. Then the person can place the MattPod next to his/her couch and enjoy a 'therapeutic' comforting experience.

Only the *relaxing mode* feature was developed in-depth for the final design and testing phase due to the limited time of the project. More development needs to be carried out regarding the other two "experiences" offered by MattPod. For instance, the *amusement mode* is meant to be tailored to the musical taste of the solitary commensal. As mentioned on theories of sonic seasoning (Spence, 2021), environmental sounds influence the tasting experience. More study needs to be done, but in a nutshell, the development of the the amusement/ enjoyment modality would require a better interaction system, for instance, a way to collect data to understand the musical behaviour of the diner. A suggestion could be to have an integrated MattPod app, where the user can configure the preferred settings of the pod (intensity of the lighting, volume, etc.). The MattPod app could also record users' general information (age, musical preferences, preferred songs, relaxing sounds, etc.). This app could be linked to the Spotify account of the solitary eater to offered tailored music. MattPod could play music that matches to the type of food the solo diner is eating. Consider, for instance, the following scenario: *"I decided to spend my Saturday afternoon at home, but somehow I feel like partying on my own. I just cleaned the house and now I want to enjoy my meal while I listen to the hits songs of the summer".*

The same applies to the *cuisine configuration*. There should be some way to customize the preferred foods of the user. For example, the solo eater could select in the MattPod app the five favourites' cuisines: Mexican, Italian, Greek, French, Chinese. Based on such preferences, the music related to those world kitchens should be tailored to the commensal. The music could be selected by simply clicking the Cuisine button in the placemat. Another option could be to add extra buttons to the placemat (for example, the CD player in a car, where a person can insert five CDs and click the buttons with the numbers from 1 to 5 to select the preferred CD). Think of the following scenario for the cuisine mode: *"I decided to cook homemade tacos because I am reminiscing about my last summer in Tulum. I am about to enjoy my Mexican tacos while I listen to the Latin Hits of the moment, that brings back such nice memories of my holidays in such paradise".*

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APPENDICES

APPENDIX A SUMMARY OF THE SEARCH STRATEGY USED IN THE SYSTEMATIC REVIEW

	Scopus		Web of Science Core Collection	
Search term	**Search fields** Article title, Abstract, Keywords		**Search fields** Topic (Title, Abstract, Keywords)	
	Applied filters	Hits	Applied filters	Hits
Commensality OR eating adj1 together OR eating adj2 company	Excluded sub-areas: Earth and Planetary Sciences; Neuroscience; Physics and Astronomy; Immunology and Microbiology; Chemical Engineering; Mathematics	283	Excluded sub-areas: Archaeology; Religion; Agriculture; Genetics heredity; Microbiology; Biochemical research methods; Infectious diseases; Classics; Paleontology; Plant Sciences; Zoology; Astronomy Astrophysics; Biotechnology Applied Microbiology; Cell Biology; Immunology; Criminology penology; Philosophy; Physical Geography; Theater Medieval Renaissance Studies;	181
Solo dining OR eating adj1 alone OR eating adj1 solo OR solo adj1 diner OR Solo adj1 eater OR Lone adj1 eating OR Lonely adj1 eating OR Anomic adj1 eating OR Solitary adj1 eating OR Dietary adj1 individualism OR Companionless adj1 meals OR Companionless eating	none	21	none	15
Single person household eating practice	none	4	none	2
Dining alone experience	none	20	none	14
Engaged dining	none	40	none	96
Commensality AND Benefits OR Advantage	none	16	none	16
Commensality AND Behavior	none	63	none	43
Commensality AND Health	none	49	none	49
Commensality AND Design	none	21	none	23
Eating alone AND Solo AND Behavior	none	4	none	6
Eating alone AND Solo AND Attitude	none	1	none	0
Solo dining AND experience	none	6	none	4
Solo dining AND effects	none	6	none	6
Solo dining AND Environment	none	4	none	3
Solo dining AND Design	none	7	none	8
Human-food-interaction	none	70	none	28
De-structuration of meals	none	3	none	2
Total: 1,114	618		496	

APPENDIX B SUB-QUESTIONS USED FOR A FULL-TEXT ASSESSMENT OF THE ARTICLES.

When an article answered YES to any of the sub-questions for inclusion, it was directly included in the review. The number of articles responding YES to any of the sub-questions is stated in the table below.

Sub-questions for inclusion	**No. articles per sub-question**
What is commensality?	8
What is solo dining?	5
What are the benefits of eating in company?	9
What are the drawbacks of eating in company?	4
What are the advantages of eating alone?	10
What are the disadvantages of eating alone?	12
How is the solo diner described in the extent literature?	4
What benefits of commensality can be transferred to solo diners?	3
How to enhance the experience of the solo diner?	3
How can technologies contribute to commensality?	12
Has a design solution already been created to tackle the disadvantages of eating alone?	13

INTRO to Diary Study "Practices during the experience of eating by oneself"

Intro Hi!

Thank you for participating in the diary study entitled ***"Practices during the experience of eating by oneself"***.

This is study is being carried out as part of a graduation assignment for the master programme Industrial Design Engineering from the University of Twente.

The purpose of this diary study is to get a better understanding of your experience of eating by oneself (eating alone).

Therefore, we would like to invite you to answer an **initial questionnaire** about yourself and your eating habits. It will take approximately 5 minutes. After completing the questionnaire, a participant ID will be sent to you. You can use the participant ID to identify yourself when filling out your diary entries.

Your participation in this study is entirely voluntary and you can withdraw at any time. Questions marked with an asterisk (*) are required.

Your answers in this study will remain confidential. All identifiable data will be removed from the data set and your name will be replaced with an anonymized identifier. After the data has been collected, no data remaining in the final data set could be linked back to you as a person.

If you have any questions about the survey, please contact the main researcher Mimi Juárez Bocanegra (n.juarezbocanegra@student.utwente.nl).
We really appreciate your input!

Q1 Name: (*)

_____

Q2 Age: (*)

_____

Q3 Gender:

- ○ Male (1)
- ○ Female (2)
- ○ Prefer not to say (4)
- ○ Other (please specify) (3) _____

Q4 Occupation / Industry

_____

Q5 What country are you from? (*)

- ○ The Netherlands (4)
- ○ Other (9) _____

Q6 In which city/town do you currently live?

_____

Q7 Dietary restriction:

- ☐ None (1)
- ☐ Vegetarian (2)
- ☐ Vegan (3)
- ☐ Gluten-free (4)
- ☐ Kosher (5)
- ☐ Other (please specify) (6) _____

Q8 For how long have you been living on your own? (*)

- ○ 0-1 year (6)
- ○ 1-2 years (4)
- ○ 2-3 years (5)
- ○ more than 3 years (8)

Q9 In a typical week, how often do you eat dinner by yourself? (*)

- ○ 0-1 days/week (1)
- ○ 2-3 days/week (2)
- ○ 4-5 days/week (3)
- ○ 6-7 days/week (4)

Q10 Overall, how would you value the experience of eating by yourself? (*)

	Very Satisfying (1)	Somewhat Satisfying (2)	Neutral (3)	Somewhat Unsatisfying (4)	Very Unsatisfying (5)
Cooking for myself (1)	○	○	○	○	○
Eating alone (4)	○	○	○	○	○

APPENDIX D FORMAT DIARY ENTRY FORM

DIARY ENTRY: Practices during the experience of dining by oneself

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D1
Hi!

Thank you for participating in the diary study entitled **"Practices during the experience of eating by oneself".** The purpose of this diary study is to get a better understanding of your experience of eating by yourself (eating alone).

WELCOME TO THE FIRST DIARY ENTRY

INSTRUCTIONS:
We invite you to use your cellphone to take some pictures (while you cook, set the table, while you eat, etc.). Think of anything important or meaningful: what makes the cooking/eating process better or more special, or if there is anything that you would like to change to make your dining time more enjoyable (*For example: "I feel more relaxed during dinner when I light up candles, so I photographed the dinner table with candles" or "I don't like to be distracted when I eat, so I turned the TV off").*

IMPORTANT: You are invited to **photograph your food/dining setting before you eat** *(for example, take a picture of your plate in the dining table, on the coffee table in front of the tv, in the kitchen desk, in the bed.... etc. Don't take so much time, we don't want your food to get cold* 🍝*).*

Please prepare your meal and enjoy your food as you would do it on a regular day *(we invite you to try to keep the dining moment as close as possible to a normal day).*

We invite you to fill out the *diary entry form* and upload your photos **after** you have eaten. Describe why you took those pictures *(why does it have an impact on the experience of having dinner alone?).*

Completing this diary entry will take approximately 25 minutes.

Your participation in this study is entirely voluntary and you can withdraw at any time. Questions marked with an asterisk (*) are required.

Your answers in this diary study will remain confidential. All identifiable data will be removed from the data set and your name will be replaced with an anonymized identifier. After the data has been collected, no data remaining in the final data set could be linked back to you as a person.

The photos and information that are submitted on this online form, will be stored on a student-personal computer, which is properly password protected, has an encrypted hard disk and it is not shared with others.

If you have any questions about the diary entry, please contact the main researcher Mimi Juárez Bocanegra (n.juarezbocanegra@student.utwente.nl).

We really appreciate your input!

Q1 Please fill in your 'Participant ID' (*)

_____

Q2 Date of the diary entry (*)

_____

Q3 Please upload here a picture of the dining setting/environment (e.g. take a picture of your food plate on the dining table, or on the coffee table, or in front of the couch, or on any place you are having your meal) (*)

Q4 Describe the process of *cooking for yourself*. We invite you to describe it **as detailed as possible**. (*)

*Consider the following questions **only as a guide** to help you describe the cooking experience:*

Describe the meal preparation process:
Why did you decide to prepare (order) that dish? Did you cook it yourself? Did you cook it from scratch? Or is it from a kit? Did you put a lot of effort into cooking? Is it practical/easy to cook? Did you order your food? Is it a microwave meal? How long did you take to cook?

_____

_____

_____

_____

_____

Q5 Describe the *food you prepared/order for yourself (*).*

*Consider the following questions **only as a guide** to help you describe your food:*

Describe the food:
What is the name of the dish? Do you think it is tasty? Why did you cook that specific dish? Was the food itself important to you? Did you spend time and effort in cooking a delicious homemade dish? Or were you just hungry and the type of food is not relevant?

_____

_____

_____

_____

_____

Q6 Describe the experience of *eating by yourself*. We invite you to describe it **as detailed as possible**, and to mention those occasions/details/moments/devices that have an impact on the experience (*)

*Consider the following questions **only as a guide** to help you describe the eating alone experience:*

Describe the experience of eating by oneself:
At what time did you have your meal? Would you say you took your time to enjoy your meal or were you in a hurry? Describe your mood while eating: e.g. were you relaxed? were you happy? What do you do to make the dining moment more pleasurable? Do you watch TV, chat or call family or relatives? Do you look at your social media? Do you read a book or magazine? How long did you take to eat it? Why do you enjoy having dinner by yourself? Why do you dislike it? Etc.

_____

_____

_____

_____

_____

Q7 Describe the *environment* where you eat by yourself (*)

*Consider the following questions **only as a guide t**o help you describe your dining environment:*

Describe the environment:
What atmosphere did you create for your meal consumption? e.g. Did you play some music, did you lighten up candles, did you set the table, did you use cutlery? Was it a formal environment *or a relaxed one? Describe the setting where your meal took place: e.g. did you have your meal at the dining table, at the kitchen bar or did you eat on the couch? Or in bed? In front of the TV?*

_____

_____

_____

_____

_____

Q8 **UPLOAD YOUR PHOTO 1**(*)

PLEASE SUBMIT AT LEAST ONE PHOTO MOMENT (You can upload up to 5 pictures in total. In the next 4 questions you can upload more pictures -one photo per question-).

Upload a picture of anything important or meaningful, which makes an impact on your dinner experience *(e.g. when cooking a special dish that reminds me of a special moment, watching TV while eating, listening to music while eating, looking at your* smartphone*/social media during dinner, calling someone during dinnertime, etc).*

Q9 Describe the photo. Why does it have an impact/importance/meaning on your dining alone experience? (*)

_____

_____

_____

_____

_____

Q10 **UPLOAD YOUR PHOTO 2**

Upload a picture of anything important or meaningful, which makes an impact on your dinner experience.

Q11 Describe the photo. Why does it have an impact/importance/meaning on your dining alone experience?

_____

_____

_____

_____

_____

Q12 UPLOAD YOUR PHOTO 3

Upload a picture of anything important or meaningful, which makes an impact on your dinner experience.

Q13 Describe the photo. Why does it have an impact/importance/meaning on your dining alone experience?

_____

_____

_____

_____

_____

Q14 UPLOAD YOUR PHOTO 4

Upload a picture of anything important or meaningful, which makes an impact on your dinner experience.

Q15 Describe the photo. Why does it have an impact/importance/meaning on your dining alone experience?

_____

_____

_____

_____

_____

Q16 UPLOAD YOUR PHOTO 5

Upload a picture of anything important or meaningful, which makes an impact on your dinner experience.

Q17 Describe the photo. Why does it have an impact/importance/meaning on your dining alone experience?

_____

_____

_____

_____

_____

APPENDIX E FORMAT FINAL QUESTIONNAIRE DIARY STUDY

FINAL QUESTIONNAIRE "Practices during the experience of eating by oneself"

Intro Hi!

Thank you for participating in the diary study entitled "Practices during the experience of eating by oneself".

We would like to invite you to answer a final questionnaire that will help us to understand better what your needs as a solo eater are. This will provide input for ideas on how to improve the experience of eating alone.
Completing the questionnaire will take approximately 10 minutes.

Your participation in this study is entirely voluntary and you can withdraw at any time. Questions marked with an asterisk (*) are required.

Your answers in this study will remain confidential. All identifiable data will be removed from the data set and your name will be replaced with an anonymized identifier. After the data has been collected, no data remaining in the final data set could be linked back to you as a person.

If you have any questions about the survey, please contact the main researcher Mimi Juárez Bocanegra (n.juarezbocanegra@student.utwente.nl).
We really appreciate your input!

Q1 Please fill in your 'Participant ID' (*)

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Q2 Using a scale of ***1=Strongly Disagree*** to ***5=Strongly Agree***, please rate the following aspects of eating by oneself: (*)

	Strongly Disagree 1 (1)	2 (2)	3 (3)	4 (4)	**Strongly Agree** 5 (5)
I enjoy the freedom of choice of when and what to eat (1)	○	○	○	○	○
I enjoy eating alone because it takes less time (2)	○	○	○	○	○
I enjoy eating by myself because it is more relaxing than eating with others (no peer, social or time pressure) (3)	○	○	○	○	○
I enjoy having "time just for myself" (6)	○	○	○	○	○
I enjoy eating alone because I can eat more healthy (11)	○	○	○	○	○
I enjoy not having to worry about manners / etiquette (4)	○	○	○	○	○
I enjoy eating by myself because I can focus just on the food itself (its quality, its flavors) (5)	○	○	○	○	○

Q3 How important are the following aspects of eating by yourself? (*)

	Not at all Important 1 (1)	**Very Unimportant** 2 (2)	**Neither Important nor Unimportant** 3 (3)	**Very Important** 4 (4)	**Extremely Important** 5 (5)
The quality of the food (I try to make an effort in cooking a delicious meal) (7)	○	○	○	○	○
Being entertained while I have dinner (I watch TV, Netflix, I listen to music, I video-call family or friends, I read a book or magazine) (8)	○	○	○	○	○
Social connectedness while I eat (I use my social media to interact with others, I post pictures of my food on social media, etc.) (9)	○	○	○	○	○

Q4 Using a scale of ***1=Strongly Disagree*** to ***5=Strongly Agree***, please tell us what do you think about the following statements (*)

	Strongly Disagree 1 (1)	2 (2)	3 (3)	4 (4)	**Strongly Agree** 5 (5)
When eating by myself, I miss socializing (sharing everyday experiences, conversations, sharing memories and stories) (17)	○	○	○	○	○
When eating by myself, I miss having company (15)	○	○	○	○	○
I would like to be (more) entertained while I eat alone (10)	○	○	○	○	○
I would like the experience of dining alone to be more playful (play a game, complete a challenge, etc.) (11)	○	○	○	○	○
I would like the experience of dining alone to be more fun/celebratory (13)	○	○	○	○	○
I would like to have more social interaction (social connectedness) when I eat alone (14)	○	○	○	○	○
I would like to eat more healthy when I eat alone (16)	○	○	○	○	○
I would like to interact, share experiences, etc. with other people who eat alone (18)	○	○	○	○	○

Q6 What do you really like about eating with others that is not included in eating by oneself? (*)

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Q7 How do you think you could make your dining alone experience more pleasurable? (*)

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Q8 Imagine having dinner by yourself in a 'perfect' scenario. Could you describe how this perfect dining experience would look like for you? (*)

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Q6 Overall, how would you value the experience of eating by yourself? (*)

	Very Satisfying (1)	Somewhat Satisfying (2)	Neutral (3)	Somewhat Unsatisfying (4)	Very Unsatisfying (5)
Cooking for myself (1)	○	○	○	○	○
Eating alone (2)	○	○	○	○	○

APPENDIX F ANSWERS TO THE OPEN QUESTIONS OF THE FINAL QUESTIONNAIRE

What do you really like about eating with others that is not included in eating by oneself?

- *The conviviality, cooking together.*
- *The after-dinner talk: deep conversations one might have after everyone had their diner and is rested and relaxed. Those are epic connecting moments. I don't view the dinner itself to embody this. Everyone could be focused on their hunger or what is coming 'next'. Not on the conversation, too much distractions.*
- *Making more of a moment of it: setting the table, candles, making more of an effort for the food, having a wine with it, sharing the food*
- *The talk about your day, what happened or to discuss about the news etc. So interaction about daily life.*
- *Having a chat with other people, doesn't have to be about anything important just daily chit chat.*
- *Sharing your day, using it as an 'outlet'.*

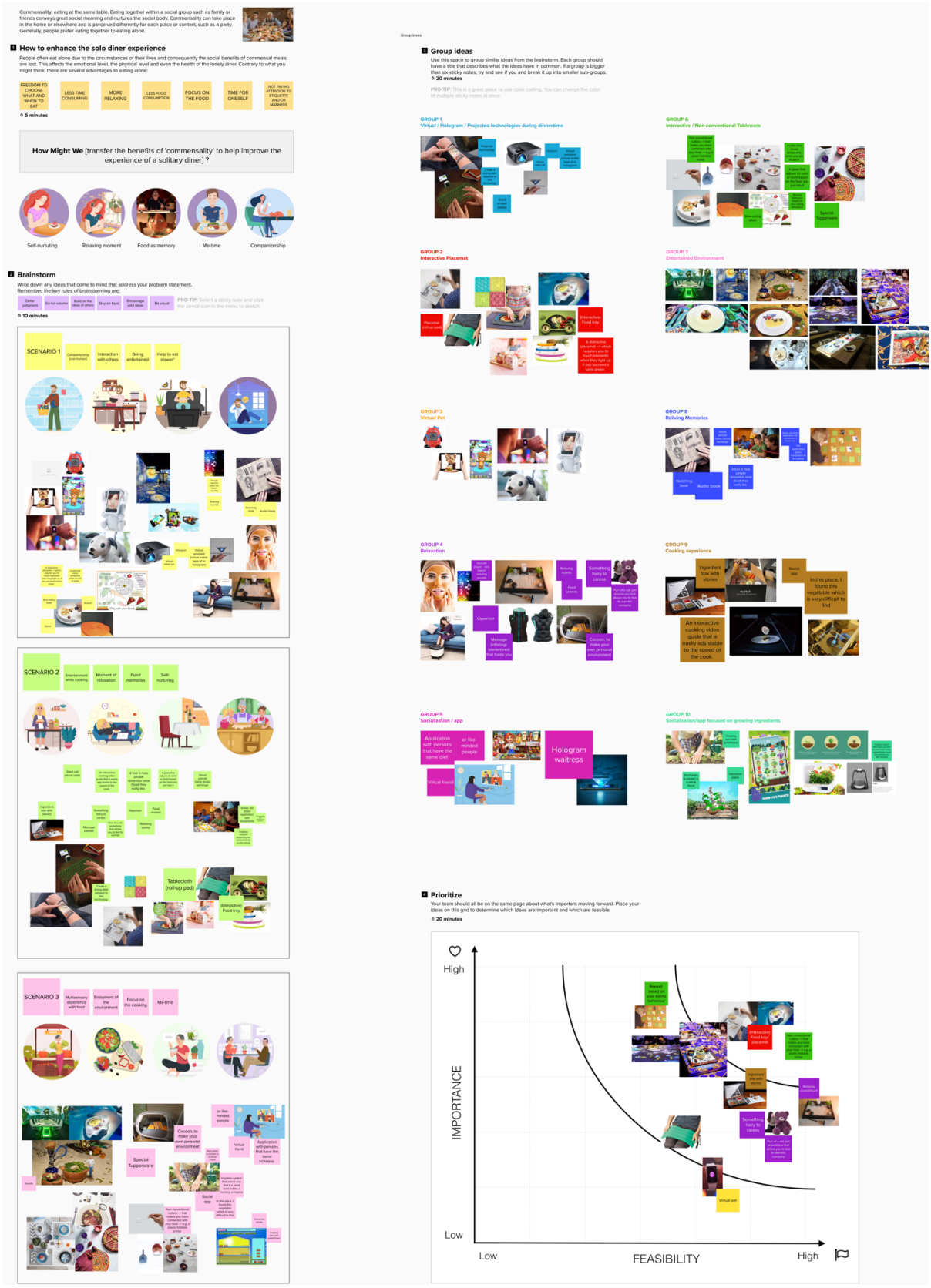
How do you think you could make your dining alone experience more pleasurable?

- *I wouldn't know that. I like it the way it is. Good healthy ingredients, delicious recipes, good equipment to prepare the food. I would only prefer to eat outside on the terrace in the summer, but that is difficult because there are always children in the playground behind my house making noise and I like to rest while eating. I shouldn't be distracted by noise. (I am highly sensitive / HSP).*
- *To me it is as pleasurable as it is when its quiet and I'm having a warm meal in a cosy room. No additives. Just plain, simple.*
- *For me it's okay as it is*
- *When you put effort in your food, of buy good food, I think it makes you feel better. You have to do something for it. Buy your groceries, find out recipes, share with neighbours for instance your recipe experience, to thought that it is not an easy bought meal makes it for me more pleasurable. Maybe also learning about other / not known ingredients, mixtures of herbs to use.*
- *I do not know; I am quite ok with how it is at the moment.*
- *Not sure. Something to watch/look at.*

Imagine having dinner by yourself in a 'perfect' scenario. Could you describe how this perfect dining experience would look like for you?

- *In a beautiful garden in good weather, birds singing, and a delicious pasta dish.*
- *See above, its quiet and I have a fresh warm meal.*
- *Not having to cook but eating something delicious and healthy and not very expensive. And then combined with a great series or documentary and nothing else bothering me (no calls, WhatsApp etc.)*
- *Food that belongs to the season, something you have devoted time and attention to and then in the winter nice and cosy in front of the TV with a nice program or read the newspaper at the kitchen table and in the summer to eat outside with a newspaper. Just enjoy the sun on your face if possible. Especially the heat of the house or the heat of the sun. Make sure your house is tidy too. Not that you're in the mess. That also gives a better feeling.*
- *I am not sure, I don't see how having dinner by yourself could be perfect or improved.*
- *Good, nutritious meal. Not in a rush. Something to look at/watch like a football game.*

APPENDIX G MURAL BRAINSTORMING SESSION



APPENDIX H QUESTIONNAIRE TO EVALUATE THE EXPERIENCE PROVIDED BY THE MATTPOD CONCEPT

In the following section, we ask you some questions about the experience provided by the concept.

Overall, how would you value the experience of eating by yourself while using the MattPod?

Very Satisfying	Somewhat Satisfying	Neutral	Somewhat Unsatisfying	Unsatisfying

Using a scale of **1=Strongly Disagree** to **5=Strongly Agree**, please rate the following statements about your experience of eating by yourself while using MattPod

	Strongly Disagree 1	2	3	4	**Strongly Agree** 5
Using the MattPod while eating by myself, I feel more relaxed	○	○	○	○	○
Using the MattPod while eating by myself, I enjoy the "me-time" more	○	○	○	○	○
Using the MattPod while eating by myself, I have a strong feeling of self-nurturing	○	○	○	○	○
Using the MattPod while eating by myself, I enjoy my food more	○	○	○	○	○
If I had the MattPod available when eating by myself, I would use it	○	○	○	○	○

What would be your reasons for using or not using the MattPod?

What do you like MOST about this concept?

What do you like LEAST about this concept?